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# The Origin of Modern Human Behavior

## Critique of the Models and Their Test Implications[1]

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Archaeology's main contribution to the debate over the origins of modern humans has been investigating where and when modern human behavior is first recognized in the archaeological record. Most of this debate has been over the empirical record for the appearance and distribution of a set of traits that have come to be accepted as indicators of behavioral modernity. This debate has resulted in a series of competing models that we explicate here, and the traits are typically used as the test implications for these models. However, adequate tests of hypotheses and models rest on robust test implications, and we argue here that the current set of test implications suffers from three main problems: (1) Many are empirically derived from and context-specific to the richer European record, rendering them problematic for use in the primarily tropical and subtropical African continent. (2) They are ambiguous because other processes can be invoked, often with greater parsimony, to explain their character. (3) Many lack theoretical justification. In addition, there are severe taphonomic problems in the application of these test implications across differing spans of time. To provide adequate tests of these models, archaeologists must first subject these test implications to rigorous discussion, which is initiated here.

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Genetic and fossil evidence currently favors a "single-origin" or "Out of Africa" model for the evolution of modern humans over the once-dominant multiregional-continuity model. The essence of the single-origin model is that biologically modern humans evolved in Africa, dispersed globally, and by 35,000 to 30,000 years ago were found throughout the Old World (e.g., Aiello 1993, Harpending and Rogers 2000, but see Wolpoff, Hawks, and Caspari 2000 and Eswaran 2002). While these models are typically framed and tested with the genetic (e.g., Quintana-Murci et al. 1999, Relethford and Jorde 1999) and anatomical (e.g., Day and Stringer 1982, Hawks et al. 2000, Stringer 1996) evidence, they have implications for an understanding of the evolution of human behavior. This is the focus of debate in the archaeological literature, and it is not new. For example, Clark and Lindly (1988, 1989*a*, *b*; Lindly and Clark 1990*a*, *b*) have argued that the single-origin model would predict a punctuated break in behavior between the Middle and the Upper Paleolithic, a break that they consider to have been absent.

Since then the single-origin model has gained increasing support, and, depending on the variant, it suggests some type of population replacement of nonmodern hominids (such as Neandertals) by fully modern hominids. The ultimate mechanism for this replacement is widely considered to be a behavioral difference between nonmodern and modern populations that lent an adaptive advantage to moderns. It is the nature of this behavioral difference that is currently being debated (d'Errico et al. 1998), and the debate is in its infancy.

Currently the disagreement is over the origin, age, and spread of modern human behavior. One source of this disagreement is the absence of a coherent body of theory defining modern human behavior (cf. Gibson 1996, Renfrew 1996, Foley and Lahr, 1997, Deacon 2001). Rather than focusing on the development of theory, many researchers have suggested behavioral traits (table 1) that

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TABLE 1
*Traits Used to Identify Modern Human Behavior*

| Trait | References |
|---|---|
| Burial of the dead as an indicator of ritual | Chase and Dibble (1987), Gargett (1999), Klein (1995), Mellars (1989*b*) |
| Art, ornamentation, and decoration | Ambrose (1998), Chase and Dibble (1990), Deacon (2001), Klein (1995), Mellars (1989*a*, *b*), Milo (1998), Renfrew (1996), Thackeray (1992) |
| Symbolic use of ochre | Chase and Dibble (1987), Clark (1989), Deacon (2001), Klein (1995), Knight, Powers, and Watts (1995), Mellars (1989*a*, 1996), Watts (1999), Thackeray (1992) |
| Worked bone and antler | Ambrose (1998), Clark (1989), Deacon (1989, 2001), Gibson (1996), Klein (1995), Knight, Powers, and Watts (1995), Mellars (1989*a*, *b*, 1996), Milo (1998), Thackeray (1992) |
| Blade technology | Ambrose and Lorenz (1990), Clark (1989), Deacon (2001), Deacon and Wurz (1996), Foley and Lahr (1997), Mellars (1989*a*, *b*), Thackeray (1992) |
| Standardization of artifact types | Klein (1995), Mellars (1989*b*, 1996) |
| Artifact diversity | Ambrose (1998), Ambrose and Lorenz (1990), Deacon (2001), Klein (1995), Knight, Powers, and Watts (1995), Mellars (1989*a*, *b*, 1996), Milo (1998), Thackeray (1992) |
| Complex hearth construction | Ambrose (1998), Barham (1996), Deacon (1989, 2001), Deacon and Deacon (1999), Gamble (1994), Klein (1995), Mellars (1989*a*) |
| Organized use of domestic space | Ambrose (1998), Deacon (2001), Klein (1995), Mellars (1989*a*) |
| Expanded exchange networks | Ambrose (1998), Ambrose and Lorenz (1990), Deacon (1989, 2001), Deacon and Wurz (1996), Klein (1995) |
| Effective large-mammal exploitation | Binford (1984, 1985), Klein (2001), Marean (1998), Marean and Assefa (1999), Mellars (1989*a*), Milo (1998), Thackeray (1992) |
| Seasonally focused mobility strategies | Klein (1994, 1995), Klein, Cruz-Uribe, and Skinner (1999), Milo (1998), Soffer (1989) |
| Use of harsh environments | Ambrose (1998), Ambrose and Lorenz (1990), Deacon (1989), Foley (1998), Gamble (1994), Klein (1994, 1995), Mellars (1989*a*) |
| Fishing and fowling | Deacon (1989), Klein (1995), Milo (1998), Thackeray (1992) |

are thought to be modern and concentrated on the empirical record for the antiquity and distribution of those traits (e.g., Clark and Lindly 1988, 1989*a*, *b*; Hayden 1993; Klein 2000; Lindly and Clark 1990*a*; McBrearty and Brooks 2000; Mellars 1995; Thackeray 1992; White 1982). For example, it has been argued that the systematic manufacture of formal tools from raw materials other than stone is a hallmark of modern humans (e.g., Gamble 1994, Klein 2000) and that pre-40,000-year-old hominids were scavengers rather than hunters of large prey and therefore not behaviorally modern. The ability to live in harsh environments such as high-altitude zones at high latitudes and harsh desertic environments is presented as a distinctly modern trait (Gamble 1994, Davidson and Noble 1992), and so is the ability to map onto seasonally punctuated food resources (Klein and Cruz-Uribe 1996, Klein, Cruz-Uribe, and Skinner 1999, Soffer 1989). Symbolic actions such as burial of the dead, production of personal ornaments and "art," and the use of ochre for decoration are further often-cited traits for identifying modern behavior (Mellars 1989*a*, *b*).

The collective idea appears to be that we can develop a litmus test for modern human behavior grounded in material correlates of specific behaviors considered to be unique to or indicative of a modern human intellect. Many discussions portray these behavioral traits as arriving as a package (Gamble 1994, Klein 2000), while others have argued that there could have been incremental addition over time (Chase and Dibble 1990, Deacon 2001). There is a tendency to frame the behavioral differences between modern and nonmodern anatomically modern humans as genetically coded differences in intellect. Klein (2000, 2001), for example, explains that a genetic mutation conferred a neural advance and thus behavioral changes currently unrecognizable in the evolution of cranial anatomy.

In recent years the disagreements have taken the form of a series of discrete models. (We use the term "model" here as it is regularly used in archaeology [a series of connected hypotheses, as in Clarke 1978].) Many of the originators of these ideas have since changed their positions, while the models are still current. Although these models provide a clear beginning agenda for research, testing of them can be effective only when we have developed a theory of modern human behavior. This development will require a vigorous debate over the quality and utility of the test implications (Hempel 1966) of these models. The purpose of this paper is not to construct an alternative model of modern human behavior and the timing of its appearance but to initiate this debate.

Currently these test implications are derived from the presence or absence of a suite of traits. However, test implications of this type depend upon a key auxiliary assumption (see Hempel 1966)—that, for example, bone tools are a measure of behavioral modernity. Auxiliary assumptions must be justified because the support or refutation of any of these models will only be as strong as the test implications employed. The empirical record for the presence or absence of these traits has recently been reviewed for Africa (McBrearty and Brooks 2000) and Eurasia (e.g., d'Errico et al. 1998, Villa and d'Errico 2001). We will focus here on how taphonomic issues complicate our evaluation of the presence or absence of the traits in the empirical record, whether the source of a trait is empirical or theoretical or both, and the epistemological legitimacy of particular traits as test implications for modern human behavior. Here we will address two questions: First, is this trait an unambiguous test implication for modern behavior? In other words, can we explain the occurrence of this trait by reference to other behavioral processes? And second, is the trait a sensible indicator of modern human behavior given what we know about technological systems, documented human behavioral variability, and the behavior of other animals?

## The Competing Models

Models for the origin of modern human behavior have tended to focus on the empirical evidence. Most of them have in common the idea that modern humans and modern human behavior evolved first in Africa. We will describe these models and provide names for them below. The construction of this series of competing models is original to us, and the names we have given them are not necessarily advocated by their proponents.

### THE LATER UPPER PLEISTOCENE MODEL

Prior to the 1990s there was widespread agreement that modern human behavior appeared only between 50,000 and 40,000 years ago. This fit the record well for a number of reasons. First, the record for this time span was (and still is) best represented in Europe (Chase and Dibble 1990), and it was obvious that the Upper Palaeolithic differed from the Middle Palaeolithic (Mellars 1973; 1989*a*, *b*), though some contested the presence of a punctuated change (Clark and Lindly 1989*a*, *b*; Clark 1992; d'Errico et al. 1998; Zilhão 2001). Second, there was the clear replacement of Neandertals by modern humans, and that population-level replacement provided an unambiguous mechanism for the entrance of modern human behavior.

As the single-origin model gained increasing support from the fossil and genetic record, the appearance of modern human behavior between 50,000 and 40,000 years ago still made sense for one critical reason. The evidence from the Levant suggested that the boundary between Neandertals and modern humans fluctuated with environmental change: Neandertals moved east and south into the Levant with colder climates, while modern humans inched out of Africa into the Levant with warmer conditions (Tchernov 1988, 1994). Advanced behavioral abilities enabled modern humans to spread rapidly north and west, overcoming this essentially climatically controlled boundary, at about 40,000 years ago. Within about 12,000 years Neandertals were extinct. This scenario lends itself to the suggestion that the tipping of the scales at roughly 40,000 years ago may have resulted from the introduction of a behavioral edge that evolved late, almost certainly in Africa. We label this the *Later Upper Pleistocene model*.

