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The Evolution of the Human Self: Tracing the Natural History of Self-Awareness

MARK R. LEARY AND NICOLE R. BUTTERMORE

The ability to think consciously about oneself is perhaps the cardinal psychological characteristic that distinguishes human beings from all other animals. Although certain other species have the capacity to engage in rudimentary forms of self-awareness and perspective-taking (Gallup & Suarez, 1986; Mitchell, 2002; Parker, Mitchell, & Boccia, 1994), none are able to think about themselves in the deliberate, complex, and abstract ways that are characteristic of human beings. As Crook (1980) observed, "the development of a capacity for objective self-awareness and description marks the boundary between the animal and the human" (p. 267). Although research on the neurological basis of self-reflection is in its infancy, recent findings point toward the prefrontal cortex (see Feinberg, 2001; Kelley, Macrae, Wyland, Caglar, Inati, & Heatherton, 2002). Whatever its neurological basis, human beings clearly possess some sort of cognitive apparatus for self-relevant thought that most, if not all other animals lack.

Even a cursory look at the implications of this ability shows its importance to human behavior. Because they can manipulate thoughts and images about themselves in their minds, human beings are able to anticipate outcomes of their actions, consider their options, prepare in advance for events that might occur, and develop plans and contingencies. They may experience emotions in response to remembering events from their pasts or imagining themselves in the future. The ability to think consciously about oneself also underlies introspection, self-evaluation, and the development of the self-concept. People are able to form ideas and images of what they are like, consciously compare themselves to their own standards and to other people, and experience emotions such as pride and shame as a result. Self-awareness also offers the possibility of deliberately controlling one's behavior and, when necessary, acting contrary to one's automatic inclinations. Given the importance of self-related thought to human behavior, it is little wonder that behavioral researchers have devoted considerable attention to the processes involved in self-awareness, self-evaluation, and self-regulation (for reviews, see Baumeister, 1998; 1999; Brown, 1999; Hoyle, Kernis, Leary, & Baldwin, 1999; Leary & Tangney, 2002a).

The fact that human beings possess an ability for self-relevant thought that other animals lack raises intriguing questions about when, how, and why this ability evolved over the time that human beings and their hominid ancestors have inhabited the earth. We are by no means the first to address the evolution of self-reflection (see, for example, Barkley, 2001; Barkow, 1978; Bickerton, 1990; Byrne, 2000; Eccles, 1989; Hallowell, 1955; Humphrey, 1986, 1998; Jaynes, 1976; Parker, 1997; 1998; Sedikides & Skowronski, 1997, 2000, 2002; Skowronski & Sedikides, 1999), but our approach and conclusions differ somewhat from previous work. In particular, we begin with the assumption that the self-awareness of modern human beings involves a set of distinct cognitive abilities that evolved at different times. We then attempt to reconstruct the prehistory of self-reflection on the basis of evidence from paleontology, evolutionary biology, anthropology, and psychology, relying more heavily upon the archeological record than most previous writers have done. We believe that human fossils and artifacts provide a surprising degree of insight into the development of self-awareness and suggest that modern forms of self-awareness emerged somewhat later in evolutionary history than most writers have assumed.

THE NATURE OF THE SELF

The word, "self," has been used in a number of different and sometimes conflicting ways by psychologists, sociologists, philosophers, and lay people alike (Leary & Tangney, 2002b; Olson, 1999). At the core of virtually all of these uses, however, is the ability to take oneself as the object of one's own attention and thought. Most conceptualizations of the self also include its executive, control functions (Baumeister, 1998; Hoyle et al., 1999), but our focus in this article is specifically on the emergence of the ability to self-reflect.

In our view, the self-awareness of modern human beings involves a set of distinct cognitive processes. The present discussion relies on Neisser's (1988, 1997) proposal that self-knowledge is based on five distinct forms of information, which he called ecological, interpersonal, extended, private, and conceptual self-knowledge. People may direct their attention toward and process information about five distinct aspects of themselves, each of which essentially establishes a different "sense of self" at the time that a particular type of self-knowledge is salient.

Extending Neisser's (1988) distinctions, we suggest that it is useful to assume that each of these domains of self-knowledge relies on a separate cognitive ability that evolved to provide a different kind of information to the organism about itself. These five kinds of self-knowledge are sufficiently distinct to require different information-processing systems, each of which permits the organism to process and act upon a different kind of self-relevant information. Our assumption that these involve five distinct cognitive systems is supported by the fact that these

abilities vary differentially across species (some animals possess only one or two of these kinds of self-knowledge, whereas modern human beings possess all five) (e.g. Mitchell, 2003) and that they appear at different times in the course of child development (e.g. Rochat, 2003).

Evolutionary psychologists generally agree that the mind is composed of a large number of domain-specific psychological mechanisms or abilities, each of which evolved to solve a particular problem (D.M. Buss, 1995; Cosmides & Tooby, 1994; Geary & Huffman, 2002; Pinker, 1997; Samuels, 2000), and it is plausible that the self-cognizing abilities of interest here may someday be traced to separate cognitive modules. At present, however, we assume for heuristic purposes the existence of five abilities for processing and acting upon self-relevant information that, collectively, give modern human beings a higher degree of self-awareness than other animals. In fact, we contend that modern human beings are the only animals that possess all five of these self abilities, a fact that helps to account for many differences between humans and other animals in domains that require the self, such as decision-making, planning, and self-regulation.

Ecological-self ability allows the organism to process information regarding its immediate physical environment. As an organism moves through its environment, it experiences visual, auditory, kinesthetic, and other cues that are intimately linked to its bodily position and movement. This self-specifying information gives the organism direct awareness of itself with respect to the physical environment. In adult humans, the ecological self gives rise to the direct, unmediated experience that "I am the person who is engaged in this particular activity at this particular place and time" (Neisser, 1988). Ecological-self ability is probably present at birth in human beings, although it develops with age and experience (see Butterworth, 1999).

Interpersonal-self ability allows the processing of information regarding an organism's unreflective social interactions with other members of its species. The designation, "unreflective," emphasizes that this ability is not responsible for conscious assessments of one's social interactions but rather for the raw awareness of one's engagement in a particular interaction at a particular place and time. Interpersonal interactions require an implicit coordination of one's actions with those of others, and the interpersonal-self processes information regarding the individual in interaction with conspecifics. The fact that the "nature, direction, timing, and intensity of one person's actions mesh appropriately with the nature/direction/timing/intensity of the other's" (Neisser, 1988, p. 41) suggests that people, as well as many animals, possess sophisticated knowledge about themselves and their ongoing behavior that permits them to autoregulate effectively in ongoing social encounters. Although it is tempting to relegate social interactions as a special case of ecological self-knowledge (wherein one's immediate environment is another person), evidence shows that people process information about themselves in interaction with other people quite differently than information about themselves in interaction with the physical environment (Mithen, 1996; Neisser,

1988). Furthermore, the developmental trajectories of ecological and interpersonal self-knowledge are somewhat different (Butterworth, 1999).

Extended-self ability permits an organism to reflect on itself over time. Whereas ecological and interpersonal self-knowledge involve information about oneself in a particular physical or social context, the extended self consists of thoughts about oneself in the past and in the future. Having the awareness that "I am today the same person who did thus-and-so last year or who will do this-or-that next week" requires an extended-self ability. This ability permits the individual to transcend the present moment to remember oneself in the past or imagine oneself in the future. Thus, the extended-self ability is necessary for autobiographical memory, planning, worry, regret, and other actions that require thinking about oneself in other times and places.

Private-self ability is involved in processing private, subjective information such as thoughts, feelings, intentions, images, and other states that are not accessible to other people. Presumably, all mammals experience such states, but only those with a private-self ability can purposefully remember and reflect on them, use them as a source of self-knowledge or to anticipate their future reactions to events, and recognize that such subjective experiences are not directly observable by others. Put differently, human beings not only have a primary representational system that represents the environment (through sensations, feelings, and thoughts) but also a higher-order system that allows secondary mental representations of those first-order representations (Hopkins, 2000). As we will see, the private self may also underlie the ability to infer other people's internal states by extrapolating from one's own private experiences (e.g. Gallup, 1997; Humphrey, 1980).

Finally, *conceptual-self ability* (which is roughly synonymous with what others have called the "symbolic self") is needed for abstract and symbolic representations of oneself, including self-representations, self-concepts, and identity. They involve the labels, traits, categories, and roles that people use to conceptualize themselves, as well as people's evaluations of those self-characterizations (as good/bad, effective/ineffective, moral/immoral, and so on). As will become clear as we proceed, conceptual-self ability is necessary for symbolic culture, which is based upon a set of agreed-upon identifications by which people think about themselves in culturally meaningful ways.

We assume that significant gradations exist in each of these five cognitive abilities—gradations that can be seen across species, over age (in human beings), and across evolutionary time. For example, as we will see, both chimpanzees and human beings possess the ability to think about themselves into the future (i.e. an extended self-ability), but the computational power of the human extended self is far greater than that of the chimp, thereby allowing human adults to imagine themselves further into the future than chimpanzees can. Similarly, although early humans may have been able to reflect on their private experiences, modern human beings can think about the private aspects of themselves in abstract, symbolic ways. Thus, the natural history of self-awareness involved not only the

appearance of new cognitive abilities that permitted qualitatively different kinds of self-reflection but also quantitative changes in the power and complexity of existing abilities.

PREHOMINID ANCESTORS

Human evolution was once regarded as an orderly and linear progression from apelike ancestors through several species of prehistoric hominids to modern human beings. We now know that the family tree of human beings is far more complex, with many collateral branches that became extinct without contributing to the modern human gene pool. In the sections that follow, we will discuss the nature of self-awareness in several hominid species, some of which (such as the Neanderthals) are not our direct ancestors. Nonetheless, it will be useful to speculate regarding the self-relevant abilities of even those species that came to an evolutionary dead-end.

The branch on the family tree that led to human beings separated from that leading to modern chimpanzees and bonobos, our closest living relatives, between 4.5 and 6.5 million years ago (mya) (Sarich, 1980; Waddell & Penny, 1996). The line leading to modern gorillas had separated somewhat earlier (around 10 mya) and that leading to orangutans even before that. The last common ancestor of chimpanzees and human beings has not been positively identified, but genetic research shows that the two lineages must have separated before 4.5 mya.

