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WHAT DOES IT MEAN TO BE HUMAN? A BEHAVIORAL PERSPECTIVE

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"...it would be impossible to fix on any point when the term "man" ought to be used....." (Darwin 1871: 230)

A new permanent exhibit at the Smithsonian's National Museum of Natural History asks the question "What does it mean to be human?" Before there were any fossils to inform us about the roads taken and not taken on our evolutionary journey, 18th and 19th century scholars wrestled with the anatomical similarities between humans and apes, especially, as Darwin noted, the African apes. Many of the human distinctions these early scholars cited were behavioral, including language, tool-making and technology-dependence, culture, use of fire, a sense of shame, burial of the dead, and a sense of the sacred. Even today, our anatomy alone may not suffice to define our genus *Homo*. Indeed in 1964 one of the oldest members of our genus, *Homo habilis*, was defined as *Homo* to a large extent on the basis of the tools found in association with its bones; the evolutionary or generic status of the bones themselves remains controversial. As in the museum's new exhibit, new approaches to understanding our past and defining our species emphasize the role of changing human behavior and its relationship to and possible role in changing our anatomy.

This paper offers a brief summary of key discoveries in the fossil record followed by a discussion of behavioral characteristics defining modern humans and their emergence through time. This is followed by a description of the evidence documenting the development of archaic, Neanderthal, and modern humans, tracing the evolution of key behaviors from 600 kya to 40 kya (thousands of years ago). Finally, the evidence for the role of Africa in the gradual evolution of distinctly modern human behaviors is argued as the paper concludes.

The Fossil Record of Human Evolution

Charles Darwin in his 1871 book, *The Descent of Man*, located the likely origination of humans in Africa due to the geographic distribution and comparable anatomy of the chimpanzee and gorilla. Other early scholars, however, thought that our two most distinctive anatomical features, our large brains and our two-legged gait, had evolved together and that these changes had happened in Europe. In Darwin's time, only a few fossils of Nean-

derthals, our closest extinct relatives, had been recovered from European sites. The 1891 finding in Java of *Pithecanthropus erectus* (now *Homo erectus)*, an upright biped with a cranial capacity of only 900cc., argued that both of these ideas were false; bipedalism came first and not in Europe. Only much later in 1924 were the first African fossils of human ancestors recovered at Singa (Sudan) and Taung (South Africa). The ca. 2-2.5 million-year-old Taung specimen of a small child with a chimpanzee-sized brain became the type fossil of *Australopithecus* (Dart 1925), a genus that is probably ancestral to our own (*Homo*). Like the *Pithecanthropus* discovery, the Taung child's human-like teeth, small brain but upright posture, as indicated by the position of the skull on top of the spine, suggested that brain development lagged behind new ways of getting around.

Most scholars in the 1920s, and some much more recently, continued to argue that major changes in the human evolutionary past occurred in Eurasia. But since the 1920s, Pliocene and Pleistocene age (5.3 – 0.01 million years ago or mya) fossil specimens belonging in the hominin lineage—representing more than 6,000 individuals—have been recovered at an accelerating pace from Europe, Asia, Africa, and Australia. Africa has yielded the oldest members of the human lineage ("hominins"), the oldest stone tools, the oldest members of our genus *Homo*, and the oldest members of our species *Homo sapiens.* Multiple genetic studies of modern human mitochondrial Y-chromosome and nuclear DNA conclude that the greatest variability, the most ancestral lineages, and the likely region of origin are all African, proving that Darwin was right in assigning us an African origin.

The emergence of a richer fossil record raises anew the question, what do we mean by human? Are the earliest hominin fossils from 7-3 mya whose skeletons reflect some level of bipedal locomotion human? (See accompanying article on the development of bipedalism.) Does the genus *Homo* begin with the appearance of stone tools 2.6 mya, or with the first reduction in molar size around 2.3 mya, or with the first signs of brain enlargement in Ethiopian and Kenyan fossils from 1.9 mya? Should we only bestow the word "human" (or the generic/evolutionary status of *Homo*) on fossils with the human-like suite of characteristics reflected in the relatively complete skeleton of the 1.5 mya "Turkana Boy." Found in northern Kenya, this fossil had a brain almost 2/3 the size of ours, smaller teeth than in previous hominins, and modern body size and limb proportions reflecting fully-committed bipedal walking and running. Should we limit the definition of "fully human" only to members of the species *Homo sapiens*, defined morphologically by large brains in relation to body size, small teeth, gracile skeletons, chins, minimal brow ridges, vertical foreheads, and faces tucked under braincases in such a way as to facilitate speech? Or perhaps only to those members of our species who demonstrated advanced abilities for symbolic behavior, innovation, and social complexity?

