The Still Bay and Howiesons Poort, 77–59 ka
Symbolic Material Culture and the Evolution of the Mind during the African Middle Stone Age

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Variations in the material culture in Africa in the Late Pleistocene indicate that it was a period of rapid cultural change not previously observed in the Middle Stone Age. In southern Africa, two techno-traditions, the Still Bay and the Howiesons Poort, have raised interest because of their relatively early cultural complexity. What might have driven the development of the innovative practices and ideas between ca. 77,000 and 59,000 years ago? Explanations for the ascent and demise of these two entities must focus on analyses of recovered materials and in situ features such as hearths and spatial patterning. They must also consider whether these innovations are likely to have ensued from cognitive evolution in Homo sapiens and trace the changes in brain organization and cognitive functions that best explain them. This article presents an updated review of the Still Bay and Howiesons Poort industries and argues that innovations during the Late Pleistocene must be related to a previous expansion of the higher association areas of the temporal and parietal cortices underlying higher theory of mind, perspective taking, and attentional flexibility.

An overview of the material culture of Homo sapiens in southern Africa indicates that the Late Pleistocene was a period during which innovations were relatively rapidly introduced, survived for a period, and then were lost or replaced by other technologies (Henshilwood 2007, 2008b; Henshilwood and Marean 2003, 2006; Henshilwood et al. 2002, 2004; Lombard 2005a, 2005b, 2007a; McBrearty and Brooks 2000; Wadley 2007; Wadley, Hodgkiss, and Grant 2009; Wurz 2000). Two stratigraphic culture entities, or " techno-traditions" (Wurz et al. 2003), that date to this time period, the Still Bay (SB) and the Howiesons Poort (HP), have raised particular interest (Henshilwood 2009b), first, because of their early cultural complexity and second, because their key lithic markers, the bifacial foliate point and backed segments, respectively, are restricted only to these techno-traditions during the Middle Stone Age (MSA) in southern Africa. New and accurate dating techniques have provided reliable ages of 77–72 ka for the SB and 65–59 ka for the HP (Henshilwood et al. 2002; Jacobs, Duller, and Wintle 2003; Jacobs and Roberts 2008; Jacobs, Wintle, and Duller 2003; Jacobs et al. 2006, 2008; Tribolo 2003; Tribolo, Mercier, and Valladas 2005; Tribolo et al. 2006).

Significant finds in SB levels include foliate lithic points, engraved ochres and bone, marine shell beads, formal bone tools, and a structured use of social space; in HP levels, backed geometric lithics, advanced projectile systems, engraved ostrich eggshell, bone tools, and evidence of individual domestic hearths have been recovered. These innovative technologies and social practices associated with the SB and the HP (e.g., d’Errico et al. 2005; Henshilwood et al. 2002, 2004; Lombard 2005a, 2005b, 2006a, 2006b; Minichillo 2005; Texier et al. 2010; Wadley 2007; Wurz 2000) are likely one part of a transformational behavioral mosaic that was also evolving in other parts of Africa at the same time (Barham 2001; Bouzouggar et al. 2007; d’Errico and Vanhaeren 2009; Henshilwood and Marean 2003; McBrearty and Brooks 2000).

Most explanations for the SB and the HP focus on interpretations of the technology and the social meanings of recovered artifacts (e.g., Henshilwood 2005; Henshilwood et al. 2002, 2004; Lombard 2005a, 2005b, 2006a, 2006b, 2007a; Wadley 2007), on in situ features such as hearths and spatial patterning (e.g., Deacon 1989; Minichillo 2005; Wadley and Jacobs 2004, 2006; Wurz 2000), and on the effects of climatic variability (Henshilwood 2008b; Jacobs and Roberts 2008; Jacobs et al. 2008). The SB and HP finds clearly demonstrate that innovative material culture appears, disappears, and reappears in the archaeological record in different forms. This...
pattern suggests that there were major discontinuities in the cultural transmission of innovations and stylistic material culture during the 77–59-ka period in southern Africa and possibly in earlier periods of the MSA as well (Henshilwood, d’Errico, and Watts 2009).

Over the past decade, the SB and HP finds have played a central role in the debate on the evolution of the human mind. On the one hand, several authors have claimed that material culture in the southern African MSA, especially that of the SB and HP periods, was indicative of cognitive and linguistic abilities equivalent to those of living *H. sapiens* (d’Errico et al. 2005; Henshilwood, d’Errico, and Watts 2009; Henshilwood and Dubreuil 2009; Henshilwood et al. 2004; Mellars 2005, 2006; Watts 2009). On the other hand, important criticisms have recently been raised against the use of general concepts such as “fully modern cognition” or “modern syntactical language” to account for southern African innovations during these periods and, in particular, for the presence of shell beads and abstract engravings to support these contentions (Botha 2008, 2009; Coolidge and Wynn 2009; Wynn and Coolidge 2007). These criticisms have been accompanied by legitimate demands to clarify the alleged link between human cognitive evolution in the MSA and behavioral innovations in southern Africa.

Connecting the evolution of behavior with the evolution of the mind, however, presents its own challenges. Cognitive archaeologists must learn, and are increasingly learning, to integrate evidence from various disciplines (primatology, neuroanatomy, cognitive neurosciences, etc.) and see how it bears on various hypotheses. In recent years, three hypotheses about the evolution of the human mind have become central to the debate. The first focuses on recursive syntax, the second on theory of mind, and the third on executive functions. Some authors have defended one or another version of these three hypotheses in close connection with the archaeological record, while others have rather focused on evidence from comparative psychology and neurosciences.

This increasing focus on a restricted set of hypotheses is good news for all those studying the evolution of the human mind. It is an indication that interdisciplinary work over the past two decades has led researchers to identify with increasing accuracy the space of plausible hypotheses. At the same time, we are still far from having a consensual description of the relationship between the evolution of the mind and the archaeological record.

Our view is that the three hypotheses just mentioned—recursive syntax, theory of mind, and working memory—all offer imperfect accounts of recent behavioral evolution. In the next sections, we explain why and argue that the time has come for students of human cognitive evolution to go beyond very general cognitive abilities and to propose increasingly precise cognitive mechanisms realized in particular neural structures, processes, or organizational patterns. This discussion sets the stage for our own proposal, in which behavioral innovations in the SB and HP periods, and most centrally the evolution of a stylistic and symbolic component in material culture, are explained by a previous expansion and reorganization of the higher association areas of the temporal and parietal cortices underlying higher theory of mind, perspective taking, and working memory.

The Evolution of the Mind: Three Hypotheses

The Evolution of Syntax

Linguistic communication is such a central aspect of human life that it seems impossible to explain the evolution of the mind without referring to it. The evolution of language is the issue that has received by far the most attention in the broader debate on the evolution of human cognition. Within language evolution, the question of recursion—understood as the capacity to embed a constituent in a constituent of the same type—is the one that has attracted the most interest. Recursion (or its cousin, the function “merge”) has been claimed to be unique to human language (Corballis 2007; Hauser, Chomsky, and Fitch 2002; Suddendorf and Corballis 2007), and its evolution has been linked to the evolution of properly modern culture in *H. sapiens* (Bickerton 1990:188, 2000, 2003; Read 2008bc703). The hypothesis, however, faces numerous challenges. In our view, these challenges are sufficiently serious to call into question the centrality of recursion in the explanation of recent cognitive evolution in the human lineage.

First, the fact that recursion is proper to human language is not definitely established. On the one hand, it cannot be excluded that other species are capable of computing recursive constructions. The evidence from European starlings provided by Gentner et al. (2006) has been convincingly contested by Corballis (2007), but some doubts remain about the ability of apes to parse recursive constructions. Research with the bonobo Kanzi has shown that he could grasp important features of syntax (Savage-Rumbaugh, Shanker, and Taylor 1998), although his ability to parse properly recursive constructions remains open to debate (Corballis 2007:702). On the other hand, humans’ ability to compute complex sentences is also debatable. It is not clear that the complex syntactic trees described in Chomskian formal analysis represent properly what is going on in our brain when we parse complex sentences. Marcus (2009) has argued on the basis of psycholinguistic data that we instead use partial trees (treetlets) to do so.

Second, even if computing linguistic recursion is beyond the reach of other species and within the reach of living humans, it does not necessarily account for the creativity of human culture. The idea that recursion is a universal feature of human language has been contested (Everett 2005; but see criticism from Nevins, Pesetsky, and Rodrigues 2009 and the response from Everett 2009). Evans and Levinson (2009:442–
have argued that, in some languages, complex relationships between propositions are worked out pragmatically, which suggests that theory of mind may be more important than recursive syntax. Moreover, it is not clear that recursive syntax accounts straightforwardly for the behavioral innovations that are most closely associated with the rise of *H. sapiens* or, in the first place, for the emergence of symbolically mediated culture. In child development, for instance, the understanding of symbols does not closely parallel the development of syntax. Children gain some understanding of symbols before they can use recursive constructions, but they grasp other aspects of symbolic culture only much later (Dubreuil 2008 and below).

Third, there are still doubts about how the ability to parse complex sentences is realized in the brain and how it relates to other cognitive abilities. Neuroimaging studies suggest that parsing complex sentences activates areas of the inferior prefrontal cortex, including Broca’s area, that are involved in the hierarchical organization and sequencing of both linguistic and nonlinguistic behavior (Koechlin and Jubault 2006; Stout and Chaminade 2009). In the literature on the evolution of the mind, however, recursion has also been linked to other cognitive abilities, often complicating the construction of clear alternative scenarios for the evolution of the modern mind. Lieberman (2005, 2007), for instance, suggests explaining the evolution of recursion by a change in subcortical structures controlling motor control. He proposes to relate this change to the evolution of the *FOXP2* gene in modern humans. Lieberman’s argument is unsatisfying for two reasons. The first is that the modern version of the *FOXP2* gene apparently evolved much earlier than modern humans and is also found in Neanderthals (Krause et al. 2007). The second is that *FOXP2*’s impact on behavior is multifaceted and its link with recursion is, at best, indirect (Fitch, Hauser, and Chomsky 2005). It is difficult to determine what would have been the behavioral and cognitive repertoire of a human population that lacked the modern version of the gene.

Other authors, including Hauser, Chomsky, and Fitch (2002) and Suddendorf and Corballis (2007:308), have pointed toward a possible link between syntax and social cognition or theory of mind. The parallel is interesting because theory of mind in humans allows for recursive constructions, in which mental states are embedded into mental states, for example, “I think that he wasn’t sure that she knew that he would arrive so late.” The parallel is also interesting because the development of embedded clauses in children is predictive of their later success in complex theory-of-mind tasks (de Villiers and Pyers 2002). But despite this developmental link, theory of mind and syntactic recursion are ultimately distinct cognitive abilities, realized in different neural networks.

Recursion has finally been connected with working memory, which imposes limits on the length of utterances that we can understand (Hauser, Chomsky, and Fitch 2002:1571). Coolidge and Wynn (2007, 2009:216–218), following Aboitiz et al. (2006), have suggested a possible link between the evolution of recursion and the expansion of human phonological storage capacity (PSC), which is the capacity to hold utterances in attention for a short span of time. They contend that while language is infinitely generative in theory, in practice our capacity to learn and use recursive syntax is limited by our PSC. An expansion of the PSC would have paved the way not only for the evolution of recursive speech but also for subvocal articulatory processing (i.e., inner speech) and recursive thinking in general (including theory of mind; Coolidge and Wynn 2007:709–710).

This argument is interesting and echoes the proposal of Savage-Rumbaugh, Shanker, and Taylor (1998:72–73) that short-term memory limitations could explain why the language-trained bonobo Kanzi stumbles with sentences such as “Show me the doggie and the milk.” But Coolidge and Wynn do not want to focus exclusively on the enhancement of the PSC. Indeed, if archaic humans had insufficient phonological working memory to develop spoken language, they might have had sufficient visuospatial working memory to develop language in the gestural modality. So Coolidge and Wynn (2007:709–710, emphasis added) “believe that a genetic neural mutation, sometime within the last 100,000 years, enhanced working memory capacity and/or PSC.” Coolidge and Wynn (2009:216–222) propose a similar picture: the evolution of modern cognition could be related to the evolution of recursion (through the enhancement of the PSC), and/or the evolution of the pragmatics of speech (through the prior evolution of recursion), and/or the evolution of episodic memory. At this point, however, the syntactic hypothesis gets conflated with two others: the evolution of theory of mind and the evolution of the executive brain.

**The Evolution of Theory of Mind**

The second influential explanation of the evolution of the modern mind focuses on social cognition and theory of mind, specifically, on the capacity to attribute mental states to others. Robin Dunbar (1992, 1993, 2003, 2007) has most famously argued that the evolution of the mind was prompted not by the need to solve technological problems but by the need to maintain social bonds and alliances. We are sympathetic to the idea that the selective pressure behind human cognitive evolution was primarily social, but we are unsure about the details of his argument.

According to Dunbar (1992, 1993), the relative size of the neocortex in primates is correlated with group size. On this basis, Aiello and Dunbar (1993) argue that encephalization in the human lineage was related to the pressure to form larger groups and alliances. Unfortunately, there is no evidence that the most important phases of encephalization (in Plio-Pleistocene and mid-Pleistocene hominins) were linked with an expansion in the size of groups or social networks. Moreover, there are no prima facie reasons to think that group size in Pleistocene foragers was not first and foremost constrained by noncognitive factors, as is generally the case in...
nonhuman primates (Lehmann, Korstjens, and Dunbar 2007).

Our most important reservations about the social-brain hypothesis concern the cognitive mechanisms that are put forward as central to the evolution of the modern mind. Dunbar’s (2007) theory builds on philosopher Daniel Dennett’s (1987) views on intentionality, according to which thinking about mental states typically involves embedding mental states into other mental states, as in “I believe that you know that he thinks, etc.” There is evidence that humans get rapidly puzzled when they need to decipher situations involving five or more orders of intentionality (Kinderman, Dunbar, and Bentall 1998; Stiller and Dunbar 2007). Although this is an interesting cognitive limitation, it cannot straightforwardly be used to account for human cognitive evolution. First, there is no evidence that orders of intentionality are causally connected with the relative size of the neocortex or, as suggested by Dunbar (2007:94), with the volume of the frontal-lobe gray matter. Second, it is far from obvious that we need three, four, or five orders of intentionality to understand symbolic, artistic, or religious behavior (Dunbar 2007:95). Third and more important, it is reasonable to presume that our incapacity to go beyond five orders of intentionality has nothing to do with social cognition, sensu stricto, but results from the limitations of our domain-general intelligence.

Indeed, social cognition and theory of mind refer to complex cognitive tasks that depend on both domain-specific and domain-general cognitive mechanisms (Apperly and Butterfill 2009; Stone and Gerrans 2006). Domain-general abilities are particularly important for the most complex social cognitive abilities, like those that develop later in infancy and are most likely to have evolved recently in our lineage. Performance in the false-belief task, most notably, is strongly correlated with the ability to inhibit self-perspective and hold in mind oppositional viewpoints on a situation (Carlson, Moses, and Claxton 2004). This holds true not only for children but also for adults (Apperly, Samson, and Humphreys 2009; Bailey and Henry 2008). The importance of domain-general cognition for theory of mind raises the possibility that the evolution of the social brain in fact resulted from the evolution of the executive brain.

**The Evolution of the Executive Brain**

A third influential group of explanations suggests that the key to the evolution of the modern mind is to be found in the executive functions of the brain, that is, its ability to manage and control lower-level psychological processes. Mithen (1996), for instance, links the evolution of the modern mind to that of cognitive fluidity and contends that modern humans became increasingly able to establish connections between previously separated cognitive modules. Deacon (1997), for his part, explains the emergence of symbolic behavior through the evolution of the executive functions of the brain, which would have made possible the construction of properly symbolic relations between indexical tokens. In several works, Coolidge and Wynn (2001, 2004, 2005, 2009) propose to explain the evolution of the modern mind by the evolution of working memory, that is, the capacity to temporarily hold in attention recently processed information and to keep it available for further processing (see also Read 2008b; Rossano 2007).

The biggest challenge of these approaches is to move beyond very general accounts of executive functions and link precise cognitive mechanisms with likely neural and behavioral evolutionary processes. Coolidge and Wynn (2001, 2004, 2005) have made an important step in this direction by introducing Baddeley and Hitch’s (1974) model of working memory into the debate on human cognitive evolution. In their initial model, Baddeley and Hitch distinguished three functional components of working memory: (1) the central executive, responsible for attention, selection, and inhibition; (2) the phonological store, responsible for vocal and subvocal rehearsal of verbal and acoustic stimuli; and (3) the visuospatial sketchpad, in charge of integration and temporary storage of visual (what) and spatial (where) information.

