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BEHAVIORAL MODERNITY IN RETROSPECT

Abstract

This paper reviews the debate about behavioral modernity in our species, listing counterexamples to the thesis that there was a dramatic change to the minds of Cro-Magnon *sapiens* in Europe in the Upper Paleolithic. It is argued that we were probably behaviorally modern from about 150,000 years ago, and that aspects of this mentality were apparent in developments in tool technologies and hunting practices across the prior *Homo* lineage. Key behaviors expressive of behavioral modernity include practical reasoning about the past and future and role-differentiated rights-based cooperation, which are more obvious in their effects than is the vague but much-used notion of symbolic thinking. Behavioral modernity leads to technological innovation but is not sufficient to maintain such innovations in face of population loss and environmental instability, which along with the vagaries of preservation explains why the archaeological record of behavioral modernity in our species is patchy until the Upper Paleolithic.

BEHAVIORAL MODERNITY IN RETROSPECT

In this paper I review the discussion of behavioral modernity in our species. According to what might be termed the classic Upper Paleolithic model, which prevailed among archaeologists in the 1980s and 90s, our minds took on their now-current form in Europe 40–20,000 years ago (40–20 kya). Faced with a significant body of counterexamples, this thesis was revised, beginning from about 2000 (see, e.g., McBrearty and Brooks 2000). A more common view since then is that the relevant suite of cognitive and behavioral capacities evolved gradually in Africa and elsewhere before culminating in the art and technologies preserved in Europe in the Upper Paleolithic. I will defend a gradualist position that tracks key signs of behavioral modernity across several *Homo* species, and that dates its fruition in *H. sapiens* to well before 40 kya; indeed, perhaps back to more than 150 kya, which saw the arrival of anatomical modernity (the gracile skeletal anatomy typical of modern humans) in our species.

In more detail, here is the plan of the argument to follow. We begin in §1 with a more complete exposition of the classic behavioral modernity position and of the criteria by which it is usually judged, these being indicators of symbolic thinking. A brief outline of our species' evolution in §2 draws attention to the discrepancy between the timing of behavioral modernity (40 kya), as given by the classic model, and anatomical modernity (150 kya). Counterexamples offered since about the year 2000 to the classic behavioral modernity position are outlined in §3. These involve behaviors of *sapiens* prior to 40 kya and distant from Europe. In addition, we can point to behaviors in other Pleistocene hominins — that is, in species not thought capable of symbolic thinking — that also seem to contradict the classic theory of behavioral modernity. The response to these undermining counterexamples could take various forms — rejection of the coherence of the notion of behavioral modernity or alternatively, revision of the criteria for behavioral modernity and/or revision of the thesis itself. We focus on the option holding that, rather than emerging gradually in our species, we were probably behaviorally modern much earlier than the classic theory maintained. And the precursors of behavioral modernity emerged gradually in earlier *Homo* species. To make the case for this, it is argued in §4 that, rather than appealing to the vague notion of symbolic thought, behavioral modernity is better indicated by sophisticated practical reasoning and role-differentiated cooperation. Evidence for these in the *Homo* lineage, but more especially in the period 400–200 kya are outlined. These mainly concern developments in tool technologies and styles of animal hunting, the topic of §5.

Because elements and aspects of behavioral modernity were already in place with the arrival of our species, it is reasonable to anticipate we were behaviorally modern by the time we attained anatomical modernity. This leaves the problem of explaining long periods in our species' history when the evidence for modernity appears to be absent and when the accumulation of knowledge and technology from generation to generation is defeated. This is addressed in §6. Both the periods of absence and the cultural efflorescence of Upper Paleolithic Europe can be accounted for by reference to interactions between factors such as population size, group size, inter-group relations and trade, climate, and environmental factors. §7 offers concluding remarks.

1. The classic behavioral modernity thesis

To understand the thinking that tried to make sense of the Paleolithic *Homo* record, we should recall how recent this area of study is. For instance, the first Neanderthal fossil was discovered in 1829 and the species was not named until 1863 (King 1864). Meanwhile, the paintings of Altamira cave, Spain, were viewed in 1879 by the amateur archaeologist Marcelino Sanz de Sautuola. Working with Juan Vilanova y Piera, he first identified them as Paleolithic in 1880. This was initially received with extreme skepticism and it was not until early in the twentieth century that the age of the pictures was accepted (Lewis-Williams 2002; Curtis 2007; Lawson 2012; Tattersall 2012). The ancient depictions in Rouffignac cave, France, were known for centuries, being mentioned in 1575. Unlike most caves, Rouffignac was not sealed and has been often visited over the past four centuries. These sightseers left graffiti, dates, and names as evidence of their visits, sometimes adjacent to prehistoric drawings. The cave is famous for its depictions of mammoths, but many other ancient animals are also pictured. These ancient animal portraits were dismissed (until 1956) as the work of comparatively recent pagan cults (Desdemaines-Hugon 2010). Chauvet cave, France, which has the oldest and some of the finest European cave paintings at 32,000 years (Clottes, Bahn, Arnold 2003; Lawson 2012), was (re)discovered as recently as December 1994.