Proponents of this model (e.g., Klein 2001; Ambrose 1998; Ambrose and Lorenz 1990; Clark 1988, 1989; Binford 1984, 1985; Gamble 1994; Tattersall 1995) argue that it is only in the early Later Stone Age or very late Middle Stone Age (various dates are given for this event) that behavioral modernity can be identified in Africa. According to this model, even if Middle Stone Age hominids were anatomically modern, they were not behaviorally modern until sometime after 50,000 years ago. The origin of modern human behavior is seen as a punctuated event, and the traits are considered to have arrived as a package. Only Klein (e.g., 1995) has suggested a mechanism for this change: he argues that it occurred as a neural advance potentially unrecognizable in cranial anatomy.

According to the Later Upper Pleistocene model, the Middle Stone Age and the Middle Palaeolithic resemble one another typologically and technologically and the former differs from the Later Stone Age in the same way as the latter differs from the Upper Palaeolithic. Its advocates rely on the argument that a particular series of traits is representative of behavioral modernity and these traits do not appear until after 50,000 years ago. They identify the key features of Middle Stone Age/Middle Palaeolithic behavior as follows (Klein 1995, Gamble 1994):

1. Material culture was simple relative to that of modern humans. There were no formal bone or ivory objects and no drilling, polishing, or grinding. Fishing and fowling gear was absent. Lithic technology displayed little variation over time and space. The emphasis was on flake technology, with few end scrapers (mostly side scrapers), and raw material came mainly from local sources. Artifacts displayed continuity over time and a lack of diversity.

2. Subsistence was fairly basic. There was no fishing, no capture of flying birds, and no hunting of prime adult animals as dangerous as the Cape buffalo and the bushpig. Meat was acquired mainly through scavenging (the evidence for this being the head-and-foot pattern in faunal remains). Seasonal opportunities went unnoticed (for example, seals were scavenged in South Africa during seasonally unfocused visits). The ability to acquire various animals was limited, and this was both a consequence of low population densities and a contributor to those low densities (evidence for this being the large average size of tortoises and limpets). In general, resources were exploited less effectively than in later times.

3. Symbolic behavior (art, personal ornaments, ochre use for other than utilitarian ends) was absent.

Empirical evidence inconsistent with this interpretation is often explained away. For example, the unique characteristics of the Howiesons Poort substage in southern Africa are attributed to climatic stress and/or environmental change rather than to technological modernity (see Ambrose and Lorenz 1990), and Middle Stone Age bone tools at sites like Blombos Cave and Katanda are argued to be in questionable context (Ambrose 1998; Klein 2000, 2001).

A recent addition to this argument is that at ca. 41,000 years ago the earliest known evidence for "modern" human behavior in Africa occurs at Enkapune ya Muto in Kenya (Ambrose 1998). Key markers found at the site are Upper Palaeolithic-like blades and ostrich eggshell beads—the latter seen as implying an advanced symbolic system with "socially-mediated risk minimization and social solidarity" (Ambrose 1998). Implicit in this model is the notion that modern behavior occurred first in Africa, spread to Eurasia (presumably by migration of anatomically modern humans), and culminated in the Upper Palaeolithic event about 40,000 years ago. The net effect is that proponents of the Later Upper Pleistocene model link and compress into a 10,000–15,000-year time frame the evolution of modern human behavior, the migration of modern humans throughout the Old World, and the extinction of archaic hominids.

One could accept a punctuated event in culture change sometime after 50,000 years ago in Eurasia without accepting the Later Upper Pleistocene model. Bar-Yosef (2000:107) takes this guarded position: "A separate argument is related to the nature of the transition; whether it was rapid and deserves the status of 'revolution,' or a long and gradual process. My position, as explained elsewhere, is that the process was rapid and therefore deserves the definition 'revolution,' and it must have a core area outside Europe." Bar-Yosef notes that we currently do not know where, when, and why it developed. While accepting the revolutionary nature of the evidence, he rejects biological change as its stimulus (Bar-Yosef 2000: 141). Similarly, Chase and Dibble (1990) accept Mellars's (1989*a*) presentation of the Middle–Upper Palaeolithic break as revolutionary but reject, as Mellars does, any linkage between this event and the first appearance of modern human behavior.

### ALTERNATIVE MODELS

Several facets of the Later Upper Pleistocene model create an immediate tension. First, assuming that the hominids from later Middle Stone Age contexts are modern, it proposes a discontinuity between anatomical and behavioral evolution. It would be more parsimonious to argue that the capacity for modern behavior evolved in step with the overall modern human morphotype, particularly cranial capacity and organization. Second, there is no anatomical evidence (and there may never be any such evidence) for a highly advantageous neurological change after 50,000 years ago. Third, the once-airtight empirical evidence for a late occurrence of allegedly modern human behavioral traits is eroding as the intensity of field research on the Middle Stone Age increases (see McBrearty and Brooks 2000; Henshilwood et al. 2001*a*, 2002). One result of this tension is the recent development of models proposing the development of modern human behavior during or before the Middle Stone Age (Barham 1996, 2001; Deacon 1989, 1993, 2001; Deacon and Deacon 1999; Deacon and Wurz 1996; Foley and Lahr 1997; Foley 1998; Gibson 1996; Knight, Powers, and Watts 1995; Lahr and Foley 2001; McBrearty and Brooks 2000; Soffer 1994; Watts 1999; Wurz 1997, 1999, with qualified support from Bar-Yosef 1998, 2000; Chase and Dibble 1987, 1990; Clark 1989; Hublin 1993; Mellars 1989*a*, *b*, 1996; Renfrew 1996).

Advocates of these alternative models argue that Middle Stone Age and Middle Palaeolithic technology share some primitive features but differ in others (see McBrearty and Brooks 2000). Middle Stone Age technology is comparable to the Middle Palaeolithic in that it emerged from Late Acheulean prepared-core technology. Substages of the Middle Stone Age (including the Howiesons Poort) are, however, characterized by a higher level of blade production than the typical Middle Palaeolithic. Further, the aim in the Middle Stone Age was to produce standardized blades, a distinctly Upper Palaeolithic feature. Howiesons Poort–type formal tools—standardized retouched, backed pieces (e.g., segments and trapezes that were hafted to form a composite tool)—do not fit the concept of what is typical of Middle Palaeolithic tools, and their imposed form and morphological standardization have clear symbolic significance. Finally, formal bone tools are now documented for the Middle Stone Age but not for the Middle Palaeolithic.

Beyond this, Middle Stone Age subsistence is seen as similar to modern hunter-gatherer subsistence in a number of respects. First, it is eurytopic and comparable to that of the Later Stone Age, displaying management of plant food resources and the ability to hunt bovids of all sizes. The distribution of sites on the landscape is similar to that of the Later Stone Age, indicating that Middle Stone Age people perceived the potentials of different environments. The absence of fishing can be attributed to concentration on shellfish collection, which provided similar benefits with less energy expenditure.

Finally, it is argued that Middle Stone Age people had the capacity for symbolic behavior. Middle Stone Age sites often have high frequencies of pigments, and ochre is associated with color and the exchange of artifacts to maintain social relations. The use of space is similar to that in Later Stone Age cave sites (including, for example, individual domestic hearths surrounded by carbonized plant materials). The use of nonlocal raw materials is common, reflecting the addition of exchange value to tools and the promotion of social relations.

We recognize three distinct alternatives for the origin of modern human behavior: an Earlier Upper Pleistocene model, a Later Middle Pleistocene model, and a gradualist model. Proponents of the Earlier Upper Pleistocene model (Deacon 2001, Foley and Lahr 1997, Foley 1998) argue that the best place to focus our attention may be the Acheulian/Middle Stone Age boundary, 250,000 years ago or earlier and roughly corresponding to the oxygen isotope stage 8/7 boundary. One of the obvious problems with this view is the lack of sufficient evidence for human anatomical modernity at that stage. If humans were not modern, then this model presupposes that archaic humans had the capacity for modern behavior.

The Later Middle Pleistocene model would place the origins of modern human behavior nearer the end of the Middle Pleistocene (oxygen isotope stages 6/5), perhaps arising under the cold and arid conditions of stage 6, 195,000 to 128,000 years ago (Deacon 2001, Deacon and Deacon 1999). McBrearty and Brooks (2000) argue that many of the traits considered indicative of modern human behavior appear in the Middle Stone Age, primarily between 128,000 and 40,000 years ago. However, sites in Africa dating to the earlier Middle Stone Age are very rare, probably because populations were small and concentrated on now-submerged offshore platforms during stage 6.

Both of these models are consistent with a punctuated event in which modern human behavior originated as a package. The obvious alternative is that modern behavior evolved gradually and piecemeal sometime during the Middle Stone Age. The gradualist model is recognizable in the comments of Chase and Dibble (1990), Foley and Lahr (1997), Gibson (1996), McBrearty and Brooks (2000), and Renfrew (1996). Within these models there are numerous potential alternatives on the specifics. For example, one might argue that behavioral modernity evolved in the Levant first, since early modern humans were present there prior to 40,000 years ago. However, researchers appear to be looking to Africa for the origin of modern human behavior. While the rationale for this African view may be strictly evidential, it may also result from habit: most major steps in human evolution occurred in this seemingly precocious continent.

## Problems with the Behavioral-Trait Approach

Our brief synthesis of the various models for the origin of modern human behavior is designed to distinguish them sharply, even at the cost of some oversimplification. We consider this one of the first steps in developing a clear research strategy. Another step is the development of specific hypotheses and test implications for the models. Numerous test implications have already been suggested for each. McBrearty and Brooks (2000) review the empirical record in Africa for these traits, and their discussion makes it clear that many of the traits are derived from the European archaeological record.