As we saw above, Coolidge and Wynn (2007) suggest that the expansion of the phonological store might be responsible for the evolution of recursion and, incidentally, of modern culture and cognition. In other papers (Coolidge and Wynn 2001, 2004, 2005; Wynn, Coolidge, and Bright 2009), they focus rather on the importance of the central executive in the evolution of the modern mind.

We have raised some doubts above about the explanatory power of recursion, whose nature, neural basis, and importance for behavior are still widely debated. The working-memory hypothesis raises problems of a different nature. On the one hand, a strong case can be made that working memory (or at least its central executive component) allows for much greater cognitive and behavioral fluidity in humans than in apes (Read 2008b). On the other hand, focusing on the central executive does not get us very far, because the concept itself is very broad and can be further subdivided into multiple functional subcomponents (e.g., inhibitory control, attention flexibility, goal selection, goal maintenance, and planning; for a review, see Jurado and Rosselli 2007). Moreover, even if it is granted that the central executive is expanded in modern humans compared to that in apes, we need specific arguments to link its expansion to behavioral evolution in modern H. sapiens. Our view is that we might be able to design more detailed scenarios for the evolution of the central executive if we turn to what we know of the evolution of the brain itself.

**The Evolution of the Prefrontal Cortex**

The executive functions of the brain are in large part realized in the prefrontal cortex (PFC). It is thus not surprising that an important part of the discussion on the evolution of the modern mind has been focused on this region (Amati and...
Shallie 2007; Ardila 2008; Cela-Conde et al. 2004; Coolidge and Wynn 2001; Deacon 1997; Dunbar 2007; Mithen 1996; Noack 2006, 2007; Noble and Davidson 1996; Read 2008b; Rossano 2007). The comparative study of the frontal lobe in humans and apes reveals interesting similarities and dissimilarities. Although the human frontal lobe underwent a dramatic expansion in absolute size during human evolution, it does not represent a larger proportion of the neocortex in modern humans than in apes (Semendeferi et al. 2002). It has been argued that the expansion of the frontal lobe in absolute terms was of more benefit to the PFC—and especially to the frontopolar cortex (BA [Brodmann area] 10)—than to the prefrontal cortex (BA 10). A final example is the greater proportion of the orbitofrontal and medial frontal areas in modern humans than in apes (Semendeferi et al. 2001; Sherwood, Subiaul, and Zawidzki 2008).

It is not easy to determine the significance of the absolute expansion of the frontal lobe for the evolution of human cognition and behavior. Although the human PFC might not be exceptionally large for a primate of our size, its expansion in the human lineage was accompanied by changes that might have favored higher connectivity within the PFC and with other brain regions. One such change is the increased level of gyrisation observed in the modern human PFC (Rilling and Insel 1999). Another is the higher proportion of white matter, which is thought to have facilitated long-distance connections with other brain regions (Schoenemann, Sheehan, and Glotzer 2005). A final example is the variation in the number and density of cortical minicolumns, which might have determined new patterns of connectivity (Casanova and Tillquist 2008). All these changes, it should be noted, are likely to have coincided with encephalization, although they might also have occurred in the absence of encephalization.

It is generally assumed that the expansion of the PFC in absolute terms must have coincided with significant changes in cognition and behavior. On the one hand, the expansion of the orbitofrontal and medial frontal areas might have led to an increased capacity to integrate emotionally and motivationally relevant information. On the other hand, the expansion of the dorsolateral areas could have come with enhanced capacity for goal selection, goal maintenance, and inhibitory control (Ardila 2008).

Although the functional reorganization of the PFC likely explains important behavioral changes in the human lineage, we contend that it cannot be so easily invoked to explain behavioral evolution in southern Africa during the SB and HP periods. Indeed, the bulk of encephalization in the human lineage occurred not only significantly earlier than the SB and HP periods but also well before the evolution of anatomically modern humans. Despite the limited number of specimens, it is reasonable to think that the encephalization quotient of mid-Pleistocene hominins in Africa and Europe was broadly within the range of modern H. sapiens (Rightmire 2004, 2008). If there was no relevant change in the size of the PFC, however, could there have been relevant changes in shape?

On the one hand, the study of the inner median-sagittal profile of the PFC reveals no significant change during the past 500,000 years (Bookstein et al. 1999). On the other hand, a comparison with more archaic specimens reveals wider frontal lobes in modern H. sapiens, but this trend is even more pronounced in Neanderthals (raising intriguing questions about its potential cognitive significance; Bruner and Holloway 2010). Certainly, the study of endocasts is not likely to reveal any possible reorganization of the PFC. However, because some of the most specific features of the modern PFC (gyrisation, proportion of white matter, number of minicolumns) interact with size and shape, it is reasonable to think that most features of the modern human PFC were already in place in Homo heidelbergensis (albeit more recent changes cannot be excluded).

Another line of evidence in favor of this conclusion comes from the archaeological record. In children, the latest-maturing parts of the PFC are the dorsolateral areas, which are involved in inhibitory control, goal maintenance, and the capacity to resist temptation (Gazzaniga et al. 2002; Gogtay et al. 2004; Knoch et al. 2006; Koechlin and Summerfield 2007; Sanfey et al. 2003). If the latest-maturing areas are also the latest-evolving areas, then a modernlike capacity for inhibition and goal maintenance would suggest a modernlike organization of the PFC in mid-Pleistocene hominins. Many behaviors that appear during the mid-Pleistocene provide evidence of H. heidelbergensis’s unprecedented capacity to stick to long-term norms of cooperation, despite the temptation to free-ride (Dubreuil 2010b). Homo heidelbergensis provides the first evidence of a subsistence strategy based on large-game hunting (and thus on extensive meat sharing), cooking, and the controlled use of fire. We also find in H. heidelbergensis the first convincing evidence of a modernlike organization of life-history phases (Robson and Wood 2008). Because prolonged infancy in modern humans has been shown to depend on large intergenerational transfers, changes in life history are likely to be informative about changes in the ability to cooperate (Kaplan and Gurven 2005). Indeed, costly intergenerational transfers can be secured only if individuals are able to stick to social norms and long-term goals in the face of competing motivations, that is, if they have a strong capacity for inhibitory control and goal maintenance. Behavioral and morphological data for mid-Pleistocene specimens therefore suggest that the PFC had already undergone its most significant reorganization long before the evolution of modern H. sapiens and thus that its evolution might not be the best candidate to explain the behavioral innovation in southern Africa during the SB and HP periods.

The Evolution of the Temporoparietal Areas

Although it has been the focus of most discussions on the evolution of the modern mind, the PFC is not the only brain area dedicated to high-level cognition. Several areas of the temporal and parietal cortices are involved in complex cognitive
tasks and might have undergone changes in recent human evolution. Wynn, Coolidge, and Bright (2009), for instance, suggest that the advent of modern brain morphology is associated with functional changes in the parietal cortex, in addition to changes in the frontal cortex. The parietal cortex is activated in several complex cognitive tasks, including visuomotor control, task switching, attention, spatial working memory, mental rotation, and mental imagery (Wynn, Coolidge, and Bright 2009:75). Their argument is based on Emiliano Bruner’s geometric, morphometric analyses, according to which the modernization of human cranium was accompanied by a nonallometric increase in parietal volume (Bruner 2003, 2004; Bruner, Manzi, and Arsuaga 2003).

This new hypothesis has the advantage of extending the discussion to areas outside the PFC. One limitation is that the parietal cortex in modern humans is not unexpectedly large for a primate of our size (Lieberman 2008; Pearson 2008). The posterior parietal areas, activated in tasks requiring selective attention, are expanded in relative terms in humans, but this expansion apparently occurred early in the human lineage, probably in Australopithecines (Holloway, Clark, and Tobias 2004). For these reasons, we prefer to remain cautious concerning a possible expansion and functional reorganization of the parietal cortex along with the evolution of modern H. sapiens, although this possibility must be considered.

Lieberman, McBratney, and Krovitz (2002) have advanced another viewpoint on the modernization of cranial morphology. They argue that the most important feature of the modern H. sapiens braincase is its overall globular shape, which they link with an expansion of the volume of the temporal lobes, which are both longer and wider in modern humans than in archaic humans. Just as is the case for the parietal lobe, the temporal cortex is activated in a wide range of complex cognitive tasks, including visual and phonological working memory and theory of mind, as well as semantics and concept formation. However, there is a general consensus that the temporal lobes, in contrast to the parietal lobe, are disproportionately enlarged in modern humans compared to those in apes (Rilling and Seligman 2002; Semendeferi and Damásio 2000). This enlargement is primarily connected to a relative increase in white matter, suggesting enhanced connectivity within the temporal lobes and with other regions of the brain, including the frontal and parietal lobes (Schenker, Desgouttes, and Semendeferi 2005).

The relative and absolute enlargement of the temporal cortex in recent human evolution might have multiple causes and effects. Although it is currently impossible to provide a detailed story of its significance, archaeological and neurological data can give us some hints. On the basis of human and nonhuman-primate comparative data, Ungerleider, Courtney, and Haxby (1998) argue that encephalization in the human lineage came with a displacement of temporal and parietal cortical areas dedicated to visuospatial working memory. Compared to that in nonhuman primates, the dorsal stream of visual working memory—the “where” stream, which processes information about objects’ location in space—has a more superior location in human parietal cortex. The ventral stream—the “what” stream, which processes information about object recognition—has a more inferior location in the temporal cortex. The displacement of the two streams of visuospatial working memory coincides with a relative expansion of the higher association areas located along the Sylvian fissure.

Comparative studies also suggest an important expansion in humans of the arcuate fasciculus, the white-matter fiber tract that arches above the Sylvian fissure and connects the higher associational cortex of the temporal and parietal lobes (including Wernicke’s area) to Broca’s area in the frontal cortex (Rilling et al. 2008). The arcuate fasciculus and other white-matter pathways that run in the temporal lobes are generally presented as connecting lexical and semantic information (stored in the temporal cortex) with syntactic processing abilities (mostly realized in the inferior frontal cortex, including Broca’s area; Friederici 2009).

In sum, we suggest that it is in the higher association areas of the temporal cortex, or in the underlying white matter that connects it with the parietal and frontal cortex, that we should look for the functional reorganization that paved the way to symbolic behavior in the southern African archaeological record.

### The Temporoparietal Junction, Theory of Mind, and the Executive Brain

The presence of a stylistic and symbolic component in material culture is probably the most striking feature of the SB and HP periods in southern Africa. Before we examine the archaeological record in detail, we explain first how the higher association areas of the temporoparietal cortex are related to complex cognitive abilities such as theory of mind and working memory and second how an expansion of these regions could account for the emergence of styles and symbols in human evolution.

The functional organization of the temporoparietal areas and, in particular, of the temporoparietal junction (TPJ) has recently been debated. Some propose that the TPJ is the seat of general metacognitive computational processes that are involved in reorienting attention (Decety and Lamm 2007; Mitchell 2008). Others argue that the TPJ is functionally differentiated and that a specific region within it is involved in processing mental states in false-belief tasks and intricate moral judgments (Saxe and Kanwisher 2003; Saxe and Powell 2006; Scholz et al. 2009; Young et al. 2007). It is clear in both cases, however, that the TPJ in general is the seat of high-level cognitive mechanisms that allow us to contrast different perspectives on objects or events (Aichhorn et al. 2006; Mitchell 2009).

This function is different from the more primitive representation of biological motions and goal-directed actions, which are realized not in the TPJ but in a network that in-
cludes the neighboring posterior superior temporal sulcus (pSTS in fig. 1), the intraparietal sulcus (IPS), and the inferior frontal gyrus (IFG; Blakemore 2008; Gobbini et al. 2007; Mitchell 2009; Tunik et al. 2007). It is also different from the representation of the affective features of the social situation, which is realized in a network that connects limbic structures such as the amygdala to the anterior insula (AI), the anterior cingulated cortex (ACC), and the medial prefrontal cortex (mPFC).

There is a growing consensus in comparative psychology that both young children (less than 4 years of age) and apes fail to reach a stable representation of false beliefs, although they both understand intentions and goal-directed actions (for reviews, see Apperly and Butterfill 2009; Call and Tomasello 2008). It suggests that the TPJ matures late in infancy and that it underwent a functional reorganization in the human lineage. The maturation of the TPJ in infancy is also likely to be responsible for children’s success in other cognitive abilities that bear some resemblance to the understanding of false beliefs. One of them is called the “level-2 perspective-taking” ability and refers to the capacity of children of 4 and 5 years of age to describe an object from another point of view (Flavell 1992); while level-1 perspective taking involves the capacity to understand what others see, level-2 perspective taking is about imagining how things look from another perspective. Another is the ability to distinguish appearance and reality, when children understand that an object can actually be different from how it appears (Flavell, Flavell, and Green 1983).

These tasks have a common feature in that they all involve one’s ability to represent conflicting perspectives on the world. The development of this ability in children arguably has an impact on other cognitive functions. This is the case of categorization. Very young children can learn to use different concepts to refer to the same object. Before the age of 4 or 5, however, they are incapable of switching from one name to another or of moving an object across basic-subordinate categories. They struggle, for instance, when they have to look at the bunny simultaneously as a rabbit or to the rabbit as an animal, although they use the concepts with the right extension (Perner et al. 2002).

The representation of perspectives is also likely to be causally linked to the evolution of episodic memory. Before 4 or 5 years of age, children rely on semantic memory to encode aspects of situations but cannot remember situations as they experienced them (Tulving 1972, 2002). Interestingly, it is also around that age that “childhood amnesia,” our inability to remember our first years of life (Freud 1966), ends. Childhood amnesia can be explained by the fact that younger preschoolers are unable to encode (or recall) memories from the perspective of the self (Perner and Ruffman 1995).

Finally and most relevant to our point, the cognitive de-
development that happens around 4 and 5 years of age comes with important changes in the way children interact with symbolic culture (although children do have a certain understanding of symbols before that age). Very young children—and apes—are very good at learning iconic relationships and can recognize fairly abstract drawings or photographs. Human children between the ages of 2 and 3 years can use a scale model or a video to retrieve a hidden object in the real world (DeLoache 2002, 2004). Between 3 and 4 years of age, they can also understand that the meaning of a picture is defined partially by the intention of the person who draws it and not only by its appearance (Bloom and Markson 1998). Things get more complicated when it comes to more complex tasks, especially the production of symbols. Young preschoolers do not typically produce recognizable representations in their drawings. Similarly, only around the age of 4 or 5 do children learn to represent a number of objects with a written number (Zhou and Wang 2004). If younger children can understand what written words refer to, they have no clue as to the source of the meaning. Typically, they think that moving a word referring to a picture in front of another picture can alter the meaning of the word (Bialystok 2000).

The higher cognitive processes that are essential to theory of mind and perspective taking are not realized only in the temporoparietal areas. Activation in the mPFC, for instance, is strongly associated with theory-of-mind tasks (Blakemore 2008). Given the morphological data on the anatomically modern cranium presented above, however, as well as the fact that the mPFC matures earlier than the lateral regions of the PFC, we doubt that the evolution of the mPFC best explains more recent behavioral innovations in Homo sapiens.

Although our focus on the temporoparietal cortex is original, it presents an interesting link with two of the hypotheses discussed above. The temporoparietal areas are involved in both complex theory-of-mind tasks (e.g., verbal false-belief tasks) and working-memory tasks (e.g., attentional flexibility). Our hypothesis is compatible with different finer-grained accounts of the impact of a change in the temporoparietal cortex on these higher cognitive abilities (fig. 2).

One possibility is that the reorganization of the TPJ affected two different mechanisms, one specifically dedicated to theory of mind and the other to more general attentional flexibility (a component of working memory; fig. 2a). A second possibility is that the change in the TPJ affected a general attentional mechanism implicated, among others, in complex theory-of-mind tasks (fig. 2b). A third scenario is that the expansion of the temporoparietal cortex did not primarily cause a functional reorganization of the TPJ but rather came with improved connectivity with the regions of the prefrontal cortex implicated in theory of mind and working memory (fig. 2c). These differing scenarios are all compatible with the basic idea that the expansion of the temporoparietal cortex is responsible for the stylistic and symbolic innovations in the southern African MSA material culture.

