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BRAIN EVOLUTION AND LANGUAGE: REFLECTIONS ON SOME ISSUES[1]

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WHAT IS MEANT BY EVOLUTION?

It means descent with modification or change in the form, phylogeny, and behaviour of organisms over many generations of time. Recognized and discussed for long in history of scientific debates, human evolution has, always a major topic of scientific discussion, come a full circle to assume the status of a focal theme in a serious domain of scientific inquiry since the days of 1866 ban by the *Societe de La Linguistique de Paris* then being merely speculative and not supported by either enough theoretical validation or even factual and research data or what American linguist William Whitney would call "*mere windy talk."* The theory of evolution today is as much scientific and as much open to probe as countless other issues dealt with by scientists. Dawkins (1976, p. 6) argues, "Today the theory of evolution is about as much open to doubt as the theory that the earth goes round the sun, but the full implications of Darwin's revolution have yet to be realized." Motivation, though, is much larger in scope than the Darwin's passion to discover nature's laws to growth and development of scientific interest for obtaining insights into a remarkably human

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creature, and this certainly is attested by the emergence of the synthesis of theories and explanations. Over the last half a century, the topic has assumed the focal significance with a scientific vigor and treatment for serious research pursuits in several disciplines. Such discussions, no doubt, directly or indirectly, bring in fresh insights and critical appraisals in the evolution of human language with scientific research data and evidences. As pointed out earlier in another paper (Sharma, 2007), it is worth referring to certain questions that appear to be at the epicenter of this scenario. Is language unique to human beings? Why is language unique to human beings? Does this uniqueness of language to humans owe to the biological nature of human language? When did humans evolve language? Obviously the domain of research interests in evolution has been to an extent defined by such vexing questions. Has language evolved due to the emergence of a perceptual system and articulation producing vocal tract unique to human beings? Does the capacity that enables humans to have, acquire and use language correlate with human brain and thus appears to be indicative of some facts and postulates that need to be examined in terms of the theory of evolution of human language.

WHAT IS BRAIN AND HOW DOES IT RELATE TO LANGUAGE FACULTY?

The brain can be regarded empirically as a purely physical device, 'physical brain', and the neuronal states accounted for by the laws of classical physics; epistemically, as an entity with neuronal states recognized through physical judgment; ontologically, described by 'physical properties' (informational properties) and 'physical ontology' thus presupposing the ontological possibility of mind. As such the biological justification for the need to have brain is that it is biologically needed for integration between different bodily functions, necessary for adaptation of the organism to the environment; to have various physical abilities ranging from sensory-motor functions to cognitive functions and thus have cognition, emotion and information processing; and to have physical properties constitutive for the brain as a brain and to also imbibe mental properties thus enabling it to develop different ontologies necessary for better distinction between environments and a more accurate prediction thereof. It is due to such biological compulsions that brain has come to acquire its role of organic necessity on the one hand and of material basis of cognition and language on the other. Through the course of evolution, brain has come to be embedded in the human body. The term 'embedment' includes two components: 'embodiment' and 'embeddedness'. 'Embodiment' refers to the 'intrinsic' relationship between brain and body while 'embeddedness' refers to the 'intrinsic' relationship between brain/body and environment. Can an injury to brain bring change? Of course, an injury to the developing brain, particularly cortex, can lead to alteration in brain,

which in turn may bring an alteration in behavioural development through an alteration in neuronal networks. Brain may be particularly plastic during "sensitive" periods in the development of cortical structures, but the ability to maintain its potential to alter the architecture to afferent input under the impact of experience which varies both qualitatively and quantitatively at different times during development. Such age-dependent plastic changes in the cortex presumably reflect the differential sensitivity of the child's brain to experience during development. One of the most striking features of brain is, therefore, its inherent plasticity or resilience to repair itself to some extent. Brain development during prenatal and early postnatal period follows rigid rules and phases in development are initiated through a cascade of genetically determined programs. This refers to an apparent capacity to replace the lost cells, although cortical organization may not remain entirely normal in several situations of impairment. Such a potential is ascribed to its growth and development during *critical period* though even in adulthood, brain has the potential to reorganize the functional organization of its neural networks on the particular demands and afferent input. Brain is a highly dynamic organ permanently adapting its functional and structural architecture to environmental needs. Study of brain evolution, therefore, can facilitate a more scientific examination of issues concerning the evolution of human language. Lieberman (2002) has rightly remarked, "…the mark of evolution on the brain of human beings and other species provides insight into the evolution of the brain bases of human language."

WHY LANGUAGE IS UNIQUE TO HUMAN BEINGS?