The piecemeal but rapidly expanding evidence base significantly underdetermined the overall picture, so those trying to make sense of the available information inevitably speculated beyond what could be proved. Meanwhile, the European focus of much of this archaeological work reinforced a bias toward viewing Europe as a cultural center in human development (McBrearty and Brooks 2000; Henshilwood and Marean 2003; Stringer 2012).

Add to this the not unreasonable assumption that we are a species that accumulates knowledge and technology over the generations. "Human cognitive ontogeny takes place in an environment of ever-new artifacts and social practices which, at any one time, represent something resembling the entire collective wisdom of the entire social group throughout its entire cultural history" (Tomasello 1999, p. 7). So, prolonged absences of advanced technologies elsewhere in the record seemed to imply minds not yet sufficiently developed to invent them.

In conjunction, these intuitions led to the view that *Homo sapiens* achieved a "modern" mind in the Upper Paleolithic in Europe. Culturally, we are their heirs. For instance, they invented the eyed needle (Wells 2002; Gilligan 2007; Fagan 2010; Cook 2013), which has been passed down to us, generation by generation, with some mechanization and improvements along the way. But by implication, there was some kind of mental rift between Upper Paleolithic Cro-Magnon *sapiens*, who arrived in Europe from the east about 40 kya, and their apparently less innovative African forebears. Our most distant ancestors were presumed not to be modern thinkers. (One wonders what the thesis of behavioral modernity was supposed to entail about the mentality of the many people who are not directly descended from early European *sapiens*.)

The emblematic mark of this behavioral modernity was supposed to be "symbolic thinking." Evidence of symbolic thinking took many forms: tools that required imagination and planning for their multipart construction, the adoption of personal ornaments and group insignia, ritual behavior, pictorial depiction (or any use of one thing to stand in for another), burial practices and the use of grave goods, and prosocial moral behaviors, such as caring for people incapable of preserving themselves. (We'll review this list later.)

This evidence seemed to be spectacularly concentrated in Europe. The developments there appeared to be unprecedented, dramatic, and comparatively rapid. They were described as a *creative explosion* (Pfeiffer 1982) and as the *great leap* *forward* (Diamond 1992). In the 1990s, many archaeologists shared the view that there was a significant change in our species' behavior following its incursion into Europe. (For example, see Mellars and Stringer 1989; Mellars 2005; C. Renfrew 2009; Henshilwood and d'Errico 2011a; Cook 2013, and for commentary Conard 2010; Nowell 2010.)

This lightbulb moment was thought to be so marked that some postulated that it was the result of a mutation that changed the organization of the brain (see Klein 2002; Curtis 2007). Multiple suggestions have been made about this: that the mirror-neuron system matured in immediately prior millennia (Ramachandran 2003), or that working memory was enhanced (Wynn and Coolidge 2007), or that domain general intelligence improved (Mithen 1996), or that parallel processing came into play (Solso 2003). This article, as will become clear, dispels with the idea of a lightbulb moment.

2. *Homo sapiens*' origins and anatomical modernity

At the close of the twentieth century it was thought that our species is about 200,000 years old (Mithen 1996; Dunbar 2004). More recently that date has been pushed back to 315,000 ± 34,000 years for the earliest *H. sapiens* (Hublin, Ben-Nce, et al. 2017; Richter, Grün, et al. 2017). The earliest *sapiens* were a morphologically mixed bunch, with some showing the marks of archaic features. And some anatomically intermediate examples date to 160–154 kya (White, Asfaw, et al. 2003; Caspari and Wolpoff 2013). However, the gracile skeletal anatomy of modern-day *H. sapiens* was in place by about 150 kya (Stringer 2007).

So, one corollary of the classic thesis of behavioral modernity, outlined in the previous section, is that *H. sapiens* anatomically similar to us spent 100,000 or more years without modern minds and the capacity for symbolic thought. The next section reviews counterevidence to that idea.

3. Challenges to the classic behavioral modernity thesis

Critics of the classic behavioral modernity thesis drew attention to counterexamples as they were found in the *sapiens* archaeological record, pointing to apparently modern behaviors at times and in *sapiens* populations where they were not supposed to be present.

Some burials prior to 40 kya show evidence of ritual treatment of corpses or funerary offerings (Pettitt 2011). This applies even to some very old burials of *sapiens* at Herto, Ethiopia, dated 160–150 kya (White, Asfaw, et al. 2003; Caspari and Wolpoff 2013.) and in multiple inhumations both at Skhūl, Israel, dated 130–100 kya years ago and at Qafzeh, Israel, dated to 100–90 kya years ago (Mellars 2007; Henshilwood 2007; Pettitt 2011; Caspari and Wolpoff 2013). The burials in Israel included perforated shells and collections of ocher.

