Language as a Critical Factor in the Emergence of Human Cognition

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ABSTRACT

Modern human beings are most sharply distinguished from all other organisms alive today by their possession of symbolic reasoning, the cognitive capacity that makes possible the mental construction of alternative versions of the world. Scrutiny of the human fossil and archaeological records reveals that, while brain sizes expanded independently in several hominid lineages over the course of the Pleistocene, this qualitatively distinctive symbolic faculty only emerged in our own. What is more, this acquisition was made remarkably recently: well within the 200,000-year tenure on Earth of our anatomically distinctive species *Homo sapiens*. The earliest anatomical *Homo sapiens* appear to have behaved in much the same manner as their non-symbolic contemporaries, although it is highly likely that they had acquired the neural wiring necessary for symbolic thought in the same event of developmental reorganization that gave *Homo sapiens* its strikingly derived bony morphology. Only subsequent to about 100,000 years ago do archaeological traces suggest that our forebears had actually begun to think symbolically. This implies that the new capacity was released by a purely cultural stimulus (after all, the biology was necessarily already in place). I suggest that cultural trigger involved was the spontaneous invention of language by members of a small population isolate of *Homo sapiens* in Africa, at some time after about 100,000 years ago. Structured, rule-bound language is intricately intertwined with symbolic thought as we experience it today; and it is possible to conceive at least in principle how each could have fed back into the other to create a new dynamic.

Keywords: origins of language, human evolution, symbolic cognition, evolutionary pattern.

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Language has long been recognized as a core peculiarity of modern human beings. But views have varied wildly as to how and when this unusually structured means of communication, and the unprecedented cognitive style that underpins and permits it, were acquired by ancient members of our lineage. Evolutionary psychologists like to suppose that hominids gradually accumulated linguistic abilities in a feedback process between brain and behavior over the entire Pleistocene epoch, roughly the past two million years during which bona fide members of our genus *Homo* have been around on the planet (Tooby & Cosmides, 2000). They are supported by certain paleoanthropologists, who have favored the appearance of some form of language early in the history of *Homo* (Tobias, 1991; Holloway et al., 2004), as well as by neurobiologists such as Terrence Deacon (1997). On the archaeological side, McBrearty & Brooks (2000) have favored a gradual emergence of "modern" behaviors over most of the length of the Middle and Late sections of the Pleistocene.

At the other end of the spectrum of possibilities, some practitioners of linguistics have advocated a recent "big bang" appearance of language. Derek Bickerton (1995, p. 69), for example, has declared that "true language, via the emergence of syntax, was a catastrophic event, occurring within the first few generations of *Homo sapiens sapiens*." Something similar has been concluded by archaeologists such as Henshilwood et al. (2002) and Marean et al. (2007), who perceive a rather abrupt appearance of "modern" behavior patterns in the Late Pleistocene. From the standpoint of genetics, Tim Crow (2002) has strongly argued that a single recent mutational event gave rise to the anatomically-distinctive species *Homo sapiens*, along with all of its cognitive peculiarities including language, theory of mind, and mental maladjustment. Crow's conclusion, it might be noted, is strikingly similar to the one reached on archaeological grounds by Richard Klein (see Klein & Edgar, 2002).

All of the participants in this debate over human origins concur that, at some remove, modern human beings are descended from a non-linguistic, non-symbolic precursor that did not, as we do today, remake the world in its head via the reshuffling in the mind of discrete mental symbols. What divides them is the issue of process. Essentially, one group believes that modern cognition was acquired steadily and gradually over the last two million years during which human brain:body size ratios have markedly increased (in multiple independent lineages). This gradual process of cerebral and cognitive increase would more or less exclusively have involved natural selection at the

individual level. Smarter individuals behaved more appropriately to circumstances, and thus reproduced more successfully, generation by generation, than less intelligent ones did. Under this view, we human beings have been honed by Nature to be intelligent and linguistic, and thus more generally to be the very unusual kind of creatures we are. Nature, in other words, has contrived to engineer us to a specific human condition.

The alternative view has profoundly different implications for the kind of organism we happen to be. For, if the unique human way of mentally processing and communicating information was in fact a recent and relatively short-term attainment in our lineage, then it is highly likely that a significant element of chance was involved in this acquisition. And if such was the case, then our behavioral repertoire was clearly not fine-tuned by selection to suit the now-vanished "environment of evolutionary adaptation" that is blamed by evolutionary psychologists and their intellectual fellow-travelers for our many inappropriate behaviors.

