# What is Behavioural Modernity?

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## 1. Establishing A Contrast

Evolutionary psychology has been dominated by a nativist program (Barkow, Cosmides et al. 1992; Pinker 1997). But in the last few years I and others have been developing an alternative model of the evolution of our mind (see for example (Tomasello 1999; Heyes 2003; Sterelny 2003; Jablonka and Lamb 2005; Richerson and Boyd 2005; Laland 2007) . That alternative emphasises four factors structuring human cognitive evolution. These are: (i) Cultural inheritance: we have complex cognitive adaptations — for example, the natural history competences of foragers — that are built by cumulative selection on culturally transmitted variation. (ii) We are adapted for cultural learning: Michael Tomasello, for example, thinks that joint attention is a key adaptation underpinning human cultural learning, allowing individuals to monitor, and learn from, the social and technical activities of others. (iii) Human cognition is plastic: very different phenotypes emerge from the interaction between environments and inherited resources. (iv) We develop in structured learning environments. So on this picture the culturally-mediated flow of information across the generations is reliable and of high fidelity in part because we are specifically adapted to suck information out of our parental generation and to pump it into the generation of our offspring (see for example ((Tomasello 1999; Alvard 2003) (Gergely and Csibra 2005; Csibra and Gergely 2006). But its reliability and fidelity also depends on the fact that we construct the learning niche of the next generation (see (Avital and Jablonka 2000; Laland, Odling-Smee et al. 2000; Sterelny 2003; Sterelny 2006)).

My aim in this paper is to show how this view of human cognitive evolution makes much better sense of an important debate in palaeoanthropology, a debate on the nature and origins of behavioural modernity. The central thesis of this paper is that behavioural modernity is an effect of the construction of the distinctively human learning niche. It is not an individual cognitive adaptation, or set of individual cognitive adaptations, but the interaction of such adaptations in an engineered informational environment.

In the palaeobiological literature, there is a significant and growing literature on the so-called problem of behavioural modernity. In its simplest form, the problem of behavioural modernity arises out of an apparent mis-match between the biological origins of our species and the origins and establishment of characteristically human behavioural patterns. Anatomically modern humans appeared on the scene roughly 250k years ago, and genetic evidence confirms that our lineage emerged as a distinct, independent lineage around that date. From about 250 kbp, there were anatomically and (roughly) genetically modern human populations in Africa. Yet these First Sapiens behaved (it seems) unlike any contemporary humans. Their material technology was much simpler; their foraging breadth was narrower; their social and cultural organization was more rudimentary. Moreover, these differences between First Sapiens and modern humans are not just the result of the spread of variation over time. As far as we can tell, the lifeways of the First Sapiens are not included within the (near-)contemporary range[1]. Those lifeways are extinct.

The existence of a contrast between First Sapiens and Moderns is not in itself surprising. Indeed, for there to be no major changes over time, some remarkable conditions would have to be met. We would expect First Sapiens to be included in Modern variation only if (i) the first humans were not just morphologically but genetically essentially indistinguishable from contemporary humans; (ii) individual cognitive capacity is essentially set by genetic endowment; genetically similar hominins are cognitively similar; (iii) the socio-cultural life of a community is a simple reflection of the individual cognitive capacity of the individuals within it. If those three conditions were satisfied, then a major contrast between us, and our genetically and cognitively identical ancestors of 200 k years ago would be indeed a surprise. I shall argue that (ii) and (iii) are false, and (i) may be false as well.

So it is not surprising that humans have changed. The task is to identify and explain those changes. To know how to explain a contrast, we need first to identify it. As far

[1] In considering the connection between history and disparity, Dan McShea makes a helpful distinction between passive and driven trends. A passive trend results from diffusion from a point of origin. As that initial lineage grows, splits, radiates, history will not preserve all the features of the founding lineage. Some of the daughters will differ from it and each other, and so variety will increase over time. A driven trend, on the other hand, leaves no daughters that still resemble the founding lineage. That suggests some form of bias, either as daughter lineages bud off, or in their survival. We are talking here, then, of a driven trend.

as I know, no-one doubts the presence of a real contrast between First Sapiens and Moderns. But there has been a considerable change in how the contrast is pictured. Until recently, it seemed as if the transition from First Sapiens to people like us was abrupt and co-ordinated. Somewhere in the band 50,000-40,000 kya, sapiens became human. Technology exploded, both in regional variation; in the size of individual toolkits; in the range of materials used, and in the complexity of individual tools. At the same time, the economic base of human life became broader. A wider range of animal species was taken, including those that are difficult or dangerous. Grains were gathered and ground to flour. Marine resources were added to the human menu, and long distance trade networks were established. These economic and technological changes were coupled to changes in how humans conceived of themselves in their world. For decoration, ornamentation, and (a little later) musical instruments, cave art and figurines appear. This pulse seemed so dramatic that some suggested that it had to be the result of some genetically-based final cognitive breakthrough (Bickerton 1990; Mithen 1996).