Although we know virtually nothing about the common chimp-human ancestor, there has been a tendency to regard it as essentially chimplike despite Darwin's warning that "we must not fall into the error of supposing that the early progenitor of the whole Simian stock, including man, was identical with, or even closely resembled, any existing ape or monkey." Recent analyses suggest that the common chimp-human ancestor may have been a suspensory/bipedal ape that traveled primarily by swinging through the trees but was also capable of bipedal walking (resembling a modern gibbon or siamang) rather than a knuckle-walking quadraped that occasionally walked upright (like a modern chimpanzee or gorilla). Anatomical evidence suggests that hominids were more likely to have evolved from an arboreal suspensory ape that occasionally walked on two legs than from a terrestrial quadraped that somehow came to walk upright (Johanson & Edgar, 1996; Savage-Rumbaugh, 1994).

Given that modern chimpanzees, bonobos, orangutans, and gorillas possess rudimentary self-awareness (Mitchell, 2002; Parker, 1998), it seems plausible that their common ancestor did as well (Pilbeam, 1984; Povinelli & Cant, 1995; Wadell & Penny, 1996). Bednarik (2003) observed that most researchers agree "that around 6 million years ago, our ancestors might have had capacities that broadly resembled those of modern apes" (p. 412). Although by no means impossible, it seems unlikely that the Miocene ape that was the ancestor of human

beings and modern apes lacked self-awareness, which then evolved independently in the separate lineages that led to modern apes and human beings (Gallup, 1997). In fact, Povinelli and Cant (1995) have proposed that the capacity for self-conception evolved precisely because it conferred an adaptive advantage to the arboreal common ancestor.[1] Thus, as a starting point, we must briefly consider the self of nonhuman primates.

Köhler's (1925) ground-breaking research on the mentality of apes is typically regarded as a study of chimpanzee problem-solving, but it also says a great deal about ape self-awareness. The fact that Köhler's chimpanzees figured out from surveying the situation how to build multi-story structures from wooden crates in order to retrieve bananas suspended high in their cages shows that they could imagine the future consequences of their actions. Essentially, they could "see" in their mind what they would accomplish if they performed certain behaviors. Köhler's chimpanzees seemed to possess an extended-self ability that allowed them to think about themselves at least a few moments into the future. In some cases, however, they later "forgot" how they had solved the problem and had to solve it anew, suggesting that their extended sense of self is short-lived and fragile. Köhler himself observed that "the time in which the chimpanzee lives is limited in past and future" (p. 282).

Research on the self-awareness of nonhuman primates began in earnest with Gallup's (1970) finding that chimpanzees can recognize their images in mirrors and that, like human beings, they can use mirrors to inspect parts of their bodies that they can not otherwise see. Monkeys, in contrast, do not recognize themselves in mirrors, even after months of experience with them. Even though they know that the image they see in a mirror looks like a monkey (Anderson, 1994), they never learn that the image is them. Since Gallup's (1970, 1977) ground-breaking research, mirror self-recognition and other signs of self-awareness have been demonstrated not only in chimpanzees but also in orangutans (Lethmate & Ducker, 1973; Miles, 1994), gorillas (Parker, 1991; 1994; Patterson & Cohn, 1994; Shillito, Gallup, & Beck, 1999), and bonobos (Hyatt & Hopkins, 1994; Westergaard & Hyatt, 1994). Although not all members of all species display self-awareness on all tasks that have been used (see Mitchell, 2002), there is little doubt that all species of modern apes possess at least a rudimentary ability to self-reflect, suggesting that their common ancestor probably did as well.

Using the framework described earlier (based on Neisser, 1988) and current knowledge about self-awareness in nonhuman primates, we believe that prehominids possessed ecological- and interpersonal-self abilities. Like modern monkeys and apes, they could process self-relevant information with respect to their immediate physical environment and their interactions with conspecifics. In addition, it is also likely that they possessed a rudimentary extended-self ability that permitted the common human-chimp ancestor to consider itself over relatively brief time spans into the past and future. We base this speculation on the fact that modern chimpanzees and bonobos can think about themselves short distances into the

Table 1. Self abilities

Ability	Function	Behavioral Implications
Ecological	Processes information regarding the organism's relationship to its immediate physical environment	Permits guided, contingent reactions to the physical environment
Interpersonal	Processes information regarding the organism's unreflective social interactions with conspecifics	Permits guided, contingent reactions to the presence and actions of conspecifics
Extended	Processes information regarding the organism over time	Permits thought about the organism in the past and future
Private	Processes information regarding private, subjective responses (e.g. feelings, thoughts, intentions)	Permits contemplation of internal states; also may underlie inferences about others' private states
Conceptual	Processes information regarding abstract and symbolic representations of the organism	Permits symbolic thought about the individual

future. For example, chimpanzees in the wild sometimes pick up rocks while en route to a feeding site where they will use them to open nuts (Boesch & Boesch, 1984), an action suggesting that the chimp can project itself at least a short time into the future to imagine that it will need the tool later. As we will see, more recent evolutionary developments expanded the length of time that hominids could project themselves mentally into the future, but given that modern apes can do so over short time spans, it seems likely that the Miocene common ancestor had a basic extended-self ability as well.

Although indirect, evidence also suggests that modern apes possess a limited private-self ability. For example, the fact that chimpanzees are able to deceive one another (and their human caretakers), often in elaborate ways, suggests that they can imagine how the world looks from another's perspective and, thus, use their private self-knowledge to infer others' psychological states (de Waal, 1982, 1986; Whiten & Byrne, 1988). Similarly, bonobos have shown evidence of sophisticated empathy and perspective-taking (de Waal & Lanting, 1997), again suggesting that they can extrapolate their own private experiences to other individuals. Of course, we do not know whether apes can contemplate their inner states as human beings do, but it seems that, within limits, they can use information about their private thoughts and feelings to draw inferences about others.

No evidence of conceptual-self ability has been observed among modern apes living under natural conditions. Some captive chimpanzees have been trained to use symbols to communicate with their caretakers and one another, but we have no evidence that they spontaneously think about themselves in an abstract,

conceptual, and symbolic fashion. Thus, there is no reason to assume that the common ancestor possessed a conceptual self. As we will see, later changes in the conceptual self during prehistory may have been responsible for most behavioral differences between human beings and the other apes. The hypothesized self-reflective abilities of the common ancestor and subsequent species are shown in Table 2.

THE EARLIEST HOMINIDS

Australopithecus, a small, bipedal primate that appeared in Africa around 4.4 mya, has long been regarded as the earliest hominid (Campbell, 1996), but recent evidence suggests the presence of earlier species dating to perhaps 5.8 mya (Haile-Selassie, 2001). However, so little is known about these earlier species that we will begin with Australopithecus.

Scientists distinguish among at least seven species of Australopiths, which differ greatly in morphology, but the differences among them do not involve implications for self-awareness and, thus, do not concern us here. Based on the spotty remains of *Australopithecus*, it seems that they may have resembled modern bonobos (formerly called pygmy chimpanzees) both in physical appearance and social structure. Not only are the bodily proportions of bonobos much more similar to those of Australopiths than those of chimpanzees or gorillas (Zihlman, Cronin, Cramer, & Sarich, 1978), but bonobo social structure and behavior are more human-like as well (see de Waal & Lanting, 1997; Savage-Rumbaugh, 1994). Unlike modern chimpanzees and gorillas but like modern hunting-gathering humans, bonobos live in stable groups composed of multiple males and females, females are sexually receptive throughout their cycle, adults develop strong intersex bonds, and males participate in child care (Savage-Rumbaugh, 1994). Interestingly, bonobos are the only other primate besides human beings that occasionally mates face-to-face.

Our point here is not that Australopiths necessarily resembled bonobos (although the case appears strong; Zihlman et al., 1978) but rather that a prehistoric hominid with a self resembling that of a modern bonobo might have lived in a surprisingly human fashion. No tools or other artifacts have been found associated with *Australopithecus*, but it is possible that they made crude wooden implements, used rocks as hammers, or threw stones as projectiles in agonistic encounters as chimpanzees and bonobos do today (Boesch & Boesch, 1984; de Waal & Lanting, 1997; Leakey & Lewin, 1977).

In any case, the self-awareness of the Australopiths may have resembled that of the common chimp-human ancestor, as well as modern bonobos and chimps. Specifically, they probably possessed both ecological and interpersonal-self ability, as well as rudimentary extended-self ability, possibly private-self ability, but no conceptual self (see Table 2).

Table 2. Proposed chronology of the development of the human self

Approximate Dates	As Exemplified by	Self Abilities Present[1]	Behavioral Markers
6.5–4.5 mya	Common ancestor of human beings, chimpanzees, and bonobos	Ecological – √√√ Interpersonal – √√√ Extended – √ Private – √ Conceptual – No	Behaviorally resembled modern chimpanzees or bonoboss
4.4–1.2 mya	Australopithecus (several species)	Ecological – √√√ Interpersonal – √√√ Extended – √ Private – √ Conceptual – No	Behaviorally resembled modern bonobos
1.9–1.6+ mya	*Homo habilis*	Ecological – √√√ Interpersonal – √√√ Extended – √√ Private – √ Conceptual – No	Made crude stone tools Carried tools
1.7 mya–1.5mya	*Homo ergaster*	Ecological – √√√ Interpersonal – √√√ Extended – √√ Private – √ Conceptual – No	Improved stone tools
1.2 mya–400,000 ya	*Homo erectus*[2]	Ecological – √√√ Interpersonal – √√√ Extended – √√ Private – √√ Conceptual – No	Improved stone tools Control of fire Cooperative hunting Extensive dispersion
700,000–200,000 ya	*Homo heidelbergensis*	Ecological – √√√ Interpersonal – √√√ Extended – √√ Private – √√ Conceptual – No	Minimal behavioral change over previous species
300,000–35,000 ya	*Homo neanderthalensis*[2]	Ecological – √√√ Interpersonal – √√√ Extended – √√√ Private – √√ Conceptual – No	Crude clothing Care of the elderly Improved stone tools
120,000 ya-present	*Homo sapiens*	Ecological – √√√ Interpersonal – √√√ Extended – √√√ Private – √√√ Conceptual – √√√	Specialized tools Culture, art, music Dwelling construction Boats Ritualistic burial

Notes. [1] √ = appeared to possess a rudimentary self ability
√√ = appeared to possess a self ability with more limited functional capacity than modern human beings
√√√ = appeared to possess a self ability with functional capacity roughly equivalent to modern human beings

[2] *Homo erectus* and *neanderthalensis* were not ancestral to *H. sapiens*. They are included here simply for comparison.