Cave art older than that in Europe has been found in Asia (Bednarik 2013; Aubert, Brumm, et al. 2014; Aubert, Setiawan, et al. 2018). And Africa has yielded evidence of advanced behaviors and technologies from earlier periods (McBrearty and Brooks 2000; McBrearty 2007; Mellars 2007; Barham 2013). At Pinnacle Point, South Africa, stone was treated with fire to alter its flaking properties as long as 164 kya (Marean, Bar-Matthews, et al. 2007). Barbed bone points in Africa date to 90 kya (d'Errico, Henshilwood, et al. 2003; Marwick 2003; Powell, Shennan, and Thomas 2009) and others in Java and India may be equally old (Henshilwood 2007; Bednarik 2013), but such points do not reappear in the European archaeological record until 45 kya. Meanwhile, at Rhino Cave, Botswana, many points made from colorful, non-local stones and dated to 70 kya have been found. These were elaborately and carefully made and, without leaving the cave of manufacture, were then burned and destroyed. This is interpreted as evidence of ritual behavior (Coulson, Staurset, and Walker 2011). And a child was buried with grave goods at Border Cave, South Africa, dated to 80 kya (Knight, Power, and Watts 1995; Pettitt 2011).

Of special interest are two traditions of working stone and the toolkit thus produced that emerged in southern Africa in the Middle Stone Age, a period of African prehistory spanning 280 kya to approximately 50 kya. (For discussion of these lithic industries, see McBrearty and Brooks 2000; Henshilwood 2007; McBrearty 2007; Mellars 2007; Powell, Shennan and Thomas 2009; Henshilwood and d'Errico 2011b; d'Errico and Henshilwood 2011.)

The first, known as Still Bay, appeared about 75 kya and the second, Howiesons Poort, about 70 kya. Both involved sophisticated heat treatments to alter the flaking properties of stone. In addition to symmetrical stone blades, piercers, and scrapers, there were multipart and bone-tipped tools and weapons, some with abstract engravings. Associated at these sites (though varying in their prominence from place to place) there were collections of ocher, engraved ostrich shells, and perforated marine shells that would have been used as personal ornaments. For instance, at Blombos cave, a South African Still Bay site, several thousand pieces of ocher were recovered, including crayons incised with abstract hatching, as well as a silcrete flake marked with a cross-hatched pattern drawn with an ocher crayon, all from approximately 73,000-year-old Middle Stone Age levels (Henshilwood 2007; Henshilwood, d'Errico, et al. 2018). Meanwhile, the bow and arrow was in use at these sites at least 20,000 years before it appeared elsewhere (McBrearty 2007; Lombard and Phillipson 2010; Lombard and Haidle 2012; Barham 2013). Though they lasted several thousand years, both of these lithic industries disappeared, to be replaced by more primitive ones (Mellars 2007; Jacobs and Roberts 2009; Stringer 2012).

The inference in such cases is first from these artefacts to burial traditions, ritual thought, personal decoration, deliberate markings, and sophisticated technologies, and then from such behaviors and practices to an intelligent mind that can negotiate symbolic thought. So, there is evidence prior to the Upper Paleolithic in Africa and Asia of *H. sapiens* capable of the kind of thought that is supposed to symptomize behavioral modernity.

3.1. Counterevidence in the behaviors of other *Homo* species

To make matters worse for the classic behavioral modernity thesis, Neanderthals, who were not generally thought to be behaviorally modern, displayed behaviors typically identified as evidence of symbolic thought before Cro-Magnon *sapiens* met them in Europe about 40 kya. They collected ocher beginning about 250 kya (Roebroeks, Shier, et al. 2012). Not only did they master the hafting of tools but also the use of birch tar as an adhesive in this process (by 187 kya). The extraction of this tar involved skilled use of fire in an oxygen-controlled environment (Barham 2013). They explored caves and built stalagmite circles there more than 170 kya (Jaubert, Verheyden, et al. 2016). They collected crystals, fossils, and oddly shaped stones, which is suggestive of an aesthetic sensibility (Mellars 1996). Apparently, they used shells as ornaments or as ritual objects (d'Errico and Zilhão 2003; Vanhaeren 2005; Zilhão 2007; Zilhão, Angelucci, et al. 2010; Cook 2013). Their use of the bones, claws, and feathers of large birds of prey, probably in ritualistic behaviors, was sustained and geographically widespread (Peresani, Fiore, et al. 2011; Finlayson, Brown, et al. 2012). A remarkable case is that of a necklace of interlocking eagle talons dating to 120 kya (Radovčić, Sršen, et al. 2015). Shells "painted" with ocher and dated 120–115 kya have been offered as examples of Neanderthal art (Zilhão, Angelucci, et al. 2010; Hoffmann, Angelucci, et al. 2018). In three Spanish caves they painted animals, linear signs, geometric shapes, hand stencils, and handprints more than 64 kya (Hoffmann, Standish et al. 2018.). The floor of Gorham's Cave, Gibraltar, is deeply incised with a pattern (under a Neanderthal layer) and dates to 39 kya (Rodríguez 2014).