A Behavioral Perspective

Like the expanding fossil record, studies of great apes in the wild have documented many human-like behaviors, blurring humans' behavioral distinctiveness. All the great apes make and use simple tools, and their tool use and other behaviors vary among populations, suggesting that groups invent and hand down different behaviors from one generation to the next, a rudimentary form of 'culture.' While spoken language is still a major defining feature of humans, many humans use other forms of communication, and some apes have proven capable of learning from humans or even from each other to communicate using elements of sign language. Psychologists focus on the expression, in humans, of such characters as "empathy" and "problem-solving abilities." However, in almost every case, at least one of the great apes (or some other animal) has shown this feature in some form. An absolute distinction between humans and non-human animals has thus far proved elusive.

What can the fossil and archaeological records tell us about the evolution of human behavior? Even before there are any tools or archaeological sites, the fossils themselves reflect behavior in the shape of bones, the position and strength of muscle markings, the form of the teeth, the patterning of reinforcing structure inside the bone and its chemical composition, as well as in signs of trauma over a lifetime. The long arms, curved fingers and toes, and upwardly-oriented shoulder joint of *Australopithecus* reflect a life still lived partially in the trees. Small canines suggest a new, less confrontational approach to male-male relationships and social organization, whilechemical studies of the teeth suggest that later ones may have begun to exploit the same foods that make up large parts of the human diet – meat and tubers. The reconstructed environments of the

sites themselves also tell a story—of early use by hominins of a wide range of environments both in and out of the forest.

Between 2.6 and 2.3 million years ago in Ethiopia and Kenya, along with *Australopithecus* and some fossils with slightly smaller teeth and shorter faces attributed on that basis to *Homo*, we begin to find material remains in the form of flaked stone tools and bones that were cut and broken open to access meat and marrow. Such archaeological sites are formed through human activities, although it has been shown that chimpanzees also leave archaeological traces of their behavior.

The fossil and archaeological records are limited in what they can say about the origins of humans, as they require definitions of humanness that are amenable to recovery in the material record. For example, one cannot recover fossil languages, at least not until the development of writing. But one can recover traces of symbolic behavior, or morphological traces of changes in brain or vocal tract morphology that suggest an ability for language. Ideologies or the capacity for abstract thought are not preserved, but one can recover traces of practices that seem to conform to ideas about spirituality—burial of the dead and cave art. Problem solving and creative innovation cannot be directly observed in the past, but one can document increases in technological sophistication and rates of innovation. Social networks and societies in which humans live are abstractions that must be inferred from physical evidence even in living populations. But through geochemical analysis of where raw materials came from, one can trace the movement of materials like stone and beads over very long distances and thereby infer human networks' size and distance.

In addition, from patterns of variability in the material record, it is possible to infer whether or not people distinguished themselves from their neighbors through their material culture, and what the size of the distinctive groupings might have been. Signs of empathy may also be evident in the survival of individuals with crippling injuries or major deficits, who could not have survived long on their own.

Defining Human Behavior

From the perspective of modern humans, behavioral definitions of humanness include what can be considered "living in our heads," enabling us to transform the natural world.

Multipurpose tools, such as hand axes, used to chop wood, butcher animals, and make other tools , dominated early human technology for more than a million years. Left to right: Africa (1.6 million years old), Asia (1.1 million years old), and Europe (250,000 years old).Photo courtesy Human Origins Program.

Humans think up cultural solutions to scarcity, risk, and the quest for food, shelter and mates, resulting in an astounding diversity of cultural forms and the transformation of vast areas of the earth's surface. Since humans' teeth and their two-legged gait are utterly inadequate for defense against natural predators, humans are totally dependent on invented technologies. Rather than living in a physical herd or a pack, humans live in what have been called "imagined communities," populated by individuals never physically encountered—distant relatives, compatriots, ancestors, and spiritual beings. Humans use symbols extensively to represent themselves, their social groups, and their thoughts. Humans have the ability to imagine the feelings and lives of others as both separate from and similar to their own—in a way that leads to extraordinary capacities for altruism and sympathy, even for individuals they may never meet.