One of the reasons for these radical divergences in perspective on human evolution is that language and other cognitive attributes do not imprint themselves directly upon the preserved record. Archaeological sites from the Pleistocene consist for the most part of temporary hunter-gatherer camps that contain the debris of occupation: mainly animal bones representing food remains, and the stone artifacts used in butchery and other activities. None of these materials can be used as direct proxies for the cognitive states of the hominids responsible for them, so that in most cases we are obliged to make very indirect inferences about all behaviors except for explicitly technological ones. And I would argue that, while many Paleolithic stone-working techniques are certainly witnesses to very sophisticated cognitive states, few if any can be used alone to infer a specifically modern human symbolic cognitive style, let alone the possession by their makers of language (Tattersall, 2008, 2012). Indeed, apart from multi-stage technological sequences requiring extensive planning and recursive inputs, it seems reasonable to insist that only explicitly symbolic artifacts can confidently be used as proxies for symbolic thought processes on the part of their makers. Of course, recognizing a symbolic artifact is not always easy, or unequivocal. Can a roughly-altered lump of stone that looks to a modern person like something vaguely familiar be considered symbolic? Was a pierced gastropod shell necessarily part of a symbolic ornamentation system? Does grinding ochre in itself imply symbolic bodily decoration? There will always be tricky cases like these. But most

archaeologists can probably agree that the engraving of a geometrical design on a flat plaque pretty certainly implies that the engraver was thinking in a modern way, and that an artist producing realistic images or repetitive elements of a notational system clearly was.

The relationship of such activities as these last ones to language is probably a relatively straightforward one. Or at least, the two are intricately and intimately intertwined. Modern symbolic thinking is basically inconceivable in the absence of modern language, while language itself depends on the combining and recombining of mental symbols in exactly the way that thought does. In other words, we can be pretty confident that an ancient human who made what we can recognize as art or symbolic objects had language as we recognize it today. On the other hand, we are most prudent to conclude that hominids who did not routinely indulge in such behaviors did not; that they were basically doing business in the old way. Of course, this is not to imply that language arose out of nowhere, or that earlier humans who lacked symbolic information processing did not possess high levels of intuitive intelligence, or lacked sophisticated means of gestural and vocal communication. Certainly it did not, and they did. But it may also be fair to claim that, prior to the advent of symbolic mental manipulation, gesture and vocalization, however sophisticated, were exclusively about expression. These behaviors were produced by the pre-existing intuitive cognitive states that they expressed. Structured, rule-bound language, with grammar and syntax as well as a vocabulary, added an extra dimension to the cognitive process: in an intricate feedback, a mode of expression became a portal to symbolic thought.

How could this astonishing transformation, this transition from an ancestral non-symbolic and non-linguistic cognitive condition, to a descendant symbolic and linguistic one, have come about? In order to understand this, we have to return to the fossil and archaeological records to determine the exact patter of change in human evolution. Was this pattern one of gradual change, as evolutionary psychologists and their allies claim? Or was change abrupt, as many others are beginning to conclude? In deciding between these two alternatives, the first task is to examine the topography of the hominid genealogical tree. And purely on the basis of the tree shown in Figure 1, we have to reject the notion that *Homo sapiens* is the most recent phase of a steady, long-term refinement of a central lineage. For no central lineage is discernible in this tree. Instead, the history of the hominids has quite evidently been one of vigorous experimentation, as one new species after another was thrown out on to the environmental stage to compete for ecological space with other species, both closely and distantly related – and ultimately, as

likely as not, to become extinct. This is a rather routine pattern for any successful mammalian group, and it applied from the very earliest days of the hominid family's existence. At times, as the figure shows, there were as many as eight hominid lineages coexisting – and that is just in the known fossil record, which represents only a fraction of past diversity. On an intensely local level, in the period around two million years (myr) ago, we have evidence for at least four different hominid species inhabiting the landscape around Lake Turkana in northern Kenya alone.