The question brings to forefront several other questions and issues which concern the evolutionary emergence of human language. What comes as an important ultimate answer to such questions is the scientific assertion of the fact that the crucial role played by language in human evolution is twofold. First, language, which emerges as a major evolutionary development in humans due to *genomes-induced evolution*, has generated an unlimited variety of living organisms including humans, and, the second is the role of language in *language-induced evolution* which enables to transfer unlimited non-genetic information among human beings and hence language itself becomes a crucial tool in further evolution of human kind once it has already emerged due to the difference it has brought to human life. Why and how did language emerge? All arguments center around two major theoretical premises of requisite *phylogenetic uniqueness* and *reciprocity and cooperation*.

WHY DOES BRAIN EMERGE AS A NECESSARY BIOLOGICAL PREREQUISITE IN LANGUAGE EVOLUTION?

Scientific interest in the evolution of human brain has drawn significant attention of scholars (Lenneberg, 1967; Dawkins, 1976; Kimura, 1979; Wilkins and Wakefield, 1995; Gould, 1982, 2002; Donald, 1991, 1995; Lieberman, 1984, 1991b, 2000, 2002; Calvin and Bickerton, 2000; Falk, 2001, 2004; Givon, 2002b; Jackendoff, 2002; Tomasello *et al.,* 2004; Sharma, 2007) and various explanations have been offered. One of the major issues in explanations is its correlation to the emergence of language or more appropriately as a necessary biological prerequisite of language. Three major prerequisites of language appear to have emerged in the perspective of evolution: *human vocal tract,* capable of generating the range of articulations necessary to make a language; *human brain*, capable of processing human language; and *language faculty* or a genetic endowment necessary for having and using human language. Several evolutionary developments occurred in course of the long-drawn pre-hominid evolution. Primitive forces of behaviour, for instance, such as taxis and kinesis involved innate responses to a stimulus that enabled movement in relation to light or in presence of a stimulus. Evolutionary neurological developments giving rise to skill acquisition and motor adaptation further enabled accurate reaching and pointing necessary for an ability to make decisions adaptively (Shadmehr and Wise, 2005). Language in the long drawn course of human evolution spanning over millions of years could have evolved much later contingent upon the emergence of the necessary biological paraphernalia. The cognitive prerequisite for the emergence of language, according to one possibility (Tomasello, 2000), is the emergence of 'the ability to understand fully intentionality, causality and the mental states of consepecifics and humans alone are in full command of this ability, other animals are not' and this stems from the nature of symbolic signals permeating language (Li, 2002). Such a position is supported by E.H. Lenneberg (1967), who regards language as a biological behaviour since it emerges before it is necessary, emergence is triggered by biological compulsions and not by any external events, its acquisition shows regular sequence of milestones in development, like any biological behaviour language also has a critical period for its acquisition, and above all language is biological because it has a biological basis due to brain on the one hand and to biological structures used to process language. So, the fact that language must have evolved as such in course of evolution gets credible support form Lenneberg's five general premises in a biological theory of language:

i. Species-specific cognitive function
ii. Specific properties of this function replicated in every member of the species

iii. Cognitive processes and capacities differentiated spontaneously with maturation
iv. Emergence of certain aspects of human behaviour and cognitive function only during infancy, otherwise relative immaturity of human beings at birth
v. Emergence of certain phenomena by spontaneous adaptation of the behaviour of the growing individual to the behaviour of other individuals around him. This implies that language acquisition is triggered and supported by language input made available through motherese, the child-directed speech used by caregivers of the growing child.

WHAT PROCESSES MIGHT HAVE CONTRIBUTED TO AND SHAPED THE COURSE OF EVOLUTION OF LANGUAGE?

According to Studdert-Kennedy (2005), emergence of language as the most potential means of communication owes much to its emergence as a system of discrete organizational possibilities. Language is a unique behaviour of man, and communication by means of speech sounds is of special interest because it forms by far the most suited fundamental basis of human language which alone sets the man apart from the rest of animals and gives him enormous advantages in his environmental adaptations, socialization, and expression of cognitive attainments (Sharma, 1979). The major processes accounted to explain the evolution of language, as outlined by Rudolph P. Botha (2003) are (spandrel) co-optation, pre-adaptation or shift of function, and natural selection. *Spandrel Co-optation*, as proposed by Stephen J. Gould (1977, 1980, 1991, 2002) posits that language is a spandrel, a non-adaptive element arising as a byproduct of other processes and thus regards natural selection as responsible for making the human brain big, but most of our mental properties and potentials as spandrels—that is, nonadaptive side consequences of building a device with such structural complexity. Chomsky gives a similar argument for the human brain's language capability explainable in terms of not as much natural selection, as physical laws thus implying that language or certain features of it arose—like the brooding chamber in snails—by a process of (spandrel) co-optation (Chomsky, 1982, 1988, 1990, 1996; Gould, 1991; Piatelli-Palmarini, 1989, 1990; Jenkins, 2000). Chomsky regards language evolution as a consequence of the brain-size and complexity. Evolutionary process of involving characters that enhance fitness in their present role though were not built for the role, is called 'exaptation' or 'co-optation'. It is pointed out that feathers in birds emerged as primary adaptations for