One way to describe the capabilities of modern humans is to separate out at least six different faculties:

Abstract thinking: the ability to act with reference to concepts not limited in time and space. A chimpanzee can be taught to use symbols correctly to solicit a reward, but not to go to the grocery store with a shopping list and remember that she forgot to write down the bananas.

Planning depth: the ability to strategize in a group context. Social carnivores share this ability in the immediate future, but lack our ability to plan for next year, or for contingencies that may never happen.

Problem-solving through behavioral, economic, and technological innovation: Many animals are good problem solvers, but modern humans solve problems that have not yet arisen and devise entirely new ways of living in the process.

Imagined communities: Our present communities, from family to nation, may include people we have never met, spirits, animals, and people who have died and the not-yet-born. These communities exist in our heads and never meet face-to-face as a group.

Symbolic thinking: Especially with regard to information storage, this involves the ability to reference both physical objects/beings and ideas with arbitrary symbols, and to act on the symbol even if the person who planted it is no longer present. It is both the arbitrariness of such symbols and their freedom from time and space constraints that distinguish our symbolic behavior from that of animals and constitute the foundations of human language.

Theory of mind: The ability to recognize oneself as a separate intelligence but at the same time to read the emotions and thoughts of others (empathy). Apes and even domestic carnivores possess this to a degree, but only modern humans can respond to humanity in individuals they will never meet.

The Early Record: 2.6 - 0.6 mya

If all these are key human abilities, when did they first appear? It is difficult to say, not only because the record is sparse and patchy, but because the capability may or may not be expressed for hundreds or thousands of years after it appears and may depend on the development of other factors or historical events. The capability for inventing computers may have existed in the late Pleistocene, but could not be expressed without the appropriate cultural and technological milieu. The limited evidence for these characteristics' early expression suggests, however, that the total package was not assembled over a short period.

Problem-solving and technological innovation. The first stone tools date to 2.6 mya from Ethiopia, slightly later in Kenya. There is little evidence for abstract thinking in these artifacts as they consist of simple flakes directly related to the form of the raw material, although the ability to choose appropriate raw materials and to derive multiple flakes from a single block is far beyond what even the smartest apes can be taught to do. The rate of change or innovation is initially very slow; new forms such as bifacially worked symmetrical handaxes appear only after the first 900,000 years; and tools remain static for more than 1 mya after that. Nevertheless, such tools made it possible for early humans to shift from the largely frugivorous diet of the great apes to a diet with substantial carnivory and exploitation of new foods such as underground tubers. By 1.9-1.6 mya, our early ancestors also could expand into the Near East, Indonesia, and China, far beyond their original range and adapt to the new environments and faunas there. Technology also seems to have made possible a shift in food preparation from teeth to tools, so that teeth became smaller while body size increased. Early human diets were probably omnivorous, with meat obtained largely by scavenging. Fire was controlled by 0.8 mya or earlier, facilitating a new diet, the use of caves, hunting, new technologies, and social time at night.

There is no evidence from this time for *imagined communities* or *symbolic thinking*. Stone and other materials appear to have largely derived from within about 15 miles (25 km) of the site. Technologies are very similar from India to England and from France to South Africa.

Empathy, which appears very early in modern children before competent speech, may already be reflected in a very early human skull from Dmanisi in the Caucasus at 1.9 mya. The individual had lost almost all his teeth a considerable time before death, a condition rarely found in wild primates. Survival of this toothless individual required either a new, very soft diet or the assistance of others.

The early appearance of these features does not mean they were as fully expressed as in modern humans or even that the full capacity existed as in ourselves. But it does indicate that the human capacities do not arise suddenly in full-blown form but rather develop over time from less human antecedents.

Late Archaic Humans and Neanderthals: 600 kya to 40 kya

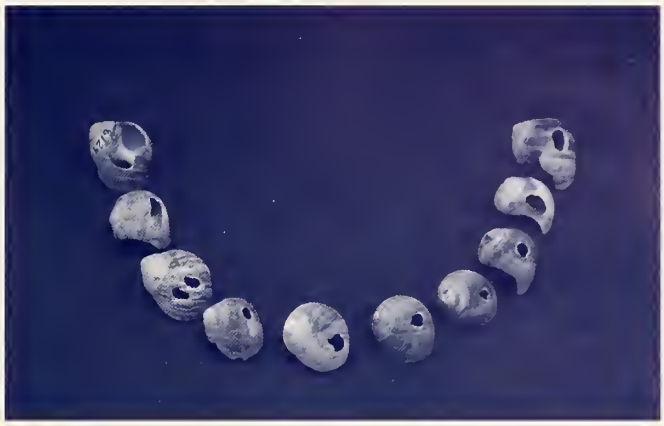
Beginning before 600 kya (thousands of years ago), most fossils in Africa, Europe, and the Near East present essentially modern brain sizes, although their teeth and faces are still large. In Africa, this shift may coincide with a new stone technology (Levallois), requiring a greater degree of ab-