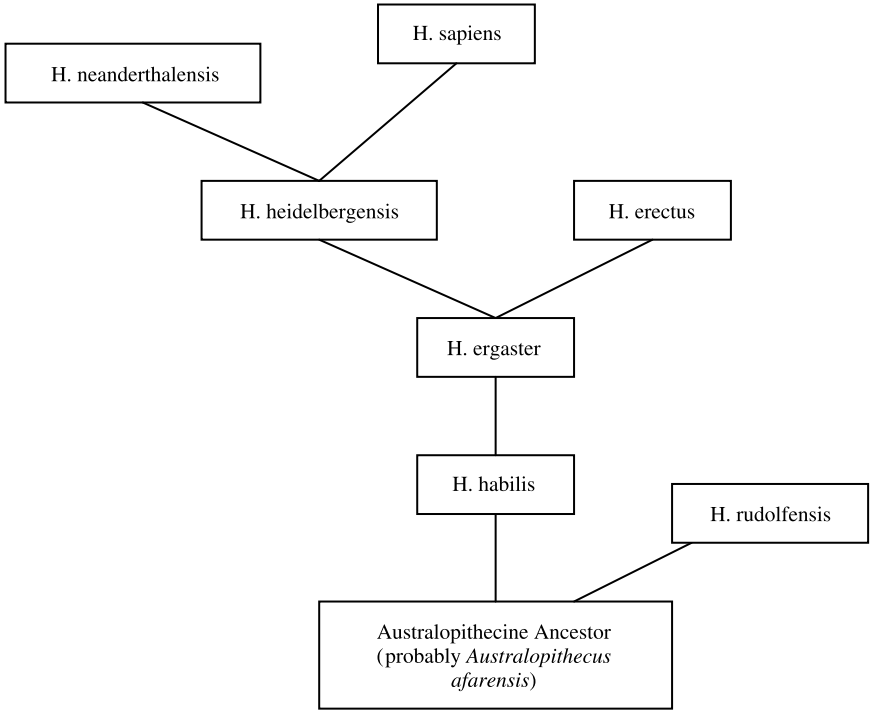

Figure 1. The human family tree
Note. Although the dating of various species of *Homo* is relatively noncontroversial, paleontologists do not agree regarding which species were ancestral to modern humans. For example, disagreement exists regarding which Australopithicene was the human ancestor, and whether the line came through *H. habilis* or *H. rudolfensis*. This diagram, which is informed by recent evidence based on mitochondrial DNA, is based on Klein and Edgar (2002).

THE EMERGENCE OF *HOMO*

Much controversy exists regarding the details of the evolution of the species, *Homo*, of which modern human beings are one member. Paleoanthropologists disagree regarding which premodern hominids should and should not be included among the *Homo* (Tattersall, 1986; Wood & Collard, 1999), how long each type existed, and which of these should be regarded as ancestral to modern humans. Figure 1 presents one model of human evolution (Johanson & Edgar, 1996; Klein & Edgar, 2002). Other models exist that differ in the identification of other species or in the presumed lineage between species (until recently, *H. erectus* was widely assumed to be ancestral to *H. sapiens*, for example), but most agree on the approximate dates that each existed. In the sections that follow, we attempt to present what appear to be the consensus views, with controversies and questions

raised as needed as we discuss the self-reflective abilities possessed by *H. habilis*, *H. ergaster/erectus*, *H. heidelbergensis*, *H. neanderthalensis*, and *H. sapiens*. Note that many paleontologists recognize other species of prehistoric hominids (such as *Homo rudolfensis* and *Homo leakeyi*), but these are known by only a few specimens and artifacts, limiting the conclusions that can be drawn about their behavioral characteristics.

Homo Habilis

The oldest tools that have been classified as early *Homo* date to approximately 2.0 mya. The hominid that is thought to have made them, discovered by Louis Leakey in the Olduvai gorge, was named *Homo habilis* ("man the handyman") because its fossils were associated with the earliest known stone tools. Recent cladistic analyses, however, question whether *habilis* ought to be regarded as a type of *Homo* or included with the Australopiths (Wood & Collard, 1999). Furthermore, some experts question whether the oldest fossils of *H. habilis* are, in fact, associated with tools, and others believe that some examples of *habilis* actually belong to an earlier species, *Homo rudolfensis*. (Harris, 1983; Issac, 1984; Johanson & Edgar, 1996). In any case, most agree that, by 1.8 mya, *H. habilis* was making simple stone tools (Campbell, 1996; Klein & Edgar, 2002). Vrba (1988) suggested that the appearance of *H. habilis* coincided with extreme climatic changes in Africa about 2.5 mya that turned much of the African forest to savanna. Vrba's analysis proposes that humans appeared on the savannah about this time because the forests had receded, explaining why early hominids moved from the safety of the forests into the grasslands. This explanation reduces the likelihood that the move was prompted by some cognitive or social change, as some have suggested.

Because tools figure prominently into the prehistory of the self, we will devote some attention to them. The earliest stone tools that appear to be the work of *H. habilis* are little more than small rocks with a few flakes chipped off to create a sharp edge. (Some believe that the sharp flakes were used more than the core portions of the rocks; Tattersall, 1995). Paleontologists have grouped these early tools into categories—such as scrapers, choppers, and chisels—but these designations may be more in the eyes of modern scientists than in the minds of their prehistoric makers. *H. habilis* did not appear to have mental templates for different types of tools (Tattersall, 1995), and differences among various tool artifacts appear to be the result of accidental differences in how the rocks splintered rather than an intention to design tools with different functions or in culturally defined ways (Issac, 1981; Wynn, 1978). In fact, many paleontologists have remarked on the uniformity of these early tools, which show virtually no variation whatsoever over thousands of miles and hundreds of thousands of years (Klein, 1999; Tattersall, 1995).

After a careful analysis of the characteristics of Oldowan stone tools (named for the Olduvai Gorge where they were discovered) from about 1.8 mya, Wynn (1985, 1996) concluded that they do not reflect a leap in intelligence or technology over the tools used by modern chimpanzees and other nonhuman primates. *H. habilis* appeared to depend on tools more than modern apes do and fashioned tools out of stone rather than (or in addition to) wood, but these reflect differences in the type and degree of tool use rather than in the kind of cognitive skills needed to make them. Wynn (1996) described these early tools as very "ape-like" (p. 268) and insisted that they do not provide any evidence that early hominids possessed language or symbol-using ability—or, we would add, a modern degree of self-awareness.

Even so, the oldest tools may provide evidence to suggest that early *Homo* had a self that was slightly more developed than that of modern apes. As noted, chimpanzees are known to make and use tools. For example, they fashion sticks by which they remove termites from their mounds for consumption, brandish and throw rocks during conflicts, and use stones as hammers to open nuts (Whiten et al., 1999; Wynn, 1996). However, chimpanzees appear to gather or construct tools only as they are needed. For example, they strip leaves from termite-removal sticks when they arrive at a termite mound or pick up a rock to open nuts while on their way to a food site. However, they do not ever make tools for use at some later time or carry tools with them in case the need for one arises (Savage-Rumbaugh, 1994). Presumably, the chimpanzees' limited extended self does not permit them to imagine themselves more than a few minutes into the future, and thus they are unable to anticipate future needs for tools.

The Oldowan tools associated with *H. habilis*, in contrast, appear to have been created for general use, suggesting that their makers could imagine themselves needing a sharp-edged rock at some time in the future. Furthermore, evidence suggests that *H. habilis* carried rocks, and possibly tools, with them. Stone tools have been found at some distance from the sources of the rock from which they were made (Potts, 1984). This behavior is not characteristic of any modern ape. As noted, chimpanzees sometimes pick up and carry a rock when they need one, but they discard it when they are finished and do not carry tools or tool-making materials around as a matter of course. The fact that *H. habilis* carried rocks and tools considerable distances supports our conjecture that it possessed a more developed ability to think about what it might need to have in its possession in the future.

Evidence of tool-carrying also suggests that *Homo habilis* had the ability to remind itself to retrieve tools that it had laid down. Other animals may carry objects, but once they drop them, they are not likely to pick them up again unless they are immediately needed. In contrast, *H. habilis* appeared to remember to take its tools from place to place, suggesting a new ability to cue oneself to remember to collect one's belongings before moving on.

The knapping of Oldowan stone tools was apparently beyond the capabilities of modern apes. Despite their best efforts, researchers were unable to train an

otherwise intelligent bonobo to make tools as skillfully as the hominids at Olduvai did (Toth, Schick, Savage-Rumbaugh, Sevcik, & Rumbaugh, 1993). The early hominid toolmakers apparently had a better understanding of tool-making than a modern bonobo is able to acquire even with human help. Whether the advantage in tool-making that *H. habilis* had over modern apes involves a relevant self ability is unclear, but it is possible that a more powerful extended-self ability would have allowed *habilis* to plan its stone-knapping more than one stroke at a time.

There remains considerable dispute regarding whether *Homo habilis* had any capacity for speech. As we discuss later, some archeolinguists believe that even *Australopithecus* had rudimentary speech, whereas others do not ascribe human beings with speech until the appearance of *Homo sapiens* in the relatively recent past (Eccles, 1989; Noble & Davidson, 1996; Pinker, 1994). Based on endocasts of *habilis* skulls, Tobias (1987) asserted that *H. habilis* was the first animal to have a spoken language, but most experts disagree. The jury is still out on this issue and is likely to remain so for some time. We return to the relationship between self-awareness and language later.

Homo Ergaster and *Homo Erectus*

We will discuss *Homo ergaster* and *Homo erectus* together because, although they are recognized as two different species, their behaviors and lifestyles seem to have been quite similar. In fact, they were not widely regarded as separate species until relatively recently, and some paleontologists still view them as African versus Asian variants of the same species (calling *H. ergaster* African *Homo erectus*). However, recent DNA analyses suggest that *H. ergaster* was ancestral to both *erectus* and modern human beings, whereas *H. erectus* was an evolutionary dead-end that became extinct in Asia (see Figure 1; Ke et al., 2001; Klein & Edgar, 2002). In light of these recent discoveries, much of what has been written about *H. erectus* in the past probably refers instead to *H. ergaster.* Rather than delve deeply into issues involving the classification of *ergaster* and *erectus*, it will suffice, for purposes of understanding the evolution of self-reflection, to consider them together.