insulation and not as they are now used for flight. *Pre-adaptation or Function shift* is the second process of evolutionary development that enabled some future stance. Accordingly fundamental features of language, e.g. syntax, originated – like bird's feathers – by a process of pre-adaptation or function shift (Lieberman, 1984), thus a series of chance events led to eventually allow later learning using complex rules that govern syntax of language. The third major process is *Natural selection* , which, drawing upon the Darwinian principle, explains that language or some of its features evolved – like vertebrate eye—through the process of natural selection. Following this Darwinian notion of an evolutionarily significant function, Pinker and Bloom (1990) explain the emergence of language as due to the rise of a complex adaptive design of language in its course of evolution. T. Givon (2002)'s *evolutionary hypothesis* thus seeks to explain how the neural circuits that support language processing in humans evolved out of their respective pre-adaptive precursors, primarily out of various components of the visual information –processing system.

HOW HAS LANGUAGE EVOLVED? WHY HAS THIS HAPPENED?

Hurford posits a hypothesis that the evolution of human language has been contingent upon certain existing pre-adaptations much like biological steps in evolution of human language, which evolved in response to some selection pressure for the improved communication between humans (Hurford, 2003). The adaptive function of language is thus consequent upon the cumulative changes and the emergent patterns necessitated thereby creating "mental modules" that compartmentalize the linguistic functions. Such adaptations include the enlargement of brain and the rapid increase in brain capacities, the cultural reading, mind-reading and such processes crucial to transmission of cultural innovations, and above all a cortical control over speech in contrast to an involuntary control of vocalizations in apes. Selection pressure enhanced by emerging social group formations led to the emergence and enhancement of linguistic abilities which encouraged to making "formidable and ever-escalating demands on cognition (Pinker, 1994, p. 368)." It is logical to argue that once the hominid brain was capable of processing language, it was obviously ready to assume this articulate signaling system for a wider variety of functions in the long run. The 'language –ready brain' of the Homo sapiens supported basic form of gestural and vocal communication giving rise to cortical areas for language (Arbib, 2005) outlines some criteria responsible for such an emergence of language-readiness: symbolization, intentionality, parity, change from hierarchical structuring to temporal ordering, capacity to think and conceptualize beyond here and now, and paedomorphy and sociality necessitating prolonged infant dependency and socialization for language. Such change seem to have precipitated symbolization; emergence of syntax, semantics and recursion; linguistic representation of the

conceptualization beyond here and now with the emergence of verb and tense; and above all learnability inbuilt in the nature of language.

WHY DID BRAIN EVOLVE?

It can be safely inferred that whereas a mirror system induced parity which catapulted the emergence of brain mechanisms supporting language. The evolutionary enlargement of brain and the concomitant cortical control as well as the brain capacities evolved in human biology certainly constituted a distinct biologically endowed innate faculty, a component of brain dedicated to language and its use that determines the course of acquisition within the human brain. This notion of language faculty as language organ permits a limited variation. What does language faculty do? It provides children with a genetically transmitted set of procedures for developing a grammar that enables them to produce and understand sentences in the language they are acquiring, on the basis of their experience. Moreover, this faculty evolved in human beings is species-specific– the ability to develop grammar of a language is unique to human beings. Language faculty must incorporate a set of *UG* principles which enable the child to form and interpret sentences in any natural language. Language module/organ (Anderson and Lightfoot, 2002; Chomsky, 2000) is rejected by Dabrowska (2004) on the basis of neuroanatomical evidence as not only there is no evidence for module, but also anatomically human brain is not very different from that of apes, only considerably larger; otherwise no evidence that humans evolved new cortical areas or structures.