Explaining Southern African Innovations

The core of our argument is that several innovations in the southern African archaeological record are characterized, at a minimum, by an interest in the appearance of objects, that is, in the way objects look from different perspectives. In addition, we argue that several artifacts likely provide evidence of symbolically mediated culture that depends on higher theory of mind. Our definition is that a symbolically mediated culture is one in which individuals understand that artifacts are imbued with meaning and that these meanings are construed and depend on collectively shared beliefs. This criterion

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Figure 2. Finer-grained evolutionary scenarios connecting the evolution of the temporoparietal areas to the emergence of styles and symbols.
is crucial. It explains how human norms and conventions differ from the ritualized behaviors found in nonhuman primates. Apes, for instance, can easily learn how the first step of a movement sequence predicts the following steps. For this reason, this first step can become ritualized and used by one individual to signal an intention to another. Infant chimpanzees, for instance, can touch the back of their mother to signal their intention to be carried (Tomasello 2008:22–23). The ritualization of intention-movement gestures requires not a theory of mind but simply an understanding that others can read our intentions in a partial realization of a movement. Why is symbolically mediated culture different from this? Why is higher theory of mind needed for a personal ornament, for instance, to come to be realized as a symbol of social status (e.g., signaling that “I am a spouse” or “I am a member of the so-and-so clan”)? Much confusion stems from the fact that we can learn a lot about symbolic artifacts without complex theory of mind. Young human children and nonhuman primates can recognize social statuses and develop rich sets of expectations about the behavior of different categories of people. Two- and 3-year-old children, for instance, easily recognize the uniform of firefighters and know what kind of behaviors are associated with them.

But children’s understanding, however impressive, does not reflect full integration into the world of symbolic culture. What is the difference in adults? Adults not only develop expectations about the behavior of people with uniforms but also understand that the rights and duties that come with wearing a uniform are collectively agreed upon (Searle 1995). In other words, they understand that the ascription of a status is causally dependent on what people think of the uniform.

It is important to stress that this additional variable (the point of view of others) not only makes symbolically mediated culture richer but also is precisely what makes it relevant for us to imbue objects with symbolic meaning in the first place. Children develop expectations about the behavior of other agents (or types of agents), but these expectations are highly idiosyncratic and are mostly based on previous interactions with these agents or types of agents.

What children do not perceive is that adults create symbolic artifacts as shortcuts for collectively shared meanings. It is not up to each of us, for instance, to decide what expectations we should have about firefighters’ uniforms—it is a collective matter, and it becomes so only because we are able to explicitly coordinate our viewpoints with those of others. This implies higher theory of mind, which is realized in the higher association areas of the temporoparietal cortex, among other areas.

In the next section, we present an updated review of the SB and HP archaeological record and explain how the behavioral innovations that have been documented for these periods reflect a concern for style and, in many cases, plausible evidence of symbolically mediated culture.

The Southern African Archaeological Record

The Still Bay

Sites containing the typical marker of the SB, the bifacial foliate point (laurel-leaf shaped), are relatively rare in southern Africa; these include nine known cave/shelter sites and at least five open sites (fig. 3). The principal cave or shelter sites are Blombos Cave (Henshilwood 2008a; Henshilwood et al. 2001b), Dale Rose Parlour (Goodwin and Peers 1953; Schirmer 1975), Dieploof Rock Shelter (Rigaud et al. 2006), Hollow Rock Shelter (Evans 1994), Paardeberg (Wurz 2000), Peers Cave (also known as Skildergatkop, Peers’s Shelter, and B102; Anthony 1963, 1967; Jolly 1948; Malan 1955; Peers 1929; Peers and Goodwin 1953), and the sites immediately adjacent to Peers Cave known as Tunnel Cave (Malan 1955) and Trappieskop (note that the Trappieskop sites include B102, C103 [known as Nero’s Cave], and G107 but not Dale Rose Parlour; see Goodwin and Peers 1953:59). Sibudu Cave is the single known SB site in KwaZulu-Natal (Wadley 2007). Open or dune sites where SB bifacials have been recovered but are now difficult to accurately locate include the “Cape Town dunefields” in Maitland (Dale 1870), Cape Hangklip (Gatehouse 1954), Blombos Sands (Heese 1933, n.d.), Kleinjongsfontein (Heese 1933, n.d.), and various sites in Wellington, Cape Province (Heese, n.d.).

The SB sites are beyond the dating range for the 14C method, and until 2002 the age of this techno-tradition was unknown (Henshilwood et al. 2001b, 2002). The SB levels at Blombos Cave have been dated with a number of methods, including thermoluminescence (TL), optically stimulated luminescence (OSL), and electron spin resonance; (Henshilwood et al. 2002; Jacobs, Duller, and Wintle 2003; Jacobs, Wintle, and Duller 2003; Jacobs et al. 2006; Jones 2001; Trubolo 2003; Trubolo et al. 2006). The MSA levels at the Blombos Cave site are divided into three phases: M1, M2, and M3 (fig. 4). A hiatus level composed of undisturbed aeolian sand above the M1 phase is dated by OSL to between 69 ± 5 and 70 ± 5 ka (Henshilwood et al. 2002; Jacobs, Duller, and Wintle 2003; Jacobs, Wintle, and Duller 2003; Jacobs et al. 2006; fig. 4). An OSL age of 72.7 ± 3.1 ka was obtained for the upper part of the M1 phase (Jacobs, Duller, and Wintle 2003; Jacobs, Wintle, and Duller 2003). The TL ages for the M1 phase are 74 ± 5 and 78 ± 6 ka (Trubolo et al. 2006). The upper M2 phase also contains SB bifacials, although in lesser quantities than in M1, and the OSL age for the layers that contain bifacial points is 76.8 ± 3.1 ka (Jacobs et al. 2006). This latter date should be regarded as the terminus post quem for the SB levels at the Blombos Cave site. The lower layers in the M2 phase (layers CG, CGAA, CBG, and CGAC) do not contain bifacial points or bone tools and have an age of 84.6 ± 5.8 ka.

Apollo 11 is the single SB site recorded in Namibia, and
the age of the SB here, obtained by the OSL method, is given as 70.7 ± 2.1 ka (Jacobs and Roberts 2008; Jacobs et al. 2008). At Sibudu Shelter, KwaZulu-Natal, the SB levels are dated at 70.5 ± 2.0 ka by the OSL method (Jacobs and Roberts 2008, Jacobs et al. 2008). The OSL age of the SB facies at Diepkloof rock shelter in the Western Cape is given as between 70.9 ± 1.8 and 73.6 ± 2.1 ka (Jacobs and Roberts 2008; Jacobs et al. 2008). Ages obtained for the same SB layers at Diepkloof with the TL method are inexplicably older and range from 99 ± 10 to 118 ± 11 ka (layers Kerry–Kate) and from 108 ± 9 to 129 ± 11 ka (layers Kim–Larry; Tribolo et al. 2009).

In summary, the dating evidence for the SB levels in southern Africa from the OSL method indicates a range from ca. 70 ka (Apollo 11, Diepkloof, Sibudu) to 76.8 ± 3.1 ka (Blombos Cave; Jacobs et al. 2006). The TL results from Diepkloof place the SB at ca. 25,000–50,000 years older.

The “lance-head” in elongated laurel-leaf form typifies the SB type-artifact, according to Heese (n.d.), and these bifacial points are now accepted as the fossile directeurs of this technocomplex in southern Africa (Henshilwood et al. 2001b; Villa et al. 2009). At the Umhlatuzana site in KwaZulu-Natal, bifacials similar to those of the SB type are reported (Kaplan 1990), and it now seems that their stratigraphic provenience is clear and that they are associated with layers with an age of ca. 71 ka (Lombard et al. 2010). Hollow-based points from
the same site are found in the post-HP facies and have an age of ca. 55–50 ka. The tear-shaped points of the Pietersburg Complex (Sampson 1974) in the Free State bear similarities to the SB points. Age estimates for the Pietersburg Complex suggest that artifacts were being made there at about the same time as those in the SB (e.g., Grün and Beaumont 2001). Elsewhere in Africa, the bifacial-type points recovered are mostly distinctive, for example, the Aterian notched bifacials (Bouzouggar, Kozlowski, and Otte 2002). The relationship of these complexes in central, east, and north Africa to the SB techno-tradition in southern Africa is not clear.

At most SB sites, there is a preference for making these from fine-grained raw materials, especially silcrete (e.g., Evans 1994; Henshilwood et al. 2001b; Minichillo 2005; Villa et al. 2009). The early evidence suggested that the SB bifacial points were restricted to the coastal belt of the Western Cape Province (Minichillo 2005:132), but the recent recovery of SB bifacial points at Sibudu (Wadley 2007) indicate that this techno-tradition was more widespread in southern Africa. The SB bifacials both identify that a SB phase is present at a site and indicate, on the basis of current evidence, that an age of ca. 77–70 ka is likely for the levels that contain this techno-tradition (Jacobs and Roberts 2008; Jacobs et al. 2006, 2008). Bifacial roughouts correspond to various stages of the reduction process, and flakes produced by thinning and shaping the bifacials are a constant presence in SB levels (Henshilwood et al. 2001b; Minichillo 2005; Villa et al. 2009).

Bifacial points likely served as multifunctional tools (Minichillo 2005), and a macrofracture analysis of the Blombos Cave bifacials by Lombard (2007a) indicates they were used as both spear points and knives. The SB bifacials are one instance of innovation where the makers clearly showed concern for the appearance of the finished object, and it seems possible that these tools also served a symbolic role (Henshilwood et al. 2001b). Minichillo (2005:133) makes the point that the interpretations of the SB techno-tradition by some of the earliest archaeologists at the Cape should now be regarded in a different light. For example, Burkitt (1928) interpreted the SB as marking the arrival of “modern people” on the subcontinent, and SB artifacts were frequently compared with the bifacials of the European Solutrean (e.g., Goodwin 1929; Heese 1933). Certainly, these scholars got their timing wrong and also showed their bias toward a European origin, but their basic conclusion remains valid. The SB bifacials represent the uppermost level of technical skill and method of manufacture as well as their makers’ often careful selection for the best-quality fine-grained raw materials (Henshilwood et al. 2001b; Minichillo 2005; Villa et al. 2009). These selected raw materials may have been chosen partially for their outstanding flaking properties, but their selection may also have been related to adding exchange value to these tools (see Wiessner 1983) and the promotion of good social relations (Mellars 1996). The latter point might suggest that human groups during the SB were integrated in structured exchange networks similar to those found in living foragers, but at present there is insufficient evidence to confirm this proposition.
Ochre, an iron-rich mineral, is found in almost all Stone Age shelter occupations in southern Africa after 100 ka, and the evidence suggests that it was used as a pigment (Barham 1996, 2001; Clark 1989; Henshilwood et al. 2001b; Knight, Powers, and Watts 1995; Singer and Wymer 1982; Wadley 2005b; Watts 2009). Ochre was also an important component in compound adhesives made from red ochre mixed with plant gum that were used to haft or attach stone implements to handles in the MSA (Wadley 2005a; Wadley, Hodgkiss, and Grant 2009:9590; Wadley, Williamson, and Lombard 2004). Wadley, Hodgkiss, and Grant (2009) stress that the ochre was not added for its color but because it played a key role in changing the adhesive compounds from an acidic to a less acidic pH, in the dehydration of the adhesive near wood fires, and in changes to the mechanical workability and electrostatic forces of the compound. The ability to produce these complex adhesives relied on multilevel operations and advanced working memory. Wadley, Hodgkiss, and Grant (2009:9590) suggest that this archaeological evidence provides a new way to clearly recognize complex cognition in the MSA without necessarily invoking the concept of symbolism. In their view, it demonstrates that there was an overlap between the cognitive abilities of modern people and those of people in the MSA.

Neanderthals in Europe are also reported to have made a birch pitch that can be produced only at temperatures of 300°–400°C. Koller, Baumer, and Mania (2001) suggest that these pitches were made with deliberate intent and show considerable technical capabilities and that the Neanderthal technical skills, in this instance, were comparable to those of modern Homo sapiens.

Early examples of ochre use before 100 ka are reported from Kapthurin (Kenya; McBrearty and Brooks 2000), Twin River (Zambia; Barham 2001), and Pinnacle Point Cave 13B (South Africa; Marean et al. 2007). At SB sites, ochre is reported from Blombos Cave (Henshilwood et al. 2001b), Hollow Rock Shelter (Evans 1994), Dale Rose Parlour (Schirmer 1975), Diepklloof (Rigaud et al. 2006), and Sibudu (Wadley 2007). Evidence of scraping or grinding is observed on many pieces, probably to produce powder, and some pieces have crayon or pencil shapes as a result of direct application of the ochre to an abrasive surface (e.g., Clark et al. 1984; Henshilwood et al. 2001b; Rigaud et al. 2006; Singer and Wymer 1982:117; Soriano, Villa, and Wadley 2007; Watts 2002, 2009). The presence of ochre at these archaeological sites is interpreted by some researchers as early evidence of the symbolic use of colorants (Henshilwood 2009a; Henshilwood, d’Errico, and Watts 2009; Henshilwood et al. 2001b, 2002; Watts 1999, 2002, 2009). The available evidence supports a multifunctional interpretation for the use of ochre (Lombard 2007b).

At Blombos Cave, hundreds of pieces of ochre more than 1 cm in length, many bearing signs of utilization (fig. 5a), have been recovered (M1 and upper M2 phases; Henshilwood et al. 2001b; Watts 2009). Six deliberately engraved pieces come from the M1 phase and two from the upper M2 phase (Henshilwood, d’Errico, and Watts 2009; Henshilwood et al. 2002). On these pieces, it is clear that the designs were made with deliberate intent, and they arguably are among the most complex and best formed of claimed early abstract representations (d’Errico et al. 2003; Henshilwood, d’Errico, and Watts 2009; Lewis-Williams and Pearce 2004; Mellars 2006; Mithen 2006).

Arguments that engraved ochres are restricted only to the Blombos site and that this means that they had no symbolic meaning beyond the site are now being challenged by new evidence. Engraved patterns on stone and ochre have recently been reported from a number of other MSA sites, for example, at Klein Kliphuis (MacKay and Welz 2008) in the Western Cape and Apollo 11 and Pockenbank (Vogelsang 1998; Vogelsang et al. 2010) in Namibia. At the Diepklloof Rock Shelter, Western Cape, 270 pieces of ostrich eggshell (OES) deliberately engraved with repetitive patterns, including hatched motifs, were recovered from HP layers with an age of ca. 60 ka (Texier et al. 2010; see “The Howiesons Poort”).

The practice of engraving OES in the HP seems restricted, as far as we know, to the Diepklloof site. That the practice of engraving in general was apparently confined to only a few sites might suggest that these sites held a special “power of place” on the landscape for some MSA people. Deacon (1988) reports this was the case in the Later Stone Age (LSA) for a number of rock art sites in the Northern Cape Province. It is now reasonable to contend that the engraved ochres from the Blombos SB levels—and arguably those from other SB sites—and the decorated eggshell from Diepklloof provide firm evidence of early stylistic elaboration in southern Africa before ca. 60 ka (Henshilwood and Dubreuil 2009; Henshilwood, d’Errico, and Watts 2009; Mackay and Welz 2008; Watts 2009).

Information from SB assemblages was in the past regarded as mostly one-dimensional because only stone artifacts were recovered during excavations. Four SB sites, three of them recently excavated, have fauna and organic material preserved. These include Blombos Cave, where fauna and some organics are well preserved (Henshilwood et al. 2001b); Diepklloof Rock Shelter (C. Poggenpoel, personal communication), and Sibudu, although the faunal results from the latter two sites are unpublished. Peers Cave, excavated first in the 1920s and finally in the 1960s, did yield some fauna in the SB/HP units, but only a minute portion was retained (Peers and Goodwin 1953; Volman 1981). At Blombos Cave, shellfish, fish, and a range of terrestrial and marine animals were hunted, trapped, and collected during the SB occupation. The overall subsistence pattern at Blombos Cave signifies that no clear distinction can be made between LSA and SB subsistence patterns at this site (Henshilwood 2008a; Henshilwood et al. 2001b); the implication is that during the SB, the subsistence mode was essentially modern.

Formal bone tools, regarded as a distinctive material culture marker of behavioral modernity in the Upper Palaeolithic in Eurasia (e.g., Clark 1989; Klein and Edgar 2002; A. I. Thackeray 1992), are rare at MSA sites (Backwell and d’Errico 2005;
Figure 5. Material culture from the Still Bay levels at Blombos Cave: engraved ochres (a), bone tools (b), and *Nassarius kraussianus* shell beads (c). Photographs by Francesco d’Errico. Scale bar = 1 cm.