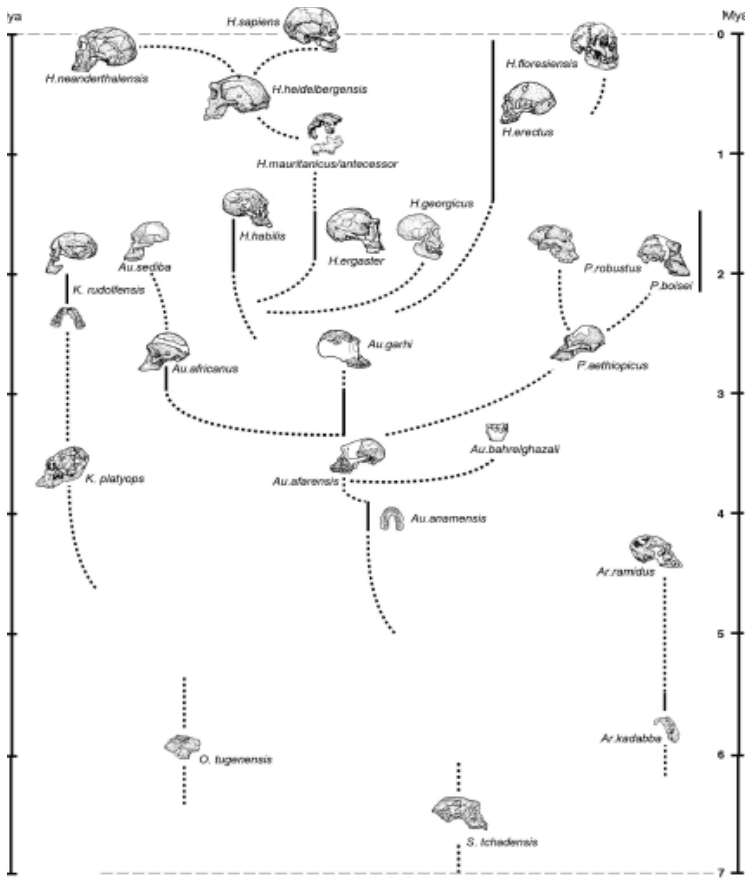

Figure 1. Highly tentative phylogeny of the hominid family, showing the diversity of species currently known within the group, and indicating some possible lines of descent. Multiple hominid lineages have typically existed in parallel. Artwork by Jennifer Steffey; ©Ian Tattersall.

What is not evident from the figure is that, also from the very beginning, innovation in the anatomical and technological realms were out of phase. New species did not bring new technologies along with them. The very first hominids were a diverse but mostly poorly known assortment of (where known) relatively small-brained seven- to four- million-year old African hominoids that are believed, for one reason for another, to have adopted upright bipedal locomotion when they were on the ground. Better known are the "australopiths," a quite diverse radiation of hominids from between about 4 and 1.5 myr ago. These were definitely bipedal when moving on the expanding woodlands and open grasslands of Africa; but they were still quite small-statured, retained substantial climbing abilities, and possessed ape-like small brains and protruding faces. It was among one species of australopith that the first use of simple sharp stone flakes to butcher carcasses may have begun as long as 3.4 myr ago (McPherron et al., 2010); and by about 2.5 myr ago (Semaw et al., 1997) the first such implements were being deliberately produced by fracturing stone through intentional percussion.

Crude but effective stone flakes of this kind continued to be made even after the first well-defined species of our own genus, the tall, slender, long-legged *Homo ergaster*, showed up in the fossil record at around 1.9 myr ago (Wood & Collard, 1999). The bifacially-flaked handaxe, the first major refinement in stone tool technology, only effectively appeared at about 1.5 myr ago (see Klein, 2009), long after *Homo ergaster*'s entrance on the scene. And then the handaxe, too, remained unrefined in concept until about 0.3 myr ago, when "prepared-core" tools were introduced: implements shaped carefully on both sides until a single blow would detach an effectively finished tool with a continuous cutting edge all around it (see Klein, 2009). This highly episodic history of innovation, happening over a period marked by epic environmental fluctuation, suggests that it was typical for hominids to greet changing circumstances by adapting old technologies to new uses, rather than by inventing new ones as we do.

Meanwhile, new hominid species were appearing and vanishing from the record. Best-known of these is *Homo heidelbergensis*, a modestly large-brained form that showed up in both Africa and Europe at about 600 kyr ago (Clark et al., 1984; Wagner et al., 2010). *Homo heidelbergensis* is particularly interesting because it is within its tenure across the Old World that many significant technological innovations were made. These included the hafting of stone tools, the building of the first complex shelters, and also the

carving of carefully-shaped wooden throwing spears (de Lumley & Boone, 1982; Thieme, 1997). It was also evidently in the time of *Homo heidelbergensis* that the domestic use of fire became an entrenched part of hominid life.