Language still carries its capability of adaptive function. Even when in its course of evolution the communicative behaviour got its status as a genetically defined nature of a faculty or module in the human body and system, its adaptive function has persisted and survived. 'Mental modules' tend to compartmentalize linguistic functions in human brain: "Perhaps a set of quasi-referential calls… came under the voluntary control of the cerebral cortex [which controls language], and came to be produced in combination for complicated events; the ability to analyze calls was then applied to the parts of each call (Pinker, *1994*: 352.)." Evolution of language faculty is interesting since language is unique only to members of the species *Homo sapiens,* the anatomically modern humans, and also as evolution of language faculty seems to have happened in a very slow and gradual process due to the emergence of homo sapiens, as with genetically determined traits via selection over millions of alleles that contribute to the human genome. But, once genetically evolved, language faculty became part of the genetic transmission, the genotype. What does language faculty do? Language Faculty provides children with a genetically transmitted set of

procedures for developing a grammar which enables them to produce and understand sentences in the language they are acquiring, on the basis of their experience. Language faculty is species-specific– the ability to develop grammar of a language is unique to human beings. Language faculty must incorporate a set of UG principles which enable the child to form and interpret sentences in any natural language. Even some explanations of a possible link between a genetic mutation and brain account for the evolutionary development of language. Oxford Professor of Psychiatry Tim Crow (2000) argues that a single mutation in the brain of Homo sapiens sapiens as a chance led to the evolution of the power of speech and language in humans.

WHAT DID EVENTUALLY CONTRIBUTE TO GENETIC PLACEMENT OF LANGUAGE AS A FACULTY?

For one, social group is the source of selection pressure towards better linguistic abilities among people with widely divergent or conflicting interests. Language as such got ingrained with its cognitive capacity in as much as it could "make formidable and ever-escalating demands on cognition (Pinker, 1994: 368)." It has already been argued that language has evolved as mosaic, and thus owes enormously to existing pre-adaptations, which must have functioned as biological steps to language-readiness. Such probable pre-adaptations include various possibilities that seem to have unfolded in a sequential manner one after another.

Hurford (2003) reaffirms a similar view: "Clearly humans are innately equipped with unique mental capacities for acquiring language. Language emerges from an interaction between minds and external events." The mosaic evolution of language includes, among other things, an evolution of complexity from simple forms. Such an emergence seems thus to be correlated with brain enlargement and its contribution to the cortical control over speech. Dabrowska (2004) examines such adaptations, eventually leading to the emergence of voluntary vocalizations in course of human evolution as opposed to the involuntary vocalizations in apes, lists them as three phases: preadaptations, cultural learning and mind reading, and cortical control over speech. Preadaptations catapulted a rapid increase in brain capacities. These preadaptations include cognitive, social and physiological preadaptations. Cognitive preadaptations included *mind* necessary for inferentiality and intentionality; *mimesis* as, proposed by Merlin Donald (1998), an ability to perform a structured action and its understanding which led to intentional representations; and *Symbolic Reference*, an ability to structure and use symbols to refer to something else as a referent. *Social Preadaptations* included *altruism and cooperation*, a certain degree of altruism and mutual cooperation necessary for socialization and social behaviour necessary as a

prerequisite for the rise of complex communication systems (Dawkins and Kerbs, 1984); *increase in group size and the need for communication* which was motivated by the emergent needs of food and behavioural manifestations thus necessitating the emergence of language as a response. *Physiological preadaptations* included increase in brain size, emergence of human vocal tract, and the emergence of language faculty. *Increase in brain size* meant a better survival and functioning of the human systems as integrated wholes, thus evolution of brain resulting in apparent purposiveness of behaviour, the capability of having negative feedback, the capability of learning, invention of memory, and the emergence of subjective consciousness as major consequential developments. Where as vocal tract made humans equipped with the potential of articulating speech sounds; and language faculty created the biological preparedness as well as endowment for having and acquiring human language, the scene was virtually taken over by the increase in brain size and the concomitant neurological developments in evolution. Evolutionary enlargement in brain size and the emergence of necessary neuroanatomical structures seen on the basis of some paleoneurolgical data or other biological and archaeological findings over a period of about two million years shows an increase in brain size almost doubled with frontal areas and cortex becoming more prominent in order to enable it cope with verbal short term memory, combinational analysis and sequential behavioural ability. Even though the two alternative models, the 'Multilineal' vs. 'Out of Africa' models, have been proposed through two different formulations accounting for the fact whether the evolution of Homo sapiens sapiens can be accounted from Homo erectus drawn in different streams of hominid populations from Africa and evolving in different regions or from Homo sapiens from Africa since other lineages of Homo erectus in South-east Asia and elsewhere became extinct and were replaced by a new radiation of hominids, Homo sapiens sapiens, out of Africa around one hundred thousand years ago. There is enough evidence to link certain definite stages of evolution: Australopithecus preceding Homo erectus, Homo erectus preceding Homo sapiens, and Homo sapiens evolving into Homo sapiens sapiens. Each stage no doubt reflects an increase in brain size—the brain of an Australopithecus barely reached the brain size of a modern human neonatal; early Homo erectus showed brain size as of a modern human one year old child; where as Homo sapiens to Homo sapiens sapiens a considerable enlargement in brain size had take place in course of evolution (Calvin, 1983; Kimura, 1979; and Lieberman, 1984, 1991a, 1991b, 1992, 1995, 1998, 2000, 2002).