Our goal here is to discuss the quality of these traits as test implications of the models for the origin of behavioral modernity. The strength of support or refutation of a model is only as strong as the test implications themselves. While there are many ways of evaluating the strength of a test implication, we will focus on three questions: First, is the test implication unambiguous? In other words, is the presence or absence of a trait best explained in only one way? Second, does the test implication have strong theoretical grounding? Third, are the empirical records for the Middle Stone Age/Middle Palaeolithic versus the Later Stone Age/Upper Palaeolithic taphonomically comparable?

We think that many of the traits have several deficiencies. First, they are empirically derived, leading to circularity, and the empirical grounding has its roots in Europe, particularly western Europe, and because they are context-specific this weakens their applicability to Africa. Second, many of the traits can be linked to resource or labor intensification and environmental pressure and thus may have nothing to do with the origin of modern human behavior. Third, some of the traits have weak theoretical grounding that undermines their utility. Additionally, each test implication is subject to a variety of taphonomic processes that are time-sensitive.

### EMPIRICAL DERIVATION AND EUROCENTRISM

Most of the traits involved are drawn from the long-recognized patterning in the western European archaeological record. This is evident in the close match between recent summaries of the trait list (e.g., Gamble 1994:157–74; Klein 1995:table 1) and one of the earliest formalizations of Middle Palaeolithic/Upper Palaeolithic distinctions from southwestern France (Mellars 1973:table 3). The European Middle Palaeolithic record is more temporally complete and chronologically secure than that of the African Middle Stone Age, with abundant excavated and published sites that document patterns of technological and cultural development. Additionally, reasonably secure correlations between human physical types and the archaeological record can be made, and changes in the behavioral and anatomical record occur within a relatively short time. Henry (1998:127; see also Chase and Dibble 1990) succinctly comments: "Had the pioneering efforts in defining the archaeological signatures and fossil associations of the Middle and Upper Paleolithic taken place in the Levant and southern Africa rather than Europe, our view of the situation likely would be quite different."

The Eurocentrically derived approach is not without its critics (e.g., Deacon 2001, Foley and Lahr 1997, Gibson 1996, McBrearty and Brooks 2000, Mellars 1996, Renfrew 1996). Chase and Dibble (1990), essentially rejecting the trait-list approach, argue that behavioral traits that characterize the Upper Palaeolithic need not be paralleled elsewhere and appear in different places at different times in response to local circumstances. Deacon (2001) points out that comparisons of technology and, by extension, behavior between the Middle–Upper Palaeolithic event and early modern people in Africa are spurious because of contextual differences. He argues that we should attempt to discern attributes of the African Late Pleistocene that serve to distinguish modern from nonmodern behavior and, in particular, concentrate on general levels of behavior rather than artifact markers. Basic environmental differences between Europe and Africa are one contextual distinction that militates against the use of many traits as a global measure of modern human behavior. Currently most of Africa is tropical or subtropical, with seasonality marked by shifts in precipitation and more muted changes in temperature. The result is that in many areas of eastern (Vincent 1984, 1985) and southern (Tanaka 1980) Africa plant foods are available year-round. In contrast, all of Europe is temperate or cold temperate and both precipitation and temperature undergo dramatic seasonal fluctuations, with the result that for prolonged periods plant foods are absent (see Marean 1997). During Pleistocene glacial advances these distinctions would have been amplified by the proximity of ice sheets in glaciated Europe and their absence in Africa. Thus, while Spain and the Cape of South Africa are reasonably similar in environment today, Spain suffered cold steppic conditions during glacial advances (Straus 1992) while South Africa remained temperate (Deacon and Lancaster 1988). These abiotic and biotic distinctions can be expected to have resulted in behavioral and technological differences between temperate and tropical zones that will confound attempts to use patterns in the European record as a measure of behavioral modernity in Africa.

For example, modern hunter-gatherer technological complexity is known to decrease from arctic to tropical environments (Oswalt 1973, 1976). The reasons for this are diverse, but a basic theory now exists (see Kelly 1995 for a summary). In environments with prolonged cold seasons, hunter-gatherers must store food to make it through long periods of limited food availability. Energy-rich foods such as carbohydrates and fats are particularly scarce from fall through early spring (Speth and Spielmann 1983). While much of Africa is subject to dry seasons, the lack of or reduced seasonal flux in temperature results in much less severe shifts in wild food availability. For these reasons, hunter-gatherers in cold and temperate environments must invest more time and effort in storage. Societies that store more also invest in technological complexity, curation, and tool maintenance for reasons generally linked to the technological requirements of surplus production (Binford 1977, 1980, 1982; Testart 1982; Kelly 1995). Woodburn (1980, 1982) has shown that these distinctions with regard to the use of storage have profound effects on the nature of economic and social systems that will likely be reflected in the archaeological record. These facts alone suggest that the temporal appearance of technological complexity in Europe and Africa may be occurring in response to processes unique to each context.

## RESOURCE AND LABOR INTENSIFICATION

Resource intensification—increase in productivity per unit of land coupled with a decrease in the efficiency of production (Boserup 1965, Earle 1980)—has long been viewed as a prime mover in hunter-gatherer technological and subsistence change among fully modern people (Earle 1980; Basgall 1987; Beaton 1991; Broughton 1994*a*, *b*; Cohen 1981; Price and Brown 1987). A prime mover for resource intensification is population pressure. It is important to note that population pressure is not the same as increasing population size; populations can be small but still under pressure. Also, populations can expand during relatively benign environmental conditions and then be stressed by climatic change that causes less favorable conditions and a reduction in exploitable land such as a change from interglacial to glacial conditions.

Several of the behavioral traits used as test implications for modern human behavior are clear candidates for an alternative explanation in terms of resource intensification. The most obvious are those that directly involve shifts in subsistence and the technological changes that often accompany them. The complexity of these technological changes is linked to mental capacity, but under benign conditions even if this capacity exists it may not be expressed as technological complexity (Chase and Dibble 1990, Foley and Lahr 1997). It may become archaeologically visible only when conditions justify the use of more labor-intensive behaviors.

Foraging theory posits that consumers choose from a potential list of food resources that are ranked with regard to net yield calculated from costs and benefits (Stephens and Krebs 1986, Krebs and Davies 1981). As high-ranked food items decrease in abundance or competition for them increases, consumers may be forced to broaden their diet, adding low-ranked items to their list of acceptable food items. The rarity of fish, flying seabirds, buffalo, and bushpig in the Middle Stone Age and their abundance in the Later Stone Age—a pattern recognized by Klein and argued to be evidence for the absence of modern human behavior in the Middle Stone Age—can be explained in terms of intensification (Deacon 1989, Marean and Assefa 1999, Minichillo and Marean 2000). The animals missing from the Middle Stone Age sites are either dangerous (adult buffalo and bushpig) or labor-intensive to procure (fish and flying seabirds). The former are low-ranked prey because their spirited defense strategies significantly raise their postencounter costs, thus lowering their net return rates relative to similar-sized but less dangerous prey (Minichillo and Marean 2000). Animals such as these could be added to the acceptable list of food items under several conditions: (1) population pressure that causes a direct broadening of the diet, (2) a decline of higher-ranked prey populations because of increasingly intensive exploitation, or (3) the development of new technology (such as the bow and arrow linked to poison) that neutralizes the handling costs associated with risk even though it is more labor-intensive to produce. Here the driving force behind the shift in technology is labor, not intellect. Fish and flying sea birds typically rank low in net return because the technology required is labor-intensive to produce and maintain and the process of capture is time-consuming.

The expansion into harsh habitats can also be explained in terms of intensification. Foraging theory argues that foragers should reside in a patch as long as the return rate is above the average for all of the patches in the environment (Charnov 1976). Thus they should not enter a patch or should leave it quickly if the initial return rate is lower than the average for the currently exploited set. This can be extended to the use of harsh or low-return habitats with a simple projection: foragers will not utilize low-return habitats if high-return habitats are available and productive. Foraging theory predicts that the expansion into low-return habitats could be stimulated (1) when increasing predation pressure in more productive habitats lowers their return rate because of resource depression, making the exploitation of harsher habitats acceptable, or (2) high-ranked habitats are already occupied and defended by other territorial hunter-gatherers (Dyson-Hudson and Smith 1978, Cashdan 1983). Additionally, populations could be displaced into lower-return habitats by other groups with technologies, social organization, or economies that lend them a competitive advantage.

Where labor intensification is reflected in the form of specialized tools made from high-quality materials, it is often coupled with resource intensification. The extraction of low-ranked food items often requires high investments in tool production and maintenance. Ground stone technology is perhaps the most often cited example (Horsfall 1987, Boydston 1989), but the same principle holds for other tools and the materials on which they are produced. Bone and antler tools, particularly ground and polished points, represent high-performance curated technologies, and their initial production is time-expensive because of the grinding it requires (Bergman 1987, Boydston 1989, Knecht 1997).

The intensification model has several strengths. First, it is firmly grounded in behavioral ecological theory, which has a strong record of epistemic value (Winterhalder and Smith 2000). Second, it encompasses other widely held explanations of technological and subsistence change in the archaeological record. Many changes in subsistence, habitat use, and technology analogous to those at the Middle–Upper Palaeolithic boundary occur in hunter-gatherer economies in many areas of the world during the Holocene, when there are undoubtedly modern people present (see Renfrew 1996). Third, it is consistent with the early appearance of several of the traits in table 1, a pattern that is taking shape as our record in Africa improves (McBrearty and Brooks 2000). Rather than attempting to explain away the empirical record, it is fully consistent with that record, with its sudden, often regionally isolated expressions of more complex material culture followed by periods of their disappearance and a gradual addition and perseverance of these traits over time until they reach sustained expression in the Holocene.

What we are arguing is that many of the traits used to identify behavioral modernity are easily explained by intensification and therefore are not unambiguous indicators of modern human behavior. The result is that we must eliminate these traits as test implications for the various models, at least until we can confidently separate the impact of population pressure from neural advance.

## THEORETICAL GROUNDING

The theoretical grounding of the traits used to identify modern human behavior has received scant attention in the literature. Here we target two points: (1) the legitimacy of the test implication relative to the variability expressed in that trait among modern hunter-gatherers, as well as other mammalian species, and (2) the way in which the trait articulates with our understanding of other aspects of technology. We illustrate the problem with just two cases: bone tools and seasonal mobility.