As well, there is evidence that Neanderthals cared for people too sick to fend for themselves (J. M. Renfrew 2009; Stringer 2012; Tattersall 2012), which was mentioned earlier as evidence of moral thinking. And they also occasionally buried their dead (McBrearty and Brooks 2000; d'Errico, Henshilwood, et al. 2003; J. M. Renfrew 2009; Pettitt 2011; Wynn and Coolidge 2012). Evidence of funerary caching goes back to 240 kya, but most burials are in the period 70–34 kya (though only some of these involve grave goods).

While little is known of the culture of Denisovans — Asian hominins who overlapped the Neanderthals — one of the very few artifacts we have from them is a nicely carved stone bracelet (Gibbons 2011).

A final case is jarring and puzzling. A shell from Java, Indonesia, is engraved with a geometric pattern. This engraving is dated to 550–425 kya and is attributed to *H. erectus*. Had the engraving been done by a *sapiens* much more recently, it would have been received as confirmation of behavioral modernity, but *H. erectu*s was not thought to be capable of abstract, symbolic thought. As the scientists who wrote up the discovery observed, "the manufacture of geometric engravings is generally interpreted as indicative of modern cognition and behaviour. Key questions in the debate on the origin of such behaviour are whether this innovation is restricted to *Homo sapiens*, and whether it has a uniquely African origin" (Joordens, d'Errico, et al. 2015, p. 228). They answer both questions in the negative, concluding that engraving abstract patterns was in the realm of Asian *H. erectus* cognition and neuromotor control.

3.2. How to interpret the counterevidence

Several responses to the weight of this counterevidence are possible. The most extreme calls into question most of the criteria that were being used, suggesting that the general idea of behavioral modernity is incoherent. Some argued, for example, that the European record in favor of behavioral modernity is less decisive than was previously thought, because the traits taken to be markers for behavioral modernity are biased against African examples, could have other explanations, and are theoretically unjustified (Henshilwood and Marean 2003; d'Errico and Henshilwood 2011). In other words, the criteria against which the classic thesis of behavioral modernity was judged were biased and ambiguous or inaccurate.

Others have retained the notion of behavioral modernity but abandoned both the timing and location postulated by the classic Upper Paleolithic model. Some have added to the European revolution another, earlier one in Africa to accommodate the Still Bay and Howiesons Poort examples (Mellars 2007; C. Renfrew 2009). But a more common interpretation acknowledging the geographical and temporal spread of counterexamples recommends against the idea that behavioral modernity is time-indexed in this way.

Now it is widely held that we were behaviorally modern from long before 40 kya (Dunbar 2007; McBrearty 2007; Henshilwood and d'Errico 2011b; Shea 2011; Sterelny 2012) and accordingly, that there was no mutation that caused a radical reorganization of our neural functions in the Upper Paleolithic (Lewis-Williams 2002; Stringer 2012; Barham 2013).

These conclusions are consistent with the view that behavioral modernity arose in our species by degrees; that is, that it emerged only gradually and was not fully realized until 40 kya. But some archaeologists adopt the stronger position that behavioral modernity came with anatomical modernity, and thus is nearer 150,000 (or more) years old. This is the stance, for example, of Sally McBrearty, an archaeologist. "This evidence [from Africa's Middle Stone Age] shows that the mental capacity for sophisticated behavior was present in Africa in the earliest *Homo sapiens*, that these behaviours arose by normal processes of innovation, and that their traces in the archaeological record accumulated sporadically over the course of the next 300,000 years" (McBrearty 2007, p. 137). Writing with Chris Stringer, a paleontologist, she adds: "In this view, early *H. sapiens* were essentially neurologically and cognitively identical to modern humans, and new behaviours seen in the archaeological record resulted from human innovation, sometimes in response to the pressures of population growth or environmental change" (McBrearty and Stringer 2007, p. 793).

3.3. Gradualism in some other *Homo* species

When it comes to *H. erectus*, *H. heidelbergensis*, and *H. neanderthalensis*, we might be more liable to question the validity of the criteria they satisfy than to accept that they too were our equals in behavioral modernity. For instance, the shell engraved by *H. erectus* could be interpreted as supporting the hypothesis that the traits used to identify behavioral modernity are inadequate. We could hold that *H. erectus* was cognitively capable of the work of engraving the shell while denying that it signals abstract or imaginative thinking. (On thinking through things, in action, without the need of mental representation, see Malafouris 2004.)

What, though, should we say about the Neanderthal behaviors? Much has been done in recent decades rightly to rehabilitate the prior image of Neanderthals as deeply inferior to Cro-Magnon *sapiens* in intellect and culture (for example, d'Errico and Zilhão 2003; Wynn and Coolidge 2004, 2012; Hublin, Harvati, and Harrison 2006; Finlayson 2009; Zilhão 2011; Stringer 2012). But it is still maintained by some paleoarchaeologists that their cognitive capacities and ability to communicate were limited by comparison with ours (for example, Lewis-Williams 2002, 2009; Barham 2004; Mellars 2005; Mithen 2005, J. M. Renfrew 2009; Fagan 2010).