There is not yet consensus. The idea that this shift was sudden and co-ordinated still has defenders (Klein and Edgar 2002); especially, it is still argued that the European archaeological record shows a rapid and profound shift (Mellars 2005). But it is now widely accepted that many of the traits supposedly definitive of the Upper Palaeolithic revolution appeared earlier (though perhaps spasmodically, and in a more rudimentary form) in Africa. So McBrearty, d'Errico and Zilhao all note early use of ornaments and ochre; complex technology (using complex lithic technologies and nonlithic materials); a widening resource base; processed plant foods. These recent papers all suggest that the gap between earlier and later humans is perhaps not quite so dramatic as a simple reading of the record suggests. A good recent review of this material is (Conrad 2006). The same themes come through repeatedly. Features of material culture and foraging capacities that were once though to be diagnostic of the Upper Palaeolithic or Late Stone Age turn out to have anticipations in the Middle Stone Age (i.e. roughly 285,000 to 50,000 years bp). So there are Middle Stone Age examples of stone blades, hafted tips, and even standardised tool shapes. There are very old spears from Germany, showing projectile technology, and bone tools of varying levels of sophistication. In short, Conrad's review of artefact culture really

does seem to show many early anticipations of, and a slow build-up to, the Late Stone Age/Upper Palaeolithic (see also: (McBrearty 2001), p 92; (McBrearty and Tryon 2005) pp 260-261, and (Kuhn, Brantingham et al. 2004) pp 246-8[2]). There was a spread of the material base of technology in the Middle Stone Age.

Moreover, there is now no serious doubt that Middle Stone Age hominins were active and successful meat-eaters (through some mixture of hunting and predatory, bully-scavenging), and that they used some plant resources (though it is not clear that Middle Stone Age hominins had a modern sexual division of labour). There is very recent evidence that Middle Stone Age peoples used coastal resources in Southern Africa, though ones easily gathered from tidal pools (Marean, Miryam et al. 2007). The same report details a similarly early use of ochre, allegedly evidence of early symbolic behaviour, for the haematite chosen at Pinnacle Point seems to have been the brightest red available, and this, the authors argue, makes it unlikely that the ochre had a purely utilitarian function (Marean, Miryam et al. 2007; McBrearty and Stringer 2007). Indeed, this is one of many claims of early anticipations of so-called "symbolic behaviour".

So there has been a shift away from a pulsed model of the origins of behavioural modernity (according to which people began to live very differently because they now thought very differently) to more gradualist models of the shift to behavioural modernity. Many of these gradualist models (though not all) treat the European change as genuinely rapid only in so far as that change is a signature of the migration into Europe of Moderns. In these models, the "Upper Palaeolithic Revolution" is real, but not the result of dramatic change within a single lineage in a single region. Rather, it is the result of the replacement of one lineage by another (plus, perhaps, some hybridisation, as the peoples in place responded to the new arrivals in part by adopting some of their technology). The puzzle has shifted, but it is still a puzzle, if we think that ancient sapiens had essentially the same cognitive horsepower as those

[2] They think these various early anticipations of upper paleolithic technology (and, to some extent, symbolism) show that there was no special cognitive constraint preventing Middle Stone Age hominins innovating to Upper Paleolithic technology: the explanation of the fade-out of these earlier innovations was environmental or demographic. So they present, in effect, a multi-regionalist model of the cultural evolution of Upper Paleolithic technology and lifeways. That phenotypic space was invaded from multiple points in Middle Stone Age space quasi-independently.

of the last 50,000 years. Why did these humans take so long to generate the material and informational technology that is such an evident and dramatic feature of the last 50,000 years? Indeed, on some views Neanderthals before their extinction were in the early phase of their own transition to modernity, and they had sapiens-like cognitive horsepower (d'Errico 2003). If so, the problem is shoved still deeper, to the roughly 500,000 year bp split between the sapiens and Neanderthal lineages, with both branches having the capacity for the materially, ecologically and symbolically rich cultures of the late Pleistocene and Holocene. But if so, why did those capacities take so long to be expressed? And what capacities, exactly, are they, and how are those individual capacities related to their historical signature?

## 2. The Trait Complex Model

One approach to behavioural modernity is to construe it as a cluster of cognitive capacities that are both critical in themselves to the contemporary human range of variation, but which also have a detectable signature in the historical record. Perhaps the most influential paper in this genre is (McBrearty and Brooks 2000); a paper which persuaded many that gradualist models of the transition to modernity fit the evidence better than pulse models. McBrearty and Brooks argued that pulse models are plausible only if we focus on the European record. The African palaeoanthropological data show that the critical cognitive competences on which contemporary human life depends were present in African members of our species long before Europe's Upper Palaeolithic Revolution.

As they see it, these cognitive competences are: abstract thinking (the capacity to think about the elsewhere and the elsewhen); the ability to plan as an individual and co-ordinate with others; symbol-use; and behavioural and technological innovativeness. And they suggest potential archaeological signatures of all of these capacities. The most obvious are technological signatures of innovation. New lithic technologies (blades, microblades, backing); the expansion to new materials like bone and antler; a larger toolkit (eg projectiles) and an increased control of fire are all signals of innovation. Planning depth and co-ordination, likewise, they argue can be detected in the historical record. For example, the expansion of the human range,

especially into very challenging environments, requires planning and co-ordination. Thus humans arrived in Australia at least 45 ky ago, and that required many sea-crossings, some quite long. So the ancient human presence in Australia is evidence both of planning and of maritime technology (hence of technological innovation). Likewise, the capacity to consistently hunt without unsustainable risk large and dangerous animals is evidence of planning and co-ordination, not just of technological ability. The exploitation of seasonal resources and those which require long distance transport also show planning and local knowledge. Shifting (say) to the coast to exploit seals in their breeding season requires planning and co-ordination. The group as a whole shifts, and shifts because they know of a seasonal peak that they intend to exploit. Symbolic behaviour, too, they argue leaves a detectable signature. The most obvious is self-adornment with beads and ornaments, but it is also evident in the use of pigment, in decorated objects, in burying the dead, and in the imposition of style on utilitarian objects.