The use of the presence or absence of worked bone as a test implication for modern human behavior is exemplified by Klein's (1994:496) assertion that "like the Acheulians, MSA people, including the makers of Howiesons Poort artifacts, do not seem to have realized that bone, ivory, and shell can be carved, polished, or ground into 'points,' 'awls,' 'hide-burnishers,' and other formal artifact types." We question the technological assumptions underlying this assertion and its relation to variability in hunter-gatherer behavior. The recognition of raw materials as having properties that make them suitable for tool production must begin with some type of interaction with that raw material. The archaeological record shows us that Middle Stone Age/Middle Palaeolithic and earlier hominids regularly processed bone for marrow extraction, as is documented by the high frequencies of hammerstone-percussion marks on large-mammal fauna (Marean 1998, Marean and Kim 1998). Thus hominids were regularly given the opportunity to observe the conchoidal fracture properties of bone, its strength, and its ability to produce sharp edges (Johnson 1985). Furthermore, there is evidence that bone was used as a tool to flake stone (Chase 1990), a pattern observed in both the Zagros Middle Palaeolithic (Kobeh and Kunji) and the South African Middle Stone Age (Die Kelders 1 and Blombos Cave) sites (Henshilwood et al. 2001*a*). It is now documented that Acheulean hominids at Swartkrans found that unworked bone could be used as a digging tool (Backwell and d'Errico 2000), albeit in an ad hoc manner.

Given this long and close relationship with the structural properties of bone, it seems unlikely that these hominids did not recognize the potential utility of bone as a raw material. A more likely explanation is that they frequently chose not to use bone, and our focus should be on why. While antler and bone tools do occur abruptly in various places in Europe and southwestern Asia after 40,000 years ago, their occurrence is geographically patchy and typically late. Bone tools become a regular feature at African sites of the Later Stone Age only after 25,000 years ago (see McBrearty and Brooks 2000), and in southern Africa bone tools are rare before 10,000 years ago (e.g., Deacon 1984:290–91). A similar pattern holds for Australia, where bone tools occur patchily in the Pleistocene and become more common in the Holocene (Mulvaney and Kamminga 1999, Lourandos 1997). Recent evidence from Katanda (Brooks et al. 1995; Yellen et al. 1995; Yellen 1996, 1998) and Blombos Cave (Henshilwood and Sealy 1997, Henshilwood et al. 2001*a*) and a variety of other occurrences (see summary in McBrearty and Brooks 2000 and Henshilwood et al. 2001*a*) suggests that bone tools occur in a temporally and spatially patchy manner during the Middle Stone Age.

Antler is superior to bone as a raw material because of its greater workability and resistance to failure

(Knecht 1997), and this probably explains why the first Aurignacian organic tools tend to be made on antler (Knecht 1994). Antler is unavailable in Africa, and thus the cost-benefit equation for predicting a regular use of organic technologies differs between Europe and Africa. In Europe we might expect bone and antler tool technology to be a more regular part of the technological inventory, as is the case after the beginning of the Upper Palaeolithic, because of the higher net return rates of antler and the harsher environmental conditions. Labor-intensive organic technologies are likely to be less frequent and later in Africa simply because of these basic environmental distinctions.

The use of mobility strategies to measure behavioral modernity is another example of an argument with a weak theoretical basis: "The implication may be that that unlike LSA people, but like hyenas, MSA people occupied the coast year round. Alternatively, they may have been unaware of the seasonal peak in fur seal availability, and thus, killed or scavenged occasional individuals they encountered during seasonally unfocused visits" (Klein and Cruz-Uribe 1996:331). Such statements generally arise from empirical observations of patterning in the archaeological data (see also Soffer 1989). There has been little attempt to relate this trait to what we know about the way other animals exploit landscapes. For example, wild dogs in the Serengeti exploit primarily a seasonally moving resource, the ungulate migration, and their strategy of following the migration produces a seasonally structured pattern of land use. Some clans of spotted hyenas maintain a defended territory, but clan members often "commute" to intercept the migration during its absence from their territory (Hofer and East 1995). If we accept seasonal mobility as a test implication for human behavioral modernity, then to be consistent we must argue that some African carnivores are superior to Middle Stone Age/Middle Palaeolithic hominids in their ability to recognize and behaviorally adapt to seasonally punctuated resources. This seems untenable given the hominids' vastly larger brains. Wadley (2001) illustrates a similar argument with chimpanzees.

In summary, we believe that the justification of the trait list has been inadequate. Some of the suggested traits, such as seasonal mobility, lack justification because they fall within the behavioral abilities of other mammals with dramatically smaller brains. Other traits, such as recognizing bone as a raw material, lack justification because they conflict with other technological evidence.

### TAPHONOMIC SENSITIVITY

Taphonomy impacts the empirical record in at least two important ways. First, many of the material correlates of traits argued to indicate modern human behavior are sensitive to diagenesis. For example, the presence or absence of bone tools will be influenced by the preservation of bone, and given similar preservational contexts (geology, sedimentology, moisture level, etc.), Middle Stone Age bone tools are less likely to have survived the longer periods of deposition. Second, the processes of decalcification and organic decomposition will, over time, successively compact sediments such that the time resolution of older sediments will be, on average, less than that of younger sediments. This means that comparisons of Middle Stone Age with Later Stone Age patterning must focus on stratigraphic units that sample equal spans of time, because longer spans of time will increase variation (Martin 1999).

While the Eurasian Middle Palaeolithic record is relatively rich in faunal assemblages, this is not the case in Africa, primarily because of the predominance of acidic ancient basement rocks as the primary cave-bearing rocks. Alkaline contexts such as limestones are rare and occur primarily in parts of north and south-central Africa and isolated locations in South Africa. In South Africa most of the caves excavated to date are formed in quartzites, and where bone is preserved it is typically because the quartzites are capped by calcretes that provide alkaline conditions through water seepage (e.g., Klasies River). Thus, the number of excavated Middle Stone Age assemblages with preserved bone and our ability to understand the abundance of bone tools are limited. Well-known sites such as Elands Bay Cave, Nelson Bay Cave, and Montagu Cave have virtually no bone preserved in the Middle Stone age deposits. Die Kelders Cave 1 (DK1), Blombos Cave, and Boomplaas are exceptions because of a limestone environment. All the bone fragments from layers 10 through 15 at DK1, including the long-bone shafts that are often used for bone tool production, have been examined under a 10–40× microscope, and there are no bone tools in the Middle Stone Age deposits. A number of finds dated at 77,000 years ago from nearby Blombos Cave (Henshilwood et al. 2002) are typically argued to be absent in Middle Stone Age contexts and include bone tools, large fish bones, engraved ochre (Henshilwood et al. 2001*a*; 2001*b*:7), and engraved bone (Henshilwood and Sealy 1997, d'Errico, Henshilwood, and Nilssen 2001). We do not have a sufficient sample of well-excavated sites with bone to reach a statistically valid conclusion on the abundance or rarity of bone tools in the Cape (Henshilwood et al. 2001*a*).

Taphonomy also plays a role in our understanding of the content of faunal assemblages, particularly in the case of some recent evaluations of the evidence for seasonality. Klein and others (Klein and Cruz-Uribe 1996, Klein, Cruz-Uribe, and Skinner 1999) have studied the ages at death of Cape fur seals from a variety of South African sites. The seal remains from a limited sample of Middle Stone Age sites (Klasies River and DK1 MSA) represent seals that were killed during various seasons, while Later Stone Age sites postdating 12,000 years ago (Dunefield Midden, Elands Bay Cave, Kasteelberg B, DK1 LSA, and Nelson Bay Cave) show a much narrower seasonal signature. Klein and Cruz-Uribe argue that the best interpretation of this patterning is that Middle Stone Age people practiced a less seasonally focused mobility strategy, probably because of a lack of the intellectual capacity to map temporal shifts in resource abundance. These seal data are, however, subject to a simple taphonomic dilemma: the Middle Stone Age seal sample (from Klasies River) spans 50,000 years of seal exploitation, while all the Later Stone Age samples are drawn from much shorter spans of time, most from just 500 years or less of occupation. Long spans of time nearly always sample wider variation than short spans of time (Martin 1999). The causative mechanism in this case is that different ecological conditions and varying sea-level changes in the long Middle Stone Age period sampled would result in changing mobility strategies and thus the Middle Stone Age sample could be lumping varying seasonally focused occupations and creating the false impression of a seasonally undifferentiated signal (Marean and Assefa 1999).

## Constructing an Alternative Approach

By and large, the trait-list paradigm, characterized by an inductivist/observational research protocol in which structure or pattern in data forms an intrinsic part of the model and the significance of the pattern is arrived at intuitively (Clark 1997:63), has become the generally accepted perspective for defining modern human behavior despite its being based on a "collection of biases, preconceptions and assumptions about the nature of our knowledge of the world of experience" (p. 61). Archaeologists tend to look for solutions that amplify the credibility of the paradigm rather than addressing its validity (Kuhn 1978). We have argued above that the trait-list approach to identifying modern human behavior in the archaeological record is inherently flawed.

Construction of an alternative approach might begin with the very broad agreement that social intelligence and symbolically organized behavior are modern human behaviors (e.g., Chase and Dibble 1987, Stringer and Gamble 1993, Soffer 1994, Mellars 1996, Wadley 2001) and therefore that the aspects of the trait list dealing with symbolic behavior may be on the right track. Chase and Dibble (1987) point out a fundamental thread shared by all modern societies despite their "cultural" differences: behavior is mediated by symbolism. By learning these symbols individual cultures are identified and transmitted. Symbols are representative of social conventions, tacit agreements, or explicit codes that link one thing to another and are mediated by some formal or merely agreed-upon link irrespective of any physical characteristics of either sign or object (Deacon 1997:70). Words in a language are symbolic signs because their meanings are given by convention and they have a referential function (Noble and Davidson 1996:112). Syntactical language use—a combination of grammar, semiotic ability, and its pragmatic application (Wynn 1991)—is an integral part of modern human behavior.