I suspect that there will not be consensus about whether we should revise the criteria of behavioral modernity to exclude Neanderthals or, instead, whether we should acknowledge their parity with us. Perhaps a middle ground is possible: they show some but not all the relevant traits, or they show them but to a lesser extent, so they are close to being behaviorally modern without matching our capacities in this regard. In other words, we could be gradualists about their psychological development as a species, even if we hold the view that our *H. sapiens* forebears had minds equivalent to ours (that is, within the range of variation of typical contemporary *sapiens*) 150 kya.

To explore this possibility, we need to adopt a new mode of analysis. Rather than listing a suite of particular behaviors indicative of behavioral modernity and then looking at the archaeological record for specific, local cases in which one or more of those behaviors is evidenced, we should take a broader and more strategic approach to the issues.

One such method might look for the neural and physiological changes that either made behavioral modernity possible or that were a direct effect of it. (The direction of cause and effect might be unclear.) For example, we can consider the process of encephalization over hominin evolution and consider the capacities and advantages that large brains conferred (for example, see Dunbar 1993).

An alternative — the one we will focus on below — looks at behaviors displayed through hominin development in light of the modes of mentality on which they depend. For instance, we can consider the long-term use and development of tools, the modes of hunting that went with them, and the kinds of social organization that lay behind all this, while asking what level of thought these must have presumed. That is, we can look for more general behaviors that were common in our hominin predecessors yet which call for sophisticated thinking, or something very much like it.

Before we get down to this task, it is necessary to indicate more precisely what will be essential to our search.

4. Practical reasoning and cooperation

We can learn from our previously successful past behaviors. When we have attained our goals by certain means and aim at similar targets in the future, we apply induction and repeat the decisions and actions that were successful earlier. More interestingly, we can also learn from our past failures or only partial successes. We ask how we could have improved on the outcome by modifying the path that we actually followed. We consider how the present could have been better if we had taken more efficacious past decisions. This involves *counterfactual reasoning*.

Drawing on past experience and the results of counterfactual reasoning, we also attempt to incline future state of affairs in our favor. We try to predict how the world will become, starting from possible scenarios and the various affordances they offer. This involves *hypothetical reasoning*.

Both counterfactual and hypothetical reasoning are crucial tools of practical reason used in plotting our way successfully through the world. We rely on them to try to achieve desirable outcomes, where these can be affected by options we choose. Their successful employment marks us as rational beings.

Both kinds of reasoning involve the imaginative construction of fictions, ones concerning what might have been but were not the case and about what is not yet the case but might become so. Rather than dealing with the world only as it is and how it presents itself to us directly, these forms of reasoning are speculative and creative. They go beyond what was or is the case. In this respect they are at least suggestive of symbolic thinking and behavioral modernity — in them, imaginative thought takes over from current experience and awareness of reality.

We apply practical reasoning not only to the material world but to the social one as well. We attempt to understand what others have done and to predict what they might do. This is important, because many of our goals can be attained only with the assistance of other people, either directly or indirectly.

Of special significance here is cooperation. This involves people working together to achieve some joint goal. Often their doing so requires that they adopt different roles within the enterprise. For cooperation in the fullest sense, there must be mutual recognition and reciprocity. The fact that one person discharges her task within the joint enterprise gives her a claim against the others that they play their assigned parts. Ants enact different roles within a complex social system, but they do not cooperate in this full sense because their responses are automatic rather than resting on reflexively produced and mutually recognized rights and duties.

A creature might fall into cooperative enterprises and feel their way to occupying a distinctive role within them. (This might be what is involved when new individuals join in the spontaneous hunts of chimpanzees, say [see Heyes 2012].) And cooperation is not always formalized and explicit. But many human social activities require rigorous planning and call for complex, long-term patterns of role-differentiated activities that must be specified in advance. Indeed, cooperation is almost inevitably needed in any socially complex activity — child-rearing, foraging, ritual. The reciprocal recognition, shared understandings, joint adoption of duties and responsibilities, mutual respect and trust that are the fundamental grounds for cooperation are on their own suggestive of insightful, imaginative thought. They indicate a mind that can map and organize multiple bearers of social significance, first at an abstract level, but then applying them to concrete, important activities. Cooperation of this kind presupposes the attributes of modern minds.

In other words, rather than trying to track the vague and ambiguous notion of symbolic thought, we would do better to look for patterns of behavior that evince practical reasoning and cooperation.

5. Tools and hunting

Let us return to what is known of the behaviors of our now extinct hominin predecessors and cousins to look for evidence of practical reason and social cooperation. Where they are present, we have the rudiments on which progress toward behavioral modernity could build, even if we do not yet have the fully-fledged capacity. Given the archaeological record, we should focus on the history of the development of tools and hunting practices.