stract thought to imagine the flakes whose shapes were predetermined by the shaping of the cores. Evidence of an increase in technological innovation, larger social networks or symbolic behavior, however, is minimal until ca. 400 kya, although new evidence of an occupation of southern England ca. 700 kya years ago suggests the ability to meet the challenges of a much more temperate environment. Ocher's increased use in Africa by 240 kya or earlier may suggest body painting or alternatively a more utilitarian function. Wooden spears or javelins from Germany and numerous remains of large animals imply a more complex hunting technology, which may have facilitated the occupation of much higher temperate latitudes.

Neanderthals, who occupied Eurasia as far east as Uzbekistan between ca. 250 and ca. 35 kya (or even later in a few 'refuge' areas) were significantly more like modern humans in their behavior than their predecessors. They buried their dead, but without clear evidence of grave goods or associated symbols, used black and red mineral pigments found as powder, lumps and "crayons," made stone-tipped spears, and were competent hunters of large game. Their fossil remains bear traces of both interpersonal aggression, in the form of a knife wound, and empathy, as elderly and handicapped individuals survived for much longer periods than previously. Although Neanderthals occupied Europe for at least 200 kya, their technology shows very little innovation or regional differentiation until the last 15 to 20,000 years of this time. The Neanderthal brain was similar in size to ours when adjusted for their larger body mass, but the relationship of the tongue and soft palate to the laryngeal space suggest that they may still not have been capable of all the complex speech sounds made by modern humans. Personal ornaments are only found at the most recent Neanderthal sites, after 50 kya, dating to a time when anatomically modern humans were already on the periphery of Europe. Does this mean the Neanderthals possessed a capacity for innovation and symbolic behavior, or only a facility for imitation?

Modern Humans, *Homo sapiens*: An African Origin

Into the 1970s it was thought that modern humans evolved in Europe. But with the advent of new fossils and better dating techniques, it has become clear that the oldest anatomically '*Homo sapiens*' fossils were African. The oldest fossil



These 30,000-year-old shells from Cro-Magnon, France, represent some of the earliest evidence of humans wearing jewelry. Some shells have traces of ocher, a clue they were colored with pigment. Photo courtesy Human Origins Program.

attributed to *Homo sapiens* in Africa is more than five times as old as the oldest *Homo sapiens* in Europe. At the same time, genetic studies demonstrate that all living humans share a 'recent' African common ancestor who lived between 100 and 200 kya. One group of African genetic lineages shares a common ancestor with all non-Africans that is considerably younger, perhaps 40-80,000 years ago. Although at first these results were disputed, repeated genetic analyses have confirmed our African origin. DNA sequences have been recovered from Neanderthals who lived as far apart as Spain and Siberia. The resulting sequences share similarities with one another but indicate at least three regional populations and contain many sequences not shared with living humans, suggesting at least 400 kya of separate evolution.

The rapid appearance of modern-looking people in Europe was not a punctuated "human revolution" or "great leap forward." It was an invasion of people with long tropical limb proportions. Asia has a more complicated but equally punctuated history, also suggesting invasion and ultimate dominance by outsiders. Indeed the first "out-of-Africa" migrations of *Homo sapiens* were to the Near East, with modern humans appearing first at Skhul and Qafzeh in Israel between ca. 110 and 90 kya, an initial wave that does not appear to have spread beyond this region until 50-60 kya. Modern humans then disappear from the Levant, as Levantine fossils from 90-50 kya are all Neanderthals. Modern humans expand again at or before ca. 50 kya.

"Rapid appearance of modern-looking people in Europe was not a great leap forward."

Modern Humans: Revolution or Gradual Evolution?