The capacity for language probably existed in humans well before it was manifested in material culture. Hence it is widely assumed that the people who crossed to Australia ca. 60,000 years ago or produced paleo-art in Europe ca. 35,000 years ago were language users (Davidson and Noble 1993:363). In both cases language can be inferred from the transmission of information and mediation of actions that would have been essential within and beyond these communities.

Modern human behavior is defined here as behavior that is mediated by socially constructed patterns of symbolic thinking, actions, and communication that allow for material and information exchange and cultural continuity between and across generations and contemporaneous communities. The key criterion for modern human behavior is not the capacity for symbolic thought but the use of symbolism to organize behavior (see Wadley 2001). Donald's (1991) three-stage model provides a framework: (1) symbol use without symbol creation, (2) construction of conceptual space using language, and (3) application of external symbolic storage, allowing material culture to intervene directly in social behavior. The transition to symbolic literacy, for example, in the Upper Palaeolithic, begins, according to Donald, in the third stage (also see Donald 1998) and is a criterion for behavioral modernity.

Physical evidence for external symbolic storage has been proposed by a number of scientists as one test for modern human behavior (Donald 1991, 1998; Ragir 1993; Deacon 1997; Hodgson 2000; Bednarik 2000; Wadley 2001). However, the model is useful only if the symbols that represent external storage can be physically recognized in the archaeological record. The most comprehensive attempt at relating this model to the archaeological record is provided by Wadley (2001). Examples of recognizable external symbolic storage include art work, personal ornamentation, lithic style, and the social use of space. Art work, represented by paintings and engravings that are representational or abstract in form, provides definitive evidence for external symbolic storage and changes in systems of communication linked to new strategies in social communication (Deacon 1997, Hodgson 2000, Sherratt 2000). There is widespread agreement that archaeological evidence of representational or abstract imagery is unequivocally associated with modern human behavior (Henshilwood et al. 2002). There is no consensus, however, that the first art is temporally and spatially linked to the Middle–Upper Palaeolithic boundary in Europe (e.g., Bahn 1998, Hodgson 2000, Henshilwood et al. 2002).

Personal ornamentation such as beads and body painting with pigments are means of external storage of symbols that may have been used to establish cultural identity (Wadley 2001) and can be read by the archaeologist as signifying modern behavior. Although direct evidence for body painting does not survive in the archaeological record, the recovery of worked pigments such as ochre may be linked to early evidence for external symbolic storage. The objection (e.g., Klein 1995, Wadley 2001) that ochre may have served a purely utilitarian function has been effectively critiqued (Watts 2002).

Linking artifact style (lithic tools, modified bone, etc.) to modern human behavior is also contentious. Manufacturing an artifact involves repetitive, controlled action that alters the natural product to a desired shape. These sequences not only alter the natural world but also have an existence in their own right and can be transferred to other contexts linked to communication (Sherratt 2000:26). The series of operations involved in artifact manufacturing reflects socially constructed patterns of thinking within a community and provides evidence for changes in social organization as well as subsistence strategies and manufacturing techniques (Ragir 1993:1). Tools, tool-making style, and the use of specific raw materials are not necessarily representational or communicative in the same sense as language, and, although they are the products of a system of communal knowledge and practices, they do not necessarily have implicit communicative functions. Encoded symbolic meaning emerged with the advent of specialized craftsmen whose products conveyed stylistically and ideographically encoded information about function, ownership, and manufacturer (Ragir 1993:6). Distinctive and consistent artifact styles that change rapidly may be linked to the establishment of social identity and the communication of social complexity through the medium of the artifacts (Wynn 1996:279). This trend is typical of the Upper Palaeolithic after ca. 30,000 years ago and could provide a marker for behavioral modernity.

As Wadley (2001:208) points out, technological innovation cannot be simplistically linked with modern human behavior even though it might appear simultaneously. Artifacts that have an economic, secular role need not have functioned in a symbolic role. "It is not the invention per se of lithic spearheads or bone points and awls that proclaims symbolism and modern human behavior but rather the subsequent use of these artefacts for purposes such as the definition or negotiation of individuals or group identity." Once these formal systems of external storage or representation were in place, they could have served to stabilize channels of power, information, and material exchange within and across groups and between generations (Ragir 1993:12). The complex syntactical language essential for encoding these symbolic referents could have emerged simultaneously and allowed for the negotiation of power during periods of increasing social pressure and higher settlement densities. Language and symbolic systems would also have facilitated trade or exchange and aided movement and contact between subdividing populations.

## Conclusion

The origin of behavioral modernity will almost certainly continue to be a focus of anthropological inquiry. Within the past ten years it has joined the other big questions (e.g., Plio/Pleistocene hominid behavior, origins of agriculture, origins of the state) that have dominated archaeological research and helped shape the growth of the discipline. Along with most of the other big questions, it will go through a period of development in which various competing models arise and are tested against the data, some ultimately being set aside. An important aspect of this development is the construction of clear test implications for the competing models. In our review and discussion we have pointed to numerous problems in the construction of these implications. In order for progress to be made on the testing of these competing models, their test implications must be unambiguously measuring behavioral modernity. Unfortunately, in many cases the test implications have been applied before they have been carefully examined. Many of the traits can be explained as the result of other processes that have nothing to do with behavioral modernity, such as climatic variation and resource and labor intensification. Many of the suggested test implications have a Eurocentric context-specific bias that detracts from their applicability elsewhere, particularly to widely varying African environments. Most of them are empirically based, and there is a subtle circularity to arguments of this type. Finally, virtually all of them involve the presence or absence of material remains that are subject to the taphonomic vagaries of time-sensitive differential preservation, and this issue has been largely ignored.

At this stage in the debate, the Later Upper Pleistocene model is the most heavily dependent on the trait list as a set of test implications. This is because the sole form of evidence supporting this model is the alleged absence of those traits during the Middle Stone Age/Middle Palaeolithic and their appearance during the Later Stone Age/Upper Palaeolithic. If these traits are not effective measures of behavioral modernity—and we have argued that this is likely—then the current patterning neither supports nor refutes the model. Similar problems arise with attempts to support the various earlier Upper Pleistocene models. This means that the testing of any of these models will depend upon the construction of test implications that can be adequately understood within a context of environmentally sensitive technological and behavioral complexity and taphonomic realities. To date, these problems have scarcely been noted (but see Chase and Dibble 1990, Zilhão 2001), much less addressed.

Our suggestions have focused on fairly specific behavioral traits with immediate adaptive impacts, but we agree with various writers (Deacon 2001, McBrearty and Brooks 2000) that the most fruitful test implications may be the ones that target the complexities of more general behavioral systems. These would include things like the construction of exchange systems as a way to manage resource distribution and alliance networks or the development of egalitarianism, with its sophisticated system of checks and balances on the accrual of wealth (Wiessner 1996, 1999).

While direct archaeological evidence for syntactical language use is lacking, the recognition of objects carrying symbolic meaning can provide vital information on likely levels of advanced communication. Decoding the meaning of a design engraved on a piece of ochre or understanding why a bone tool is crafted much more carefully than necessary for a utilitarian object is difficult, but objects like these are strongly suggestive of the advanced levels of symbolic thought and language that were necessary for the development of modern behavior. Investigating this aspect of the human past holds much promise.

We contend that modern human behavior did not suddenly emerge at ca. 50,000 years ago and cannot be defined by the simple presence or absence of items on a Eurocentrically derived trait list. Seeking evidence of continuity from presymbolic to symbolic material behavior and focusing on behavioral systems that require substantial amounts of brainpower will produce a better understanding of what modern human behavior is and help to identify when and where it developed.

# Comments

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I am pleased to see that the concept of "modern behavior" is receiving scrutiny in the context of Africanist prehistory, where it threatened to take on a life of its own. Essentially, I agree with Henshilwood and Marean's analysis, but I would like to add a few supplementary comments.

The problem with the term "modern behavior" is that it can refer to a number of different things and each definition has different logical consequences for archaeological research. Taken at face value, "modern behavior" would include agriculture and e-mail. Since this is clearly not what Paleolithic archaeologists mean, what do they mean? I can think of at least four possibilities.

First, behavior may be called "modern" if it is associated with biologically modern humans. This is an empirical, not a theoretical definition and depends on a prior definition of biological modernity in terms of either morphology or speciation. Of course, such a definition is useful to the study of human evolution only if there is reason to believe that the change to biological modernity was related to the behavior(s) in question. Behaviors (such as agriculture or e-mail) that postdate the biological change will be irrelevant, as will behaviors (such as tool making) that modern humans share with other species. Using behavioral differences to explain the replacement of archaic by modern humans implies that behaviors meeting these criteria exist and may be documented in the archaeological record.

Second, if, as Klein (1995, 1999, 2000, 2001) argues, the archaeological record of morphologically modern *Homo sapiens* indicates initial behavioral continuity with earlier hominins followed by a discontinuity unassociated with either morphological change or speciation, then both the definition and the logic of "modern behavior" change. Modern behavior is still defined empirically on the basis of the archaeological record. If, as Klein suggests, there is a constellation of traits that appear more or less simultaneously and these indicate a neurological change that is morphologically invisible in the fossil record, then it is this constellation of traits that constitutes "modern behavior." At one level, this is essentially the same as the first definition, because modern behavior is associated with biological change. However, in the first case the basis for recognizing modernity is the fossil record, while in this case it is the archaeological record. The biological modernity of a fossil is determined not by its morphology but by its association with modern behaviors recognizable in the archaeological record.

Third, one may define "modern behavior" theoretically. For example, Henshilwood and Marean define it in terms of the use of symbolism to organize behavior. A theoretical definition arises from ideas about what is important in the human way of life, independent of the empirical facts of either the fossil or the archaeological record. Once it has been shown why this behavior rather than another should be used to separate modern from archaic, the fossil and archaeological records are used not to define modernity but to trace its evolution or to test the model.