Of course these crucial human capacities are not instantly recognisable in the human record: they are recognisable only once they have been magnified by history and culture. For example, the capacity to innovate will only be recognisable once a cluster of innovations have established and spread. So we are not seeing origins in the record, but the cultural effects of capacities as their effects accumulate. We do not see the first instance of an innovation; we see it once it has become a routine feature of the community toolkit. But over time and place these elements of the modernity suite will leave traces. McBrearty and Brooks do not explicitly commit themselves to a view of the origins of these capacities. But given that they see the archaeological signature beginning to emerge in Middle Stone Age Africa, presumably their model commits them to the view that in their current form, these capacities originated with *sapiens*. They are not a shared Inheritence of sapiens and the Neanderthals from our joint, large-brained ancestors. And hence despite their obvious capacities, Neanderthals lacked the ability to be fully modern in our sense[3]. For otherwise we should see much earlier anticipations of modernity than the middle of the Middle Stone Age.

[3] So the comparison of Moderns and Neanderthals in glacial and interglacial Europe is important, as they faced similar environmental challenges. Until recently, Neanderthal technological capacity has been undersold. April Nowell has recently argued that if we compare Neanderthals with their temporal equivalents in Africa, rather than their successors in Europe, we see broadly comparable levels of technological and ecological capacity Nowell, A. (forthcoming). Cognition, Behavioral Modernity and

There are two fundamental problems with the McBrearty and Brooks account of behavioural modernity (and these generalise to similar models). How reliable is the archaeological signature of these cognitive capacities? And why select just these capacities? As (d'Errico 2003) reasonably remarks, we are given no criteria for selecting the criteria, and there are other candidate members of the human suite which seem as distinctively modern. Think, for example, of intergeneration skills transfer; extensive co-operation and a division of labour; advanced "theory of mind" skills; normative cognition.

I shall return to this second question, for there is a school of thought that takes symbolic use to be the breakthrough capacity. But I shall first discuss the issue of signal reliability. One crucial problem is that the economic foundations of life depend on environment and demography, not just cognitive capacity. So the fact that we do not see innovative technology, or the expansion of humans into new habitats, or the systematic exploitation of hard to capture or process foods (birds, fish, grain) might just show that those humans had no need to impose those burdens on themselves; not

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the Archaeological Record of the Middle and Early Upper Paleolithic. The Evolution of Mind, Brain, and Culture. G. Hatfield. Philadelphia, Pennsylvania Museum of Archaeology and Anthropology Press. For example, there is recent evidence that they controlled the use of fire expertly enough to make a birch pitch whose production required fine-grain temperature control (see also (d'Errico, F. (2003)). "The Invisible Frontier: A Multiple Species Model for the Origin of Behavioural Modernity." Evolutionary Anthropology **12**: 188-202. p193). That said, given the technological cline of increased complexity noted by Henshilwood and Marean, it arguably speaks against equivalent capacity that Neanderthal technology of roughly 50,000-40,000 bp seems only to be broadly comparable to that of their sapiens contemporaries. Despite their experience of the glacial/interglacial cycle, and the highly seasonal nature of their worlds, Neanderthal technology was not more complex than that of their contemporaries in Africa, as an environmental forcing model might predict. Despite having occupied Europe for much longer than the incoming moderns, and having spent a hundred thousand years on the glacial cross, they never produced the surge of technology and material culture Moderns produced in the Upper Palaeolithic revolution (see eg Mellars, P. (2005). "The Impossible Coincidence. A Single-Species Model for the Origins of Modern Human Behavior in Europe." Evolutionary Anthropology **14**: 12-27.), though this revolution might have taken the best part of 20,000 years. Thus Mellars notes the following upper Paleolithic innovations: improved blade technology; new scraper and burin forms; increased tool standardisation; complex bone, ivory, antler tools; personal ornaments, art forms, and music instruments appear and/or become much more common; long distance trade networks grow; missile technology improves; technological patterns change more rapidly, and domestic space is used in a more structured way. D'Errico argues that some of these innovations took place in parallel in late Neanderthal populations, but there seems little doubt that some of these are wholly or large Modern phenomena. Even here though it has been argued that the difference results from demography rather than differences in individual capacity, as d'Errico, F. (2003). "The Invisible Frontier: A Multiple Species Model for the Origin of Behavioural Modernity." Evolutionary Anthropology **12**: 188-202, Zilhao, J. (2007). "The Emergence of Ornaments and Art: An Archaeological Perspective on the Origins of "Behavioural Modernity"." Journal of Archaeological Research **15**: 1-54. argue.

that they were incapable of carrying them. It has been suggested (for example) that the "broad spectrum revolution" — the extension of the human ecological base to birds, fish, grain — was simply a response to the exhaustion of more valuable resources as populations expanded. It is the signal of new needs, not new capacities (Stiner 2001).