Backwell, d’Errico, and Wadley 2008; d’Errico and Henshilwood 2007; Henshilwood et al. 2001a). More than 30 bone tools have been recovered from the SB levels at Blombos Cave, including awls and formal “points” (d’Errico and Henshilwood 2007; Henshilwood and Sealy 1997; Henshilwood et al. 2001a, 2001b; fig. 5b), and a further 20 have yet to be described. The majority are awls made on long-bone shaft fragments, further manufactured by scraping and then used to pierce soft material, such as leather, and to pierce shells to make beads (d’Errico and Henshilwood 2007; d’Errico et al. 2005). At least five points, completely finished by careful polishing after being shaped by scraping, are probably spearheads made for hafting. It is noteworthy that points are treated differently from awls. The high polish on these points may have served to give them a distinctive appearance, an “added value,” as is reported for projectile points made by the Kalahari San (Wiessner 1983). It seems apparent that, here again, the makers showed concern for style and finish. Also noteworthy is the presence of a bone fragment from the SB levels that is marked with eight parallel lines. Microscopic analysis of these lines indicates that they are the result of deliberate engraving and possibly were made for symbolic purposes. A number of other bone tools carry similar markings (d’Errico, Henshilwood, and Nilsson 2001; d’Errico and Henshilwood 2007; Henshilwood et al. 2001a).

The formal ordering or division of living space is regarded by some as a further marker of behavioral modernity (Deacon 2001; Henshilwood and Marean 2003, 2006; Kolen 1999; Wadley 2001b, 2006). This may involve the way that areas within a cave or open site were used, for example, the location of particular hearths, perhaps “owned” by the women within a family group (Deacon 2001), or specific areas used mainly for sleeping (bedding hollows) or for tool making. Wadley (2001b:215) describes the use of space in a campsite as being similar to the use of artifactual style. Both require the communication of “cultural theory” taught through language. The appropriate use of space within a cultural group must be taught, and the way that space was used and divided at MSA campsites was likely passed on across generations. However, archaeological evidence for the physical alteration of campsites or caves in the MSA is limited. Wadley (2006) presents evidence of spatial patterning in the distribution of MSA hearths at Rose Cottage Cave, and Deacon (2001) indicates that living space, in particular hearths in the MSA levels at Klasies River, were formally organized.

On the eastern side within Blombos Cave (fig. 6), a chamber filled with more than 75 cm of unexcavated deposit and ca. 15 cm of airspace extends for more than 4 m in a northeasterly direction. During the SB occupation of the site, the inhabitants constructed a 90-cm-long barrier, using quartzite and calcrite cobbles, to apparently block off this chamber from their living area. The base of the barrier lies on layer CB/CC and extends into layer CA. Layer CC is dated at 72.7 ± 3.1 ka (Jacobs et al. 2006).

The construction of this barrier may simply have been to keep out drafts emanating from a possible second entrance
to the cave that is not currently visible. We think that this barrier might also have served to self-consciously and deliberately alter the space used by the SB people. It may have acted to separate their social/working area in the open part of the cave from “the other,” a drafty, cramped space. In other words, the barrier may represent a manipulation of social space by people seeking to delineate the boundary between social or public and nonsocial space and also to improve the conditions in their living space.

Personal ornaments occur in the SB in southern Africa and at sites with similar ages in North Africa and the Near East (Bar-Yosef Mayer, Vandermeersch, and Bar-Yosef 2009; Bouzouggar et al. 2007; d’Errico, Vanhaeren, and Wadley 2008; d’Errico et al. 2005; Henshilwood et al. 2004; Vanhaeren et al. 2006). The discovery of marine shell beads of the SB at Blombos Cave (d’Errico et al. 2005; Henshilwood et al. 2004) and at Sibudu (d’Errico, Vanhaeren, and Wadley 2008) has added a new dimension to modern-human-behavior debates. An analysis of 41 of the recovered Nassarius kraussianus “tick” shells from Blombos Cave shows that they were carefully pierced with a bone tool to create a keyhole perforation (d’Errico et al. 2005; Henshilwood et al. 2004). These perforations are anthropogenic and deliberate. The beads were then strung, perhaps on cord or sinew, and worn as a personal ornament. In addition, the beads provide insights into SB technology, including the ability to drill, the use of cord or gut for threading, and the probable tying of knots to secure the beads. Repeated rubbing of the beads against one another and against the cord resulted in discrete use-wear facets on each bead that are not observed on these shells in their natural environment. These use-wear patterns are the principal factor that defines the shells as beads. Microscopic residues of ochre occur inside some of the beads and may result from deliberate coloring or from transfer when worn (d’Errico et al. 2005; Henshilwood et al. 2004). At Sibudu, six Afrolittorina africana shells were recovered from the SB levels. Three of these had been deliberately pierced, and the most likely interpretation is that they were purposely collected to be transformed into personal ornaments (d’Errico, Vanhaeren, and Wadley 2008).

The wearing and display of personal ornaments in the MSA, behavior recently unknown for this time, was not idiosyncratic, as is demonstrated by the presence of beads at a number of MSA sites in Africa (Bouzouggar et al. 2007; d’Errico et al. 2005, 2009; Henshilwood et al. 2004; Vanhaeren et al. 2006). At Blombos Cave, discrete groups of beads with wear patterns and coloring specific to that group were recovered from various levels and squares within the site. This patterning suggests that at Blombos Cave a number of individuals wore beads, perhaps on their person or attached to clothing or other artifacts. In the literature on the evolution of the mind, the wearing of beads has also been taken as a proxy for modern syntactical language, which would have been essential for
the sharing and transmission of the symbolic meaning of personal ornaments within and between groups and also over generations (d’Errico et al. 2005; Henshilwood, d’Errico, and Watts 2009; Henshilwood et al. 2004; Mellars 2005, 2006; Watts 2009).

This last interpretation has been contested recently, and a debate has ensued regarding the exact implications of the wearing of beads for the evolution of human cognition (Botha 2008, 2009; Coolidge and Wynn 2009; Henshilwood and Dubreuil 2009; Malafouris 2008; Wynn and Coolidge 2007) and group identity (Watts 2009). Wynn and Coolidge (2007; 88) suggest that, at a minimum, personal ornaments indicate the presence of theory of mind and a capacity to pay attention to one’s appearance and personal identity. Malafouris (2008: 406), in a similar vein, argues that Blombos beads provide stronger evidence of “self-awareness” than of symbolism. These arguments are interesting because they both accept the wearing of beads as evidence of a capacity to understand the perspective of others relative to oneself, but at the same they both regard the inference that beads act as symbols as unwarranted.

We agree in part with this interpretation. At a minimum, the wearing of beads is one of the many innovations of the SB and HP periods that provide evidence of a concern for style and of the appearance of innovative material culture. The emergence of these behaviors, we suggest, is best explained by the impact of an expansion of the later-maturing temporoparietal areas on higher theory of mind and on perspective-taking abilities. Two things can be said regarding the inference that beads are symbols. The first is that the use of personal ornaments was not idiosyncratic, since beads come from different levels and squares. This distribution is difficult to explain unless we accept that beads functioned as symbols, that is, that their function depended on collectively agreed-upon meaning (and not on the idiosyncratic interest of individuals in their appearance). If one contests the symbolic interpretation of beads, one has to find a more parsimonious way to account for the fact that different people at different times used similar personal ornaments.

The second point is that there are good reasons to believe that the same cognitive abilities are required to imbue objects with symbolic meaning and to develop a concern for one’s personal appearance. Indeed, both depend on the capacity to inhibit one’s own perspective and pay attention to potentially conflicting views on objects. Both depend on the late-maturing areas in the prefrontal and temporoparietal areas as well as on the connections between them. This parallel explains why young children not only have little concern for their appearance but also have great difficulty understanding how the symbolic meaning of objects depends on collectively agreed-upon meaning.

Thus, in our view, the inference that beads can act as symbols is parsimonious. Even if it is rejected, however, the cognitive implications that we draw from the SB period stand because of the intimate connection between theory of mind, symbolic behavior, and concern for one’s appearance.

The Howiesons Poort

Accurate modeling of the transition from the SB to the HP is uncertain, but OSL ages indicate that the HP phase may be restricted, at least at some sites, to the period from ca. 65 to 59 ka (Jacobs and Roberts 2008; Jacobs et al. 2008; but see Tribolo et al. 2009). HP sites are more numerous and geographically more widely distributed than SB sites in southern Africa. Most occur south of the Zambezi River, and 32 sites are reported from this region (Jacobs et al. 2008). This geographical limitation, Deacon (1992:181) suggests, defines the area in which there was a shared concept of artifact style and the related exchange of information. The principal HP sites are shown in figure 3 (for site details and references, see Henshilwood 2008b; Jacobs and Roberts 2008; Jacobs et al. 2008; Lombard 2003b).

HP-like assemblages are reported in other parts of southern Africa and north into central and eastern Africa. Examples are the Bambatan/Tshangulan in Zimbabwe (Barham 2001; Deacon 1995), a Bambatan site in Botswana dated at ca. 70–80 ka (Brooks et al. 1990), and the Mumba site in Tanzania (McBrearty and Brooks 2000). A similar industry is also reported by Ambrose at the Norikiushan site in Kenya (Mellars 2006). In the absence of dates for many of these northerly sites, it is difficult to relate their age to those of sites in southern Africa, but Mellars (2006:9384) speculates that the HP, and possibly the SB, may have originated in the eastern or central parts of Africa, although there is limited evidence to support this theory.

An age of about 70 ka for the HP at Klasies River is indicated by Deacon (1989, 1992), but a series of dates based on the thorium-uranium method give an average of about 65 ka (Vogel 2001). A suite of luminescence dates for Klasies indicate an even younger age of about 50–60 ka (Tribolo 2003; Valladas et al. 2003). Francis Thackeray’s (1992, 2007) estimates of 58–48 ka, based on microfauna, oxygen and deuterium isotope ratios, and marine mollusks, are in line with the luminescence dates. Thorium-uranium dates of 70–60 ka are reported for the HP levels at Boomplaas (Vogel 2001). Luminescence dates of 74–60 ka (Parkington 1999) were provided for the HP at Diepkloof, but it has been argued that these dates may be too old (Riaud et al. 2006). Tribolo et al. (2009), in a new study, however, suggest that at the Diepkloof site the ages of the HP levels extend from ca. 60 to 90 ka.

OSL dates for the HP levels at Sibudu Cave fall within the ca. 64–49-ka range (Wadley 2001a; Wadley and Jacobs 2004), and those at Rose Cottage Cave are in the 60–55-ka range (Tribolo 2003; Valladas et al. 2005). Gibson, Wadley, and Williamson (2004) suggest a date of 60–56 ka for the HP at the latter site. A considerably older date for the HP of 80 ka, based on electron spin resonance, is reported for Border Cave...
(Grün and Beaumont 2001), Tribolo (2003) suggests that this date may be too old, and Feathers (2002) indicates his support for a younger range of dates for the HP of around 60–55 ka.

The HP deposits at eight sites were recently resampled by Jacobs et al. (2008; also Jacobs and Roberts 2008), and their ages were calculated by OSL methods. These sites are Apollo 11, Diepkloof Rock Shelter, Klein Kliphuis, Melikane, Ntloana, Tsoana, Rose Cottage Cave, Sibudu, and Klasies Cave 1a. On the basis of these ages, Jacobs et al. suggest that the HP started at ca. 64.8 ka and ended at 59.5 ka. When these results are compared with the range of 71.9–71 ka suggested by these authors for the SB sites they dated—Apollo 11, Diepkloof Rock Shelter, and Sibudu—the inference is that there is a ca. 6,700-year gap between these two techno-traditions (Jacobs et al. 2008:734). A subsequent set of ages for Diepkloof, calculated by the TL method, suggests that the HP levels are considerably older at this site (Tribolo et al. 2009), and these ages are not concordant with the Jacobs et al. OSL ages. Tribolo et al. report ages ranging from 60 ± 6 to 96 ± 10 ka for layers associated with HP artifacts. The reasons for the differences in the ages reported by Jacobs et al. (2008) and Tribolo et al. (2009) have not been resolved. In summary, the most consistent ages for HP sites fall within the range 65–59 ka.

Segments, blades, and a near-microlithic technology that was likely linked to the manufacture of hafted composite tools are considered by some to be key aspects linking HP lithics with behavior considered "modern" (Ambrose 2001; Deacon 1992; Henshilwood and Marean 2003; Lombard 2005b; Wadley 2001b; Wurz 1999, 2000). The short, thin blade blanks with high-angled, off-center platforms that were retouched to make these backed pieces are seen as characteristic of the industry (fig. 7; Lombard 2005b; Wurz 2000:138). It seems likely that these backed pieces were hafted with compound resins (see Wadley, Hodgkiss, and Grant 2009) in much the same way as smaller segments were hafted to form arrow tips in the LSA (fig. 7). Their larger size in the HP suggests that they were used in the construction of spear heads and may have been replaced when broken (Deacon 1992:188; Villa et al. 2010), although their use as tips for arrows launched from a bow cannot be ruled out (Lombard and Phillipson 2010; Mellars 2006; Wadley and Mohapi 2008). The manufacture of backed segments or crescents, hafting, standardization of shape and size, the use of resins, and the ability to repair composite tools through the replacement of parts are directly comparable to characteristics of the Wilton period after about 12 ka (Deacon 1992).

Blade-based industries are relatively common in the African MSA and also in the European Middle Palaeolithic, but none of these can be considered microlithic, and backed pieces are absent. The presence of these features by at least 65 ka in the HP points to an early sophisticated technology that would not be out of place in an LSA or Upper Palaeolithic context (Ambrose 2001; Deacon 1992; Lombard 2007a; Mellars 2006; Minichillo 2005; Wurz 2000). This does not suggest, however, that this “precocious” industry originated elsewhere (see Mellars 2006) or that it resulted from the arrival in the region of people with a different lifeway, as suggested by Singer and Wyner (1982). To the contrary, Wurz’s (2000) analysis of the lithics from the HP levels at Klasies River shows them to be an integral part of the MSA in the region. There is also clearly a change in the HP technology over time (Soriano, Villa, and Wadley 2007). It is nevertheless of interest that although the term HP is used to describe a lithic industry that is geographically restricted to southern Africa, Ambrose (2001) points to similar lithic industries in eastern and central Africa. Reliable dates are lacking from many of the latter sites, so at this stage the relationship, temporal and cultural, between these eastern-African industries and the HP is not clearly understood.

Flint knappers in the HP selected for fine-grained raw materials like silcrete and quartz to make the bladelet blanks, while quartzite remained their dominant choice on the coast but not necessarily inland (Soriano, Villa, and Wadley 2007). This can be seen, for example, at Klasies River and Nelson Bay Cave (Minichillo 2005). The reasons for the selection and transport of nonlocal raw materials, often over long distances, continue to generate debate. Adding value through rarity is one argument, particularly if a system of reciprocal exchange was in place (Tanaka 1982; Wiessner 1983). Janette Deacon (1995) argues that this was the case during the HP and that the exchange of backed artifacts made from exotic raw materials provides clear evidence of symbolism. Ambrose and Lorenz (1990) suggest that because people were simply more mobile, perhaps driven by climatic conditions, they also had greater access to nonlocal materials.

As is the case for the SB, ochre is ubiquitous at HP sites. Compared to earlier substages of the MSA, there is an increase in both color variability and quantity (Watts 2002; Wurz 2000). Much of the ochre was worked to produce powder, which was probably extensively used as a symbolic coloring agent (Deacon 1993; Wurz 2000). At Diepkloof and Hollow Rock Shelter, pieces of ochre with patterns of incisions similar to those found at Blombos Cave are reported in the MSA levels (Rigaud et al. 2006:841). An escalating presence of ochre in the SB and the HP suggests the increasing presence of behavior mediated by symbolism (Henshilwood 2009a; Henshilwood and Dubreuil 2009).

Residue studies on backed pieces from the HP at Rose Cottage Cave and Sibudu and on other MSA lithics show concentrations of ochre and plant material near proximal and medial portions (Gibson, Wadley, and Williamson 2004; Lombard 2007b; Wadley 2005a; Wadley, Hodgkiss, and Grant 2009). If ochre assists with the hafting process, as Wadley (2005a; also Wadley, Hodgkiss, and Grant 2009; Wadley, Williamson, and Lombard 2004) suggests for these two sites, then the mineral may have been used in the same way to haft backed pieces or in the manufacture of armatures at other HP sites. Another use suggested for ochre is to assist in the healing process (Velo 1984). The iron compounds in ochre, in particular the iron salts, have a powerful astringent and
antiseptic effect and are used by Aboriginal peoples in Australia to arrest hemorrhaging and promote healing.