Fourth, one may identify as "modern" the list of behaviors that seem to separate the Upper from the Middle Paleolithic in Europe. For me, as for Henshilwood and Marean, this is the least useful definition, but it seems to underlie (at least implicitly) a considerable amount of thinking and research. It is perfectly logical for those who see a sharp change of behavior in Europe to explain it, as Mellars (1991, 1996*a*, *b*, 1999) does, by the immigration of anatomically modern humans with new cognitive abilities. However, this is very different from arguing that the European Upper Paleolithic should be used to define modern behavior worldwide. There is no reason to believe, a priori, that Upper Paleolithic behavior is congruent with either of the first two definitions of "modern behavior" for the simple reason that both those definitions are empirical. The definition of modern behavior as symbol-based will not change whatever the empirical facts of the European Upper Paleolithic record turn out to be. Thus, as a foundation for research, the trait list of the Upper Paleolithic of Europe has no theoretical basis and no worldwide empirical basis.

It would probably be best if the term "modern behavior" were simply forgotten. It is all too often left undefined, which leads to confusion and potentially to unclear analysis. Terms such as "symbolically organized behavior" or "the behavior of anatomically modern humans" would cause less confusion. Second, the term all too often refers to a trait list based, for purely historical reasons, on the European Upper Paleolithic, a concept that, as Henshilwood and Marean point out, has little to recommend it as a basis for research.

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Every ten years or so there seems to be an important synthesis about the evolution of human behaviour (see

Mellars 1973, Dennell 1983, Gibson and Ingold 1993), and this paper seems likely to be important in the same decadal tradition. Over a period of nearly 15 years writing about the evolutionary emergence of language and its recognition in the archaeological record, Noble and I have covered several of the points raised in this paper. It is difficult not to agree with most of it, but I would place some emphases differently. Our 1991 paper (Noble and Davidson 1991) pointed out (p. 23) that "modern human morphology may be necessary, but is not sufficient to support language; hence the discovery of prehistoric skeletons having modern form does not constitute evidence that the behaviour of those creatures included language." Given the uncertainty about the attribution of skeletal remains to species (Collard and Wood 2000, Gibbs, Collard, and Wood 2000), the best evidence for modern human behaviour comes from the archaeological evidence supported by appropriate theory. While Henshilwood and Marean emphasize the archaeological evidence, they do not escape the biological trap altogether and seem to think that brain size alone may be an important feature. We addressed some of the many problems with this position in our 1991 paper, and I have argued elsewhere (Davidson 1999) that arguments about brain-size changes need to address all of the known history of changes in cranial capacity rather than attribute significance to changes around the dates when we think there are behavioural changes on other grounds. (Aiello and Dunbar [1993; Dunbar 1993] make the other error, positing changes while ignoring the evidence from archaeology.)

Modern mental abilities are involved both in the production of new artefacts and in the ways in which they function in society. It is true that "artifacts that have an economic, secular role need not have functioned in a symbolic role," but there is more to symbolic representation than this. Symbolic representation may be involved in the creation of artefacts of particular forms, and, indeed, even artefacts made as a result of symbolic representation may not have functioned in the sorts of symbolic ways that Henshilwood and Marean (and Wadley [2001]) are talking about. Mellars (1996*b*) stressed "imposed form," but there is some difficulty in operationalizing his concept. Imposed form was unquestionably present in the backed stone artefacts of the Howieson's Poort Middle Stone Age (Davidson and Noble 1993, Wurz 1999) and in the watercraft that brought the first people to Australia (Davidson and Noble 1992), but it is not easy to construct an argument that either of these functioned in a symbolic role for their makers. I would say that the bone tools from the Middle Stone Age of southern Africa also indicate the conceptualization that results from language use, and, against the authors, what is important is that they could be conceived. One, like the Tata tooth (Schwarcz and Skoflek 1982) or the Berekhat Ram modified pebble (d'Errico and Nowell 2000, Marshack 1997), might be an accident (however unlikely that is), but the repeated production of them cannot. It does not matter that they are not found in all sites. The point is simply that the hominins (now called humans) did make some and that the mental abilities required are consonant with the mental abilities to make backed artefacts, to use ochre, and to mark patterns on ochre and bone (d'Errico, Henshilwood, and Nilssen 2001, Henshilwood and Sealy 1997, Henshilwood et al. 2001*b*).

Putting it this way, though, raises further problems that Henshilwood and Marean do not address. First, are there other artefacts that required the same symbolic conceptualization as the Howieson's Poort backed artefacts? Second, are the watercraft that brought people to Australia the earliest such craft? For the first, some would see handaxes or the Levallois technique as indicating precisely the conceptualization in question. Indeed, some would argue that there was symbolic use of handaxes. No argument about the evolutionary emergence of modern human behaviour can avoid dealing with this issue (see Davidson 2002). In my view, symbolic construction, symbol use, and language are still not the simplest explanation for the apparent regularity of handaxes. For the second, it is necessary to deal with the early presence of hominins across at least two water barriers in Flores (Morwood et al. 1999, 1998; O'Sullivan et al. 2001) and there are arguments against this too (Davidson 2001, Smith 2001).

The story is not as simple as either Henshilwood and Marean or Noble and I have posited (Davidson 2003). Recent finds and reinterpretations (e.g., d'Errico and Soressi 2002) suggest that some behaviours that seem modern anticipated the better-known changes at the Middle/Upper Palaeolithic transition. None of the models we have discussed has taken into account the possibility that symbolic behaviour was precocious both in Europe and in Africa. We will have some hard thinking to do to interpret this. The situation will be made more exciting because linguists are now beginning to take seriously the issues of evolutionary emergence that have been out of bounds for them (Jackendoff 1999). The new synthesis that will emerge will take into account that the earliest symbolic communication and its associated behaviour did not look like modern human behaviour and the language was not like modern language.

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Henshilwood and Marean are forcing an open door in their critique of our current understanding of the human revolution in the Pleistocene. The precedent is the reevaluation of Childe's Neolithic revolution which began in the 1960s (Higgs and Jarman 1969) and arguably created, during the 1980s, the climate that recognized a fresh origins question concerning modern humans in the Late Pleistocene (Gilman 1984, Mellars and Stringer 1989). The reevaluation of the Neolithic revolution was fuelled by new data from both inside and outside the primary hearth of domestication in south-western Asia.

It also depended on new models and frameworks derived from ecology and ethology as well as significant developments in chronometric dating and the systematic recovery and analysis of biological data. Henshilwood and Marean assemble a comparable range of data to support their view that the origin of modern humans is Eurocentric and that the trait list which supports this cradle needs replacing.

I do not disagree with this conclusion, having previously argued against the use of trait lists for identifying complex hunters (1999:26) and questioned the utility of an archaeology driven by origins questions (2001: 171–72), however big they may be. No doubt the Afrocentric view presented here will be reevaluated in the next decade as work proceeds apace in India, China, and elsewhere. I am sure that the dating revolution that is currently under way for the preradiocarbon time scale still holds as many surprises as those first thermoluminescence dates from Skhūl and Qafzeh. Moreover, the geneticists, unless convinced otherwise, will continue to identify from their data alone when and where the "great leap forward" (modern humans) and the "second big bang" (agriculture) (Wells 2003) took place.

If archaeologists are not to be left in this genetic wake, then they need to ask what they want now that the door has been pushed open. The impression from Henshilwood and Marean is more of the same: a better definition of modern humans, more rigorously tested, that takes into account taphonomy and the patchy nature of fieldwork. They still want a universal definition of what a modern human is, and they also subscribe to an essentialist perspective. In short, they expect that some artefact categories will contain unequivocal evidence of that behavioural state, the modern human, so long as the definition, the testing, and the models are right. But here they are revisiting a problem identified by Binford (1972) at the time of the reevaluation of the Neolithic revolution, namely, that working towards definitions is not enough by itself to achieve a scientific explanation. This is the problem with trait lists and expectations that "the key criterion for modern human behavior is not the capacity for symbolic thought but the use of symbolism to organize behavior." Therefore we are to look for evidence of external storage while focusing "on behavioral systems that require substantial amounts of brain power." To complete the interpretive circle, this focus will apparently improve our definitions of "modern humans" and allow us to be more precise about where and when they/we appeared.

Recourse to a model involving "substantial amounts of brain power" takes us back to an earlier archaeological world that linked cranial size and stone tools in a progressive account of human evolution. In such accounts the essentialism was evident in interpretations of increasing intelligence through time. Where once the punch-struck blade was considered an advance on the flake, now we have symbolic behaviour as an advance on the presymbolic. Brain power and intelligence moved human evolution on in an apparently vitalistic manner, working towards our preferred definition.

Henshilwood and Marean try to tackle this problem by invoking population pressure rather than neural advance. However, they acknowledge that choosing between the two is currently impossible. They contend that resource intensification is brought about by increasing population pressure without telling us why the relationship is this way round and, more important, why population pressure occurs. For population pressure to have any explanatory value we need to know why dispersal and extinction were not options. To infer population pressure every time we find a piece of ancient ochre, a pre–Upper Palaeolithic blade technology, or a meal of tortoises returns us to our initial definitions rather than pointing to an explanation.

Henshilwood and Marean have provided a valuable critique of modern-human-origins research. I had hoped that they would use it to draw a line under such approaches and so redirect research into the archaeology of hominids. Others have undertaken this task. Ingold (2000:chap. 21) presents an alternative to the flawed concept of 30,000-year-old "modern" humans, which, as he points out, is as ethnocentric in its own way as the Eurocentric trait list criticized by Henshilwood and Marean. Proctor (2003) places such universal descriptions in their historical context while arguing, in concepts unfamiliar to students of human evolution, that the choice of when we became humans is a moral one. Dobres (2000) provides an approach to technology that is driven not by definitions and progressive change but by human action and involvement in the world. The lesson I draw from such approaches, as well as theoretical developments elsewhere in archaeology during the past 20 years, is that grand narratives are currently on hold, universal statements should be treated with caution, and local rather than global is currently king.