In particular, the Australian record is a serious challenge to the idea that we can read cognitive capacity off the archaeological record. The initial expansion of humans into the Sahul about 45,000 years bp could not have been accidental. There were too many water-crossings, some quite wide, for anything remotely resembling the "pregnant women on a log" scenario to explain human arrival. These humans were genetically modern, and they must have been in crucial respects cognitively modern too: they must have had the capacity to plan and co-operate. Moreover they had technology complex enough to cross significant stretches of ocean. However, before the Last Glacial Maximum, 20k years or so ago, the archaeological record resembles that of Middle Stone Age Africa. So for the first 25,000 years they were here, the first Australians seem to have a limited technological toolkit; exploited a narrow resource band, and showed very limited signs of symbolic culture. Only over the last 20,000 years, that same lineage developed the usual archaeological signatures of behavioural modernity: broad-range foraging; environmental management; technological innovation; obvious symbolic culture (Brumm and Moore 2005; Keen 2006; O'Connell and Allen 2007).

Along similar lines, (d'Errico 2003) has argued that the Upper Palaeolithic expansion of the technological toolkit has an environmental explanation (once again, in interaction with the changing demography of the humans in question), it reflects, he suggest "adaptive strategies unique to the problem of colonizing Europe" (p199) rather than the cognitive signature of sapiens becoming fully modern. Henshilwood and Marean develop a similar argument. They point out that amongst contemporary hunter-gatherers, there is a technological cline; as one moves from equator towards the poles. For as climates become more seasonal, agents need to invest more in storage, and that in turn both requires and allows more investment in tool complexity and maintenance (for there are long periods in which tool manufacture and upkeep have few opportunity costs) (Henshilwood and Marean 2006). The general point,

then, is that technology, foraging, and habitat occupation is the result of a complex interplay between individual cognition, demography and the physical and biological environment.

From the perspective of McBrearty-Brooks models, the most obvious threat is the false negative: latent capacities not manifest in the record. Could there be false positives as well; misleading signals of innovative capacity, symbol use, or abstract thought? Perhaps. There are many examples of apparent early anticipations of technologies or cultural practices that seemed not to permanently establish. They appear, then vanish. On one view, these anticipations show ancient latent capacities, and are yet further confirmation that technological variation in the human record over the last 300,000 years is a reflection of environmental and demographic variation, not a sign of change in human capacity to invent and use technology. But equally, these might be signs of technological sleepwalking; stumbling into good technological tricks, but not fully assimilating a chance discovery. The upshot, then, is that if we identify behavioural modernity with a complex of individual cognitive capacities, there is no uncontroversial signature of modernity in the archaeological record. I shall shortly suggest that there is a more fruitful way to model modernity. But first I need to discuss an alternative approach, one that sees symbolic behaviour as the core feature of contemporary human behaviour.

## 3. The Symbolic Species Revisited

> "symbolically mediated behaviour … has emerged as one of the few unchallenged and universally accepted markers of modernity" (d'Errico, Henshilwood et al. 2005)

Technology, resource harvesting and habitat occupation are driven by utilitarian motives, and these are sensitive to the resources offered by an environment, and the ratio of population size to resource envelop. So perhaps it is not surprising that archaeologists have come to focus on symbol use as the distinctive signature of the modern mind. Symbolic behaviour in all its manifestations, from language to art, style, decoration and ritual, seems genuinely central to what we are. Moreover, the archaeological record suggests that it is a recent development, and so distinctive of, not just universal to, sapiens (and possibly our large-brained sister species). In many

of its manifestations — art, music, style — it is not a response to immediate environmental demands. So we might suppose that the problem of latent capacity is less pressing. Technological innovativeness may be present but latent, because innovativeness is not necessary. But in many cases symbolic expression is not a response to environmental pressure, hence we have no reason to expect a capacity to be present but latent.

So one reason to focus on symbolic cognition is just the thought that we might be able to detect its presence more reliably than other elements of the modern cognitive suite. We will see that there is some reason to suspect that the reliability of symbolism's signature is oversold. But some also think that symbolic cognition is somehow fundamental to modernity (see for example (Wadley 2001; Henshilwood and Marean 2003; Zilhao 2007). Arguably, the use of public symbols is central to behavioural modernity because such symbols have transformed human groups. For one way human groups differ from animal societies is in being groups for themselves, not just groups in themselves (Cohen 1980). Individuals self-identity with their communities, and identity with their distinctive norms and customs. Physical symbols are a reasonable archaeological criterion of the existence of such groups; they are badges or insignias of group membership and identity

This focus on symbol use and group identity reveals a critical ambiguity in the idea of behavioural modernity. In the last section, we treated behavioural modernity as a feature of individual cognitive agents, though one whose archaeological trace is typically collectively generated. Individuals plan and invent. But groups shift to new habitat, occupy space, deplete resources, take up and spread innovations, and it is these collective activities that leave a trace in the record. Symbol-use can be thought of as an individual competence in the same way. But in another important sense, symbols are essentially public and collective devices. For their meaning depends on the conventions and responses of the community. Rituals, customs and norms are collective rather than individual phenomena, and often when archaeologists talk about the central role of symbol use in behavioural modernity, they have in mind the material traces of these group-defining activities. So for example, McBrearty and

Stringer clearly have this concept of the role of symbols in modern human life when they write:

> "The ability to manipulate symbols is considered an essential part of modern human cognition and behaviour, although definite traces of symbols in the archaeological record are difficult to recognize and are often obscured by the ravages of time. All humans today express their social status and group identity through visual clues such as clothing, jewellery, cosmetics and hairstyle. Shell beads, and haematite used as pigment, show that this behaviour dates to 80,000 years ago in coastal North and South Africa" ((McBrearty and Stringer 2007) p793)

If symbolic behaviour defines the transition to modernity because modernity is a transition in the nature of human culture, then behavioural modernity is a feature of human social worlds rather than individuals.