The earliest known remains of *ergaster/erectus*, dating to between 1.5 and 1.8 mya (Campbell, 1996), represented a step forward in human evolution. Noting the considerable changes in anatomy and lifestyle that occurred with *H. erectus*, Sedikides and Skowronski (1997) suggested that the modern symbolic self first emerged about 1.7 million years ago: "the late Pleistocene epoch (inhabited by *H. erectus*) is an excellent candidate for the time period in which a symbolic self – one that bears content, structural, and functional similarities to the modern symbolic self – emerged" (p. 86). They conceded that the modern symbolic self might have appeared even earlier than *erectus* but did not consider the possibility, as we believe the evidence suggests, that it might have emerged much later. They noted, however,

that that the initial symbolic self that appeared with *erectus* would have likely become more sophisticated over time due to evolutionary selection pressures (Sedikides & Skowronski, 2002).

Sedikides and Skowronski (2002) conceptualized the symbolic self in terms of three cognitive capacities involving the ability of an organism to: depict itself in ongoing relation with its environment (i.e. reflexivity), represent itself cognitively in symbolic ways (i.e. representational ability), and control its own thoughts, feelings, and behavior (i.e. agency). Thus, their view of the symbolic self includes characteristics that we conceptualize as functions of different self abilities. Even so, their conceptualization is consistent with our view that the modern human self includes all of these capabilities.

Sedikides and Skowronski based their conclusion that *H. erectus* possessed a symbolic self on three primary arguments—that, with the appearance of *H. erectus*, the brain increased substantially in capacity and complexity, cooperative hunting became increasingly important, and humans exhibited increasingly complex social organization characterized by stable, cooperative groups that often used home bases rather than roamed nomadically. Although their discussions of the evolutionary basis of the symbolic self are well-reasoned, we do not agree with their conclusion that *H. erectus* possessed a symbolic (or conceptual) self for three reasons.

First, although it is true that *H. erectus* (and *H. ergaster*) possessed a larger and, presumably, more complex brain than its predecessors and looked decidedly less apelike as well (Aiello, 1996; Falk, 1987; Tattersall, 1995), it is impossible to say how large or complex a brain must be in order to sustain a particular type or level of self-awareness, and brain size is only weakly related to cognitive ability and its social and cultural concomitants. Each successive species in the human lineage prior to around 300,000 years ago had a larger brain than the one before, so there is little reason to assume on basis of brain size alone that the transition to *H. ergaster* or *erectus* in particular was associated with the emergence of the modern self. In fact, the Neanderthals (which we discuss momentarily) had brains as large, if not larger, than modern human beings, yet they had more limited cognitive abilities and showed little evidence of conceptual self-thought.

Second, we question whether a symbolic self is needed for cooperative hunting. The transition from *H. habilis* to *H. ergaster* and *erectus* was probably associated with a change in food acquisition strategies that involved increased reliance on hunting (Issac, 1978). Sedikides and Skowronski (1997) suggested that this change may have required new cognitive abilities—to track moving game, classify prey, cognitively map the location and movement of animals, and cooperate with other hunters in tracking and cornering animals—and natural selection probably selected for individuals who possessed these skills (see also Pinker, 1997; Mithen, 1996). Yet, given that other animals without a symbolic self can achieve these feats suggests that a conceptual-self ability is not necessary to execute these behaviors. Animals as diverse as wolves, wasps, and chimpanzees display similar abilities as

they work together to pursue and kill prey. This does not disconfirm the notion that *erectus* had a modern self, but it suggests that joint hunting does not require one.

Finally, for us, the most convincing evidence that *Homo ergaster/erectus* did not possess a modern self is that neither species left behind a single shred of evidence to suggest that it possessed a capacity for conceptual or symbolic self-thought. There is a total absence of artifacts that reflect any hint of ritual, art, religion, symbolism, identity, language, culture, or other products of a conceptual self (Wynn, 1996). Even after 1.5 million years of existence, H. e*rectus* failed to develop a capacity for the types of symbolic activities that we normally associate with human beings.

Although we see no evidence that *H. ergaster* or *erectus* possessed a conceptual (or symbolic) self, we do not dispute that the cognitive abilities of *ergaster* and *erectus* exceeded those of earlier species. Eccles (1989), Donald (1991), Mithen (1996), Sedikides and Skowronski (1997), Klein and Edgar (2002), and others provide a strong case for changes in cognitive ability with the appearance of *H. ergaster* and *erectus* around 1.7 mya. In addition to the development of cognitive capacities that facilitated hunting, archeological evidence involving stone tools, the use of fire, and dispersion patterns also suggest cognitive changes.

By 1 mya, some of the tools associated with *H. erectus* in Asia had moved beyond those of the Oldowan tradition and, according to Wynn (1996), beyond the tool-making abilities of modern apes. In particular, the biface tools—almond shaped wedges with a point at one end and a butt at the other—required more effort to hone, and their standard design may suggest that their makers fashioned them to conform to a particular mental template rather than merely flaked chunks off rocks as *H. habilis* did.

Even so, the design of the bifaces differs little across sites and hundreds of thousands of years. Experts have debated why *H. erectus'* tools are so homogeneous, wondering whether it reflects an innate preference for objects of a certain shape, the natural consequences of flaking chunks from oval or round stones, or the result of direct instruction from one person to another (Wynn, 1996). Our explanation is that, without a modern self with a clear past and future, there was no impetus for deliberate innovation, which requires perceiving a need for a better way of doing things plus the ability to imagine future improvements. Furthermore, without an adequate extended-self ability, a particular toolmaker who accidentally invented a new and more useful type of implement might be unable to remember how he or she did it and unable to form an intention to do it again.

The lack of cultural differences in tools across groups also argues strongly that *H. ergaster* and *H. erectus* did not possess a modern self. Among modern human beings, specific ways of making objects become associated with particular groups. Tools designed for precisely the same function look somewhat different depending on the group that made them. The lack of diversity in *ergaster/erectus'* tools across time, space, and groups suggests the lack of culture and group identification.

By 300,000 ya, the situation had changed only slightly. Tools were still comprised primarily of crude Oldowan-style tools and bifaces, although the bifaces had become somewhat more refined and symmetrical (Wynn,1996). Even so, there is little evidence that tools were designed for specific functions. Furthermore, no evidence of betwee–group differences in tools is seen, again suggesting the absence of in–group and cultural identification. Bifaces show some variability in construction, but this variability bears no relationship with time or location. Tools excavated from sites separated by hundreds of thousands of years or thousands of miles are virtually identical. Even as of 300,000 ya, these tools do not appear to be the work of human beings with a modern self who can foresee the need for improvement and fashion implements that meet that need.

Homo erectus may have been the first human to use fire, somewhere between 700,000 and 1.4 million years ago (Stringer, 1985). However, clear evidence that *erectus* was able to start and control fires (as opposed to keeping naturally-occurring fires going) does not appear until 300,000 to 400,000 years ago (James, 1989; Klein & Edgar, 2002). The deliberate use of fire was a major advance in human behavior and may reflect some advance in cognitive skill, but it does not seem to involve more than the ecological-, interpersonal-, and extended-self abilities that were present previously.

Perhaps the most impressive accomplishment of *H. erectus* was its dispersion to virtually all parts of the habitable world that could be reached from Africa by land routes. *Erectus* was long considered the first hominid to leave Africa, but recent discoveries in the Republic of Georgia suggest that a smaller, earlier hominid may have dispersed earlier (Gore, 2002). Even so, *H. erectus* was a far more accomplished traveler. Remains of *erectus* have been found not only in Africa, where it presumably evolved, but also in the Middle East, China, Indonesia, and southern Europe. On the basis of their enlarged brains, tools, control of fire, use of base camps, and dispersion to much of Africa, Asia, Europe, and Indonesia, Donald (1991) argued that a major threshold in human cognitive evolution was crossed with the appearance of *H. erectus*. He attributed the crossing of this threshold to cognitive changes involving the ability to communicate nonverbally through mimesis. According to Donald, *H. erectus* had mimetic skills that allowed it to produce "conscious, self-initiated, representational acts that are intentional but not linguistic" (p. 168). Deliberate use of nonsymbolic forms of representation—such as pointing, emphatic gestures, facial expressions, and other nonverbal behaviors—would have allowed a considerable advance in communication beyond that of *H. habilis* even without the capacity for speech. If nothing else, it permits a degree of coordination among individuals that is otherwise not possible.[2]

If Donald (1991) is correct, his hypothesis has implications for the nature of the *Homo erectus* self. Beyond having abilities for ecological, interpersonal, and extended self-thought, deliberate communication via mimesis would presumably require the ability to know what one wants to communicate. Thus, mimetic skill requires private-self ability. As noted, the private self is involved in processing

private, subjective information such as thoughts, feelings, intentions, and other psychological states. Possessing a private-self ability allows people to reflect on their subjective experiences, use inner states as a source of self-knowledge, and consciously anticipate their reactions to future events, all the time recognizing that their private experiences are not observable by other people. In essence, private-self ability is responsible for private self-awareness (A.H. Buss, 1980).

Emergence of the capacity for private self-reflection had three important evolutionary implications, two of them related directly to Donald's (1991) concept of mimesis. First, private-self ability would permit an organism to know what it desires and, thus, to formulate intentional behaviors to communicate that desire to others. Whether asking for food, coordinating a group activity (such as hunting or foraging), or conveying one's displeasure, access to one's private states is essential for deliberate, tactical communication.

At the same time, deliberate communication requires the communicator to infer how the audience is likely to react to various communicative acts and, as noted earlier, private self-awareness may underlie the ability to infer other people's states. There seems to be no way to understand and predict other people's reactions except with reference to our own inner states. We infer others' feelings, intentions, and attitudes, for example, by extrapolating from our own (with adjustments based on knowledge about the other person), thus requiring the capacity for private self-reflection (Humphrey, 1980, 1982, 1986; Povinelli & Prince, 1998; Lewis & Mitchell, 1994). Mithen's (2000) suggestion that early human beings first showed evidence of having a more sophisticated theory of mind than nonhuman primates around 500,000 ya is consistent with the idea that changes occurred in private-self ability about this time.