Bipedalism arose before the evolution of intelligence or large brain volumes associated with humans. A shift to upright walking or bipedalism thus preceded the substantial evolutionary enlargement of brain and was to be a catalyst later in course of hominid evolution. Lieberman (2002) has argued that with Homo erectus neural

systems evolved for enhancing adaptive motor control may have led to the evolution of human speech and complex syntax. Major stages in hominid evolution correlate with distinct manifestations of brain enlargement which probably arose due to change in food habits and habitat: Australopithecus, Homo habilis, Homo ergaster, Homo erectus, Homo sapiens, and Homo sapiens sapiens. Australopithecus was a bipedal ape whose several numerous species ranged in Africa around 2.5 mya (million years ago) from Ethiopia to South Africa. Numerous Australopithecine species recognized by scientists are known as Australopiths. Major changes due to brain enlargement and evolution can be seen at the major stages of hominid evolution from Australopithecus to the emergence of Homo sapiens sapiens, the anatomically modern human beings.

AUSTRALOPITHECUS (c. 4.4 mya – 1.8 mya): Numerous Autralopiths show several traits with modern apes and humans and a mixture of primitive features in the skull, and advanced features in the body. They provide with a strong evidence of bipedality with their pelvis and leg bones far more closely resembling those of modern human beings. Their brain capacity has been accounted to range from 435 to 650 cc according to broad estimates though some have regarded this as 413 to 530 cc only, thus within the gorilla and chimpanzee range. It could be pointed out that such a brain development, though barely equal to a neonatal human today, yet it marked the greater mental dexterity than other primates due to the development of cerebral cortex; and later the emergence of expanded frontal lobes more human like than that of any living primates (Falk, 2001, 2004). Where as A. *afarensis* (3.9 mya - 3.0 mya) showed the brain capacity about 375 to 550 cc, A. *africanus* (3.0 to 2.0 mya) with a slightly larger brain had 420 to 500 cc, A. *robustus* (2.0 to 1.5 mya) showed average brain capacity of 530 cc. Australopiths were fundamentally bipedal hominids with approximately 35% of modern human brain, showed a certain degree of sexual dimorphism, and an increasing brain capacity over the long period of evolution.

HOMO HABILIS (C 2.4 – 1.5 mya): Found over South Ethiopia, the earliest known species of the genus homo, with brains considerably larger than Australopiths, showed brains 30% larger than A. *africanus*. They used primitive tools. With large molars and flat face, homo habilis resemble the Australopithecus. But, they showed reduced post canine tooth size, distinct sexual dimorphism with males larger than females; their average brain capacity of 650 cc was considerably higher than Australopiths; their brain shape was like humans today. The most interesting feature of the brain is emergence of the bulge of Broca's area essential for speech and language production.

HOMO ERGASTER (C 1-8 to 1-2 mya): The earliest known species of the genus Homo**,** Homo ergaster had the height and morphological features as that of Homo habilis. Other features include their robust human skeleton, higher cranial vault, rounded cranium, thinner cranial bones, and smaller teeth. The average brain capacity was 750-1250 cc. They lived throughout eastern and southern Africa around 1.9 to 1.4 million years ago with the advent of the lower Pleistocene and the cooling of the global climate. Their use of advanced (rather than simple) tools sets this species apart; they first began using these tools 1.6 million years ago. Their remains have been found in Tanzania, Ethiopia, Kenya, and South Africa. The most complete Homo ergaster skeleton ever discovered was made at Lake Turkana, Kenya in 1984. Evidence of the charred animal bones in fossil deposits and traces of camps suggests that they made creative use of fire. Another notable characteristic is their similar body proportions (longer legs and shorter arms) as of Homo *sapiens sapiens.* The *reduced* sexual dimorphism; a smaller, more orthognathic face; a smaller dental arcade; and a larger (700 and 850cc) cranial capacity are some striking evolutionary features found in Homo ergaster.