But significantly, members of this species, like their predecessors, did not make anything that we can confidently interpret as a symbolic object. Smart and resourceful these hominids undoubtedly were; but they were evidently not processing information about the environment using any version of our mental algorithm. The same can even be said of *Homo neanderthalensis*, an endemic European and Western Asian species that flourished between about 200 and 30 kyr ago. Most famous for having brains larger on average than ours today (though not than those of Pleistocene *Homo sapiens*), the Neanderthals are incomparably better-known than any other extinct hominid species. But although they were excellent craftsmen in stone, showed considerable curiosity (picking up fossils and carrying them home, for example), occasionally buried their dead, hunted some fearsomely large animals, and flourished in sometimes very severe climatic conditions, they did not show the spark of creativity that distinguishes *Homo sapiens.* Smart they undoubtedly were, but they were not smart in our way; they were evidently not symbolic thinkers. It is probably as a consequence of this cognitive difference that (along with cognitively archaic hominid species in other regions) the Neanderthals promptly disappeared when their heartland was invaded by cognitively modern *Homo sapiens*.

As for *Homo sapiens* itself, fossils of this very anatomically distinctive species are first found in Ethiopia, in deposits ranging between about 195 kyr and 160 kyr old (White et al., 2003; McDougall et al., 2005). Yet the archaeological contexts in which these fossils occur are notably archaic, and indeed they include the very last handaxes found in Africa (Clark et al., 2003; see also Klein, 2009). The earliest *Homo sapiens* fossils known outside Africa are from the adjacent Levant. Around 100 thousand years old, they occur in archaeological contexts that are once more indistinguishable from those of penecontemporaneous hominids, in this case the Neanderthals (Bar-Yosef, 1988). In other words, there was no replacement of Neanderthals by anatomically modern *Homo sapiens* for as long as the two species were functioning on similar cognitive levels.

In waiting for some considerable time after the appearance of anatomically modern *Homo sapiens* to find any evidence of modern behavior/cognitive patterns, we once more find a discontinuity between the arrival of a new

species and the appearance of a new technology. The lapse was apparently in the order of 100 kyr, since at about 100 kyr pierced marine shell beads and ochre deposits begin to show up in deposits around the Mediterranean and in South Africa (Bouzouggar et al., 2007; Vanhaeren et al., 2006). But even if this kind of proxy for modern cognitive processes seems a little tenuous, we do not have long to wait. At about 77 kyr, Middle Stone Age (MSA) levels at Blombos Cave on the southern African coast have yielded not only ground ochre and shell beads, but a smoothed ochre plaque on which a geometric design was engraved (Henshilwood et al., 2002). This basic design is found repeated at a slightly later South African MSA site (Texier et al., 2010), supporting its identity as a symbolic motif with social meaning. At around 72 kyr, the nearby MSA caves of Pinnacle Point have additionally yielded evidence of a complex multi-stage heating technology for converting the abundant soil derivative known as silcrete from a poor tool-making material into an excellent one (Brown et al., 2009). Especially in concert with the early appearance of microliths (Brown et al., 2102), this is a technology sufficiently elaborate to allow the fairly confident inference that it was produced by symbolic minds.

There are no diagnostic hominid fossils associated with these early expressions of behavioral modernity in South Africa. But that they were the work of members of our species is very firmly implied by early *Homo sapiens* occurrences at other sites of comparable age in Kenya and Sudan and elsewhere in Africa as well as in South Africa itself (Schwartz & Tattersall, 2005). It thus seems quite clear that *Homo sapiens* had begun to acquire its modern cognitive processes somewhere in Africa well before 60 kyr ago, the date by around which molecular evidence from modern populations (Templeton, 2005) suggests that our species definitively emerged from the continent of its birth. In contrast to its earlier failed and apparently nonsymbolic foray into the Levant, once out of Africa the newly symbolic *Homo sapiens* rapidly took over the world, in the process displacing those hominid species that were already resident in Europe and across Asia. By 40 kyr ago (Pike et al., 2012) the inauguration of the dazzling tradition of European cave art had already begun to leave the most eloquent expression possible of a fully-formed modern sensibility. And, possibly most significantly of all, it is in the African MSA that we find the beginnings of that restless appetite for technological and presumably other change that has been so fundamental a component of the human psyche ever since.

The evidence to hand thus indicates that, after some seven million years of hominid evolution, something happened in Africa that revolutionized hominid life and experience. Up to this point, significant change, both anatomical and behavioral, had been both rare in hominid history, and highly sporadic. Over the eons hominid lifestyles, and the beings themselves, had undeniably become more complex. But they had done so in an incremental manner rather than along a smooth trajectory; and for vast periods change had been the exception, rather than the rule. What is more, it seems fair to say that, except at the point of appearance of the physically novel genus *Homo*, successful new entrants on the hominid scene had been improvements on their successors, rather than radically new entities. And then, at around 100 kyr ago something happened to upset this pattern once again, this time in the cognitive realm. Members of one particular hominid species began to process information in an entirely new and unprecedented way. Significantly, this change happened well *within* the tenure on Earth of our distinctive species *Homo sapiens*. In other words, the extraordinary and unprecedented transition from non-symbolic to symbolic cognition was a cultural event rather than a biological one. Intuitively, this might seem rather odd. But in fact it is hardly surprising, because in order for this change to occur, the enabling biology must necessarily already have been in place. Indeed, as we have seen, changes in the biological and cultural domains were typically out of step throughout human evolution.