Homo erectus lived in somewhat larger groups than *Homo habilis*, possibly to reduce the predation risk of living in open areas (Alexander, 1974; Crook & Gartlan, 1966; Kummer, 1971). If the community life of *H. ergaster* and *erectus* resembled something between that of bonobos and modern hunter-gatherers, it was probably not characterized by the strict dominance hierarchies common among gorillas and chimpanzees. Rather, bonobo and hunter-gatherer groups tend to have flexible social systems in which individuals shift status and roles to some extent as the context changes. This kind of living arrangement places a greater cognitive demand on the group members than a strict dominance hierarchy in which one's place in the social system is relatively clear (Dunbar, 2000; Sedikides & Skowronski, 1997). This variety of group living seems to require the ability to infer and anticipate the reactions of other group members, and particularly other members' reactions to oneself. Members of such a community can get along only to the extent that they know how they are affecting others, with implications for social support, cooperation, and thus individual survival. And, this task becomes more difficult as the group becomes larger and each member must sustain a large number of interdependent relationships (Dunbar, 2000).

Along these lines, Gallup (1982, 1997) has argued that self-awareness may have evolved because it conferred a reproductive advantage by allowing hominids to compete and cooperate more effectively. His reproductive hypothesis suggests that early human beings who were aware of themselves could create cognitive models of the experiences and states of others. Such models facilitated drawing accurate inferences about other people and allowed them to compete and cooperate more successfully. If Gallup is correct, his analysis applies to the private-self ability only. The fact that *H. erectus* lived in larger groups than earlier humans suggests that *erectus* had a greater capacity for interdependent, cooperative group living (Issac, 1978; Trivers, 1985). And, although by no means definitive, it suggests that *H. erectus* may have been able to infer one another's private reactions, implying the existence of a private-self ability that may have been more powerful than earlier species.

Humphrey (1986) also argued that the capacity for private self-reflection (what he called the "inner eye") evolved because it enhanced success at understanding other people. Once people could use their inner thoughts to understand themselves, they could extrapolate to the inner states of others, inferring their thoughts, motives, and emotions. As Humphrey put it, "We could, in effect, imagine what it's like to be them, because we know what it's like to be ourselves" (p. 71). Possessing private-self-ability allowed people to make sense of others' behavior by projecting what they knew about themselves.

In addition to facilitating communication and cooperative group living by putting people in touch with their own and others' inner states, private-self ability would have allowed people to think about their own likely reactions to future events—that is, to engage in affective forecasting. This ability partly freed human beings from the control of their immediate inclinations, motivations, and emotions. Without an ability to think about its private states, an animal can react to situations only in terms of its current state, as determined by its instincts, temperament, previous experience, and the features of the immediate environment. It can not stop to think about whether a particular course of action will be beneficial in the long run. In contrast, an animal with extended- and private-self abilities can look into its future to imagine the affective consequences of its behavior. As a result, its behavior can be regulated in terms of the anticipated hedonic consequences. A great deal of modern human action is regulated by an awareness of how one will feel later about what one does now (Mischel & Morf, 2002). Viewed in this way, improvements in private-self ability may have set the stage for an increasing ability to engage in purposeful self-control.

We have no evidence for deciding whether private-self ability evolved because it facilitated people's social effectiveness via mimesis, promoted social and reproductive success, helped people autoregulate adaptively on the basis of affective forecasting, or emerged for some other reason. Whatever the case, we see at least some evidence that *H. erectus* may have possessed private-self ability with greater computational power than that of its predecessors.

Homo Heidelbergensis

Although *Homo heidelbergensis* was first named in 1907, it did not become widely accepted as an identifiable species until the 1990s. It is now regarded as a transitional species, both in terms of its appearance and tools. In fact, specimens of *H. heidelbergensis* were previously identified as either *erectus* (now, *ergaster*) or *neanderthalensis* because they possessed features of both (Johanson & Edgar, 1996). In addition, many paleontologists regarded the later members of this species as an early form of *H. sapiens,* calling it *archaic Homo sapiens*. However, on the basis of its morphology and artifacts, most experts now recognize *heidelbergensis* as a separate species that was a descendent of *H. ergaster* and the immediate ancestor of both Neanderthals and modern human beings.

The tools that have been associated with the remains of *H. heidelbergensis* were generally no more technologically advanced than those of *H. erectus* or *H. ergaster* sites of the same time period. The one exception may be the Late Acheulean hand axe, a refined version of an *ergaster/erectus* implement that may have originated with *heidelbergensis* (Klein & Edgar, 2002). However, their tools showed little technological or stylistic variability over time or location, suggesting the absence of innovation and cultural standards (White, 1996). Furthermore, these individuals left no evidence of symbols, ritual, art, or other artifacts that would imply the existence of a more sophisticated self than previous species.

Homo Neanderthalensis

Discovery of the Neanderthals provided the public with the image of the prototypical "cave man." Stocky and heavily built, with large brow ridges and strong muscles, *Homo neanderthalensis* was once believed to be the immediate ancestor of modern human beings. However, consensus has emerged that the Neanderthals and *Homo sapiens* were collateral branches on the human family tree that shared a common ancestor about 600,000 ya (probably *H. heidelbergensis*). Recent studies of mitochondrial DNA show that the Neanderthals did not contribute to the gene pool of modern human beings (Mountain, 1998).

The Neanderthals appear to have evolved in Europe by about 300,000 ya (Johanson & Edgar, 1996). Contrary to the popular image of violent, brutal cavemen, the Neanderthals were, in fact, associated with small cultural innovations and possibly the first glimmer of modern self-awareness (see Table 2). The fact that they were able to survive in climates that were as inhospitable as those faced by modern Eskimos suggests that they likely made crude clothing (Campbell, 1996). Such difficult climates must also have demanded the use of fire, and evidence of hearths is present at many excavated cave sites. Unlike the hearths of later people, however, Neanderthal hearths were very simple, and, other than

simple stone walls, are the only type of manufactured structure associated with this time period (Klein, 1999). Still, the construction of even simple structures suggest an increased capacity for future-oriented thought and planning.

The Neanderthals were proficient at stone flaking to make tools. Their Mousterian tools require more time and greater foresight to construct than the older Oldowan and biface varieties, suggesting that Neanderthals had a more sophisticated extended-self ability that allowed them to plan further ahead. Furthermore, they used their various stone tools to shape other objects out of wood, cut animal carcasses, and tan hides (Oakley, 1959; Schick & Toth, 1993). Yet, the flaked tools from this time period found on different continents are virtually identical, thus offering evidence that Neanderthals had a limited ability for innovation and no capacity for cultural identification (Klein, 1999).

Archeologists have uncovered several Neanderthal burial sites, some dating to at least 100,000 ya, the first evidence of human burial. Graves are typically shallow and simple, and burial appears to have been relatively rare when compared to the large number of fragments of human bones unearthed at Neanderthal sites (Klein, 1999). Although some have interpreted Neanderthal burials as evidence for belief in an afterlife (Hayden, 1993), the consensus is that the Neanderthals buried corpses simply to get rid of them and did not practice ritualistic burial (Dickson, 1990).

Despite slight movement toward modern human behavior and lifestyle, evidence regarding Neanderthal culture is equivocal. Some archeologists have described what they believe are rudimentary Neanderthal art objects such as pendants, figurines, and designs engraved on bone (Hayden, 1993), but other experts argue that these were created by natural forces such as animal bites and erosion (Klein, 1999). Other researchers have suggested that Neanderthals used ocher pigments to create perishable art, perhaps by decorating their own bodies or the bodies of others in their groups (Hayden, 1993; Klein, 1999; Pfeiffer, 1982). However, no direct evidence of such art has been found, and such claims are based solely on fragments of ocher found at Neanderthal sites where ocher does not naturally occur (Klein, 1999). In brief, little evidence exists that Neanderthals possessed symbolic culture or conceptual-self ability.

Neanderthals disappeared rather abruptly at about the time that evidence of modern human beings appears, leading many to suggest that the disappearance of the Neanderthals was tied directly to the appearance of *Homo sapiens* in Europe (Klein, 1999; Tattersall, 1995). Klein (1999) suggested that while modern humans may have initially differed very little from Neanderthals, an eventual neurological change gave moderns a unique "capacity for culture that gave them a clear adaptive advantage over the Neanderthals and all other nonmodern people." (p. 492). If so, it may be that this neurological change gave rise to ability to think about themselves conceptually. A human being with the ability to think abstractly and symbolically about itself would be at a decided advantage compared to those who could think about themselves only in concrete terms.

Homo Sapiens

Paleontologists do not agree on precisely where the boundary lies between the earliest *H. sapiens* and the species from which it evolved in eastern Africa (most likely *H. Heidelbergensis*). The traditional view was that the earliest members of our own species appeared between 200,000 and 300,000 years ago (Campbell, 1996). However, recent studies of mitochondrial DNA indicate that the genetic lineage of all living human beings can be traced to a female *H. sapiens* (or, more likely, a small group of highly related females)—the ancestral "mitochondrial Eve"—who lived in Africa within the last 200,000 years (Cann, Stoneking, & Wilson, 1987; Vigilant, Stoneking, Harpending, Hawkes, & Wilson, 1991; Waddell & Penny, 1996) and possibly as recently as 130,000 ya (Stoneking, 1993; Stoneking, Sherry, Redd, & Vigilant, 1993). The oldest fossils that appear incontrovertibly modern date to approximately 160,000 ya (White et al., 2003). Although controversy remains over both the exact date and location (e.g. Maddison, Ruvolo, & Swofford, 1992; Nei, 1992; Stringer, 2003), evidence increasingly supports the idea that *H. sapiens* arose in east Africa around 150,000 ya, then dispersed elsewhere in the relatively recent past (Mountain, 1998). Furthermore, recent studies of the Y-chromosome have refuted the earlier notion that some groups in Asia and Australia evolved from *H. erectus*, showing instead that the ancestors of all living Asians originated in Africa between 35,000 and 89,000 years ago and that there was not even a minimal genetic contribution from the hominids who lived in east Asia at the time (Ke et al., 2001). Together, these genetic studies have three important implications: (1) only one local population of *H. heidelbergensis* (the one from which *H. sapiens* evolved) left any maternal descendants among people living today, (2) the most recent common ancestor of all living human beings was African, and (3) all current races of human beings differentiated from a common ancestor less than 150,000 years ago.