Bone tools are rarely reported at HP sites, but there are exceptions. A bone point and other bone tools were found at Sibudu (Backwell, d’Errico, and Wadley 2008), and bone tools and decorated bone were also found at Apollo 11 (Vogelsang 1998). At Klasies River, Singer and Wymer (1982) found a bone point (SAM-AA 42160) in Cave 1a in Layer 19, but it is not thought to belong to the MSA layer in which it was found.

A reexamination of this point by d’Errico and Henshilwood (2007) shows that at the proximal end the piece has been reduced, suggesting that it was used as a double-ended point. Also, the manufacturing technique and morphology of the piece indicate that it is similar to LSA and San bone arrow points. In Layer 20 in Cave 1a, Singer and Wymer (1982) report a bone fragment with marks on one surface. A reexamination of the piece (d’Errico and Henshilwood 2007) shows that it is a midshaft fragment of a large limb bone with a weathered surface and polish in places. Four parallel lines were incised on this surface with a sharp lithic point, and although they were made after the piece had been weathered, their antiquity is supported by their condition. These lines were deliberately engraved, suggesting that bone was being used at this time to embody symbolic markings.

At Peers Cave, Jolly recovered a bone point from the talus...
in ca. 1947 that was probably left during the Peers excavation in the 1920s. It is mostly covered in a thick layer of manganese, but traces of manufacture are visible in the form of longitudinal grooves produced during scraping (d’Errico and Henshilwood 2007). The exposed areas are polished, and the dimensions of the tool are similar to those of one of the bone points from the SB levels at Blombos. Carbon and nitrogen analysis of the Peers point and several bones from the MSA and LSA levels at the same site demonstrate that the Peers point derives from the MSA levels. It likely derives from either the SB or the HP (d’Errico and Henshilwood 2007). The evidence suggests that bone tools were uncommon during the HP.

A notable find in the ca. 60-ka HP levels at Diepkloof Rock Shelter are 270 pieces of OES (fig. 7) deliberately marked with repetitive patterns, including hatched motifs (Parkington et al. 2005; Rigaud et al. 2006:842; Texier et al. 2010). Similar marked OES is not reported from other HP sites in southern Africa. Texier et al. (2010) claim that the pieces from Diepkloof attest to an engraving tradition that is the earliest reliable evidence of what is a widespread modern practice. The repetitive production of patterns on an everyday object, probably used to carry water, signifies that individual and collective identities and individual expressions are being clearly communicated (Texier et al. 2010). This symbolic behavior is no different, they contend, from that of LSA and extant communities in southern Africa that still make abstract linear depictions on functional items (eggshell containers) with the clear intention of symbolic communication. These engraved pieces are the most obvious examples of stylistic elaboration and symbolic markings in the HP period, and they complement the engraved ochres recovered from the SB and earlier levels at Blombos Cave and other MSA sites.

Discussion

Southern Africa and the Evolution of “Modern” Cognition

The archaeological record of the SB and HP periods offers, for the moment, the richest evidence in favor of early yet multiple behavioral innovations in Homo sapiens. We have argued that these innovations offer convincing evidence of an interest in the appearance of artifacts as well as plausible evidence of symbolically mediated culture. We have also argued that their emergence in the archaeological record is best explained by reorganization in modern H. sapiens of the temporoparietal areas implicated in higher theory of mind and attentional flexibility or of their connection with other parts of the brain dedicated to higher cognition.

Here we wish to emphasize what this hypothesis does not imply for the larger debate on human cognitive evolution. First, we do not claim that the SB and HP periods are the earliest phases of behavioral innovations in the MSA. Several putative instances of symbolic behavior, for instance, have been documented earlier in the MSA, and others almost certainly will be (Barham 2007; Vanhaeren et al. 2006; White et al. 2003). To date, however, the SB and the HP industries still provide the best-documented evidence.

A second limitation concerns the evolution of the “modern” mind. Although we believe that the authors of the SB and HP industries were broadly similar to living humans in terms of cognitive abilities, we cannot exclude more recent cognitive and neural evolution in modern H. sapiens. Coolidge and Wynn (2009:240–242), for instance, emphasize that the presence of symbolically mediated behavior in the SB period does not strictly imply “modern” cognition. They recognize that the wearing of beads implies a form of theory of mind, but they contend that only the Upper Palaeolithic offers clear evidence of modern cognition, which they associate with enhanced working memory and executive functions.

We concur with Coolidge and Wynn that it is impossible, on the basis of the SB and HP archaeological record alone, to exclude more recent changes in working memory and executive functions. Nevertheless, we doubt that such changes could have been very significant. The behavior of Middle and Late Pleistocene hominins reveals more working-memory ability than suggested by Coolidge and Wynn. As mentioned above, we already find in Homo heidelbergensis advanced forms of cooperative feeding and breeding. This implies the presence of a capacity for self-control, which in modern humans depends on the executive functions realized in the late-developing areas of the dorsolateral PFC (Dubreuil 2010b). The emergence of a stylistic and symbolic component in material culture—because it depends on higher theory of mind and perspective taking—also implies advanced forms of working-memory and executive functions. Coolidge and Wynn seem to neglect this point in their discussion of SB personal ornaments:

The kinds of social categories implied by the Blombos beads (I belong to group A, as opposed to group B, with whom we exchange spouses; group C with whom we fight; group D who are occasional but unreliable allies, etc.) are not abstract, and do not combine elements from distinct categories. Neither are they “superordinate” categories—categories of categories—which too might implicate executive functions . . . . So, although the Blombos beads imply category formation process, they did not, we believe, require executive functions and enhanced working memory. Coolidge and Wynn (2009:242)

We think that the categorization process described here does not capture the cognitive operation underlying symbol use in humans. As mentioned above, very young children are able to develop expectations of the kind “members of group A wear those kinds of beads and behave in this way.” Even baboons are able to understand group membership and to develop specific expectations toward the behavior of group members (Cheney and Seyfarth 2007). But baboons do not imbue artifacts with symbolic meaning, and there is little
reason to believe that young children would create symbolic culture if they were left on their own.

In what sense are adults different? Adults understand that the symbolic meaning of an artifact is a function of what others think of these artifacts. Not only do they associate symbolic markers with particular behavioral expectations (as young children and nonhuman primates do); they also understand that their expectations must vary, depending on what other people think of these markers. The cognitive ability implied here is higher theory of mind, which, as developmental psychology shows, is very demanding in terms of working memory and executive functions.

To be sure, working memory goes beyond theory of mind, and we are happy to agree that the presence of personal ornaments provides no indisputable evidence that the authors of the SB and HP industries had exactly the same working-memory abilities as living humans. Given the history of modern human populations, however, we doubt that it is parsimonious to imagine significant differences.

The Ascent and Demise of the SB and the HP

In southern Africa, the SB and the HP represent two remarkable phases that provide vital information about the evolution of modern behavior in *H. sapiens*. Whether these behavioral developments contributed directly or indirectly to the expansion about 80–60 ka of *H. sapiens* within and outside Africa and their subsequent dispersal across the Old World remains a debatable issue. However, it does raise the question of the origins of the SB and the HP as well as that of the cause of the behavioral innovations associated with these techno-traditions.

Insights about these origins might come from comparisons with other African regions. In particular, the similarities of the SB and HP lithics to industries elsewhere and the use of *Nassarius* shells as beads in northwestern and southern Africa between ca. 85 and 75 ka (d’Errico et al. 2009) seem unlikely to be coincidental. If cultural complexity is linked or encouraged by ecological variability (e.g., Alvard 2003; Potts 1996; Richerson and Boyd 1998), then the reported drought conditions that persisted from ca. 135 to 70 ka (Scholz et al. 2007) in the tropical and subtropical zones in eastern and central Africa may have been one stimulant for populations to migrate into southern or northern Africa (Henshilwood 2008b; Marean and Assefa 2005; Mellars 2006; Wadley 2007). It is conceivable that the SB techno-tradition of bifacial points emanated from farther north because these points bear at least some resemblance to the lanceolates of the final Lupemban-Tshitolian tradition from Twin Rivers in Zambia, with a provisional age estimate of ~95 ka or later (Clark and Brown 2001). The Aterian levels at Dar es-Soltan I, on the Atlantic coast of Morocco, contain thin, bifacially flaked lithic points and evidence of personal ornaments (d’Errico et al. 2009) and use of red ochre. OSL dates for these levels (Barton et al. 2009) indicate an MIS 5 age that is coincident with the age of the SB in southern Africa or even older. The distinct physical similarity between the Zambian lanceolates and those of the Aterian and the SB may be more than coincidental (see Clark and Brown 2001:325).

Whether a pan-African cultural tradition was then in place is speculative, but it is possible that there was a drift of ideas from south to north, and vice versa, that may have coincided with the movement of people (Henshilwood 2008b). This same drift of ideas may have occurred during the HP period, and local variants of the SB and the HP in the western Cape may have developed in situ. If humans migrated to the southern and western Cape coast during the SB and HP periods, then an increase in population levels may have stimulated innovation and cultural complexity. A problem with this model is the low number of SB sites that have been found, suggesting that the human population was not large at this time.

Conclusion

During just the past decade, our understanding of the Middle Stone Age (MSA) and, in particular, of the SB and the HP has grown exponentially. Examining all the processes that interacted and generated the cultural variants that define the SB and the HP is beyond our relatively limited knowledge of these periods, but one avenue that has been pursued in the past and is worth pursuing in the future is the relationship between material culture and behavioral evolution.

The innovative technologies and social practices recorded at archaeological sites during the period 77–59 ka in the western Cape are only one part of a behavioral montage that also spread across other regions in Africa at this time. Rapid advances in human cognition after ca. 200 ka were manifested in material-culture practices not previously observed in the MSA. After ca. 100 ka, symbolically mediated behavior seems strongly allied to material culture (Henshilwood, d’Errico, and Watts 2009). The innovations that were manifested during the SB and HP periods may have been driven by group or individual endeavor to adapt or adopt technology to cope with variable environments, or so-called variability selection (Alvard 2003:142).

Once the capacity for complex human culture was in place, the process that followed is unlikely to have been random. Cultural novelty is never random but is generated and assimilated both strategically and contextually (Gabara 2001:219). Innovation is a reflection of the accumulated knowledge of individuals, the circumstances they find themselves in, and the social structure in which they are embedded. Innovations will thus have a much better than chance probability of being fitter than their predecessors (see Boyd and Richerson 1988; Shennan 2002).

Theoretically, this may explain why the key features of the HP and SB material cultures appear so different. What worked for one group at 75 ka may not have worked for another at 60 ka. The incremental, marginal modifications built up over
many generations contributed to the complexities of subsistence systems, material culture, and languages during the SB and the HP. We are able to work now only with a fraction of the knowledge that drove these processes then, but amid this complexity it seems that climatic determinants, demographics, and resource distribution, as is the case today, were major drivers in promoting innovation and variability in material culture in the past.

A second avenue that is worth pursuing is the identification of the cognitive and neural changes that underpinned the behavioral innovations in southern Africa and probably elsewhere in Africa during the Late Pleistocene. Tracing likely changes in cognitive and neural organization in extinct hominin populations is a difficult task. Our view is that progress is possible only through the integration of all the relevant methods, including comparative neuropsychology, developmental neuropsychology, and paleoneurology. Many hypotheses about the evolution of the mind are proposed without due integration of these methods. As a consequence, some authors tend to focus on archaeological and psychological data but neglect entirely neural evolution. Others, by contrast, consider comparative or developmental neurosciences but pay little attention to the details of material culture. Given the well-known limitations of the different approaches to the evolution of the mind and behavior, only the thorough integration of approaches is likely to constrain hypotheses in an interesting way.

This article builds on this strategy of integration to criticize three influential hypotheses about the evolution of the mind. Recursion, theory of mind, and executive functions, as habitually formulated, cannot properly account for the evolution in material culture in the SB and HP periods. The most central innovative feature of material culture during these periods was the presence of a symbolic component or, at a very minimum, a concern for the appearance of objects, persons, and living spaces manifested in engraved ochres and ostrich eggshells, shell beads, finely made bifacials, bone tools, and standardized backed segments as well as in the formal ordering of living spaces.

The hypothesis that we propose implies that both the capacity to engage in symbolically mediated culture and concern for the appearance of things evolved as a consequence of one and the same cognitive and neural change. In our view, the integration of paleoneurology, comparative neuropsychology, and developmental neuropsychology suggests that this change was linked to a reorganization of the temporoparietal areas implicated in theory of mind, perspective taking, and attentional flexibility—or to improved connectivity of these regions with the prefrontal cortex.

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Comments

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Henshilwood and Dubreuil have raised the level of discourse on the evolution of the modern mind by providing both an explicit neurocognitive model for executive functions and a thorough review of the archaeological evidence in its support. We agree with their central conclusion that executive functions are the key neurocognitive ability enabling modern thinking. Here we would like to highlight some of the differences between their approach to executive functions and ours.

We also differ on key points of archaeological inference, in particular the bridging arguments about beads, human activities, and cognition (Botha 2008, 2010; Wynn 2009). First, although the inference that Still Bay shell beads were ornaments is reasonable, it is not, in fact, the only possibility. The beads may have been tokens on a tallying device, a string of beads used to keep track of quantities. Such a use would have equally interesting cognitive implications that are quite different from those of ornament use (Overmann, Wynn, and Coolidge, forthcoming; Wynn, Coolidge, and Overmann, forthcoming). Although one could argue that this tally interpretation is less parsimonious than the ornament interpretation, both interpretations effectively account for the archaeological evidence. Our second disagreement with the bead chain of inference falls on the link between ornament and conscious symbol use. Often, anthropological literature fails to define symbolism or defines it vaguely, acting as if “I know it when I see it but cannot define it.” Of course, there is danger in such failures or vagueness. Henshilwood and Dubreuil employ the words “symbol(s),” “symbolic culture,” “stylistic . . . innovation,” “symbolic component,” “symbolically mediated culture,” and “symbolic behavior” without clear definitions until well into their discussion. They finally offer the following definition of symbolically mediated culture: “one in which individuals understand that artifacts are
imbued with meaning and that these meanings are construed and depend on collectively shared beliefs.” They later reinforce this definition with the contention that the function of symbols is dependent on their collectively agreed-upon meaning. One of the problems with such definitions is that they exclude any private meanings for a particular artist or that, as Carl Jung claimed, symbols represent the unknowable. Thus, for example, doodling or cave doodles, which might have held very personal meanings for their makers, would not be symbolic according to Henshilwood and Dubreuil because they do not have collectively shared meanings. Such personal meanings were undoubtedly a precursor to collectively shared meanings. We hold to our contention that private meanings for personal ornaments and stylistic engravings, requiring only basic theory of mind and basic self-awareness (à la Malafouris), might better explain their appearance, disappearance, and reappearance in the SB and HP archaeological periods. As Henshilwood and Dubreuil have implied, something may have served as a barrier to their transmission, thus resulting in their spotty appearance. Why not the absence of collectively shared meanings? Instead, it may have been their private, idiosyncratic, or group-delimited meanings that hindered their reliable transmission across place and time.

Henshilwood and Dubreuil challenge us to find “a more parsimonious way to account for the fact that different people at different times used similar personal ornaments.” Does shared agreement about appearance require that people imbue objects with symbolic meaning? We think not. Many of our students sport body piercings, tattoos, and jewelry. None admits to understanding any meaning to these items. They wear them because their friends and acquaintances wear them. Yes, they are indexes of membership in some vague group, but they have no explicit or even implicit meaning beyond a simple association of appearance and social role. It does require self-awareness and awareness of others’ perspective, but not “inhibit[ing] one’s own perspective” or paying “attention to potentially conflicting views on objects.” The parsimonious explanation is that the beads were indexes, not symbols. Yes, perhaps the Blombos people believed that wearing beads meant high status or motherhood, but they need not have done so. This distinction between index and imbued meaning is not, we think, trivial. Symbolic use of objects in the modern world relies on both. A Christian cross stands for the resurrection, but this symbolic meaning builds on the indexical link between cross and crucifixion. It seems unlikely to us that arbitrary, imbued meaning arose before indexical use. Indeed, indexical use of objects such as beads may have provided the scaffold on which arbitrary meaning developed.