The earliest *Homo sapiens* in Europe and Asia, ca. 40 kya and later, were almost certainly capable of the same range of behaviors as we are, as indicated by their cave paintings, sculptures, musical instruments, beads and other jewelry, trade networks, technological innovations, regional diversity, economic flexibility, and ability to colonize the entire globe. There is considerable debate about earlier humans in Africa who were physically similar to us in many ways. Some scholars argue that they were physically modern but behaviorally primitive. To these scholars, modern behavior came about suddenly, a "Human Revolution" tied to a rapidly spreading genetic mutation for language.

In a 2000 paper, Sally McBrearty and I argued otherwise, that the capabilities for these behaviors began to be expressed and therefore existed even before modern physical appearance, with a gradual assembly of the kinds of behaviors we see later. This assembly was not unilineal but geographically and temporally spotty, with many reversals.

Archaeologists look especially for technological innovation and complexity as proxies for problem solving; for long-distance exchange and economic intensification as proxies for both planning depth and imagined communities; for regional styles that change over time as proxies for symbolic thinking and/or imagined communities; and for beads, images, and notational pieces along with burial of the dead as proxies for abstract and symbolic thinking and theory of mind. For all of these material expressions of behavioral capabilities, there are modern, even living groups without them. While demonstrably capable of producing such items, these groups clearly lack the impetus or the history to do so, so absence may not be a good marker of non-modernity. But absence of all of these over long archaeological stretches of time cannot be characterized as "modern behavior."

Since 2000, the rapidly accumulating record of human behavioral evolution in Africa has confirmed, rather than contradicted, our basic model of an earlier and more gradual accumulation of complex behaviors expressed in material culture. Beads, decorated ocher and ostrich eggshell, innovative technologies involving hafted projectiles, and even the possibility of complex projectile weapons systems, have all been argued for Middle Stone Age (MSA) peoples predating 60 kya. Furthermore, new dating and study of previously excavated materials have shown that burials of *H. sapiens* with grave goods are found both in South Africa and in the Near East, dating to 66-90 kya and 90-100 kya, respectively. These burials suggest that symbolic behavior characterized at least some of the early members of our species long before the main "Out of Africa" event suggested by genetic dating.

But after more than a million years with little change in technology, the African record suggests that well before the first appearance of *Homo sapiens,* even before 285 kya, behavior had begun to change. New technologies produced standardized stone flakes and long thin blades, ocher processing increased, and many sites have small quantities—up to 5%—of stone material derived from sources a considerable distance away, as much as 125 miles (200 or more km)— the first sign of an expanded social network. The behavioral changes reflected in these finds are not sudden or directional. The evidence for them is interspersed with sites containing the old symmetrical large cutting tools, or simple flake technologies, or lacking evidence for ocher or exotic stone. But the general trend is towards more complex behaviors with time. Importantly, by ca. 267 kya, several sites in South and East Africa include carefully made stone points, designed for hafting onto spear shafts.

New Technologies

More dramatic changes in behavior occur after the appearance of *Homo sapiens*. From South Africa to Egypt and from the western Sahara to Ethiopia, evidence for complex technologies and new tools increases especially after 100 kya. In Ethiopia, the first *Homo sapiens* at about 195 kya are associated with advanced flake technologies but the older symmetrical large cutting tools continue at some sites in the Horn of Africa. Before 90 kya, stone points are large or thick, and were likely hafted onto thrusting spears used in close encounters with prey. But after 90 kya, the points become tiny and light. Possibly these very small later points, which could not have delivered a lethal blow to a large animal, were hafted on the ends of spear thrower darts or arrows, and even associated with the use of poison.

As early as 130 kya, another set of technological innovations appears to have focused on fishing. In the eastern Democratic Republic of Congo (Zaire) our team discovered a series of what appeared to be Middle Stone Age localities along the river. Excavations at three sites revealed mammalian fauna and lithic artifacts but also a series of barbed bone points associated with thousands of fish bones. The dates for these sites have varied, but luminescence dating suggests an age of 80-90 kya, and there is no evidence for an age less than 60 kya. Again, this is a complex technology that appears to have been outside Neanderthal competency.

Small projectile armatures in a complex weapons system could have given the edge to later modern humans, allowing populations to expand both within and outside Africa at the expense of the Neanderthals and other archaic populations. Neanderthals had many injuries from personal encounters with large dangerous animals, but later moderns had very few. Neanderthals also had many more signs of dietary stress in their bones and teeth than the early moderns who succeeded them.