By approximately 100,000 ya, at least two distinct species of humans walked the earth–*H. neanderthalensis* and *H. sapiens*. *H. neanderthalensis* remains at this time are found primarily in Europe, and *H. sapiens* appeared to be confined to Africa. (Some paleoanthrolpologists believe that *erectus* also existed in Asia as late as 50,000 ya.). Around 95,500 ya (+/− 18,000 years), one or more groups of *H. sapiens* moved out of Africa (Waddell & Penny, 1996) heading north and east into areas populated by n*eanderthalensis*. *Homo sapiens'* remains dating to around 100,000 ya have been found in the Middle East (Stringer, 1990), suggesting that the dispersion out of Africa was underway by this time.

THE CULTURAL BIG BANG

Late in the Paleolithic epoch, approximately 40,000–60,000 years ago, the archeological record regarding *Homo* reveals a remarkable change. After millions of

years of virtually no progress in tool-making or culture, specialized stone tools and many features of human culture appear within a relatively short period of time. At no other period in the prehistory of human beings do we see such a qualitative and dramatic shift in human life in such a short time-span. Known to archeologists as the Middle-Upper Paleolithic transition, writers have dubbed this period the "great leap forward" (Diamond, 1992), "cultural big bang" (Mithen, 1996), "creative explosion" (Pfeiffer, 1982), "cultural explosion" (Boyer, 2000), "human revolution" (Deacon, 1989), and "dawn of human culture" (Klein & Edgar, 2002) to convey the profound changes that occurred among human beings at this time. Clearly, something dramatic happened at the time of the Middle-Upper Paleolithic transition.

These changes in technology and culture were so spectacular that many observers have suggested that it is virtually impossible for us to imagine from our current perspective what human behavior and life were like before them. Prior to the transition, human beings (such as *Homo erectus, neanderthalensis*, and *heidelbergensis*) were not people simply "like us" who lived more primitively, with less complex tools, simple social systems, and no culture. Rather, these species were probably so different from us in a psychological sense that it is impossible for us to imagine what their lives and experiences were like. As White (1996) observed, "life in the Lower Paleolithic may have been so different from the modern human condition that it is barely recognizable to us." (p. 242). Only after about 35,000 years ago, after the Neanderthals became extinct, is there reason to believe that all people on Earth, though undoubtedly living primitively, were anatomically, psychologically, and culturally modern.[3]

Many explanations have been offered for the cultural big bang. For example, Mithen (1996) proposed that the human mind consists of a set of distinct abilities, each of which handles a particular information-processing domain. According to Mithen, the cultural big bang came about because of an increase in "cognitive fluidity"—the ability for information to be exchanged and integrated across separate abilities. In contrast, Tattersall (2001) and others place a great deal of emphasis on the acquisition of symbolic ability. These theorists rightly note that many of the behavioral changes that accompanied the Middle-Upper Paleolithic transition—painting, ritual, body adornment, music, and so on—rely on symbolic cognitive processes. In another vein, Klein and Edgar (2002) argued that the dawn of culture resulted from a "fortuitous mutation" in the brain that was responsible for the human ability to innovate (p. 270). Other theorists have explained the Middle-Upper Paleolithic transition in terms of the emergence of language (Bickerton, 1990; Mellars, 1991; Noble & Davidson, 1996). Indeed, it seems certain that the advances of the cultural big bang could not have occurred without language, although it is less clear whether language created the big bang or was simply coincident with it.

The fact is that no one knows precisely why human lifestyle and culture changed between 40,000 and 60,000 years ago. Nonetheless, we assert that a full

understanding of this event must take into account human beings' capacity for self-reflection. We do not dispute the role of any of the other factors that have been proposed as involved in the cultural revolution in the Upper Paleolithic. Indeed, as we discuss shortly, many of these cognitive factors—such as symbolization, innovation, language, and self-reflection—are highly interrelated, and the advances of the cultural big bang would have required all of them. Rather, our point is that a previously neglected force behind this dramatic transition in human behavior was a radical change in the human self. For the first time, human beings possessed a modern ability to think about themselves in abstract and symbolic ways. Combined with the extended-self ability that allowed them to project themselves into the future, this new ability allowed people *to imagine themselves in the future in symbolic and abstract ways*, a trait needed for intentional innovation, symbolic culture, and efforts at self-improvement.

If accurate, our analysis not only establishes a date for the emergence of modern self-awareness—an ability that, for the first time, provided people with a perceived identity that extended into the past and future—but also adds another piece to the puzzle of the Middle-Upper Paleolithic transition. In the sections that follow, we offer evidence for our hypothesis that the conceptual self appeared just prior to 50,000 years ago, evidence involving technological advances (e.g. tools, housing, clothing, boats), art, body adornment, and ritualistic burial.

Technological Advances

For the two million years since *H. habilis* appeared, hominid tools remained quite crude. *H. erectus* had improved slightly on the Oldowan tools with the addition of bifaces, but until *H. neanderthalensis* refined flaking techniques around 100,000 ya, tools had changed little. As *Homo sapiens* moved into the Middle-Upper Paleolithic transition, however, major innovations in tool design began to appear. Starting about 85,000 ya, the monotony of the biface technology that had existed for over a million years was replaced by tools that were clearly designed for specific tasks such as chopping and scraping.

Afer 40,000 ya, advances in tool technology were particularly rapid, and regional distinctions in tool manufacture became even more apparent. Improved flaking technology led to the production of blades that were sharper than earlier flaked tools and had a longer cutting edge (Klein, 1999; Kozlowski, 1990; Oakley, 1959). Other innovations included awls and burins, as well as the use of antler, ivory, and bone to make points and harpoons (Gamble, 1999; Hadingham, 1979; Oakley, 1959). By 15–20,000 ya, the archaeological record bears evidence of multi-component tools such as spear throwers, bows and arrows, and fish hooks. This period also reveals the first evidence that people hafted tools to wooden or bone shafts (to make axes and hammers that had handles) and sewed using bone needles (Oakley, 1959; Pfeiffer, 1978; Schick & Toth, 1993; Wynn, 1996).

Furthermore, unlike the previous 2 million years of human evolution, *sapiens'* tools showed marked variation over time and location, suggesting cultural differences in how tools were made. Klein and Edgar (2002) interpret these cultural differences as evidence of "identity-conscious ethnic groups" (p. 233), suggesting the presence of a conceptual-self ability. Also remarkable is the transportation of raw materials, such as flint, hundreds of kilometers for the purpose of making tools (Gamble, 1999; Hadingham, 1979).

Given the improvements in their tools, it is not surprising that *H. sapiens* were more effective hunters than their predecessors as evidenced by the greater number and variety of animal remains at their living sites. In particular, *H. sapiens* fed on a larger proportion of airborne fowl, fish, and dangerous game (such as buffalo and pigs) than earlier species of hominids did (Klein & Edgar, 2002). It is also noteworthy that the cultural big bang was associated with the first recorded instance of human beings having a large scale impact on the natural environment. A major megafauna extinction, in which large game animals (such as mammoth) were apparently hunted to extinction, occurred approximately 50,000 ya (Broswimmer, 2002). Although improved hunting technology undoubtedly accounts for part of *Homo sapiens'* hunting success, we speculate that the self was also involved. As people were able to think about themselves in more abstract, symbolic, and complex ways, they were undoubtedly able to plan more effective, coordinated hunting expeditions.

Throughout the Paleolithic, it is likely that hominids preferred to live in rockshelters and caves when they were available. However, evidence of postholes suggests that, when natural shelters were not present, *H. sapiens* built their own dwellings (Campbell, 1992; Oakley, 1959; Pfeiffer, 1978). Wood and bone was probably used for structural support, with animal hides serving as the sides of the shelter (Bordes, 1968; Kozlowski, 1990). Whether cave or teepee, *H. sapiens* made their shelters more habitable through better control of fire. By approximately 35,000 years ago, hearths begin to show evidence of oxygen channels dug from their centers, allowing fires to burn warmer and brighter (Campbell, 1992).

By 40,000 ya, human beings inhabited some of the coldest regions of eastern Europe and northern Asia (Klein, 1999). One necessary advance for the inhabitation of such climates was adequate clothing. As noted, Neanderthals probably wore crude clothing, but the invention of bone needles by *H. sapiens* would have made clothes better and easier to make. Female figurines found in Russia appear to be clothed in fur (Campbell, 1992; Wymer, 1982), and a skeleton found at a Russian burial site dating to 22,000 ya was clothed in leather garments that were decorated with beads (Klein, 1999).

The cultural big bang was also associated with the first evidence of boats. The earliest archaeological sites in Australia date to at least to 40,000 ya and possibly to 60,000 ya (Campbell, 1992; Jones, 1989; Wolpoff, Wu, & Thorne, 1984), although there are reasons to be skeptical of the older date (Klein & Edgar, 2002). Given that travel to Australia at this point in time would have necessitated travel

over water for up to 90 km, we must assume that *H. sapiens* built viable boats by this time. The construction of watercraft capable of making such a journey suggests the presence of a self capable of extensive planning (Noble & Davidson, 1996). Although *H. erectus* had lived in southeastern Asia for nearly 1.5 million years without venturing over water, it took *H. sapiens* with a modern self only a few thousand years to conceive of a craft that would permit it to travel over long stretches of ocean.[4]

Technological advances in tools, housing, clothing, and boats attest to the presence of a forward-looking self that could imagine novel solutions to life's challenges. Whatever other cognitive changes may have occurred at this time (Mithen, 1996), these innovations would have been facilitated by a new-and-improved ability to self-reflect.

Art and Music

Until approximately 35,000 – 40,000 ya, the archeological record contains virtually no evidence of art. Two earlier examples of objects that show evidence of human modification have been reported dating from before 200,000 ya (Bednarik, 2003; Marshack, 1997), but their meaning remains unclear. It is possible that earlier people may have possessed the ability to make iconic (but not symbolic) objects. It has also been suggested that people may have decorated one another's bodies before this time (Pfeiffer, 1978, 1982), but the evidence is soft. The earliest surviving evidence of decorative art consists of engravings of animals and simple figures on cave walls (Dickson, 1990; Leroi-Gourhan, 1967). The earliest cave paintings, found mostly in France, have been dated to approximately 30,000 ya (Chauvet, Deschamps, & Hillaire, 1996; Mithen, 1998; Pfeiffer, 1982). These paintings of animals and people are usually not located in caves that were used as living spaces but rather in isolated areas hidden deep underground. Their seclusion suggests that the paintings might have been part of early sanctuaries or used in rituals associated with hunting (Campbell, 1992; Hadingham, 1979; Leroi-Gourhan, 1982; Pfeiffer, 1978; Wymer, 1982). If, as some suggest, this artwork was believed to bring luck to the hunt, the artists not only were capable of looking into the future to think about an upcoming hunt but also were able to take symbolic actions that they thought would help them to achieve their goals.