Henshilwood and Dubreuil confuse our argument about the referential role of beads with their contention that beads are evidence of modern syntactical language. We have not denied some referential role for shell beads. We do deny that shell beads are prima facie evidence of modern syntactical language. Botha (2010) has made clear the dangers of this inferential leap. Beads were made intentionally. Yes. Beads were worn. Yes. Beads may have had some personal or limited interpersonal (collectively shared) meanings. Yes. Beads are evidence of modern syntactical language. No! Not necessarily. Taking shell beads as evidence of syntactical language is an unjustified inferential leap, and the authors’ implication that full behavioral modernity is attached to shell bead making and incised ochre is unjustified as well.

Henshilwood and Dubreuil also claim that “our focus on the temporoparietal cortex is original.” We would argue that it is not. Wilkins (2009) argued the importance of the parietal-occipital-temporal junction (POT) plus Wernicke’s area, which she noted were areas of the brain that are “necessary, if not sufficient, for language” (275). She contended that the neural mosaic comprising Broca’s area and the POT initially evolved to improve the neurological control of the hand and thumb but subsequently became available for language and other higher cognitive expectations after the divergence of the hominid lineage.

Perhaps the weakest of the authors’ suppositions is related to their quest to provide “increasingly precise cognitive mechanisms realized in particular neural structures, processes, or organizational patterns.” While we think that they appropriately evaluated the roles of recursion (inadequate to explain symbolic thinking alone), theory of mind (the social brain resulted from the evolution of the executive brain), and executive functions (complex and imprecisely delineated) in the emergence of symbolically mediated culture, the crux of their proposal of “more precise” neural substrate and mechanisms is to proffer the temporoparietal juncture and a “higher theory of mind” (emphasis added). We would contend that offering the temporoparietal juncture is not more precise neuronally, and perhaps a greater lacuna is that they never defined what they meant by “higher” theory of mind. We do not disagree that the POT may be critical to modern thinking. Bruner (2010) noted that the hypertrophy of the superior parietal lobes in modern humans (compared to Neandertals) was also accompanied by the displacement of the inferior parietal lobes into Wernicke’s area. Henshilwood and Dubreuil ignore both the hypertrophy and the displacement in Bruner’s work. However, as we noted, the greater problem with their contentions is the vagueness of their hypothesis that symbolically mediated culture required “higher” theory of mind. We would refer Henshilwood and Dubreuil to Baron-Cohen’s (1995) work on levels of theory of mind. Briefly, he hypothesized a multicomponent theory of mind consisting of four independent skills: detection of the intentions of others, detection of eye direction, shared attention, and a final component called the “theory of mind module.” The final component, whose onset in humans is thought to develop by the age of 4, contains a complex set of social-cognitive rules and, combined with the other three components, creates the full-fledged, adultlike theory of mind. Although Baron-Cohen’s final component may be criticized for a lack of specificity, we have no idea whatsoever what Henshilwood and Dubreuil mean by “higher” theory of mind.
In summary, this is a noble attempt to propose “precise cognitive mechanisms realized in particular neural structures,” and it is heuristic to review the roles that recursion, executive functions, and theory of mind might play in the emergence of symbolic culture, but Henshilwood and Dubreuil do not succeed overall in proposing a more precise cognitive mechanism or a more precise neural structure.

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Henshilwood and Dubreuil seek a neurological explanation for the apparently abrupt increase in cultural and technological sophistication around 77 ka. The difficulty is that there is no obvious discontinuity in measurable aspects of brain anatomy, and brain size evidently reached a peak in Neanderthals, not in Homo sapiens (Wood and Collard 1999). Some authors, including Chomsky (2010), have argued for a mutation, or some other process causing a “rewiring” of the brain, that gave rise to syntactic language within the past 100,000 years, but such arguments are post hoc and in defiance of Darwinian principles underlying the evolution of complex structures (Pinker and Bloom 1990).

From an evolutionary perspective, it seems more likely that language and other recursive cognitive functions, such as theory of mind and mental time travel, evolved during the Pleistocene (Corballis 2009) and did not appear as a sudden evolutionary leap within the past 100,000 years. For most of this period, however, language may have been based primarily on manual gestures, perhaps with increasing vocal accompaniment. The gestural theory has a long history, ranging from Condillac (1971 [1746]) to Hewes (1973), and is increasingly endorsed (e.g., Arbib 2005; Armstrong and Wilcox 2007; Corballis 2002; Donald 1991; Rizzolatti and Sinigaglia 2008; Tomasello 2008). The critical change that occurred within the past 100,000 years, before the dispersal from Africa, may have been the emergence not of language but of speech. Of course, manual gestures persist in signed languages and as an accompaniment to speech, but effective communication need not depend on hand movement. Speech may perhaps be regarded as an early example of miniaturization, with the burden of communication restricted to the mouth, freeing the rest of the body for manufacture of objects and manipulation of the environment.

The emergence of speech would have involved anatomical changes, including changes to the vocal tract, and cortical control over vocalization. Whether such changes were present in Neanderthals remains a matter of contention; Lieberman (2007) has maintained that the Neanderthals would have been incapable of speech, but this has been challenged (Boe et al. 2007; but see also de Boer and Fitch 2010). One possibility is that a mutation of the FOXP2 gene permitted autonomous vocalization, but there is also controversy as to whether this mutation occurred within the past 100,000 years (e.g., Coop et al. 2008; Enard et al. 2002) or whether it was also present in Neanderthals. It is also possible that the final emergence of autonomous speech was a cultural invention (Corballis 2002), as was the later invention of writing.

From the perspective of evolutionary psychology (e.g., Tooby and DeVore 1987), it is likely that the changes that gave rise to language, and eventually to speech, were incremental and took place mainly during the Pleistocene. Facial gestures may have supplemented manual gestures, with voicing added to render the partly invisible gestures of the tongue accessible to the receiver. This might have culminated in autonomous vocal gestures, with a nonobligatory manual accompaniment, in our own species within the past 200,000 years. The advantages of vocal over manual communication were probably practical rather than linguistic, since signed languages appear to have all of the linguistic sophistication of spoken ones. Speech not only frees the rest of the body for nonlinguistic functions but also allows communication at night, and it is less demanding of energy resources than manual communication. Although signed languages include noniconic gestures, speech may well have given added impetus to abstract representations, leading more readily to such developments as counting and mathematics—beginning, perhaps, with the wearing of beads!

As the example of writing illustrates, changes in the medium of communication can have profound influences on human culture. This is further illustrated by the invention of the printing press and most recently of the cellphone and the internet. The earlier discovery of the power of speech over the power of gesture may have been the most profound of all. The argument presented here is not necessarily in contradiction to the various possibilities discussed by Henshilwood and Dubreuil, but it may suggest some alternative avenues for exploration.

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Inference about the evolution of cognition can take several forms (for some discussion of this, see Barnard 2010; Davidson 2010a). The most secure starts with a model of the cognition of the last common ancestor of humans and other apes and then looks at the differences between modern humans and modern nonhuman apes. The third step is to produce a model of how cognitive processes must work if natural selection took our ancestors from that ancestor to ourselves (e.g., Barnard et al. 2007). This model should then be tested against the evidence of the archaeological and paleoanthro-
polological record. Bridging arguments are often needed to show how archaeological materials demonstrate the cognition needed to bring them about (e.g., see how the recognition criteria for working memory may be assessed individually for one archaeological problem in Davidson 2010b). Similarly, the paleoanthropological record is most generally thought to contribute to discussions of cognition through arguments about aspects of brain function and mind (e.g., Bruner 2010). The evidence of changes in the size and shape of the external form of the brain needs arguments linking it to cognition, and these must recognize that the brains of our ancestors were different from ours. If we are to avoid circular reasoning, however, the only evidence of the way in which those different brains functioned is through inference from the behavioral evidence in the archaeological record. Finally, there is a whole body of theory about how the brain comes to be how it is in both developmental and evolutionary terms. One important element of this is the question of the impact of learning and changes in the learning environment through time on brain and cognitive function (for the impact of changes in life history, see, e.g., Nowell and White 2010).

These are complex issues. Noble and I (Davidson and Noble 1989; Noble and Davidson 1991, 1996) struggled hard to develop a fruitful interaction between archaeology and psychology, requiring reassessment of our positions in both disciplines and the successive development of different aspects of the required thinking. In this we emphasized that language was fundamental to human cognition and that the important aspect of language was the emergence of symbols, broadly conceived as nothing more than things that stand for something other than themselves (with the exception of the words “symbol” and “word”). Crucially, one important feature of human cognition is the symbolic representation of concepts in thought before their production. These authors do not seem to embrace this general meaning of the role of symbols in the construction of key artifacts of the period, as Henshilwood did not in an earlier publication (Davidson 2003; Henshilwood and Marean 2003), a criticism that went unanswered then.

Unfortunately, use of the word “language” in this argument allowed some to think that what we were emphasizing was the importance of syntax. Henshilwood was memorably taken to task, at a Stellenbosch conference, for not providing the theoretical underpinnings for such an argument (Botha 2009, 2010), although Holloway (1969) had seen the necessity for such linking arguments long ago. These authors (Henshilwood and Dubreuil 2009) did not answer Botha’s criticisms, and here they have shifted away from syntax but still fail to make the linkage between empirical studies and theoretical issues of relating the brain evidence securely to cognition and of connecting either brain or cognition to the archaeological evidence. I agree that there must be a connection somewhere, but it is not found in this paper.

Several claims appear exaggerated, detracting from the merits of the argument. This can be demonstrated in two Stellenbosch conference papers published in a companion volume to the one in which these authors’ previous collaborative paper was published. It is not true that no one has related numbers of orders of intentionality to the relative size of the neocortex (Dunbar 2009). Similarly, the authors claim that their “focus on the temporoparietal cortex is original,” but Wilkins (2009) made this point, reiterating an earlier argument (Wilkins and Wakefield 1995). We are all guilty of missing key publications relevant to our work, but some have more excuse than others. There seems to be a pattern here of selective citation and the avoidance of difficult issues.

The finds from Blombos have been meticulously excavated and documented, and for this Henshilwood deserves lasting credit. Those finds are of the greatest importance (although I have heard some suggest that southern Africa is peripheral), but this paper does not help anyone understand why.

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Before presenting my central argument, I want to comment on the notion of a symbol. Henshilwood and Dubreuil define a symbolically mediated culture as “one in which individuals understand that artifacts are imbued with meaning and that these meanings are construed and depend on collectively shared beliefs.” This definition is a variation on the traditional one within anthropology and archaeology.

Henshilwood and Dubreuil’s definition should be contrasted with the Saussurian notion of symbol as commonly used within linguistics, philosophy, and computer science: a symbol is an arbitrary sign used to refer to some entity. In discussions of the evolution of language, this definition seems more appropriate.

The two meanings of “symbol” are often not kept separate in the literature. Henshilwood and Dubreuil indicate a connection between the two when they write that “the wearing of beads has also been taken as a proxy for modern syntactical language.” However, ornaments are not evidence of symbol use in the Saussurian sense, at least not in any direct way. As Hurford (2006) has pointed out, the two meanings are indeed radically different: a Saussurian symbol (typically a word) is arbitrary, is (and must be) learned, is common to the community, is cheap to produce, and is ephemeral (at least when spoken). In contrast, the anthropological/archaeological symbol (typically an artifact) is iconic, invented, individualistic, nonreferential, enduring, and often costly to produce.

My central argument concerns the connection, albeit indirect, between ornaments and the evolution of language. In earlier writings, I have focused on the role of cooperation in the emergence of Saussurian symbols (Gärdnforr 2004, 2008, forthcoming; Gärdnforr and Osvalth 2010). Two forms of
cooperation seem to be uniquely human and are central to the evolution of symbolic language: cooperation toward future goals and indirect reciprocity. Since future goals are not immediately present, symbolic reference is required in order to communicate about them. Any evidence of cooperation toward future goals in the archaeological record is also evidence of the presence of Saussurian symbols. From the arguments of Gärdnors (forthcoming) and Dubreuil (2010b), it seems reasonable to assume that this kind of cooperation was present in Homo heidelbergensis, for example, in relation to large-game hunting (Thieme 1999), as, indeed, Henshilwood and Dubreuil suggest.

More critical for my argument is cooperation in the form of indirect reciprocity. Reciprocal altruism ("You scratch my back, I'll scratch yours") is found in several animal species. Indirect reciprocity is a more extreme form of altruism: "I help you, because somebody else will help me." The conditions for this form of cooperation to evolve as an evolutionarily stable strategy have recently been modeled by Nowak and Sigmund (2005). Their model is based on the notion of individual reputation, a key factor in determining with whom to cooperate.

Verbal communication is not the only method for signaling and maintaining reputation; ornamental artifacts and symbolic markings can also contribute. In particular, the costly nature of ornaments may be an indicator of the status of the wearer. The cost might be the time invested in producing the artifact, or it might be the danger or effort involved in obtaining the raw materials. (This mirrors to some extent Zahavi's [1975] handicap principle in biology.) The evidence presented by Henshilwood and Dubreuil indicates that individual reputation was indeed important in the techno-traditions of Still Bay and Howiesons Poort.

Henshilwood and Dubreuil argue that imbuing objects with symbolic meaning and concerning oneself with personal appearance both "depend on the capacity to inhibit one's own perspective and to pay attention to potentially conflicting views on objects." Both these capacities are indicators of executive cognitive functions and advanced theories of mind. Henshilwood and Dubreuil's mention of "collectively shared belief" in defining symbolically mediated culture implies that the members of such a culture must have a well-developed theory of mind. As I argue (Gärdnors 2008), the evolution of Saussurian symbols also depends critically on an advanced theory of mind. Both the Saussurian and the anthropological/archaeological approaches to symbols therefore require a theory of mind that goes beyond the capacities of nonhominin species (as currently understood). The upshot is that, when interpreting the significance of the archaeological record, it might be more rewarding to focus on the complexity of the theory of mind required (see, e.g., Gärdnors 2007) and the implications for what forms of cooperation are possible than on the presence of symbols.

In conclusion, I suggest that the ornaments of Still Bay and Howiesons Poort are best understood as evidence that indirect reciprocity based on reputation—along with the requisite theory of mind—were present in these techno-traditions.

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Henshilwood and Dubreuil provide a superb review of South African archaeological finds and of certain aspects of neural function and intelligence. They ignore, however, the implications of the profound plasticity of the human brain, a plasticity that assures that developing human brains are functionally responsive to existing cultural conditions (Gibson 2002, 2005). Their entire review, moreover, is based on two questionable assumptions. (1) Modern intelligence derives from a few key cognitive advances, each of which appeared at a distinct point in human evolution in response to the emergence of a new neocortical area, tract, or organization. (2) These key human neural and cognitive events emerged in synchrony with and were causally responsible for specific events in the archaeological record, such as the first appearance of material symbols and/or blade tools.

Assumptions that the only neural evolutionary events pertinent to the evolution of intelligence occurred in the neocortex or in tracts interconnecting cortical regions are clearly erroneous (Gibson 1999; Gibson and Jessee 1999). The cerebellum, basal ganglia, and hippocampus experienced two- to three-fold increases in absolute size during human evolution, and humans, in comparison to apes, have greater numbers of neuronal fibers that descend from the neocortical motor areas to spinal cord and brain stem motor nuclei. The cerebellum contributes to higher cognitive and linguistic functions in a major way (De Smet et al. 2007). Along with the basal ganglia and the premotor cortex, the cerebellum also mediates procedural learning, a type of learning needed for the mastery of efficient and novel motor skills such as dance, sport, speech, and tool use. The hippocampus mediates semantic memory and contributes to our understandings of spatial relationships. Direct projections from the neocortex to subcortical motor neurons partially underlie our abilities to make precise movements of the hands and speech organs. Hence, human, as opposed to ape, behavioral capacities reflect the expansion of multiple cortical and subcortical structures and include advances not only in cognitive and social domains but in motor and motor learning domains as well (Gibson and Jessee 1999).