The oldest stone tools date to 3.3 million years ago (mya), prior to the *Homo* genus (Harmand, Lewis, et al. 2015). These involved the reduction of a core by knapping, along with battering activities. Any such process is anticipatory; it presupposes an awareness of possibility, as well as insight into how desired change can be effected. By the time of the earliest Oldowan tools at 2.6 mya, their makers had a "sophisticated understanding of stone fracture mechanics and control" (Semaw 2000, p. 1197; see also Hiscock 2014). Notwithstanding this, the long-term conservatism of this lithic industry, which remained largely unchanged over a million years, suggests a relative absence of innovative thinking. These were not people who felt driven to improve and refine their technology!

The Acheulian came with early *Homo* at about 1.75 mya (Lepre, Roche, et al. 2011) and featured the introduction of the hand axe, a bifacial, tear-shaped, hand-sized cutting implement (Klein 2000; Lumley 2009; Jeffares 2010). The production of such axes required training and experience (Sterelny 2012; Barham 2013). As well as stone tools, the first bone tools occur at 1.8–1 mya (d'Errico, Henshilwood, et al. 2003). During the 1980s it was assumed that hominins at this time had to be meat scavengers, because they were thought to lack the intellect to plan and coordinate hunts of the large mammals that sometimes they ate (Stanford and Bunn 2001). It became increasingly clear, however, that, at this time in Africa, *Homo* hunters used opportunistic ambush hunting, rather than scavenging their food or exhausting their prey by running pursuit (Bunn and Pickering 2010; Bunn and Gurtov 2014).

Ambush hunting, along with the much later technologies of traps, nets, and snares, all involve anticipating the behavior of target animals. Even if the ambush technique of hunting is adopted opportunistically, planning and preparation are needed. Information acquired earlier must be applied to the current situation before catching can take place. For instance, laying an ambush at a site where a herd has been observed to ford a river (and then is especially vulnerable) requires sophisticated knowledge of animal movements and their timing, of elements of refuge and prospect in the local landscape, and the capacity to synthesize this knowledge ahead of the hunting event. Even if ambush is as uncontrived as sneaking up on animals that have been encountered by chance, a great deal of care, patience, and sensitivity to the animals and their environment will be needed for success. Ambush hunting could serve as a paradigm for counterfactual and hypothetical reasoning and is indicative of a developed, though perhaps circumscribed and specialized intelligence.

Meanwhile, beginning about 1 mya, raw materials were transferred over growing distances, suggesting development in trade as well as inter-group communication (Marwick 2003).

These early Pleistocene glimpses of technological and hunting intelligence should not be overestimated. But beginning about 400 kya (with *H. erectus*, *heidelbergensis*, and *neanderthalensis*) a highly suggestive confluence of elements emerges — a much more advanced level of technological sophistication and innovation, hunting practices requiring detailed planning and role-differentiated cooperation, which in turn are possible only with means of clear communication, and, as we will see, even the emergence of a concern with appearance and form in tools that hints at an aesthetic sensibility.

This period from 500–180 kya saw an increasing use of multipart tools, with hafted tools (especially in the range 280–180 kya) of special interest (see Barham 2013, chapter 5):

> In total, the making of a hafted tools [sic] involves 9 actions [e.g., obtaining raw materials] and between 29 and 99 understandings [e.g., of how to transport raw materials] depending on the type of haft used and if there is a need for adhesive, binding, and for re-hafting after use. By comparison, making a symmetrical and finely thinned hand-axe using an organic soft hammer involves 5 actions and 17 to 28 understandings. …

> Much of the additional cognitive load associated with hafting comes from the expanded range of materials involved and the potentially greater separation of activities in time and space. A compelling argument has already been made that the recipes and procedures used to make complex adhesives provide the best evidence we have for the existence of abstract reasoning in the early archaeological record (Wynn 2009). The act of putting together a composite tool also requires the ability to envisage the correct position of components (mental rotation) (Wadley, Hodgskiss, and Grant 2009), as well as the ability to hold in the mind chains of multiple thoughts (extended working memory). We could also speculate about the high levels of intentionality (theory of mind) and social learning embedded in hafting, as has been done for the making of hand-axes (Hallos 2005), but the case has now been well made by others for the complexity inherent in the combinatorial principle (e.g., Rugg 2011, Lombard and Haidle 2012). (Barham 2013, pp. 197–8.)

The oldest hunting spears are about 400 kya and were found in Schöningen, Germany (Dennell 1997; Thieme 1997). They were associated with stone tools and the butchered remains of more than ten horses. The capacity of these *Homo* hunters to kill such large, wild animals surely depended on pre-arranged cooperation. When hunting takes place in groups and requires the effective coordination of the participants, some form of planning will be necessary, especially when different individuals must take on different but meshing jobs within the enterprise. Think of the complex synchronization needed to drive wild animals off cliffs or into swampy ground, or to corral them so that they then can be attacked by other members of the group from above.