The earliest known depictive image etched in stone dates to 54,000 ya (Marshack, 1996). Shortly afterwards, people began to paint and etch images on bone, stone, antlers, and ivory (Conkey, 1996; Dickson, 1990; Leroi-Gourhan, 1967). Most of the images were animals and geometric figures. Also contemporaneous with the earliest paintings are so-called Venus figurines, small carvings of human females with exaggerated sexual characteristics. These figures are found across a wide swath of Europe from western France to central Russia (Campbell, 1992; Dickson, 1990; Pfeiffer, 1982; Wymer, 1982). The sexualized appearance of these

figurines has led to the conclusion that they were associated with fertility rituals, which would demonstrate the existence of both extended- and conceptual-self abilities.

Building on advances in the ability to control fire, clay firing was discovered by 30,000 ya. A site in the Czech Republic dating to 28,000 ya holds the oldest known kiln, in which people fired a mixture of clay and bone to make figurines (Campbell, 1992; Klein, 1999; Wymer, 1982). Some of the more mysterious objects of this time period are the so-called laurel-leaf blades. These masterpieces of flaking technology are too delicate to have served any purpose in daily activities such as hunting, and are hypothesized to be either ritualistic tools or a type of currency (Campbell, 1992; Klein, 1999; Wymer, 1982).

The first definitive musical instruments also appeared at the time of the cultural big bang. Bone flutes measuring approximately eight inches long have been unearthed in Europe and dated to 36,800 ya (Gamble, 1999; Pfeiffer, 1982). It is also possible that the perforated toe bones of deer, found throughout Europe, were used as whistles, perhaps to organize hunting parties (Wymer, 1982) and that painted mammoth bones discovered in Russia could represent the first percussion instruments (Pfeiffer, 1982). Although it is not clear to us how the conceptual-self relates to music (or even whether music requires a self), we suspect that a relatively sophisticated level of self-reflection is needed to design and construct musical instruments.

Body Adornment

Early evidence of body adornment, dating to 45,000 ya, has been found in Africa at both living sites and in burials (Klein, 1999). The oldest adornments are shell beads, but pendants, bracelets, rings, pins, and beads made from bone and teeth appear soon afterwards (Pfeiffer, 1978, 1982; Schick & Toth, 1993; Wymer, 1982). Other forms of adornment may have included armbands, bracelets, ankle bands, and hats. A painting in a cave in Spain portrays a human figure wearing a beret-like cap, and a site in Italy revealed a body buried in a headdress of shells (Pfeiffer, 1982).

Body adornment indicates that these people had the ability to imagine how they were perceived by others and to take symbolic steps to enhance their appearance, desirability, or status through the use of ornaments. The ability to contemplate how one will be perceived and evaluated by others–public self-awareness–is a relatively sophisticated ability that does not appear in other animals or in infants (A.H. Buss, 1980). This capacity seems to require the extended-, private-, and conceptual-self abilities: (a) The extended-self ability allows people to think about how they will be perceived in the future if they do thus-and-so now; (b) the private-self ability is needed because people can infer others' perceptions of them only through extrapolation from how they themselves would react to someone

who did thus-and-so; and (c) the conceptual-self ability is required in order for people to consider the abstract, symbolic meanings that others will attach to them (i.e., that others will draw inferences from their behavior or appearance that they are good or strong or sexually appealing) and to use symbolic means of enhancing their image.

Body adornment may also have also reflected symbolic identifications with one's group (Pfeiffer, 1978). Today, people often manage their appearance (through clothing, hairstyle, jewelry, tattoos, and so on) to express their group memberships. Once early *Homo sapiens* were able to construe themselves symbolically, there's no reason to think that they would not have used body adornment as one means of self-identification to others.

Burial of the Dead

Although archeologists have uncovered Neanderthal burial sites dating to 100,000 ya, not until the Middle/Upper Paleolithic Transition and the appearance of modern humans does the archaeological record yield any substantial proof of ritualistic burials as opposed to burials intended simply to dispose of the corpse (Campbell, 1992; Klein, 1999; Pfeiffer, 1982). Burial with grave goods is first apparent in this time period and suggests belief in an afterlife (Dickson, 1990; Schick & Toth, 1993). If so, the extended-self ability had progressed to the point where people could imagine themselves and others well into the future.

Beads and shells, which became a prominent component of burial during the later Paleolithic, are first observed in burials about 30,000 ya (Gamble, 1999). One burial site in Russia yielded the bodies of two boys who were buried skull-to-skull and covered by 8,000 ivory beads. In addition, the boys were interred with bracelets and rings, as well as weapons (Campbell, 1992; Hadingham, 1979; Klein, 1999; Pfeiffer, 1982). The fact that burials with grave goods may not have been a common practice (relatively few such burials have been found compared to the number of individuals who would have died; Wymer, 1982), has suggested to some the emergence of early class distinctions. Perhaps only individuals of a certain status received elaborate burials (Dickson, 1990). If so, we have yet another piece of evidence to suggest the presence of a conceptual self through which people could compare themselves with others along relatively abstract social dimensions, but this evidence is admittedly speculative.

The Rise of the Modern Self

The archeological evidence shows clearly that something notable happened to human beings at the Middle-Upper Paleolithic transition. After nearly 4 million years in which our ancestors were little more than intelligent apes, modern

human behavior burst onto the scene around 50,000 ya. Over the course of approximately 20,000 years, we see more changes in human behavior and culture than in the previous five million years since the first hominids appeared.

Our view is that this dramatic change reflected the emergence of conceptual-self ability which, in tandem with the four other abilities already in existence, gave rise to modern human self-reflection. We are not the first to suggest that changes in consciousness occurred at the time of the cultural big bang or that self-awareness plays an essential role in human culture. For example, Ingold (1996) proposed that a "distinctively human mode of objective self-awareness" is necessary for culture (p. 178) (see also Carruthers, 1998; Eccles, 1989; Hallowell, 1955). However, previous authors have tended to regard the emergence of the self as an all-or-none affair, which is not reflected in the fossil record. By distinguishing among distinct self abilities, our analysis traces the step-like prehistory of the self. Furthermore, it helps to explain why the hominid archeological record reveals gradual movement toward modern humanity over 2 million years (beginning with *H. habilis or rudolfensis*) but does not reach its current state until the cultural big bang. Each of the technological, artistic, interpersonal, and cultural changes that define the cultural big bang rely upon an ability to reflect on oneself in abstract and symbolic ways.

SYMBOLIZATION, LANGUAGE, AND THE SELF

Our hypothesis that the modern human self made its appearance just prior to the Middle-Upper Paleolithic transition raises many questions. One of the most important questions—the one whose answer may best clarify how self-awareness evolved—involves the intimate connections among symbolization, language, and self-thought. Adequately addressing this issue would require delving deeply into the nature and evolution of both symbol-use and language, which would take us far beyond the scope of this paper. However, we think it is important to raise a few issues about the relationships among symbolization, language, and the self.

Self-relevant thought, as it operates in people today, relies heavily upon symbolization and language. Imagining or characterizing oneself in one's mind necessarily involves a symbolic process in which the person creates and manipulates symbolic representations of him- or herself. When imagining oneself in the future, for example, people use a mental stand-in for themselves—what Jaynes (1976) called the "analogue-I"—to anticipate the likely outcomes of their actions. A person who plans to perform a particular action can imagine what may transpire when he or she does so. Sometimes this analogue-I is a mental image of oneself in action—as if one were watching the imagined scene, but it is often an unembodied perspective that imagines the scene in question through the person's own eyes. In either case, symbolization is involved in the sense that the hazy image or the unembodied perspective are abstract, symbolic representations of "me."

Similarly, self-reflection in human beings relies heavily upon language. Not only do people regularly "talk to themselves"—cautioning or chastising themselves, giving themselves advice, debating options, and so on—but thoughts about oneself often occur in the form of propositional statements in which "I" is the subject (e.g. "I shouldn't have overslept this morning; I'm looking forward to my vacation next week") (Bickerton, 1990). In fact, from our perspective today, it is somewhat difficult to imagine precisely how people would think about or talk to themselves in their own minds without language. Furthermore, the construction of personal identity relies on language as people use words to conceptualize who they are and what they are like, and first-person pronouns play a central role in people's self-thoughts (Ingold, 1996).

These considerations suggest that self-relevant thought as we know it today was not possible until people developed an ability to use symbols and language. This does not necessarily mean that people could not self-reflect before the appearance of language and symbolization but rather that the nature of their self-thoughts would have, by necessity, been concrete and nonsemantic. Other kinds of self-relevant information (e.g. ecological, interpersonal, extended, and private, to varying degrees) could be processed without language.

Like many issues in paleontology and evolution, the evolution of symbol-use and language is hotly debated (e.g. Bickerton, 1999; Deacon, 1989; Donald, 1991; Krantz, 1980; Noble & Davidson, 1996; Pinker, 1994). However, there seems to be emerging consensus that although language may have evolved gradually over three million years "the cognitive skills necessary for complex modern languages were finally achieved some time between 100,000 and 30,000 years ago" (Gibson, 1996, p. 422). We do not think it is a coincidence that the date that Gibson (1996) specifies for modern language coincides with the date we posit for the emergence of the modern self. Language requires not only symbolic thought (Donald, 1991) but also awareness of one's own communication and awareness of others as receivers (Jolly, 1996). In a somewhat different vein, Mithen (1996) suggested that changes in human cognitive architecture between 150,000 and 50,000 ya led to the ability to use symbolic language for nonsocial reasons.

The fact that self-reflection, symbol-use, and language are at least partly interdependent and mutually constituted suggests that their evolutionary trajectories may have been linked. Prior to the emergence of symbolization and self-reflection, hominids undoubtedly "spoke" in the sense of communicating through sounds; after all, modern apes use a wide array of grunts, shrieks, squeals, and other vocalizations to communicate with one another (Mithen,1996; Tattersall, 2001). However, it seems unlikely that they possessed true language, if by "language" we mean a system of symbolic communication that has both vocabulary and syntax. (What would our language be like if we lacked the ability to use symbols or to self-reflect?)