HOMO ERECTUS (C.1.8 to 1.5 mya): Many researchers deny any validity to the species at all, though on the whole, most researchers see too little difference between *ergaster* and *erectus* to form the basis of a species of the former, separated from the latter. As a general rule of thumb, one can consider most attributed *ergaster* specimens to be early *erectus* geographically confined to Africa (however, this is not a hard and fast rule). The dates for *erectus* have become earlier and earlier, while *habilis* remains have been found in later and later deposits, making a lineage involving *habilis* ancestral to *erectus* increasingly unlikely. Specimens that are considered *erectus* are dated very securely to at least 1.8 mya, and fairly securely to 1.9 mya. Those who accept the validity of *ergaster* usually consider *erectus* an evolutionary dead-end that went from Africa into Asia, and went extinct there. Those who see *erectus* as a modern human ancestor, either see the Asian specimens as a dead-end side branch, or see all the *ergaster*, *heidelbergensis*, and *erectus* specimens as belonging to Homo sapiens. These specimens were discovered in Java and the most diagnostic specimens consisted of a skull cap which showed the thick cranial vault, sagittal keel, and prominent brow ridges which are all characteristic of *H. erectus*. Wide spread over large parts of the world, their fossils remains are found in Africa, Asia, and Europe. They were definitely a large brained species with a brain capacity of 800 to 1300 cc., a 50% increase in relation to Homo habilis. At the initial phase they had an average brain capacity of 900 cc, though the later average is found to be 1100 cc. They thus show the largest brain similar to modern humans, although

configured differently. Their dentition is also identical to modern humans. They had developed abundant technology and associated stone tools and skills. Bipedal locomotion, of course, is their striking most evolutionary manifestation and, as pointed out by Lieberman (2002), certainly a functional feature of the neural system tat could have triggered the emergence of language in hominid evolution by having initiated "the process that yielded the neural bases of human linguistic ability." They not only occupied a variety of environments, but also showed the emergence of more complex social organization, inter-group competition, and emergence of symbolic cognition and communication.

HOMO SAPIENS (C 300, 000-100, 000): First appearance of Homo sapiens is noted as early as 500, 000 ya, though more evidence points to a later appearance. With some continuity or change from H. *erectus*, Homo sapiens, the precursor to Homo sapiens sapiens or the anatomically modern human beings, have remained as much a theme of scientific discussion as whether and how they evolved from h. erectus or to the modern human beings. In spite of the large scale similarities, they represent an evidence of undergoing gradual enlargement of brain eventually acquiring the increased brain capacity of 1350cc. Use of sophisticated tools and technology, social organization and social behaviour, and emergence of linguistic communication are some major features of Homo sapiens which set them apart from the earlier Homo erectus, at least to some extent, and assign them the status of a precursor to modern humans.

HOMO SAPIENS SAPIENS (130000 in Africa to 90000 years): Anatomically Modern Humans with large brains are not much different from Homo sapiens except that their brains seem to have further evolved, though very gradually, thus enabling them to unfold more use of brain in cognition and linguistic communication. Though the origin of modern Homo sapiens is still debatable, the two polemic theoretical perspectives have been proposed. The first, "*Multiregional Hypothesis*," regards the distribution of anatomical traits in modern human populations in different regions as inherited from local populations of Homo erectus and intermediate "archaic" forms. Multiregionalists look for similarities between populations in the same geographic location that are separated spatially, while people who follow replacement look for differences. Accordingly all modern humans evolved in parallel from earlier populations in Africa, Europe and Asia, with some genetic intermixing among these regions. Support for this comes from the similarity of certain minor anatomical structures in modern human populations and preceding populations of Homo erectus in the same regions. The second, "*Out of Africa Hypothesis*," holds a small, relatively

isolated population of early humans evolved into modern Homo sapiens, and that this population succeeded in spreading across Africa, Europe, and Asia eventually replacing all other early human populations as they spread thus implying the variation among modern populations as a recent phenomenon. Part of the evidence to support this theory comes from molecular biology, especially studies of the diversity and mutation rate of nuclear DNA and mitochondrial DNA in living human cells which points out an approximate time of divergence from the common ancestor of all modern human populations around 200,000 years ago, thus supporting the ancestral population of all living people migrated from Africa to other parts of the world. The *regional continuity* (or multiregional evolution) *model* advocated by Milford Wolpoff (1999) proposes that modern humans evolved more or less simultaneously in all major regions of the Old World from local archaic *Homo sapiens* The perspective thus holds that all populations of H. *erectus* living around the old world contributed to successive generations, eventually leading to modern humans, with enough genetic migration to maintain close species bonds, while still allowing the suite. The *replacement model* of Christopher Stringer and Peter Andrews proposes that modern humans evolved from archaic *Homo sapiens* about 200,000-150,000 years ago only in Africa and then some of them migrated into the rest of the Old World replacing all of the Neanderthals and other late archaic *Homo sapiens* beginning around 100,000 years ago. If this interpretation of the fossil record is correct, all people today share a relatively modern African ancestry. All other lines of humans that had descended from *Homo erectus* presumably became extinct. From this view, the regional anatomical differences that we see among humans today are recent developments. The revised Out of Africa model refers to a second migration from Africa of a hominid population i.e. a migration of *H. erectus* out of Africa into Asia and Europe, as the populations already there (seen in materials like the Chinese and Indonesian *erectus*) did not contribute a significant amount of genetic material to later populations that led to modern humans. At approximately 200 kya, there was a second migration of hominids out of Africa.