So one reason for focusing on symbol-use is the idea that there is a special connection between physical symbols and the distinctive form of contemporary social life. Of course, humans were social and cultural beings long before sapiens evolved. But pre-sapiens humans might not have been enculturated in just this way. Culture, mediated by the use of symbols whose meaning is determined by collective practice and collective response, welds people into members of a community that identify as members. Humans are not just members of communities; they think of themselves as members of communities. Human groups are "symbolically marked"; they share distinctive norms, customs, rituals and the like, and mutual knowledge of these shared aspects of life underwrite individual identification with groups in which they are embedded. For those that think of culture this way, the emergence of decoration, public art, "style" is the archaeological signature of the transition from a group in itself to a group for itself; from membership to consciousness of membership (Wadley 2001; Henshilwood and Marean 2003). Perhaps this form of cultural life is relatively recent, and marked in the record by early material symbols.

We might conjecture that if groups for themselves have only quite recently become a feature of the sapiens landscape (perhaps 80,000 years ago), their appearance will have made an earlier aspect of human culture more efficient, by making the advantage of information pooling more reliably available. Peter Richerson and Robert Boyd

argue that the features of psychology that make groups for themselves possible are adaptations for co-operation. Think how in our world how these public symbols — rituals, badges, decorations and styles — are co-opted in team sports, military units and the like. When this co-option works, defection and free-riding pose much less of a threat to co-operation (Richerson and Boyd 2001). This group-for-itself form of culture is built on top of, and enhances, an earlier and more widespread form of group cultural life, one based on the cultural transmission of information and expertise, as naïve individuals profit from their exposure to less naive ones. Information-pooling, and the co-operation of the knowledgeable with the ignorant will increase the efficiency and scope of the cultural transmission of environmentally relevant information. Culture in this information-transfer sense is certainly ancient (arguably, pre-dating the human-chimp split (Laland and Galef forthcoming)). But it is much enhanced by distinctively hominin capacities. Most obviously, language and imitation learning amplify the power of cultural learning. But so too, perhaps, do the psychological adaptations for groupishness, by making information-sharing more likely.

Symbol-use was part, though only part, of the McBrearty-Brooks individual cognitive competence model of behavioural modernity. It is plausible to treat symbol-use as part of the modern suite, because even if we think of behavioural modernity as a feature of individual cognitive agents, symbol-using is an distinctively human and sophisticated cognitive capacity. But this is true only of some kinds of symbols. The different aspects of culture distinguished earlier both depend on symbols, but on different kinds of symbols. Each of these make different cognitive demands on their users. So symbol-use contributes to both information flow and to the members of groups being aware of, and identifying with, the groups of which they are a part. But each job exploits a different kind of symbol. Understood one way, symbol-using really is a signature of cognitive sophistication. For example, Lyn Wadley (Wadley 2001) argues that symbolic cognition is the core feature of behavioural modernity, and in doing so, she relies on Terry Deacon's argument that the transition from icon to symbol in the evolution of language is a cognitive revolution. For the meaning of a symbol cannot be learned by any form of associationist mechanism (Deacon 1997). But Deacon's argument relies on two critical premises. First, words are arbitrary:

there is no iconic or mimetic element that supports interpretation, for (in almost al cases), there is no resemblance relationship between word and referent. Second, reference is (often) temporally and spatially displaced: we can and typically do use "tiger" to talk about tigers in their absence. Indeed, we talk about things which do not exist at all, in fiction and in myth.

Crucially, symbols that serve as insignias of social place and which are visible to archaeology need have no such properties. Ochre markings; face paintings; feathers and masks worn in ritual and ceremony are not temporally displaced. The ornaments a person wears to signify membership and status are on him or her; the practice of sending the king's ring in place of the king is not known to be part of Upper Palaeolithic social behaviour. Likewise iconic elements almost certainly played a role in decoration and ornamentation — for example, in emphasising or drawing attention to particular features. It is not (for example) an accident that swords or maces (rather, than, saw flowers or fish-heads) are often symbols of kingly status. Likewise, consider personal ornaments— shell beads, ostrich shell fragments. These seem to become common roughly 40 kya (and to be a part of Neanderthal life too). But there are a few examples of early personal ornaments[4]. What should we make of these early African beads? These clearly are not utilitarian in any mundane sense. But it does not follow that ornaments are symbols in the sense claimed by (say) (d'Errico, Henshilwood et al. 2005) in their account of the significance of 78,000 year old beads from South Africa. They say: "A key characteristic of all symbols is that their meaning is assigned by arbitrary, socially constructed conventions ... personal ornaments and art are unquestioned expressions of symbolism that equate with modern human behaviour." (p 4). But there is no reason to believe that the meaning of these beads is arbitrary. To the contrary: the rarity of these objects suggests that they are special, and so are most plausibly seen as expensive signals of status, skill, or success. They are Middle Stone Age Ferraris. And the whole point of Ferrari possession is that its meaning is not conventional or arbitrary. Its genuine cost means that its an honest signal of success.