Hartmut Thieme observes that "the hunting spears and horse carcasses from Schöningen dramatically show that *Homo erectus*, and by extension Neanderthals as well, did not depend on scavenged meat ... but were instead sophisticated hunters ... *Homo erectus* in the Middle Pleistocene was fully capable of organising, coordinating and successfully executing the hunting of big game animals in a group using long-distance weapons. They therefore possessed some of the key capacities that have previously only been ascribed to anatomically modern humans" (Thieme 2005, p. 129). The same surely applies to *H. heidelbergensis* hunters 500 kya at Boxgrove, England, who ambushed and butchered aurochs, buffalo, deer, horses, rhinoceros, and other large animals (Fagan 2010; Stringer 2012). And to deer assemblages at cave hearth sites in Israel in the period 400–200 kya (Stiner, Barkai and Gopher 2009; Stiner, Gopher, and Barkai 2011; Stiner 2013). The Middle Paleolithic hominins who occupied these sites pursued big game, especially deer, and were cooperative hunters who transported high quality body parts to cave-based hearths for processing and sharing. Discussing one such place, Rivka Rabinovich and colleagues comment: "We interpret the Gesher Benot Ya'aqov data as indicating that the Acheulian hunters at the site (1) were proficient communicators and learners and (2) possessed anatomical knowledge, considerable manual skill, impressive technological abilities, and foresight" (Rabinovich, Gaudzinski-Windheuser, and Goren-Inbar 2008, p. 134). The claim here is not that these hominins had syntactically sophisticated, full-blown language, but that they could communicate effectively enough to formulate shared plans that assigned multiple roles for the execution of their hunting strategies (Collins 2013, pp. 115–16).

In the period under consideration, hafted tools did not supersede hand axes. Along with more primitive tools, these continued to be produced (Barham 2013). But beginning about 400 kya, a minority (about 2%) of hand axes were made to be "special." They were worked more than was functionally necessary until they were made perfectly symmetrical, or they were created from unusually colored stone, or from stone featuring mineral veins or fossils, or they were made in outsize versions that could not easily be used. These hand axes often seemed to be surplus to requirements and did not show signs of having been used for cutting.

These exceptional hand axes have been widely interpreted as revealing an aesthetic sensibility — a concern with beauty or awesomeness — in their makers (for example, Oakley 1981; Dissanayake 1988; Kohn and Mithen 1999; Mithen 2003; Corbey, Layton, and Tanner 2004; Currie 2009; Lumley 2009). Some have even suggested they were the first artworks (see Sandars 1985; Lumsden 1991; Currie 2011; Zaidel 2015).

Aesthetic ornaments often are vehicles for social messages about who we are. Those that are used deliberately to this end illustrate clear examples of symbolic behavior. But where aesthetic ends are pursued for their own sake alone, as might be the case here, do they also indicate the presence of a modern mind? This "pure" aesthetic divorces beauty from sexual attractiveness and separates it also from practical or functional goals. It suggests a creative or contemplative interest that looks beyond the everyday and finds something of intrinsic value there. Like an interest in religious or mystical experiences, this transcending of the ordinary can be interpreted as a symptom of behavioral modernity.

Of course, we must be careful in extrapolating from ancient tools and hunting practices to the mental life of ancient tool makers and hunters (Dibble, Holdaway, et al. 2017). And we should bear in mind the vastly long stretches of time over which behaviors and technologies changed only a little, if at all. We should also be wary, however, to avoid the extremely negative assumptions made by earlier generations of archaeologists about the intellectual capacities of extinct hominin species. The more we learn about Pleistocene hominins, the nearer to us they seem. At the very least, they mastered a great deal of practical knowledge and attendant skills, along with the social adroitness necessary for group living.

At 200 kya, were our hominin predecessors behaviorally modern? It is hard to say. Whatever the differences, these did not prevent us from interbreeding with Neanderthals (Hublin, Harvati and Harrison, 2006; Green, Krause, et al. 2010; Tattersall 2012; Ackermann, Mackay, and Arnold 2016) and with Denisovans (Gibbons 2011; Tattersall 2012; Cooper and Stringer 2013) when we encountered them in Europe and Asia. And in any case, they showed sufficient of the attributes thought to mark behavioral modernity that it is plausible to suggest that, when anatomically modern *H. sapiens* arrived on the scene around 150 kya, we were already equipped with the kinds of minds that the classic theory of behavioral modernity attributed only to Cro-Magnon *sapiens* of 40 kya.

6. The absence of evidence

Having abandoned the classic theory according to which we became behaviorally modern about 40 kya, and having turned from seeking symbolic thought to look for evidence of practical reasoning and cooperation, we have been exploring the possibility that behavioral modernity emerged gradually and partially in prior, now extinct, hominin species (*H. erectus*, *heidelbergensis*, *neanderthalensis*, and possibly others such as *denisova*, *floriensis*, *nadeli*, *luzonensis*) and that our species, *H. sapiens*, was behaviorally modern by about the time it was anatomically modern, roughly 150 kya. We will now consider some difficulties faced by this position.