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Henshilwood and Marean have put together an extremely insightful and important contribution to the continuing debate surrounding the origin of modern human behavior and one which has multiple ramifications for both archaeology and human paleontology. Here I would like to focus on just a few of the ramifications for the latter discipline, especially with regard to Neandertal behavioral capabilities. Specifically, as the authors briefly mention, there is a well-known and long-standing inherent bias against the Neandertals. This bias in its simplest form is as follows: Most paleontologists agree that Neandertals (*Homo neanderthalensis*) are a separate species from anatomically modern humans (*H. sapiens*). Archaeological data suggest that these two species coexisted for a relatively brief period in Europe, shortly after which the Neandertals disappeared. Therefore, modern humans supplanted the Neandertals because of our species's superior intellectual capabilities (or the

Neandertals' inferior capacity). This conclusion, however, is certainly not a necessary inference from the archaeological data; biologists seldom invoke differences in intelligence in explicating similar replacement events. For example, the fact that wolves (*Canis lupus*) recently reintroduced into Yellowstone National Park are displacing the resident coyotes (*C. latrans*) is not argued to be the result of the latter species's inferior intellect. Only when our own lineage is involved is intelligence wheeled out as the adaptive linchpin responsible for our "triumph." I believe this bias to be the product of two phenomena. The first is the grip of the ever-pervasive 19th-century notion of inevitable "progress" from which we anthropologists have yet to fully extricate ourselves. The second is the fact that we humans continue to be enthralled with our own intelligence—it is one of only a few remaining features that we still consider to be "uniquely human." I do not discount the importance of human intelligence; I only argue that Henshilwood and Marean's analysis suggests (at least to me) that it would be imprudent to limit "modern" human intelligence to our species alone.

In this light, Henshilwood and Marean's definition of modern human behavior as that which is "mediated by socially constructed patterns of symbolic thinking" and may be recognized in the archaeological record in the form of artwork or personal ornamentation has special relevance to the study of Neandertals. It has been known for some time now that Neandertals produced personal ornamentation such as grooved and perforated animal teeth at sites such as Grotte du Renne and that red ochre was used by the makers of the Uluzzian industry, who are generally assumed to have been Neandertals (d'Errico et al. 1998). Whether one believes that these modern behavioral features were an autochthonous development (d'Errico et al. 1998) or due to some form of cultural exchange with anatomically modern humans (Mellars 1996*b*) is really irrelevant, since the capacity for fully modern culture was apparently selected for in Neandertals or their ancestors. Certainly the expression of these capabilities may vary between populations and/or by region, but, as Henshilwood and Marean have demonstrated, differential manifestations of many of the traditional "hallmarks" of modern human behavior are quite often explained by climatic variability, resource or labor intensification, and/or population density (or even taphonomic processes). I suspect that the expression of art and/or personal ornamentation is subject to many of the same forces. The bottom line is that Neandertals appear to share with us the capacity for what would broadly be considered modern human culture, and that the most parsimonious explanation for these shared capabilities is that they were present in the last common ancestor of the two species. Estimates for the timing of the cladogenic split between *H. neanderthalensis* and *H. sapiens* vary from ca. 250,000 years ago (Lahr and Foley 1998) through ca. 450,000 years ago (Hublin 1998) to ca. 700,000 years ago (Bermúdez de Castro et al. 1997), and thus it seems likely that the underlying mental capacity for modern human behavior actually evolved in the Middle Pleistocene among makers of the Acheulean (perhaps "Mode 3" Acheulean?) industry. Of course, any of the above dates implies such an early origin for modern behavioral capacity that behavioral modernity is clearly divorced from anatomical modernity, as the earliest evidence for modern anatomy is ca. 160,000 years old (White et al. 2003). I personally do not see this as particularly problematic and would like to offer the following semantic suggestion: perhaps we should stop referring to culturally mediated, complex social behavior as "modern" but rather refer to it as "fully cultural." This terminology does not invoke the notion of behavior and morphology evolving in lockstep with one another, nor does it imply that only one hominin species should be considered truly human.

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Henshilwood and Marean criticize the idea of a relatively abrupt shift towards fully modern behavior 50,000–40,000 years ago, arguing that it relies on a trait list that has no theoretical link to modern behavior and is Eurocentric. There is no theoretical reason to call the traits on this list "modern," but they were widespread among historic and recent prehistoric hunter-gatherers, and to me the key question is when they become widespread in the archaeological record. The answer is 50,000–40,000 years ago, and to the extent that these traits commonly characterize historic hunter-gatherers it seems reasonable to suppose that only people after 50,000–40,000 years ago were behaviorally modern in the same sense. The historic and late-prehistoric hunter-gatherers who provide the baseline were mainly extra-European, and the trait list is thus independent of Europe. A sharp increase in the extent of artifactual variability through time and space after 50,000–40,000 years ago suggests that the "modern" traits signal a significantly enhanced ability to innovate, perhaps grounded in neurological change.

Henshilwood and Marean dismiss the idea of neurological change because it cannot be tested from fossil skulls. However, genes that underlie cognition or communication in modern humans may provide an alternative check. The recent isolation of FOXP2, a gene involved in speech and language (Enard et al. 2002, Zhang, Webb, and Podlaha 2002), illustrates the possibility even if FOXP2 itself eventually proves irrelevant. Henshilwood and Marean argue further that archaeological evidence for enhanced innovative ability can be alternatively explained by foraging theory or taphonomy. Thus, they suggest that an increase in dangerous terrestrial ungulates and fish in southern African sites postdating 50,000 years ago might simply reflect resource intensification driven by increased population pressure. Perhaps so, but what, then, increased population pressure, and where is the evidence for an increase? One possible response is that the increase followed on a significant technological advance, but if so, how

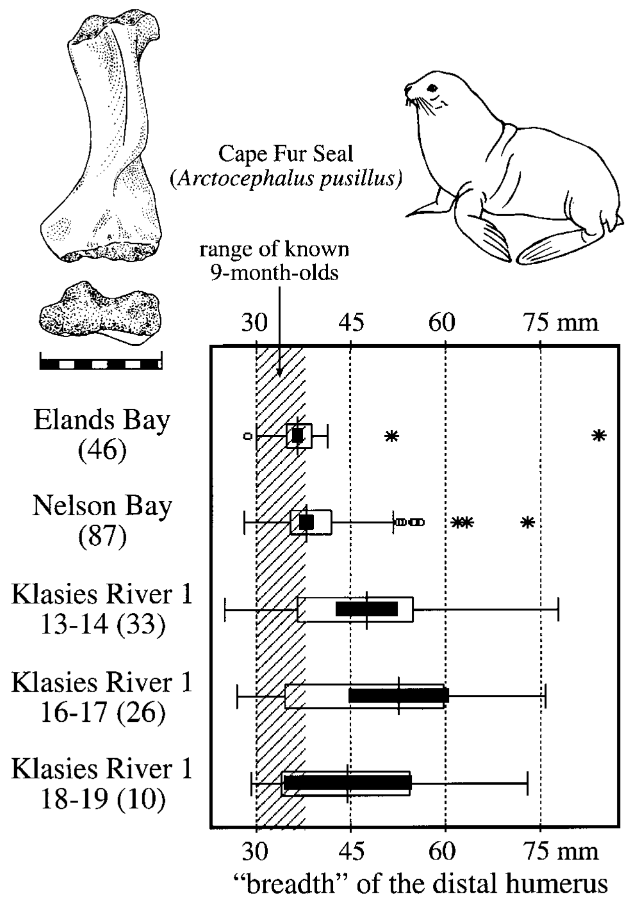


FIG. 1. *The "breadth" of Cape fur seal distal humeri in the samples from Elands Bay Cave, Nelson Bay Cave, and successive units at Klasies River (Singer and Wymer excavations). In each plot, the vertical line near the center is the median, the open rectangle encloses the middle half of the data (between the 25th and 75th percentiles), the black bar is the 95% confidence interval for the median, and the vertical lines at the ends mark the range of more or less continuous data. Circles or starbursts indicate outliers. The number of specimens in each sample is given in parentheses. Samples for which the 95% confidence limits do not overlap differ significantly at the 0.05 probability level or below. The hachured bar indicates the range for known 9-month-olds.*

would we differentiate the resource-intensification explanation from the neural one? The neural hypothesis could explain the technological advance, does not have to explain why similar resource intensification failed to occur during previous periods of comparable population stress, and depends only on the kind of selectively advantageous genetic change that must underlie much of earlier human evolution.

Henshilwood and Marean invoke taphonomy to explain a difference in fur-seal ages between the Klasies River Middle Stone Age site and a variety of Later Stone Age sites on the coasts of South Africa. The widely dispersed ages at death of fur seals at the Klasies River site suggest human occupation at all seasons, while tightly packed seal ages in the Later Stone Age sites suggest occupation centered on the August–October interval, when 9–11-month-old individuals are commonly washed ashore exhausted or dead and can literally be harvested. Only Later Stone Age people demonstrably had portable water containers in the form of ostrich eggshell canteens, and I have hypothesized that this allowed them to move away from permanent water when young seals or other local resources became less abundant (Klein, Cruz-Uribe, and Skinner 1999). Henshilwood and Marean counter that "the Middle Stone Age seal sample (from Klasies River) spans 50,000 years of seal exploitation, while all the Later Stone Age samples are drawn from much shorter spans of time, most from just 500 years or less of occupation." However, two key Later Stone Age samples—from Elands Bay Cave and Nelson Bay Cave—span roughly 11,000 years each, and they are on different South African coasts separated by more than 700 km of shoreline. If sampling within large time intervals would be expected to increase variability, so would sampling across such great distances. Yet my figure 1 shows that the Elands Bay and Nelson Bay samples both exhibit the same emphasis on 9–11-month-old seals, while the Klasies River sample exhibits a more dispersed pattern, even when it is subdivided among stratigraphically successive units that probably span about the same amount of time as the Elands Bay and Nelson Bay deposits. In this light, a difference in human seasonal movements is surely more likely than taphonomy to explain the observed contrast.

It is rare that archaeological observations all point the same way, and observers must then decide what is pattern and what is noise. To me, the vast majority of observations suggest that a dramatic behavioral change occurred around 50,000 years ago and it was this change that allowed modern Africans to spread to Eurasia, where they swamped or replaced the Neanderthals and other nonmodern people. The biggest obstacle to this idea is that there are few African sites in the 50,000–40,000-year range, and the postulated behavioral shift is predicated mainly on contrasts between sites older than 60,000 years and ones younger than 25,000 years. There is the additional problem that even if additional 50,000–40,000-year-old sites confirm the shift, the reason for it is not established. My own view, stated above, is that neural (genetic) change provides the most economical explanation, but this needs to be tested in the modern human genome.