Long-Distance Exchange

At several sites in East and Central Africa, some stone tools made by early modern humans use stone that does not come from the local area. Throughout East Africa there is a preference in many sites for obsidian, a fine black volcanic glass with very specific chemical characteristics. In many areas, such as the Aduma area in the Middle Awash region of Ethiopia, obsidian sources do not occur in the immediate vicinity of the sites, and the obsidians themselves are varied and appear to derive from multiple sources. When the chemistry of the obsidian can be matched to specific sources, as at Mumba in Tanzania, it suggests that obsidian was being moved more than 125 miles (200 km) in some cases. This suggests the existence of trading networks, or "imagined communities." Distant trading networks would benefit from the use of symbols to identify members of such a community, so it is not surprising that ocher and other minerals were also processed for pigment at some sites such as Twin Rivers in Zambia, as early as 240 kya. Other indicators of imagined communities are the regional "styles" of projectile points that possibly identify social entities in space.

Symbolic Behavior

So far, we have demonstrated the presence of technological innovation, economic intensification, long distance exchange, and regional styles in the behavioral repertoire of early modern humans. But is there hard evidence for symbolic behavior? In 2002, an extraordinary piece of engraved ocher was described from Blombos cave in South Africa. It and a second similar piece clearly suggest that ocher had more than a utilitarian function. Many other pieces of ocher, bone, and eggshell with engraved geometric or linear designs are known both from this site and from other southern African sites, including fragments of decorated ostrich eggshell containers from ca. 65 kya at the Atlantic coastal site of Diepkloof.

Beads and other body ornaments are unequivocal evidence for symbolic behavior and for fully human status, as they have little utilitarian function. In traditional hunting societies, beads provide the basis of exchange networks that served to tie distant people together in a mutual support network, particularly useful when times are bad. Individuals deliberately build these networks up as they grow into middle age and acquire major responsibilities for raising and marrying off children or for supporting elderly parents. As they age and their needs decrease, individuals begin to reduce the size of these networks.

Beads and personal ornaments such as rings or headpieces also serve as markers of social identity or status worldwide. Examples include wedding bands, the colorful collars of the Maasai, and diamond necklaces of soci-

ety women (or men). Despite extensive excavation, no beads are known from Europe before ca. 50 kya. Early African sites have yielded a few ostrich eggshell beads in early sites—an unfinished one from South Africa (Boomplaas) dated to ca. 60-80 kya, and several from Tanzania (Mumba) dated directly to between 45 and 52 kya. In 2004, a series of perforated shell beads from the coast of South Africa, dated to 76 kya, made headlines as the oldest evidence for personal ornaments. Even older shell beads have been described from sites in North and East Africa, as well as in sites of early modern humans in the Near East.

The evidence for human burial practices with grave offerings indicative of symbolic behavior within Africa is limited, due in part to the relative dominance of open air excavations where bone preservation is poor, and in part to probable cultural practices of burial away from living sites. Two relatively elaborate cave burials at early dates, however, confirm the antiquity of this practice among modern humans at opposite ends of their early geographic range: an elaborate modern human burial at Qafzeh in Israel dated to 100-130 kya, a time when both modern humans and African faunas expanded into the Levant and the burial of a child at Border Cave in South Africa dated to 66-90 kya. The child burial is associated with what appears to be ocher and has a large perforated *Conus* shell in its chest area. The nearest source for the shell is the Indian Ocean ca. 50 miles or 80 km away. The Qafzeh individual was associated with 71 pieces of red ocher, and also with a perforated bivalve shell. These two sites constitute the earliest clear evidence for symbolic burial with grave goods and red ocher, practices that suggest a belief in the survival of a spirit after death.

Emergence of Humanness: A Gradual Process

The accelerating rate of technological innovation was a stepwise process, not a sudden event related to language. By 70 to 60 kya, well before the out-of-Africa event that led to Neanderthal extinction, anatomically modern humans in Africa, and occasionally in the Levant, had light complex projectile weaponry, fishing and bone fishing spears, long distance exchange networks, ocher, deliberate burial with grave goods, regionally distinctive point styles, symbolic engravings and personal ornaments. Within Africa, there was probably a complex web of inter-regional migration and local extinction that makes the record patchy and discontinuous. In addition, demographic and climatic factors may affect the degree to which any of these modern human capabilities are expressed. Ethnographic studies suggest, for example, that symbolic expression, subsistence practices, and regional networks intensify under condition of resource stress.