[4] Though these are not very early: none are significantly earlier than about 100kya ago McBrearty, S. and C. Stringer (2007). "The coast in colour." Nature **449**(17 October): 793-794..

In short, understood one way, the ability of a mind to use and understand symbols really is a signature of cognitive sophistication. But those are not the symbols used in group self-identity, and hence are not the symbols whose presence becomes obvious in the Upper Palaeolithic and Late Stone Age. Social marking is not, in and of itself, obviously a sign of distinctive, trans-hominin cognitive capacities. If the expansion of symbol use in Upper Palaeolithic Europe, Late Stone Age Africa, and Holocene Australia is of central importance, it is because behavioural modernity is a collective phenomenon, not because the ability to use ochre or beads signals a transition in cognitive sophistication. One problem for the symbols-as-core-competence model is that it does not distinguish these two classes of symbol — social markers versus arbitrary and displaced referential devices — nor these two conceptions of modernity. Moreover, this model draws some of its plausibility from assimilating them: modelling modernity as a cognitively sophisticated new form of culture. The formation of groups for themselves may have been a socio-cultural transition stretching previous cognitive capacities, but not because ochre and beads pose especially intractable interpretative problems.

Moreover, symbol use (in the insignia sense) is not archaeologically transparent. Consider, for example, recent arguments that insignia-symbols have quite a deep African history, long pre-dating the Upper Palaeolithic (d'Errico, Henshilwood et al. 2005; Conrad 2006; Marean, Miryam et al. 2007; Zilhao 2007). The most systematic early examples of possible "symbolic behaviour" are burial of the dead and the use of ochre. But while there is evidence of fairly systematic burial of the dead, the significance of this practice is not clear. It is one thing not to treat as refuse the corpse of your father, sister, daughter. It is another to construct a magical narrative about their ongoing significance. Especially in the absence of grave goods, there is no evidence of magical narrative. In short, while burial of the dead is evidence of modern-like emotional attachment, it is not evidence of anything else. Ochre seems to have been quite widely used in the Middle Stone Age, with deep dates: some are very early Middle Stone Age, at roughly 280kya (McBrearty and Stringer 2007). But in thinking about ochre, the literature seems to have fallen victim to a false dichotomy. Ochre may have purely utilitarian purposes: as a preservative, insect repellent, or ingredient of glue. But suppose, in some cases, such mundane uses can be excluded. It

does not follow that the use of ochre is symbolic, either in the sense of displaced reference, or in the sense of social marking. It could, for example, be used in signal enhancement: making a face, a shield, a person more visible, startling or threatening. Imagine, for example spooking animals by suddenly emerging from cover in a game drive. Signal enhancement would make such a tactic much more effective[5]. Camouflage is another possibility: for example, using ochre to break-up contours. This suggestion seems especially relevant given recent reports of Neanderthal use of dark ochres.

Finally, it is quite possible that the archaeological signal is an effect of demography, not just the emerge of self-identifying groups. The demographic suggestion flows from the observation that physical symbol making emerges at different times in differing sapiens groups. "Symbolic marking" is pervasive in Upper Palaeolithic Europe, about 35, 000 bp; it is not pervasive in Australia until roughly 5000 bp ((Brumm and Moore 2005). According to the population-structure hypothesis, the appearance of physical symbols of group membership in the archaeological record has nothing to do with people first beginning to think of themselves as members of groups (Steven Mithen's hypothesis about the role of music is an alternative account of group solidarity that would make self-identifying groups an ancient feature of hominin landscapes (Mithen 2005)). Rather, it is the invention of advertising. Members of a group only needed to badge their identity – to wear insignias — once their social world became dense enough. After that threshold, they regularly met others who did not know them as individuals located in a specific network (Kuhn, Stiner et al. 2001; Brumm and Moore 2005) (Kuhn and Stiner 2007). That transition selected for physically advertising group membership.

## 4. Building The Accumulation Engine

> "Accumulate, accumulate! That is Moses and the prophets!" (Karl Marx, Capital, I, chapter 24)

[5] (For a somewhat similar suggestion, but in the context of interpersonal interaction, see Kuhn, S. and M. C. Stiner (2007). "Palaeolithic Ornaments: Implications for Cognition, Demography and Identity." Diogenes **214**: 40-48..

Let's return to the Australian case. (O'Connell and Allen 2007) interpret it as showing that people can be behaviourally modern without showing that they are behaviourally modern. For they suppose that the first humans to reach Australia must have been behaviourally modern, for they would have needed the central elements of the modern suite (minimally, planning and innovative technology) to arrive and establish. They then argued that because of environmental and demographic factors, modernity left no trace for upwards of 25k years. For many thousands of years, Australians were behaviourally modern without seeming to be behaviourally modern. They do not consider the idea that Australians ceased to be modern after they arrived. Neglecting this possibility makes sense if we think modernity is coded and canalised in individual genomes. (For while no doubt there were genetic changes in Australian, no-one imagines that any major genetic overhaul took place). But it makes no sense if behavioural modernity is wholly or partially constituted by the organization of social life. That might have changed fundamentally as small numbers of people dispersed into an enormous landscape. Nor does it make sense if behavioural modernity is a developmentally contingent feature of individual phenotypes. That is by no means impossible. For human development, and especially cognitive and behavioural development, is very plastic. Our "reaction norm" is broad. In different environments, the one set of genes will express very different phenotypes. In particular, human cognitive skills depend very heavily on the epistemic technology and communal information resources to which we have access.