Nevertheless, the oldest fossil evidence for anatomically modern humans is about 130,000 years old in Africa, and there is evidence for modern humans in the Near East sometime before 90,000 years ago. This marked the beginning of the present species with average large brains: skull size and other distinctive features of brain such as the expanded frontal portion of the brain case, increase in brain capacity with average brain capacity of 1350 cc; sharp rise of the forehead thus with a striking similarities of skull size and shape with the modern human beings; very small or more usually absent eyebrow ridges; the prominent chin; smaller teeth; and the much less robust body form and skeleton. The evolved bipedal species showed subtle sexual dimorphism, and the use of symbols as ell as linguistic communication. There is

enough of evidence to show a shift to more sophisticated technology such as the use of grinding stones as an evidence of dependence on agriculture; mechanical projectiles such as spear throw; heat treatment to manipulate raw materials; use of needle; burials and ceramic ware and art work. Thus sophistication of technology enabled making of cloth and clothing; engraving; engraving; sculpting; fine art work; clay figurines; musical instruments; spectacular cave paintings.

Lieberman *et al*. (1969) in an earlier study of comparative mammalian physiology observed that the vocal tract in humans is strikingly different from other primates in having a lowered larynx, implying a configuration more suited to produce a wider variety of vowel sounds than other species. Studies of animal formant production and perception have shown that the most basic mechanisms underlying speech have a long evolutionary history, and suggest that certain perceptual mechanisms that were once believed uniquely human (e.g., vocal tract normalization) may in fact be part of the primitive perceptual toolkit inherited from our prelinguistic ancestors. However, the most significant of these preadaptations was language faculty in addition to brain. It is necessary to reiterate a position already made clear elsewhere that even though the notion of language faculty in the articulate human species is doubted by many scholars on the basis of its questionable physical credentials, there is hardly any credible argument against the fact that language is unique only to members of the species Homo sapiens sapiens, the anatomically modern humans. The philosophical notion proposed by Noam Chomsky is an important theoretical postulate to offer biological explanation to uniqueness of language in humans and also convincing to researchers seeking to explain the position in other disciplines. As pointed out by the famous archaeologist Colin Renfrew, members of the species Homo sapiens sapiens show very limited differences. Such differences are generally the acquired cultural differences, which account for a specific language and hence contrast with the genetically transmitted differences of the Homo sapiens sapiens and account for their language ability (Renfrew, 1999). No doubt evolution of language faculty in modern humans has occurred as an integral part of the larger domain of human evolution (Sharma, 2007).

The language faculty has evolved though in a very slow and gradual process along with the evolution of Homo sapiens sapiens just as other genetically transmitted traits have evolved, via selection over millions of alleles that contributes to the human genome. Evolution of human languages, indicative of the vast linguistic diversity among the human populations, has been much faster once the language faculty was evolved. The long-drawn process of the phylogenetic evolution of language faculty in humans must have been slower in comparison to the sociocultural evolution of individual languages. Once genetically evolved in Homo sapiens sapiens, human language faculty becomes part of the genetic transmission, the genotype. “In

theory a modern human language faculty could pass intact through thousand of years in a totally silent community (assuming the community itself could somehow survive); with the lifting of the vow of silence, the children of the new generation would be as ready as any others to acquire any language they were exposed to" (Hurford, 1999).A question that arises out of such an explanation for the evolution of language faculty is: Why did, after all, language faculty evolve? In order to answer this question, preadaptations have been used to justify its emergence in humans. As argued by Hurford (1999), "The initial conditions providing the platform for the adaptation must be presumed to contain some unique factor or combination of factors." This was further driven by selective pressure for individuals (or groups) to be better adapted to their environments. As Wilkins and Wakefield (1995) point out, "the neuroanatomical structures that underlie linguistic ability… arose in human taxa as a direct result of evolutionary reappropriation." Certain adaptive changes resulted in a paired expansion of the frontal and parietal cortex in the Pleistocene primate lineages and associated with manual throwing behaviours. Such an expansion, according to their argument, resulted in the simultaneous emergence of Homo habilis with two interconnected cortical areas in brain, the Broca's area and the POT, the later a configurationally unique junction of the parietal, occipital and temporal lobes of the brain indicative of the Wernicke's area. The now subservient extended form in brain had a motor function only. These neuroanatomical structures, however, soon reappropriated for a new function of processing sensory input into conceptual structures, both as amodal and hierarchically ordered. Such a structured modality-neutral representation evidently led to the conceptual structure, which became "a prerequisite to language" thus offering the hierarchical ordering necessary for modern syntax and morphology.