Brains and guts are both metabolically expensive organs (Aiello and Wheeler 1995), so much so that any major change in brain size requires reduced gut size and hence increased reliance on high-energy, easy-to-digest foods. At various points in prehistory, this meant increased reliance on meat,
tubers, roots, shellfish, fowl, and fish. These changes, in turn, demanded both technological and social advances. From early hominin times, the acquisition and preparation of high-energy foods probably demanded digging sticks and cutting tools. Ultimately, containers, the control of fire, and tools for capturing and killing animals or fish also became mandatory in virtually all cultures, as did male/female divisions of labor, food sharing, and adult provisioning of young. The archaeological record documents many, but not all, of these changes. Both Neandertals and the earliest anatomically modern humans, however, had slightly larger brains, on average, than modern humans, and hence must have already evolved metabolically critical technological and social intelligences. The key question is whether either or both of these taxa already possessed essentially modern brain functions or whether something new was needed to propel the development of fully modern intelligence. Arguments that more was needed rest primarily on the absence of evidence of material symbolism in Neandertals and the earliest modern humans. However, many human populations with fully modern intelligence and language create material symbols only from perishable materials such as feathers, bark, wood, and plant fibers. Thus, an absence of material symbols capable of surviving the ravages of time for 40,000 years or more cannot be used as evidence that any culture, modern or ancient, truly lacked symbolism, theory of mind, working memory, or any other essential component of human intelligence.

The manufacture of beads and the creation of most art work, perishable or not, requires tools, artifacts, and techniques such as awls, cordage, extracted pigments, and weaving. Art and material symbolism are thus not merely cognitive or social advances; they are also technological endeavors that build on preceding technological advances and require the motor and procedural learning skills necessary for skilled object manipulation. Moreover, the initial appearances of material symbolism represented only the first of a seemingly never-ending series of cultural revolutions (e.g., Neolithic, Industrial, computer). This “sapiens paradox” (Renfrew 1996) is not explicable in terms of repeated emergences of new neural structures. It is explicable in terms of a plastic brain capable of both absorbing previous technical advances (Malafouris and Renfrew 2010) and building on them through the interactions of multiple cognitive, motor, and social capacities (Gibson and Jesse 1999). Parsimony suggests that all critical capacities were in place by the time brains reached their modern size. Shell beads are simply the earliest incontrovertible material manifestation of this intelligence.

The main argument of Henshilwood and Dubreuil can be broken down into three major parts. (1) A wide range of behavioral innovations have been identified in the archaeological remains from southern Africa during the Late Pleistocene. (2) These innovations testify to the evolution of a symbolic component in material culture. (3) This stylistic or symbolic component can be explained in cognitive terms by way of a previous brain reorganization of the temporoparietal areas implicated in theory of mind and perspective taking.

To start, Henshilwood and Dubreuil offer, no doubt, an important and timely synthesis of the available archaeological evidence from the Still Bay and Howiesons Poort periods in southern Africa. In trying to make sense of the evidence and reveal its cognitive implications, Henshilwood and Dubreuil rightly suggest, it is necessary to move beyond general abilities and look for “precise cognitive mechanisms realized in particular neural processes.” The interdisciplinary integration of all the relevant methods is thus needed. I welcome the direction and inspiration that Henshilwood and Dubreuil’s integrative approach provides in current archaeological thinking. Where I disagree with their analysis, however, is with the underlying “internalist” and “brainbound” logic that seems to characterize the way they perceive the role of this methodological integration in the archaeology of mind. In particular, the big challenge that Henshilwood and Dubreuil propose is to find the possible links between mind and behavior, more specifically for their purposes here, between symbolic thinking and material culture. Trying to meet this challenge, Henshilwood and Dubreuil go halfway, by drawing attention to the importance of identifying the cognitive and neural changes that might have underpinned the innovations of the Late Pleistocene, but they fall short of recognizing the problem of our limited archaeological understanding of the nature of material signification (Malafouris 2007, 2010b). As a result, their examination of the archaeological evidence simply reiterates the usual conventional assumptions about the putative “symbolic” character and stylistic function of certain categories of artifacts. But why, for example, does a series of deliberately incised lines suggest or embody symbolic meaning? When or how are the markings symbolic? No satisfactory answer is given to these basic questions.

To my mind, the presence of a symbolic component as “the most central innovative feature of material culture during these periods” should have been the end rather than the starting point of Henshilwood and Dubreuil’s analysis. Rather than being taken for granted, how and why a “deliberately engraved” ochre or a “shell bead” comes to stand for something else in an explicit, conscious way—that is, as an arbitrary sign—is precisely what must be established and accounted for. Take, for instance, the example of personal decoration. The authors claim that “at a minimum,” the wearing of beads provides evidence of a concern for style. They suggest that the appearance of beads indicates the presence of developed theory of mind and a capacity to understand the perspective of others relative to oneself. For reasons that I discuss exten-
sively elsewhere, in my approach to early personal decoration I prefer to emphasize the issue of “self-awareness” (Malafouris 2008). Nonetheless, I think that Henshilwood and Dubreuil’s interpretation offers a very interesting and complementary way of approaching the issue of early personal decoration. What I find problematic, however, is how they use their proposed association between changes in prefrontal and temporoparietal areas and changes in higher theory of mind and perspective-taking abilities to warrant their claim for the symbolic use of beads. I think that their argument at this point is unsatisfying. I cannot see anything “parsimonious” about the inference that beads can act as symbols, although I do recognize them as potentially powerful, enactive material signs (Malafouris 2007, 2008) capable of bringing forth a new conception of selfhood and perspective taking rather than reflecting an already formed symbolically equipped human mind. More is needed before a material sign can be identified as a symbol. Any attempt toward a cognitive archaeology of symbolism must be grounded on a clear framework of material semiotics. It is something of a missed opportunity, therefore, that the authors do not go on to explain how their “strategy of integration” is likely to constrain hypotheses in this direction.

I would like to end with a final critical comment. Our attempt at building bridges between brain and culture can easily mislead us to adopt a sterile “neurocentric” or “internalist” stance on human cognitive becoming. While Henshilwood and Dubreuil emphasize the archaeological evidence, they do not escape this trap, since they obviously think that it is neural biological change (by way of reorganization in the human brain) that drives cultural innovation. I believe that this one-directional flow of cause and effect violates the synergetic embodied nature of the relationship between cognition and material culture. In fact, I argue that to prioritize (causally or ontologically) brain reorganization over behavioral or material changes is grossly misleading. I contend that in building a neuroarchaeology of mind, our overarching research assumption should be that human intelligence “spreads out” beyond the skin into culture and the material world (Clark 1997; Malafouris 2010a, 2010c). Our primary focus should be on the study of the inextricable enfolding of brain and culture, avoiding the reduction of the one to the other.

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Henshilwood and Dubreuil provide a useful and timely overview of the implications of the Still Bay and Howiesons Poort techno-traditions for early cultural complexity. Their observation that single-factor, mental-capacity explanations do not account for the richness of the material products produced during the Middle Stone Age is well taken. The evolution of human mental processes is almost surely due to multiple, interconnected neurological evolutionary trajectories, including brain functioning in one domain exapted as part of brain functioning in other domains. The question, then, is not whether recursion, executive function, or theory of mind is the primary causal driver giving rise to the cognitive abilities of modern Homo sapiens. Rather, we need to understand the interplay among these factors, as shown by the evidence of evolutionary changes in the trajectory leading to modern H. sapiens. In so doing, we also need to take into account social conditions that affected further development of one or another of our cognitive abilities.

With regard to recursion, the important question is not whether all languages are syntactically recursive (although that is an important linguistic question) but the role of recursion in expressing complex relations among ideas and events. Everett (2005, 2009) may be right that the Pirahã language of Amazonia lacks a recursive syntax, but as he points out, this does not mean that recursion is not part of their discourse, as there are “recursive groupings in Pirahã, but of ideas rather than sentences” (Everett 2009:436). As others have noted, “we expect those languages [without syntactic recursion] to show recursion at other levels” (Hollebrandse and Roeper 2007, as quoted in Everett 2009:438). One of these other levels is the incorporation of recursion in lithic technology production, in accordance with expansion in the size of working memory during the ancestry of H. sapiens (Read and van der Leeuw 2008). In contrast, the limited size of working memory in Pan precludes recursion (Read 2008b), and we do not see evidence of the incorporation of a recursive procedure, rather than repetitive flake removals, before the development of the Levallois technique for flake production (Read and van der Leeuw 2008). Recursion became integral to artifact production with the flourishing prismatic-blade technology in the Upper Paleolithic, and we find in that period a plethora of tools produced using recursive production techniques (Hofacker 2007).

The authors make the important point that a critical juncture occurred in our cognitive evolution once our ancestors conceptualized that individual awareness of the meaning of artifacts—perhaps through the tasks that may be performed with them—are also meanings common to others as well. In contrast, even if each chimpanzee cognizes the meaning of a termite stick through its functionality for obtaining termites from a termite mound, the result is shared meaning in only a statistical sense. The authors note that the critical step goes from statistically shared, individual meanings about objects to awareness that others also hold the same meaning. Shared meaning in this sense is a prerequisite to the development of symbolically mediated culture. However, the “cognitive distance” from awareness that others hold the same meaning for objects to symbolically mediated culture is large, and here their argument becomes more speculative. The perforated shells at Blombos suggest a conscious notion of self, as op-
posed to nonself, as argued by Malafouris (2008), but the logical negation of self is undifferentiated and does not form a conceptual opposition that is part of symbolically mediated culture. Contrary to the assertion of Coolidge and Wynn (2009) that categories such as spouse exchange "are not abstract" (242, as quoted by Henshilwood and Dubreuil), the formation of categories in opposition, such as wife-giver versus wife-taker, is not simply through the logical negation of a category but requires the abstract, cultural construction of categories in opposition (see El Guindi’s theory of mediating structures; El Guindi and Read 1979). In brief, equating (1) shared meaning with (2) categories in opposition with (3) symbolically mediated culture drastically oversimplifies the conceptual distance involved when going empirically from (a) wearing shells on a cord as an indicator of self as opposed to nonself to, for example, (b) a concept of marriage versus reproduction as a basis for kin relations and then to (c) social organization based on a culturally constructed kinship system (Read 2001, 2007) that includes the formation of superordinate categories of categories and relations of relations. Nor, as the authors point out, can development of conceptual complexity be reduced to demographic growth, as has been suggested (e.g., Powell, Shennan, and Thomas 2009), since, as they state, the population size in southern Africa was small during the relevant time period. The demographic model is also contradicted by data from hunter-gatherer groups (Collard, Kemery, and Banks 2005; Read 2006, 2008a) and uses invalid assumptions (Read 2011). Rather than reduction, we need, as Henshilwood and Dubreuil note, “an integration of approaches.”

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I commend the authors on an interesting paper that moves discussion of the evolution of modern cognition forward. I have a question and a suggestion that I hope will continue that forward motion. First, the question: What is it precisely that is new and significant about the perspective-taking ability manifested in the Still Bay (SB) and Howiesons Poort (HP) industries? It cannot simply be the ability to appreciate that another’s perspective on a situation is different and leads to a different knowledge state. Studies with chimpanzees show that in competitive situations, they appear to understand how another’s viewpoint affects what they know (where food is hidden and where it is not). Thus, the human/chimpanzee last common ancestor had some minimal perspective-taking abilities.

These may or may not have included the ability to appreciate that others make judgments about the self based on self-appearance or the self’s possessions and products. Evidence of ochre use (some of it very likely used to enhance self-appearance) and carefully crafted symmetrical hand axes substantially precedes the SB and the HP. When people painted their bodies with ochre or created aesthetically pleasing hand axes, were they not as concerned with how they or their products appeared to others as the makers of the SB/HP industries? Would the authors argue that the hand axe maker never “mentalized” his creation in the same way that the SB/HP artisans did? In other words, the hand axe maker did not understand the hand axe as something that others cognitively or emotionally evaluated; rather, he simply recognized that when he created a certain visual/physical form in stone, he received a positive reaction from others. Maybe so, but what can we point to in the archaeological record to support this interpretation?

Second, I would like to suggest a way of theoretically situating the beads and other self-reflective artifacts of the SB/HP that can circumvent the unproductive “are they symbolic or not” debate. I suggest that we start thinking about them as an incremental and necessary step toward the wholly arbitrary, cognitively demanding, all-encompassing symbolism uniquely associated with our species. Symbolism is a concept that encourages dichotomous thinking: you either have it or you do not, and if you have it, you have modern cognition. But this is too simplistic. There are different levels of referential thinking that make varying cognitive demands. Beads and other self-reflective artifacts may be understood as symbolic in the sense that they stand for something else (e.g., the clan to which one belongs), but they may be best understood as what Peirce called “indexes.” An index gains its power by virtue of a consistent temporal or spatial connection to its referent (smoke indicates fire, tears indicate sadness, etc.). If a certain clan always wears a certain bead, then those beads “stand for” the clan, indexically. True symbols (in the Peircean sense) are more arbitrary and rarely if ever occur in the same context as their referent. We regularly use words such as “drudgery” and “angel” with no concrete referent in sight (or maybe even possible). Beads are, however, an artificially constructed index. At their inception, an arbitrary connection was made: somebody decided that this bead would serve as an indicator of that clan. From that point, spatial and temporal reinforcement could keep the connection going and minimize the cognitive load. This combination of arbitrariness supported by constant spatial/temporal reinforcement may have served as an important bridging step in moving from simple, naturally occurring indexes (smoke-fire) to entirely culturally constructed, naturally unsupported, cognitively demanding, all-encompassing symbol systems within which human social life is fully and uniquely immersed.

An enhancement of perspective-taking ability may be necessary before the arbitrary bead-to-clan connection can be made. The motivation to use an object as a personal or social-group representation may first require the capacity to appreciate that another holds the object in high positive regard. If...
I can see that you “like” and “admire” the object, then I might be able to redirect that positive regard toward me and my social group by adopting it as a personal/social representation. Thus, what we are seeing in the SB/HP are not yet the complex symbol systems of modern human cognition but an important move in that direction: arbitrarily constructed indexes that help span the cognitive gap from minimally symbolically capable cognition to fully symbolically immersed cognition.

Modern cognition is not an either/or proposition but something incrementally achieved. Therefore, it should not be surprising to find evidence of bits and pieces of it in the archaeological record and in nonhuman species. An enhanced capacity for perspective taking may indeed be a critical foundational piece of modern cognition, but what exactly does this enhancement entail, and how do we situate that ability on the evolutionary road to uniquely human thought?

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This paper is a welcome and fascinating addition to the literature engaging cognitive archaeology. I limit my comments to a few generic issues that arise from the central premises of this paper. These premises are that (1) theory of mind was enabled by functional reorganization of the brain that took place during temporoparietal evolution; (2) theory of mind is needed for symbolic manifestations of material culture; and (3) beads and engraved ochre and ostrich eggshell are symbolic manifestations.

Complex cognitive capacities, such as those demonstrated by people today, are the result of developments in the brain through time; there can be no controversy over this realization. However, when we start to ask questions (When, why, and how did these enhancements take place, and what is modern thinking?), either the answers are not forthcoming or they are convoluted.

If we accept that cognition is an evolutionary modification, then it must be an inherited genotype, but we do not yet know which genetic changes are applicable (Welshon 2010). Genotypic changes certainly influenced cognitive developments, but a lot more research is necessary to understand how this might have happened to *Homo sapiens* about 100,000 years ago. Neandertals are strictly not relevant to this discussion because they did not live in Africa, yet studies of their genetics are prescient for African hominids. The fact that language-related gene FOXP2 is shared by Neandertals and modern humans implies that it was acquired by a common ancestor before the era that interests us here. A recent, and remarkable, genetic discovery is that Neandertals may have had kin relationships based on patrilocal mating behavior (still the most common form today; Lalueza-Fox et al. 2011). This bodes well for the possibility that genetic studies will eventually provide information about forms of social behavior that link directly and exclusively to *H. sapiens* that we recognize in Africa from 100,000 years ago. Regrettably, this has not happened yet.

Brain encephalization took place much earlier than the period under discussion in this paper, and at present there seems little hope of finding morphological evidence of changes leading to cognitive enhancements within the past 100,000 years. It seems far more likely, as Henshilwood and Dubreuil concede and as Mithen (1996) concluded some years ago, that neural connectivity between multifarious components of the brain facilitated advanced cognition. The challenge is to recognize and localize neural changes chronologically (Bruner 2010). The absence of a reliable chronology for the cognitive developments proposed in the Henshilwood and Dubreuil paper is, through no fault of theirs, a major impediment. They compensate in the only way that they can: by using circumstantial evidence for the recognition of complex cognition and by indirectly dating relevant material culture through dosimetric methods applied to sediments or the rocks found in them.