In brief, there is no reason to assume that behavioural modernity is a fixed and genetically canalised feature of individual phenotypes; and that once behaviourally modern, always behaviourally modern. That will not hold: (i) if behavioural modernity is a feature of individual phenotypes, but one which is developmentally plastic, not emerging in all viable developmental environments; (ii) if behavioural modernity depends on an interaction between individual phenotypes and social environment; or (iii) if behavioural modernity is a feature of groups — the sharing of social symbols — rather than individual agents. I shall defend the second of these options: I shall defend the idea that behavioural modernity is a stabilised system of interaction between individual agents and their social environment. Specifically, it is

the stabilised interaction pattern that makes the accumulation of cognitive capital not just possible but reliable.

There is an important distinction between the conditions that allow information to be preserved reliably, and those that allow it to be expanded reliably. This difference allows us to make sense of the hominin record, which falls into three phases: a long phase of mere preservation; a not yet stable shift to expansion, and a final phase in which innovations and additions to the communal stock of information are much more reliably transmitted to the next generation. Thus hominin history began with a very long phase of technological conservatism. Technology did change, but very slowly. Long periods of technological, ecological and cultural stasis are punctuated by shifts to more complex technologies Simple chopping tools and flakes emerge approximately 2.6 million years ago in Africa and make a first appearance in Europe some time later. At about 1.6 million years ago, this technology is eventually supplemented with the classic Acheulian handaxe. These are bi-facially flaked, and often have a standardised "tear drop" shape. Middle Stone Age points begin to appear about 280k years ago, and this change signals the arrival of hafted rather than hand-held tools. These points require not just attachment to a shaft; the points themselves require a two-step manufacturing process. From about 200,000 years ago, technological and ecological traditions become less conservative. As we have already seen, there is innovation in this period which anticipates later technological revolutions, but often these innovations seem to fade out. The accumulation of innovation is not yet stable. The final phase, of course, is the signature period of behavioural modernity: innovation, regional variation, and expansion into all but the most forbidding habitats and inaccessible regions. This overall pattern records the shift from one mode of cultural transmission to another: from transmission being reliable enough and of high enough fidelity to be able to preserve key informational resources of a community to transmission being sufficiently reliable and accurate to allow informational resources to be accumulated and transmitted.

As I have just noted, the conditions that allow accumulation and transmission are much more onerous than those that merely allow preservation. For they demand both fidelity and bandwidth. Accumulation requires innovative small changes on

established practices to be transmitted, not just the base practice itself. And it requires an increase in the volume of information that is transmitted. These require both individual cognitive adaptations and the right social environment. In the intermediate period (I suspect) the individual cognitive adaptations have evolved, but have probably not yet fine-tuned. But the social and developmental environment necessary to accumulate cognitive resources have not yet stabilised. The cultural transmission of, for example, complex tracking skills requires tracking informational packages to be made available to the young. But they also require the learning environment to be reliably rebuilt in the next generation. Children need access to the expertise of those with the relevant skills; they need time and opportunity to practice; they need to be provided with feedback. For social signals of error are much less costly than the ones the world provides (Castro, Medina et al. 2004), and social signals can make subtle differences salient.

Moreover, the size and organization of the local community is extremely important to its capacities to accumulate new information, and to preserve those resources. In particular, population size and structure are relevant to the complexity of a group's information stock in at least three ways. (i) Redundancy plays a critical role in buffering the group's informational resources. Larger groups store information in more heads than smaller ones. Information can easily drift out of a small group, through unlucky accidents to those with rare skills ((Henrich 2004), though in response see (Read in press)). In addition though, as we shall shortly see, redundancy plays an important role in compensating for low fidelity cultural learning. (ii) Second, the selective regime changes in larger groups. As Haim Ofek has noted, a larger market size allows more specialisation and more division of labour, both of which impact positively on a group's informational resources (Ofek 2001). (iii) Finally, all else equal, a more diverse group with a varied skill set is more likely to innovate than a small, more homogeneous group.

Richard Dawkins has repeatedly pointed out that the biological evolution of complex adaptation requires the high fidelity transmission of genetic resources from one generation to the next; this includes the preservation and transmission of any fortunate change at generation N to N+1 (Dawkins 1996). Unfavourable mutations are edited

out by selection, but favourable ones must be preserved, if cumulative selection is to build complex adaptations. Likewise, cultural evolution is a hidden-hand process in which feedback mechanisms can preserve and amplify successful innovations, while culling less successful ones. So the cultural evolution literature is home to a vigorous debate on fidelity. Michael Tomasello argues social learning can transmit similarity over the generations only if it is reliable and of high fidelity. In turn, high fidelity social learning requires special cognitive adaptations; in particular, the ability to learn by imitation (Tomasello 1999). In response, Avital and Jablonka show that some information can be created and preserved without specific adaptations (Avital and Jablonka 2000). Traditions based on social learning can be stabilised by niche construction. An animal innovates successfully. As the result of that innovation, the animal's life ways are re-organised. The resource to which it now has access plays a central rather than a peripheral role in its ordinary ecological life. As a result, in those social species in which the offspring accompany their mother, ordinary exploration and trial and error learning (perhaps enhanced by the salience of adult activities to the young) will give the young many opportunities to learn to exploit the new resource. The initial innovation may have been a low probability event, but the transmission of the skill can be very probable, without any need to invoke high-cost cognitive adaptations.