WHAT IS THE RELATIONSHIP BETWEEN TERRESTRIALITY, BIPEDALISM, AND BRAIN AND LANGUAGE EVOLUTION?

Evolution of the current brain size and inferred cognitive and linguistic abilities has occurred only during the last quarter of a million years. The unique human abilities are the legacy of their ancestors' adaptations of terrestrial and bipedal locomotion, which contributed to the unique human propensity for vocal communication, and its enormous range of articulation. It is interesting to note that the constricted bipedal pelvis, as pointed out by Aiello (1996), would have necessitated the birth of less mature offspring while the brain was still growing and developing since the large brain demanded a high quality diet thus resulted in lifestyle changes and consequent increased need for larger group size of the homo erectus about 1.8 million years ago

reaching a stable hominine adaptation over 1.5 million years ago. The increased brain size and the consequent changes and needs contributed to the emergence of language. It has been argued by Richard Dawkins in The Selfish Gene (1976) that evolution of human brain is linked with the continuous need of the survival machine to achieve more complex and indirect relationship with time and space and has further given rise to the emergence of consciousness. The second most interesting thing with regards to evolution of brain and its relationship with language is the emergence of recursion as an important feature of human language as it has not only shaped the future potential of linguistic communication in particular, but has also shaped the destiny of human culture and civilization at large. Emergence of syntax in human language can be seen as a sequel to the need of producing and using an unlimited number of linguistic expressions. How can one reconcile these alternative perspectives? The argument of Corballis (2002, 2003) is that language emerged not from vocalization, but from manual gestures, and switched to a vocal mode relatively recently in hominid evolution, perhaps with the emergence of *H. sapiens*. This argument, though, has not found general favor among linguists or anthropologists, perhaps because it fails to establish a direct evidence to show how any hominid ancestors of humans gestured rather than spoke. Human language, accordingly, is one of the finest accomplishments of biological evolution and its capacity to generate ideas that allow us to cognitively go beyond here and now in as much as it entailed the capacity in humans to describe events and phenomena that have never existed and as such has been crucial to the human species' success.

A close link between language evolution and memes is an important theoretical step formulated in the recent past by Blackmore (1999) in her The *Meme Machine* postulates the emergence of language as to aim at improving the fecundity and fidelity of memes with the recursive structure of existing memes thus leading to the development of more and more complex memes and eventually to the existence of more complex system of rules as grammar in a self-sustaining process. This has in all probability exerted pressure on genes thus creating a selection pressure for the evolution of brain requisite for language. Her argument suggests such an evolution of language due to the fact that emergence of sounds puts the high-fecundity transmission of behaviour to an advantageous position with the emergence of lexicon in human language further enhancing the fidelity of transmission.

Could it be possible, then, that evolutionary processes have unfolded some genetic change in humans' necessity for the emergence and transfer of the biological predisposition for language in humans? Even though genomic explanation assumes that humans with chimpanzees share 99% of 24000 genes, humans have evolved language due to the substantial genetic difference that has taken place owing to the process of evolution. Uniqueness of language to humans has motivated the possible

examination of the issue of evolutionary development of language as a genetic manifestation. It is a point of enormous value that in spite of their close genetic similarities to other primates, humans show a massive difference in their cognitive abilities, the most remarkable difference being in their capacity for language. Such a new cognitive development in humans is explained as a consequence of a specific genetic change. The argumentation at large has given rise to a distinct strand of research on molecular evolution of language with a focus on the distinctive ability of humans to acquire and develop language, which no doubt happens to be by far the most suited fundamental basis of human communication, and obviously a driving force for the development of a culture distinct from chimps and other apes. Two main arguments against 'only a genomic explanation' to the emergence of human language are: first, *the Arithmetical problem* (Muller, 1996: 626) as out of 2400 genes 99% are shared with chimpanzees, does it mean only the reminder constitutes the basis for uniqueness of human language? Second, *the plasticity of cortical tissue* to support a variety of different representations depending on the input it receives particularly in view of the fact of a neurological basis of human language and its representation. The human child is relatively immature at birth and brain has to unfold its growth and development with regards to its potential function, including language and cognition. It is true that patterns of connectivity which can support complex computations such as language processing emerge later, largely as a result of experience. It is also true that Evolution of human language is not only central to such fundamental evolutionary events but can at best be explained in relation to evolution of a distinct brain in human beings.

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