Neanderthals, on the other hand, before 50 kya, had hafted spear points, used a large amount of black coloring materials, and practiced simple burials without offerings or ocher. There is little evidence in this early time range for Neanderthal fishing and none for bone tools, musical instruments, cave art, or personal ornaments. After 40-50 kya, when modern humans were already on the Neanderthals' periphery or perhaps in their midst, Neanderthals developed or adopted some of the same traits—particularly the beads and stone technologies. But they still lacked small light projectile armatures (points) and rarely if ever went fishing. And the really long distance raw materials are only marginally present towards the end of their existence at the northeast edge of their range in Eastern Europe and Central Asia. In both regions we would expect human territories to be very large and populations sparse.

Why was *Homo sapiens* able to replace Neanderthals in Eurasia after 50 kya but not before? There seem to be three possibilities: 1) a sudden genetic mutation, 2) technological superiority, or 3) more sophisticated social networks. These networks, supported by a greater use of symbols or even language, would have buffered humans against risks. A fourth hypothesis is that invading Africans brought with them epidemic diseases to which the Neanderthals had no resistance.

In any event, Neanderthals survived long enough to leave archaeological and/or fossil traces in several sites in southern Europe that are contemporary with sites of early modern humans in Europe over a period of at least 6000-7000 years. Co-existence in the Near East may have occurred over an even longer period. New work on the nuclear DNA genome of Neanderthals even suggests that modern populations in Eurasia (but not in Africa) carry a small percentage (1-4%) of Neanderthal genes, implying that Neanderthals and modern humans interbred in the Near East, before modern humans expanded to the rest of Eurasia. (This and other new genetic studies bearing on human evolution and migration will be covered in a future *AnthroNotes* article).

While the answer to the question of why *Homo sapiens* was able to replace Neanderthals is almost certainly more complicated than any of these three simple hypotheses offered above, and may involve combinations of them and others, the evidence against a revolutionary genetic event is strong when you consider Africa. That continent is characterized by the earlier appearance of technological and economic complexity, as well as of complex symbolic behavior. The patterning of change both during and at the end of the Middle Stone Age period of early *Homo sapiens* is also very different from that consistent with a genetic revolution, as it is both spotty and gradual. Such gradual patterning is much better explained in earlier anatomically modern humans by assuming the existence in earlier anatomically modern humans of modern behavioral capabilities that are variably expressed when conditions call for them. When either climate change or population growth created effective crowding, in an otherwise sparsely inhabited landscape, such pre-adaptation could have become expressed in modern behavioral capabilities.

Conclusion

Currently available data suggest that our ancestors possessed some basic capacities for technological innovation and symbolic behavior before the line leading to Neanderthals in Europe diverged from the line leading to Anatomically Modern Humans (AMH) in Africa, a split which genetics and archaeology concur in dating to between 400 and 800 kya. These more human capacities became more elaborately expressed earlier in Africa because of its larger population, more diversified landscape, and greater potential for interregional interaction. As a result, by 60 kya, AMH entering Eurasia were able to expand and replace Neanderthals, who responded initially with increased expression of some of these capabilities on their own, but were ultimately unable to prevail. In the future, new data from the fossil and archaeological records but also from the evolutionary history of the brain, its faculties, and genes that affect behavior may shed further light on the question of what it means to be human.

Alison Brooks at Olorgesailie, Kenya.

References

Ambrose, S. 2001. "Paleolithic Technology and Human Evolution." *Science* 299 (5509): 1748-53.

Anton, S.C., and C.C. Swisher III. 2004. "Early Dispersals of *Homo* from Africa." *Annual Review of Anthropology* 33: 271-96.

Barham, L.S. 1998. "Possible Early Pigment Use in South-Central Africa." *Current Anthropology* 39: 703-20.

Bouzouggar, A., *et al.* 2007. "82,000-Year-Old Shell Beads from North Africa and Implications for the Origin of Modern Human Behavior." *Proceedings of the National Academy of Sciences* 104: 9964-69.

Brooks, A.S. 2010. "What is a Human? Anthropological Perspectives on the Origins of Humanness." *In* M. Jeeves, ed., *Rethinking Human Nature*. Eerdmans. In press.

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Brooks, A.S., *et al.* 2006. "Projectile Technologies of the African MSA: Implications for Modern Human Origins." In E. Hovers and S. Kuhn eds., *Transitions before the Transition: Evolution and Stability in the Middle Paleolithic and Middle Stone Age,* pp. 233-55. Kluwer Academics/Plenum.