This model fits Oldowan technology quite naturally. A successful innovation by a single individual or small group sparked a local re-organization of their lifeway around the new resource. That change automatically re-organised the learning environment of the next generation. So some accumulation and preservation is possible without specific adaptations for hi-fi social learning, so long as the social environment is friendly to the transmission of the new skill. The young have to stay with their parents, to be tolerated in close proximity while they play with what their parents use. Almost certainly, it is necessary for the young to find their parent's behaviour salient, for them to be inquisitive about what their parents are up to. Importantly, we do not need to suppose that adaptations for social learning preceded early, stable but simple and low bandwidth technological traditions. Rather, their establishment via niche construction created the selective environment favouring those adaptations. For once these lifeways establish and become typical for the

species (as lithic technology clearly did for early hominins), this sets up new developmental and selective environments. The initial shift to a lithic lifestyle depended on pre-existing mechanisms of adaptive plasticity; pre-existing potentials for manual dexterity; pre-existing foraging patterns. Once established, the new lifestyle will select for genetic variants that enable these new skills to be acquired with high reliability and low cost (it is easy to lose eyes and fingers flint-knapping). However, Tomasello's point is important too, even if initially over-stated. Imitation-learning allows a subject to learn not just the outcome of a procedure, but the procedure itself. The innovation-lifeway reorganisation-new learning environment cycle can explain how some innovations establish without dedicated mechanisms for social learning. But it cannot explain the transmission of fine-tuning innovation, which is the key to cumulative improvement.

Avital and Jablonka's ideas show that in an appropriately organised learning environment, agents do not need individual adaptations for social learning to learn socially. Peter Richerson and Robert Boyd develop a similar idea. They do not doubt the importance of individual adaptations for social learning. Modern humans are clearly individually adapted for social learning, and not just because we can learn by imitation. Imitation is just one element of a psychological complex which often involves the model as well, and hence mutual theory of mind skills. For social learning often involves joint attention, in which both the informed an the naive agent are aware of an object, and are aware of, and track, each others' awareness of the object-agent-agent triangle. But Richerson, Boyd and their colleagues doubt that these are high fidelity mechanisms, and argue that the social environment compensates for low fidelity through redundancy. Naïve agents have many opportunities to acquire specific skills and critical information, and they develop models to show that redundancy — for example, a naive agent using many models rather than a single model — can compensate for low fidelity one-on-one learning. Thus so long as there is sufficient redundancy, a population can preserve its informational resources in transmission to the next generation through low fidelity channels (Henrich and Boyd 2002; Gil-White 2005; Richerson and Boyd 2005; Henrich, Boyd et al. forthcoming).

However, while redundancy together with low fidelity transmission can preserve informational resources, allowing already established and widespread skills to be

copied via multiple trials to the next generation, such mechanisms will not allow small, incremental improvements to existing techniques to be preserved, copied to the next generation, and spread to be the foundation for further improvement[6]. For this reason, it is clear that the cultural learning characteristic of the Upper Palaeolithic transition and later periods of human culture — social transmission that demands both a large bandwidth and sufficient accuracy for a ratchet of improvement — requires both individual cognitive adaptations for cultural learning and highly structured learning environments. In the recent past, apprentice learning offers a good general model of the combination I have in mind. A skilled cabinet maker (for example) has absorbed an enormous amount of information and skill from his/her teachers. An apprentice obviously brings to the learning environment a complex set of individual cognitive adaptations: physical skills, theory of mind, joint attention, conditional reasoning, observation learning. Most apprentices acquiring complex skills benefit from explicit advice and instruction (though there seems to be enormous cultural variation in the extent of explicit teaching), and a good deal of information comes from the observation of expertise in action. Often, those learning share information too, about both failure and success. But most learning is hybrid: apprentices mostly learn through socially structured trial and error learning. They learn on the job, but they are assigned jobs by those who understand how much or little they can do. So their trial and error learning often involves structured trials. Skilled craftsmen assign tasks that they judge within, or close to, their current capacity. Those tasks build foundations for more complex skills. Failure and success are sometimes signalled from the task itself, but often the signals are social.. The overall result is that apprentice learning systems combine high fidelity with large bandwidth.

The Upper Palaeolithic revolution was not, of course, the result of the formation, 50,000 years ago, of a Palaeolithic equivalent of medieval craft guilds. But I do think that the information rich, expertise dependent, forager lifestyles of this phase of human life did indeed depend on a similar combination of the organization of learning with specific adaptations for social learning. The persistence of these lifeways depended both on models sharing their expertise and on the reliable replication of the

[6] Henrich and colleagues has developed redundancy based models on the basis of which they claim that they can explain accumulation as well. But in my view, those models have no plausible psychological interpretation; see (Sterelny 2006).

learning environment in which crucial expertise was acquired. Only thus can cognitive capital be accumulated; only thus did we become behaviourally modern.

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