Increasing intelligence led not only to advances in technology and the associated skills needed to use it, but also to more complex social organization,

symbolically-mediated cognition, and full-fledged language (Campbell, 1996). In turn, symbolic ability and language changed the way that people thought, including how they thought about themselves (Tattersall, 2001). In fact, Bickerton (1990) argued that language provided the "infrastructure for consciousness" (p. 209) and that the development of self-reflexive consciousness in human beings was tied to the emergence of secondary representational systems based on language. Thus, we do not claim that the Middle-Upper Paleolithic transition involved nothing more than the acquisition of the conceptual-self ability. Rather, the sweeping changes in human behavior and culture during the big bang were a function of several interrelated cognitive changes. Even so, we believe that the ability to think conceptually about oneself was a necessary part of this transition. Neither symbolization nor language would have had such pronounced effects, if they could have occurred at all, without the ability to represent oneself cognitively in abstract, symbolic ways.

No one has, as yet, offered a compelling explanation for why such marked changes in human behavior occurred between 40,000 and 60,000 ya. Whether one tackles the question from the standpoint of symbolic ability, language, cognitive fluidity, or, as we suggest, conceptual-self ability, a convincing answer remains elusive. It is tempting to assume that the change was precipitated by some major anatomical change in human beings about this time, but paleontologists concur that anatomically modern humans appeared 50,000 to 100,000 years before they started to show evidence of modern thought and behavior (Klein & Edgar, 2002; Tattersall, 2001; White et al., 2003). Paleontologists, archeologists, biologists, and evolutionary psychologists have grappled with the inconsistency between the anatomical and cultural evidence for many years, and, although each offers an explanation, most agree that the data do not unequivocally support any of them and that the issue remains unresolved.

It is certainly conceivable that a neurological change occurred in the brain at the time of the Middle-Upper Paleolithic transition among people who were otherwise anatomically modern, a subtle change that is not reflected in the archeological record (e.g. Klein & Edgar's [2002] "fortuitous mutation;" see also Bickerton, 1999). However, this scenario runs into trouble because incontrovertible evidence of symbolization and selfhood do not appear in Europe and Asia until roughly 50,000 years after *H. sapiens* first left Africa (approximately 95,000 ya). Nor do we find evidence of modern human behavior in Africa that date to the earliest appearance of *H. sapiens* (Klein & Edgar, 2002). If the dates of these events are correct, they suggest that the first anatomically modern humans who migrated from Africa did not carry the cognitive abilities (including symbolization and self-awareness) that led to the cultural big bang.

The fortuitous mutation explanation might be salvaged if we someday find strong evidence of selfhood and culture closer to the appearance of modern humans prior to 100,000 ya. It might also be salvaged if there were at least two dispersions of *H. sapiens* from eastern Africa between 100,000 and 50,000 ya. The

earlier dispersion involved people who appeared anatomically modern but lacked a conceptual self; the later, post-mutation dispersions involved people who were both physically and behaviorally modern. Although it seems likely that *H. sapiens* trickled out of Africa over this time period, there is no evidence that those who left later possessed conceptual-self ability whereas those who left earlier did not.

Another possibility is that the neurological substrates for conceptual-self ability were in place before *H. sapiens* began to disperse out of Africa but that it did not manifest in human behavior for some time afterwards. When modern thought and behavior did arise, it then did so in different populations at different times between 60,000 and 30,000 years ago (Mithen, 1996). Along these lines, Marshark (1996) believes that the cultural big bang "often documents an already highly evolved, variable, and sophisticated set of symboling skills and modes" (p. 362). This explanation is certainly plausible, but the factors that triggered modern thought and behavior are difficult to identify. This may reflect a case of parallel evolution in which cognitive changes that occurred before the dispersion from Africa had evolutionary momentum (Mithen, 1996) or neurological changes that were already present manifested as the social or physical environment changed. Some have suggested, for example, that increased population sizes required new forms of communication or social organization, or that climatic changes (due to either actual changes or movement into new climates) prompted the need for problem-solving and innovation (for reviews, see Klein & Edgar, 2002; Megarry, 1995; Mithen, 1996; Tattersall, 2001). The fact is that no one knows.

We must caution against assuming that conceptual self-thought was necessarily an adaptation. Simply because these cognitive abilities offer many advantages does not necessarily indicate that they evolved specifically for the purposes that they eventually came to be used (see Flanagan et al., 2002). Instead, they may be exaptations that evolved for some other reason and were later appropriated for symbol use, language, and self-reflection. In fact, if cognitive adaptations are highly modularized and specialized, as most evolutionary psychologists believe (Cosmides & Tooby, 1994), it is unlikely that a "general conceptual-self ability" that permitted abstract and symbolic self-thought evolved as a unitary adaptation because it enhanced inclusive fitness. This in no way contradicts our contention that the conceptual self appeared at the time of the cultural big bang but rather raises the possibility that it was not an adaptation per se. Far more research is needed to offer a cogent and convincing explanation of why symbolic ability and the conceptual self evolved precisely as they did.

CONCLUSIONS

Table 2 summarizes our speculations regarding the emergence of self-awareness among human beings and their hominid ancestors (and cousins). Our analysis was greatly aided by Neisser's (1988, 1997) suggestion that self-knowledge is based

on five qualitatively different sources of information. Given how different these sources of information are yet how easily each is processed by modern human beings, we propose that they involve at least five distinct cognitive abilities that process information about the self. (We leave open the possibility that other abilities related specifically to self-cognizing may exist as well.) Viewing the self as multifaceted helps to explain the gradual evolution of human behavior from the common ancestor over 4.5 mya to the cultural big bang a mere 50,000 ya. Distinct self abilities arose to meet new challenges as hominids became bipedal, moved from the forests to the savannah, adopted a hunting-gathering lifestyle, and dispersed around the globe.

According to our interpretation of the evidence, the self-awareness of the earliest hominids was not noticeably different from that of nonhuman primates today. Patterns of tool use around 2 mya suggests that *Homo habilis* had a greater ability than earlier species to think about itself into the future, and this extended-self ability seems to have reached another level of power more recently with *Homo neanderthalensis* and *Homo sapiens*. The first evidence of private-self ability that exceeded that of other apes appeared with *Homo erectus*, who looked and behaved in a decidedly more "human" fashion than earlier species, but *Homo sapiens* surpassed earlier species in the cognitive sophistication of the private self. Most importantly for our purposes is the fact that no solid evidence of a conceptual or symbolic self appears until *Homo sapiens* within the last 60,000 years or so. The changes in artifacts at the time of the Middle-Upper Paleolithic transition—the Cultural Big Bang—provide evidence of sweeping changes in human consciousness that we believe are linked to the ability to think about oneself in abstract, conceptual, and symbolic ways. This ability seems to be responsible for the emergence of human society as we know it.

Whereas the Miocene ape from which humans and other modern primates descended likely possessed the ability to process only ecological and interpersonal information (with perhaps a very rudimentary extended and private self), modern human beings can also think about themselves infinitely into the future (extended-self ability), reflect on their own (and others') private states (private-self ability), and conceptualize themselves in abstract and symbolic ways (conceptual-self ability). Importantly, these abilities may work in tandem so that modern humans can, for example, ponder how they will feel in 20 years (extended + private), think about how they have changed as a person since childhood (extended + conceptual), and draw conclusions about the kind of person they are now based on how they think they will feel when a future event occurs (extended + private + conceptual).

All evolutionary explanations are necessarily speculative, being based on a large amount of evidence that is not only incomplete and spotty, but whose interpretation is often strenuously debated. We are acutely aware of the speculative nature of our account and the inherently uncertain status of the paleontological, anthropological, and psychological evidence on which it relies. Even so, we believe that our conclusions add to our understanding of the human self and offer directions

for future investigation. Furthermore, contrary to the oft-stated objection that evolutionary analyses are no more than "just-so" stories that can be neither confirmed nor disconfirmed, we believe that our account of the prehistory of self-reflection is decidedly falsifiable. For example, should paleontologists discover evidence that hominids prior to the cultural big bang were able to think about themselves in the future (i.e. discoveries of boats, calendars, long-term construction projects, ritualistic burials), adorned themselves, or used self-signifying symbols, our account would be called into question. Most of our claims about the emergence of self-reflection can be easily disconfirmed by future discoveries.

The study of the self has been approached from many directions in recent years—from the standpoint of cognition, emotion, interpersonal behavior, culture, neuroscience, development, and so on (Baumeister, 1999; Hoyle et al., 1999; Leary & Tangney, 2002a). Our hope is that considering how, when, and why human self-reflection evolved will shine additional light on the phenomena of interest to researchers who study self processes and raise important questions for future investigation.

Mark R. Leary
Department of Psychology
Wake Forest University
Winston-Salem
NC 27109
USA
leary@wfu.edu

Nicole R. Buttermore
College of William and Mary
Department of Psychology
Millington Hall
Williamsburg
VA 23187
USA

NOTES

[1] According to Povinelli and Cant (1995), large tree-dwelling apes, unlike other small arboreal primates, must continually consider whether a particular branch or vine will support their weight. For example, as modern orangutans (which Povinelli and Cant use as the model for the common ancestor) clamber through the forest canopy, they appear to evaluate their options on an ongoing basis rather than moving automatically (and often blindly) as monkeys do, a locomotion pattern that suggests rudimentary self-awareness. Povinelli and Cant's clambering hypothesis suggests that arboreal apes developed self-awareness to allow them to clamber effectively and safely. If true, this hypothesis applies only to the ecological- and extended-self abilities of the common ancestor and not to its capacity for conceptual self-thought.

[2] Donald (1991) compares the mimetic communication of *Homo erectus* to that of illiterate deaf-mute adults. This comparison is not quite correct, however, because, although illiterate deaf-mute adults can not talk, write, or use other linguistic devices, they nonetheless possess symbolic abilities that were not present in *Homo erectus*. Such abilities are not necessary for mimetic communication per se, but they would give modern deaf-mute humans a decided communicative advantage over *Homo erectus*.

[3] White (1996) suggested that the dramatic difference between people who lived prior to 35,000 ya and modern human beings should discourage us from using modern hunting-gathering people as the model for understanding prehistoric life. People living before the Upper-Middle Paleolithic transition were fundamentally different psychologically than any people living today (or, for that matter, in the past 35,000 years).

[4] Bednarik (1999) suggested that earlier species crossed the Strait of Gibraltar 200,000 years earlier, but this evidence is less widely accepted than that involving the passage to Australia.

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