Green, R.E. *et al.* 2010. "A draft sequence of the Neandertal genome." *Science* 328: 710-722.

Henshilwood, C.S., *et al.* 2004. "Middle Stone Age beads from South Africa." *Science* 304: 404. (See supporting online material for pictures). See also *Journal of Human Evolution* 48, no. 1 (2005): 3-25.

Henshilwood, C.S,*et al.*. 2002. "Emergence of Modern Human Behavior: Engravings from South Africa." *Science* 295: 1278-80.

Lieberman, P., and R. C. McCarthy. 2007. "Tracking the evolution of language and speech: Comparing vocal tracts to identify speech capabilities." *Expedition* 49 (2): 15-20.

Lordkipanize D, *et al.* 2005. "Anthropology: The Earliest Toothless Hominin Skull." *Nature* 434: 717-18.

Marean C.W., *et al.* 2007. "Early Human Use of Marine Resources and Pigment in South Africa during the Middle Pleistocene." *Nature* 449: 905-08.

McBrearty, S., and A. Brooks. 2000. "The Revolution That Wasn't: A New Interpretation of the Origin of Modern Human Behavior." *Journal of Human Evolution* 39: 453-563.

McDougall, I., F. H. Brown, and J. G. Fleagle. 2005. "Stratigraphic Placement and Age of Modern Humans from Kibish, Ethiopia." *Nature* 433: 733-36.

Mercader, Julio, *et al.* 2007. "4,300-Year-Old Chimpanzee Sites and the Origins of Percussive Stone Technology." *Proceedings of the National Academy of Sciences* 104 (9): 3043-48.

Pearson, Osbjorn M. 2001. Postcranial Remains and Modern Human Origins. *Evolutionary Anthropology* 9 (6): 229-47.

Pettitt, Paul A. 2001. "The Neanderthal Dead: Exploring Mortuary Variability in Middle Paleolithic Eurasia." *Before Farming* 1: 1-19.

Potts, Richard and Christopher Sloan. 2010. *What does it Mean to be Human?* National Geographic.

Roche, H.A., *et al.* 1999. "Early Hominid Stone Tool Production and Technical Skill 2.34 Mya in West Turkana, Kenya. *Nature* 399: 57-60.

Semaw, S., M. *et al.* 2003. "2.6 Million-Year-Old Stone Tools and Associated Bones from OGS-6 and OGS-7, Gona, Afar, Ethiopia." *Journal of Human Evolution* 45: 169-77.

Sherwood, C. C., F. Subiaul, and T. Zawidzki. 2008. "A Natural History of the Human Mind: Tracing Evolutionary Changes in Brain and Cognition." *Journal of Anatomy* 212 (4): 426-54.

Vanhaeren, M., *et al.* 2006. "Middle Paleolithic Shell Beads in Israel and Algeria." *Science* 312: 1785-88.

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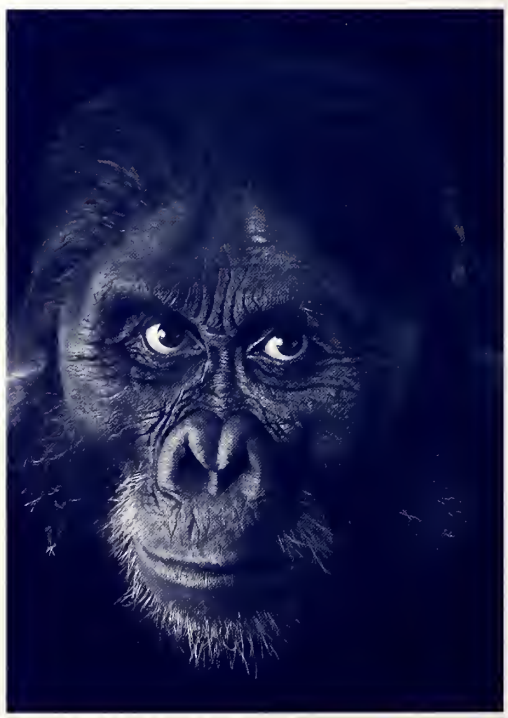

Australopithecus afarensis. Starting with a cast skull, artist John Gurche builds layers of muscle, fat, and skin to create hyper-realistic busts of human ancestors featured in the new *David H. Koch Hall of Human Origins* at the Smithsonian's National Museum of Natural History.