This formative event in human evolution took place within a context of extreme climatic instability. The hominid populations of Africa would have been regularly battered by the climatic vagaries of the late Pleistocene, a period during which frequent climatic oscillations must at times have caused dramatic decreases in hominid numbers, the desolation of large swaths of territory, and the isolation of small hominid populations in local refugia with relatively kind environmental conditions. Tiny isolates restricted to such refugia would have provided exactly the demographic circumstances in which novelties, both behavioral and genetic, would have been most likely to become "fixed" as population attributes. It was such demographic conditions that presumably accounted for the initial origin of anatomically recognizable *Homo sapiens*, and, later, for the emergence of its behaviorally modern descendant populations.

Anatomical *Homo sapiens* is hugely derived skeletally, and this distinctive species almost certainly appeared in a single event involving radical developmental reorganization that occurred at around 200 kyr ago. It is quite

plausible that this change (large in its effects, but very probably structurally minor at the genomic level) also had ramifications in other organ systems of the body. Affected systems would likely have also included the already large brain; and the changes involved would almost certainly have involved augmented anatomical connections among the cerebral structures physically permitting the associations that underpinning symbolic thinking. It has been energetically debated exactly what those fateful neural changes were (see, e.g., Lieberman, 2007; Coolidge & Wynn, 2009); but while this question has yet to be satisfactorily resolved, the radically new capacity was evidently not co-opted immediately by its possessor. It needed to be "discovered," just as the ancestral birds learned that they could use their feathers to fly only millions of years after acquiring these unusual features.

So what was the evidently cultural agent of this discovery? By far the most plausible candidate for this role is the invention of structured language (Tattersall, 1998), something we know can spontaneously happen among modern human populations (Kegl et al., 1999). After all, language is the human faculty that is most intricately intertwined with the processes of human thought. Both of these fundamental human possessions are inherently symbolic, and each is literally unimaginable to us today in the absence of the other. What is more, it is quite easy at least in principle to imagine how the addition of structured sequencing, to a complex pre-existing system of vocal communication based on utterances as symbols of particular emotional or intuitive states, could have created a pattern of associations that initially mimicked, and then constituted, what we now experience as thought. Such is not self-evidently the case with such other putative drivers of symbolic cognition as theory of mind (e.g., Dunbar, 1998), which is by its nature internalized. And, as an externalized group property rather than an internalized one, language would have had the advantage over theory of mind in being readily transmitted within a population that happened, exaptively, to be already biologically enabled for it. What is more, if language was invented by hominids that possessed the highly specific anatomical attributes of *Homo sapiens*, notably the retracted face and its sequelae (see Lieberman, 2011), then the peripheral vocal apparatus needed to express this qualitatively new behavioral proclivity was also already in place, having initially been acquired in some other functional context entirely, or perhaps purely as a matter of chance.

In this scenario language, in its modern structured, articulate form, was an essential catalyst in the amazingly recent attainment of fully behaviorally

modern humanity. Originating as a means of communication (even possibly among children at play: Tattersall, 2012), language acted simultaneously as a portal to internal thought, providing a framework within which the brain could form and shuffle symbols to create new and alternative visions of the social and physical worlds. Significantly, although they were based on the fruits of many million years of vertebrate evolution, language and symbolic thought were not merely extrapolations of what had preceded them. A final addition to an ancient structure that had been accreted in a complex manner had produced an organ with an entirely unprecedented and emergent potential. But this potential evidently had to be released by a behavioral innovation: a requirement that neatly explains the disconnect between the earlier acquisition of the underlying potential, and its later behavioral expression.

The product of the stimulus provided by the invention of structured articulate language was, and is, without doubt an altogether remarkable one. Indeed, it is not too much to say that in cognitive terms we modern *Homo sapiens* are qualitatively entirely discontinuous with anything that preceded us. The large-brained Neanderthals were complex and resourceful beings, of that there is no doubt. But, as among all of our other known extinct relatives, among whom change of all kinds seems to have been both rare and highly sporadic, there is scant reason to believe that the Neanderthals ever processed information symbolically. The resulting contrast between their lives and those of the neophiliac modern humans who replaced them could scarcely be greater. On the other hand, purely in terms of evolutionary process, nothing unusual had happened at all.

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