This brings me to the second of their central premises, which is that theory of mind is the cognitive capacity necessary for creating symbolic material culture and sharing the meanings of these symbolic items. Theory of mind and social cognition are said to enable people to attribute mental states to others, to inhibit self-perspective, and to hold in mind opposing viewpoints. Orders of intentionality have been used elsewhere to define theory of mind, but Henshilwood and Dubreuil exclude this attribute from their definition because symbolic behavior can be understood without it. As will be clear from the discussion above, the first appearance of theory of mind cannot be calibrated chronologically, and even though this faculty may be linked to temporoparietal evolution, it is also not possible to tie it securely to any recent evolutionary changes in the brain.

Symbolic artifacts are said to have been created as shortcuts for collectively shared meanings. The consensus view is that beads, engraved ochre, and engraved ostrich eggshell are examples of symbolic manifestations in the Middle Stone Age of Africa (for different opinions, see, e.g., Botha 2008; Wynn and Coolidge 2009), although complex cognition can also be inferred from behavior that has little to do with symbolism (Wadley 2010). Henshilwood and Dubreuil point out that complex theory of mind is not needed to comprehend all symbolism. Small children (and even nonhuman primates) differentiate social status and categories of people; for instance, 2- or 3-year-old children easily recognize firefighters’ uniforms, and they know that the behavior associated with wearing this uniform is collectively agreed upon. However, these children cannot create symbolism, even though they can read it. I should be pleased if Henshilwood and Dubreuil could produce bridging theory and methodology to link the...
concept of theory of mind with the creation, rather than the reading, of symbolic material culture.

Henshilwood and Dubreuil have come some way to sensitizing their readers to research that needs to be undertaken. Every such contribution to cognitive archaeology helps to clear the mist obscuring our view of the mountain before us. One day, when the peaks are sharply in focus, we shall, like early travellers, be empowered to plan an ascent or perhaps a strategy for chipping a path to our destination. In brief, there is a lot of work ahead.

Reply

We first want to thank all commentators for their valuable inputs. We have the impression that the study of cognitive evolution has made rapid progress in recent years and that this is in large part because of the work done by many of our commentators. Forums like this one provide an invaluable opportunity to raise the level of the debate, both by clarifying old issues and by presenting new arguments and evidence.

In this paper, we are indeed tackling an old issue: how one can infer symbolic material culture from the archaeological record and how this emergence can be related to the evolution of the human brain and cognition. Our argument is that we can infer symbolic culture from the diffusion—in SB and HP material culture—of an interest in the appearance of things and that this evolution must be related to the evolution of an attentional mechanism located in the TPJ and essential to higher theory of mind. The aim of our paper is to address previous criticisms about inferring symbolism from the archaeological record, but we understand from the comments that we still have some way to go. We begin by answering comments on the nature of symbols and their foundation in social cognition. We then move to the possibility of relating cognitive evolution to the SB and HP material culture and conclude by clarifying the implications of our arguments for the evolution of brain and language.

What is a symbol? At the conceptual level, much of the contention relates to the notions of symbol and theory of mind. Matt Rossano notes that understanding symbolism in terms of either/or may be unproductive and suggests using categories that do not encourage dichotomous thinking. We wholeheartedly agree with this view and, in fact, have written our paper as an attempt to move in this direction. The challenge, however, is to find ways of characterizing types of symbol use that make sense at the cognitive level. We found some useful suggestions in the replies to our paper. Rossano and Coolidge and Wynn, for instance, make use of C. S. Peirce’s distinction between indices and symbols. Can this distinction help clarify the issues we address?

In Peirce’s view, indices get their meaning by way of physical association with their objects. In his classical text (Peirce 1978 [1931]), he presents guideposts and pronouns as typical instances of indices. Symbols, by contrast, get their meaning through convention or by some form of tacit contract within a group of speakers. Peirce mentions individual words such as “give,” “bird,” or “marriage” as typical instances of symbols. Peirce’s distinction is useful, but interpreting it at the cognitive level is tricky. The most influential attempt to do this has been proposed by Deacon (1997). Deacon argues that understanding indices is made possible by the mechanism of associative learning. Understanding symbols, by contrast, requires something more; it is what Deacon (1997) describes as the capacity to go “beyond the mess of associations” (89).

Deacon’s book advanced our understanding of cognitive evolution in several ways, but it also introduced some confusion into the field. The problem is that both indices and symbols, as understood by Peirce, implied more at the cognitive level than simple associative learning. Most centrally, understanding that a guidepost or a pronoun refers to something—in the same way that we understand the meanings of words like “give,” “bird,” or “marriage”—implies the capacity to read the referential intentions of others. Reading intentions—the most basic form of theory of mind—goes beyond associative learning. It implies causal knowledge, in which “intentions” function as underlying causes of observable behavior (Gopnik and Schulz 2007). This is why children grasp the meaning of indices and single words pretty much at the same time, around their first birthday or as soon as they begin to grasp referential intentions of others.

The fact that indices and single words develop at the same time in infancy raises no problem for Deacon, because he thinks that single words are indices. Symbols, he thinks, are something else. But what exactly? This is where things get more elusive. Deacon (1997:83–90) explains that symbols proper arise when one grasps the “complex functions,” “higher-order regularities,” and “patterns” between indices. We understand symbols when we go beyond the mess of association. But going beyond the mess of association—that is, accessing causal knowledge—is already a precondition to understanding the referential intentions of indices and single words, so that we end up with no clear idea as to why indices should be seen as precursors of symbols.

We see Peter Gärdenfors’s distinction between Saussurian and anthropological meanings of symbols as a more promising way of going beyond an either/or approach to symbols. From a Saussurian viewpoint, a symbol—or rather a sign—is an arbitrary association between a sound and a thought. This view is different from the traditional anthropological or archaeological view, on which we focus in the paper and which is closely connected with the idea that material culture is imbued with shared beliefs and meanings. According to Gärdenfors, both types of symbols require more sociocognitive skills than are found in great apes. He then suggests linking Saussurian symbols to human ability for cooperation and anthropological/archaeological symbols with human concerns with reputation and indirect reciprocity. From an evolutionary
viewpoint, human cooperation and Saussurian symbols would have preceded anthropological/archaeological symbols and concerns for reputation and indirect reciprocity.

Gärdenfors’s argument makes much sense at the cognitive level and complements our arguments advantageously. Apes do not spontaneously come to use Saussurian signs or Peircean symbols, but the reason is not an inability to go beyond the mess of association. In fact, they can read intentions, as Rossano reminds us, but they lack the socioaffective and sociocognitive abilities underlying human cooperation, including the disposition to spontaneously share attention and intentions with conspecifics ( Tomasello 2008). Along with Gärdenfors, we think that evidence in favor of increased cooperation in apes and among young children (Tomasello 2008) is the idea that to imbue material culture with symbolic meaning requires more than the social-affective and sociocognitive abilities underlying cooperation and use of Saussurian signs. Gärdenfors’s ideas are in agreement with ours on this point, and we suggest that emphasis should be placed on the complexity of theory of mind required for particular behaviors. That is precisely what we tried to do by focusing on “higher theory of mind,” “higher perspective taking,” and the “attentional mechanism” realized in the TPJ. But what do these concepts refer to?

Coolidge and Wynn note that we do not give a proper definition of them. We are happy to clarify our view if our definition in the paper is not clear. “Higher theory of mind” simply refers to the understanding of false beliefs and other abstract mental states (e.g., higher-order desires). It is different from the capacity to read intention that is present in apes and young children. “Higher perspective taking” refers to the task known as “level-2 perspective taking,” in which the subject has to describe how an object appears from someone else’s viewpoint, which is different from the capacity to determine whether someone else sees an object (an ability that Rossano reminds us is present in both apes and young children). Children younger than 4 years of age are well known to fail both higher theory-of-mind and higher perspective-taking tasks, and the TPJ is well known to be involved in these tasks in adults.

Coolidge and Wynn suggest that a focus on this mechanism is not as precise as we claim. It is true that “being precise” is a matter of degree. Our hypothesis is more precise than those that simply refer to “working memory,” “theory of mind,” or “recursion,” but it could be further developed in different directions. For instance, we do not know whether there is a higher-theory-of-mind module realized in the TPJ or whether success in the false-beliefs and level-2 perspective-taking tasks is driven by the development of general cognitive resources in childhood (see fig. 2). What we know for sure, however, is that there is a crucial change in a child’s ability to deal with abstract mental states at around 4 or 5 years of age, that these new abilities build on previously existing intention-reading abilities, and that they further improve during childhood and adolescence, along with the development of general cognitive abilities and of late-maturing brain areas (including the PFC and the TPJ).

This development of social cognition coincides with radical changes in children’s behavior, which are of interest for the study of cognitive evolution. One of those crucial changes is an interest in fashion and a desire to look fashionable, which develop relatively late in childhood and of which there is little evidence among young children. Just like apes, children younger than 4 sometimes alter their appearance to produce an interesting effect on their audience (e.g., wearing witch or fireman costumes for Halloween), but they are not very good at making sure that they look good. Typically, they do not even care about looking good or maintaining their “reputation.” The most obvious reason why is that they lack higher theory of mind, which is a precursor of complex social emotions such as pride, shame, and contempt. Young children and apes see that others see them, but they do not grasp that the way others see them has an impact on where they stand in the game of indirect reciprocity described by Gärdenfors.

This brings us to piercings and tattoos. We are happy to grant to Coolidge and Wynn that those artifacts have no specific meaning. People wear them because they think that they make them look cool. In exchange, they may grant us that using piercings, tattoos, and jewels is highly demanding in terms of social cognition. Indeed, young children sometimes use body adornments, but their behavior is both idiosyncratic and cheap. By contrast, teenagers wear costly adornments (jewels are costly, while tattoos and piercings are both costly and painful), and they do it in ways that are not idiosyncratic: in the United States, no less than 25% of people aged between 18 and 50 have tattoos, and 14% have body piercings (Laumann and Derick 2006). These two factors (the fact that body adornments are costly and not idiosyncratic) indicate more than basic self-awareness (e.g., “I see that others see me”). They indicate the presence of widely shared standards of coolness, as well as of a strong desire in young Americans to improve their position in the game of reputation.

So are piercings and tattoos indices or symbols? It all depends on what we mean. On the one hand, we can argue that piercings do not symbolize coolness; they indicate it. They are thus better understood as indices rather than as symbols. On the other hand, they do not indicate coolness by way of physical association—the distinctive feature of Peircean indices—because “coolness” is not a physical property that one can point to ostensively. Coolness refers to the way a behavior or an object is appraised within a certain group. It takes the form of abstract and socially shared standards that we use to find our way in the game of reputation. Thus, piercings may not symbolize coolness in the same way that, for instance, the cross symbolizes the crucifixion, but they certainly rest on an arbitrary (and conventional) connection between a physical object and a shared representation of coolness. This feature seems sufficient for piercings to qualify both as sym-
Can beads act as symbols? The clarifications above should help us respond to comments concerning our inferences from archaeology to cognition and, more precisely, concerning the possibility of turning SB and HP innovations into proxies for symbolically mediated culture. First, Kathleen Gibson reminds us that the absence of earlier evidence of symbolic behavior is not evidence of absence of the capacity for symbolic thought, which might have been in place "by the time brains reached their modern size." Similarly, Matt Rossano notes that early pigment processing and hand axes' symmetry might provide evidence of an interest in the appearance of material culture that would precede the SB and HP periods. We perfectly acknowledge these possibilities. In fact, it is quite unlikely that the SB and the HP will provide the earliest evidence of the cognitive abilities in which we are interested, although earlier evidence remains quite flimsy for the moment. We should also emphasize, along with Wadley, that the "production-comprehension gap" is ubiquitous in social cognition and that it is highly likely that the capacity to understand symbolic material culture preceded the creation of symbolic artifacts.

More central are the concerns raised as to whether it is possible to infer symbolically mediated culture from the SB and the HP. Coolidge and Wynn suggest that Blombos marine shells might not have been used as personal ornaments but could have served as a tallying device. The proposal is worth examining, as are its cognitive implications. Nevertheless, the interpretation of shells as personal ornaments seems more reasonable, because the use of personal ornaments is ubiquitous among human foragers, while that of tallying devices is not.

Coolidge and Wynn also argue that beads “are indexes of membership in some vague group, but they have no explicit or even implicit meaning beyond a simple association of appearance and social role.” Malafouris contends that we simply reiterate the assumption that Blombos artifacts are symbolic without defending this point explicitly. In the same vein, Read suggests that there is significant cognitive distance between “awareness that others hold the same meaning for objects” and symbolically mediated culture.

Let us begin by emphasizing one point that, we hope, will help clarify the debate. If by “symbolization” we mean the relationship between the cross and crucifixion—the fact that the cross stands for crucifixion—then it is perfectly possible that SB and HP engravings and personal ornaments were not symbolic. It is perfectly possible that they acted in the same way as piercings, simply indicating coolness or good taste. But our point is that turning an object into an indicator of coolness makes sense within a social group only if there is some shared understanding of what is cool and what is not. “Being cool” is not like “being red” or “being a bird.” It is an abstract property that indicates where one stands in the market of reputation, in other words, in the public space where we care about the fact that people are looking at us in a certain way. We call this conventional link between an abstract property (coolness) and an artifact (personal ornaments) “symbolic.” We think that this use is in line with the Peircean notion of symbol, although maybe not with any understanding of it.

This may also help explain why we think there is no cognitive distance between the type of awareness evidenced by SB and HP material culture and symbolically mediated culture. This can be a matter of debate, but we see no prima facie difference, at the cognitive level, between understanding that there is conventional link between an artifact and an abstract property (e.g., beads and being cool) and understanding that there is one between an artifact and an event (e.g., the cross and crucifixion). In both cases, it is insufficient to see that people see things: one must see how people see things. This is higher theory of mind and perspective taking.

How does this relate to brain evolution? Is our focus on the TPJ original? Davidson and Coolidge and Wynn suggest that it is not, and they point to Wilkins’s (2009) discussion of the importance of this region for the evolution of language. We confess that there is little originality in proposing that the TPJ played some role in cognitive evolution. Our originality is limited to our use of this brain area to interpret behavioral changes in early Homo sapiens.

In addition, Davidson suspects our use of "selective" citation and notes that Dunbar (2009) did relate the relative size of the neocortex to orders of intentionality. We do not dispute that Dunbar (2009) made this connection, but his argument is based on the (at least) contentious suggestion that apes have second-order intentionality (compared to first-order intentionality in monkeys) and that there must have been a linear increase in orders of intentionality during human evolution, along with encephalization. We reiterate that Dunbar presents no evidence to support this contention.

More fundamentally, Kathleen Gibson criticizes our focus on the neocortex and argues that subcortical structures were also crucial to cognitive evolution. Her point is hardly disputable, and we would be happy to discuss how potential subcortical changes can help shed light on the evolution of human behavior, but our intention in this paper was to improve on the most prominent hypotheses that have been used to account for some southern African Middle Stone Age (and potentially earlier) behavioral innovations.

Gibson and Malafouris both see in our approach a neurocentric bias that ignores brain plasticity. We may be responsible for the misunderstanding here, but we want to emphasize that our primary intention is to establish a correlation between the evolution of the TPJ and behavioral evolution and that we are more than happy to remain agnostic about the exact causal story that has linked brain and behavioral evolution. Given all the uncertainties about early H. sapiens, it would be immensely naive to argue that there has been a single causal pathway from brain to behavioral evolution—and we do not do so.
Aboitiz, Francisco, Ricardo R. García, Conrado Bosman, and Enzo is not necessarily the case, a point also granted in Dubreuil to express metarepresentations. Botha (2010) argues that this and perspective taking. This is true. In Henshilwood and Du-

If syntactic recursion is not absolutely needed to express metarepresentations, does it mean that it is likely to have evolved after the SB and HP periods? In Henshilwood and Dubreuil (2009:59), we give reasons (reiterated in this paper) to think that this is unlikely. One reason is ontogenetic: recursive constructions appear much earlier in language than does higher theory of mind (obviously, we know that ontogeny does not always recapitulate phylogeny). Another reason is the inability of cognitive linguists and neuroscientists to explain what the cognitive and neural foundations of syntactic recursion are, suggesting that recursion may result from more general features of human cognition (including theory of mind and working memory). Those are not knock-down arguments, but Botha (2010) and Davidson have not (yet) presented any reason to think that they should have no weight.

Along with authors such as Tomasello (2003), we are increasingly inclined to see syntax as the outcome of a cultural evolutionary process, triggered by the evolution of social cognition, rather than as a cognitive development of its own. We do not make this point in this paper, and our argument does not hinge on the exact relationship between social cognition and syntax.

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