The classic behavioral modernity thesis seemed to explain the (apparently) sudden efflorescence of sophisticated, creative thinking exhibited by Cro-Magnon *sapiens* in Upper Paleolithic Europe, accounting for this in terms of a brain mutation, and it also explicated the (apparent) absence of such behaviors at earlier times and places. The counterexamples listed previously eroded the story about *suddenness* and *absence*. But the revised view we have been exploring, that we were behaviorally modern from 150 or more kya, has to explain why the evidence of *sapiens* innovation is not more continuous and should identify what conditions led to the dramatic arrival of art, of religion, and of rapid technological change in styles of working stone in the Upper Paleolithic in Europe.

The first step in this process involves the rejection of an assumption mentioned earlier — that cumulative technological improvement, as each generation builds on what it inherited from the previous one — is a requisite indicator of modernity.

For current *sapiens*, this — what Tomasello (1999) calls the "ratchet effect" in the cultural transmission of knowledge and technology — is the norm. How long has it been so? Thousands of years, perhaps back as far as the Upper Paleolithic. But if we go by the African Middle Stone Age evidence, loss was relatively frequent. No doubt there were cases of innovation and creative thinking the evidence for which has disappeared. But there are also long gaps with no signs of bows and arrows, for instance, and there are cases like the replacement of Still Bay and Howiesons Poort technologies with more primitive ones. When we look in closer detail, we can find more recent cases of technological regression; for example, in the settlement of the Pacific (Henrich 2004) and in the isolation of Tasmania (Diamond 1978; Henrich 2004).

Rather than exclusively one of gradual improvement and consolidation in technological and cultural innovations, *H. sapiens*' history was more likely one of improvised discovery followed by loss, time after time. As the Middle Stone Age lithic industries show, advanced technologies might be sustained for thousands of years, but eventually disappear. Indeed, discovery followed by loss — technological snakes and ladders — may have been the most common pattern up to the Upper Paleolithic.

So, if not a dramatic brain reorganization, what drove this pattern? Two factors were mentioned in the quotation from McBrearty and Stringer given earlier — population density and environmental change. Stringer spells this out more explicitly while discussing the loss of technologies that took place in Tasmania (see also Potts 1998a, 1998b; Shennan 2001; Gilligan 2007; Stringer 2007; Bradtmöller, Pastoors, et al. 2012):

> In the past, … small populations would have been prone to population crashes and even to extinction, or forced into relatively rapid movement or adaptation to survive, and this could have led to the regular loss of innovations that might have been useful in the longer term. Thus repeated 'bottlenecking' did not just remove genes but also eradicated discoveries and inventions … and rapid environmental change or population movements would have had the same effect. … [T]he populations who progressed the most culturally … were able to network and pass on learning in large groups, and to maintain those group sizes most consistently through time and space. … Density was thus important for developing new ideas, but migration between groups was also vital, to ensure that such ideas had a better chance to persist and thrive, rather than decay and perish. (Stringer 2012, pp. 221–4.)

In summary, the perpetuation of innovations requires communities of sufficient size, communication between groups, and environmental stability. Climate or environmental instability and overpopulation can sometimes spur originality and invention, but can also give rise to technological regression.

The story is complicated and incomplete, but it looks as if it is possible to account for the creative flowering in Europe in the Upper Paleolithic in terms of just such factors (as discussed in Davies 2018). And, though the evidence is thinner, both the success and the failure of the Middle Stone Age industries in southern Africa seem to correspond to changes of the kinds identified as stimulating innovation and leading to its loss (Ziegler, Simon, et al. 2013; Davies 2018).

The possibility of providing plausible explanation of technological inventions, their perpetuation, and their loss by reference to relevant environmental factors supports, indirectly at least, the view that our pre-European ancestors had modern minds like ours.

7. Conclusion

We began with the 1980s classic model of behavioral modernity, which saw it as a development in Cro-Magnon European *sapiens* in the Upper Paleolithic, and we traced some of the revisions forced on this model by geographically widespread and temporally dispersed counterexamples. These suggested that, as a species, we might have been behaviorally modern from a much earlier period, say from 150 kya. In order to consider how elements of behavioral modernity might have arisen gradually in predecessor *Homo* species, thereby laying the foundation for its early appearance in our species, we looked for evidence of practical reasoning and role-differentiated cooperation, since these seem to underpin or presume intelligent, creative, and symbolic modes of thought. Sophisticated practical reasoning and complex role-differentiated cooperation were apparent to some degree throughout the *Homo* lineage, but more evidently so in the period 400–180 kya, which encompasses the arrival of our species. But though we might have been behaviorally modern from 150 or more kya, small numbers, population crashes, climatic instability, rapid environmental change, and the like often conspired to rob us of our innovations and achievements, at least until about 40 kya. This explains the patchiness of the evidence for behavioral modernity over most of our species' history.

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