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This paper, with its critique of the "trait-list" approach, is a welcome addition to the discussion of the origin of modern human behavior. In our examination of the African Middle Stone Age record (McBrearty and Brooks 2000), Brooks and I adopted a list of diagnostic traits for modern human behavior derived from the late Pleistocene European record because, largely for historical reasons, archaeologists were nearly universally agreed that the Upper Palaeolithic of southwestern France was the archaeological yardstick for behavioral modernity. We discussed some of the historical background to this peculiar situation and in fact argued that it was not really suitable for tropical Africa. But the recommendation of Deacon and Deacon (1999) that the African record be accepted on its own terms is difficult to operationalize and opens one up to the charge of special pleading.

Largely because *Homo sapiens* and Upper Palaeolithic technology appear in Europe at the same time, it is possible to assign the different technologies with some confidence to their correct makers: Neanderthals made the Middle Palaeolithic artifacts and *H. sapiens* made the Upper Palaeolithic artifacts. Unfortunately, in Africa the presence of multiple species in the late Middle Pleistocene renders attribution more complex. Recent finds from the Upper Herto Member of the Bouri Formation in the Middle Awash region of Ethiopia (White et al. 2003) show that *H. sapiens* was present there by 160,000 years ago. The Bouri evidence also shows that Acheulian artifacts, usually thought to have been made by *H. erectus*, persisted there until 160,000 years ago (Clark et al. 2003). Redating of the Kapthurin Formation in Kenya (Deino and McBrearty 2001) shows that Middle Stone Age artifacts, usually attributed to *H. sapiens*, appeared there before 285,000 years ago. There is therefore a temporal overlap of 125,000 years between the two traditions. Furthermore, Acheulian and Middle Stone Age occurrences in the Kapthurin Formation are interstratified (Tryon and McBrearty 2001). Chronological control for this period in Africa needs improvement, but *H. helmei* and perhaps late survivors of the more archaic *H. rhodesiensis* may have shared the Middle Pleistocene East African landscape with early *H. sapiens*. We do not really know whether the artifact arrays at the Kapthurin sites represent different aspects of a single, flexible technological tradition or were made by separate hominid groups, each with its own distinct technology, occupying the region intermittently.

How might we decide which, if any, Middle Pleistocene hominid group was behaviorally modern? The two features that Henshilwood and Marean favor as telltale signs of modern behavior are external symbolic storage and the use of style to negotiate group identity. As with most of the thorniest problems in archaeology, the difficulty is in linking theoretical criteria with observational data. External symbolic storage may be the easier to recognize. The best examples so far in the Middle Stone Age are Henshilwood's own find of incised ochre at Blombos, South Africa (Henshilwood et al. 2002), and the elaborately carved bone points from Katanda, Zaire (Brooks et al. 1995), both dated to > 70,000 years ago. Watts (2002) has argued for a symbolic rather than a utilitarian function for red ochre, and if we accept that, symbolic behavior mediated through the use of red ochre was present in Africa as early as 285,000 years ago and certainly by 230,000 years ago (McBrearty and Brooks 2000, Barham 1998, Barham and Smart 1996). The presence of style is a tougher nut to crack. Does the presence of different styles of projectile points in the African Middle Stone Age signify regional ethnic identities or simply independent technological trajectories in widely separated human groups? Here the problem of the long time span of the Middle Stone Age and the relatively small number of well-dated examples is particularly acute.

My own belief is that the cognitive capacity for modern behavior was present in earliest *H. sapiens* but that it took a few hundred thousand years to put together the package that we now recognize as modern behavior. How and why the speciation event leading to *H. sapiens*, with its accompanying cognitive change, occurred is a question that has yet to be addressed by paleoanthropologists. In contrast to Henshilwood and Marean, I believe that technological complexity itself is an indicator of modern behavior because it implies the presence of social learning. As Henrich and McElreath (2003:124) put it, "Foraging, as it is known ethnographically, would be impossible without technologies such as kayaks, blow-guns, bone tools, boomerangs, and bows. These technological examples embody skills and know-how that no single individual could figure out in his lifetime." The body of knowledge that a society accumulates over its history, combined with an ability to adapt to novel situations if required, allows one generation to build upon the experience of its precursors (Alvard 2003, Tomasello 1999, Boyd and Richerson 1985). The transmission of complex knowledge across generations and the spread of innovations are seen as key to modern human culture (Laland and Hoppitt 2003), but we must develop appropriate criteria and accumulate sufficient field data to recognize innovation and to determine when the behavior we observe is complex enough to be deemed "modern." That is the task ahead.

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Human societies 30,000 years ago were clearly different from those of ca. 100,000 B.P. Thus, it is appropriate to refer to the changes that occurred across the intervening time period as a "revolution." In the framework of the mitochondrial-Eve paradigm, this revolution came to be explained as a by-product of the emergence of anatomically modern humans. Henshilwood and Marean accept this framework and seek to show how the difficulties encountered by the various biologically based models of the origins of "behavioral modernity" relate to the use of Eurocentric trait lists. Their observations are all pertinent but fall short of recognizing that the real problem is that (1) archeologically visible behavioral criteria designed to include under the umbrella of "modernity" all human societies of the historical and ethnographic present are also shared by some societies of anatomically nonmodern people and (2) archeologically visible behavioral criteria designed to exclude from "modernity" all known societies of anatomically nonmodern people also exclude some societies of the historical and ethnographic present. For instance, Henshilwood and Marean argue that "external symbolic storage" is a "defining factor for behavioral modernity" and point to personal ornamentation as one means of such storage, but personal ornaments are a well-known feature of the Châtelperronian, and the use of manganese crayons is documented in the Mousterian of Acheulian Tradition of Pech de l'Azé I (d'Errico et al. 1998, Soressi et al. 2002, d'Errico 2003). Conversely, figurative art is not documented, at present, among anatomically nonmodern humans, but the same is true for many human societies of the historical and ethnographic present.

The use of Afrocentric trait lists does little to improve the situation, and indeed it is easy to see that the problem does not lie in the trait-list approach per se. For instance, it is not difficult to compile a trait list effectively discriminating 100% of the time between industrial and hunter-gatherer societies of the historical and ethnographic present. Ever since the 19th century, however, most anthropologists have refused to frame the differences between such societies in terms of the emergence of the biological capabilities required for the development of "industrial behavior." The problem with the "origin of modern behavior" is that the postulated link between modern anatomy and modern behavior makes sense only in the framework of the paradigm that (1) "archaics" (namely, Neandertals) and "moderns" are different species and (2) in the genus *Homo*, behavior is species-specific, and therefore archaics must have been behaviorally different from moderns. In simpler terms, the paradigm is that, organically and behaviorally, the Cro-Magnon people have more in common with, say, the contributors to CURRENT ANTHROPOLOGY than with penecontemporaneous "archaics" (namely, Neandertals). Simple common sense, however, suffices to show that, even if that assertion may hold where anatomy is concerned, it certainly does not hold when it comes to culture.

The point is that "human behavior," a.k.a. "culture," is cumulative, and therefore the passage of time, a.k.a. "history," is in itself a powerful explanator (through the buildup of social knowledge and population numbers) of differences between human societies separated by tens of thousands of years. In the framework of the realization that modern anatomy emerged in Africa and expanded from there to the rest of the world, a biological model for "modern behavior" was scientifically legitimate, but the model must be abandoned if it fails to produce testable propositions or if the predictions it generates fail to be confirmed by empirical evidence. Henshilwood and Marean point out that the only biological mechanism so far proposed to explain how modern behavior emerged among modern Africans is untestable, and the predictions derived from this model have all failed. The implication, therefore, is that the model can no longer be considered a scientific hypothesis.

Gilman (1984) suggested a theoretical framework for exploring the change in human lifeways between 100,000 and 30,000 years ago as a consequence of technological innovation and demographic success. In this framework, the biological transformations we observe in the osteological record are easy to understand (Zilhão 2001, Zilhão and Trinkaus 2001): skeletal consequences or correlates of cultural developments, indicators of the demographic processes involved (population extinctions, population bottlenecks, population movements, population admixtures, population replacements, etc.), or contingent, nondirectional changes with no definite adaptive cause that were retained simply by sexual selection or genetic drift. Moreover, since such cultural developments seem to have occurred across the taxonomic boundaries of human paleontology, referring to them as the origins of "modern" behavior is misleading. The "Upper Paleolithic revolution" or the "origins of symbolic behavior" may be old-fashioned, but at least they have the advantage that they do not implicitly convey the notion that we are dealing with processes related to the "genesis" of a small group of "chosen people."

# Reply

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One of the key goals of our paper was to initiate a discussion on the way we define modern human behavior and use that definition to recognize its occurrence in the archaeological record. A second key goal was to identify critical flaws in the current research paradigm for investigating modern human behavior and to begin to develop a new approach that is less ambiguous and more effective. The comments overwhelmingly indicate that current models for defining modern human behavior are badly in need of an overhaul.

Chase agrees with much of our critique and contributes a cogent discussion of the different things "modern human behavior" can mean to Palaeolithic archaeologists. He suggests that the concept may be overly burdensome and should perhaps be replaced with a protocol whereby we examine the evolution of such things as symbolically organized behavior. This is a useful suggestion and may eventually rise to prominence in this debate. Alternatively, there may be a distinct suite of traits that, taken together, describe modern humans in a unique way relative to other hominids. For example, wildlife ecologists regularly describe the scope and variety of the anatomy and behavior of a species (e.g., Estes 1991), and these descriptions form the definition of that species relative to others. No two species are exactly alike in their behavioral and anatomical repertoires, and these taxonomically based descriptions form the empirical starting points for the recognition of patterns in behavior and anatomy and eventually for the development of a general theory about the relations between such things as environment and social behavior.

Could we seek similarly succinct definitions of *Homo sapiens* and *H. neanderthalensis*? If they are different species (and we believe that they are), then a singular description must exist for each; otherwise their divergent evolution followed an evolutionary pattern unknown among other animals. The description of *H. sapiens*, then, would be our definition of "modern human behavior," and we believe that symbolically organized behavior would be at its foundation. We would extend this foundation by suggesting, in agreement with Chase, that we need a new term for "modern human behavior." He suggests "symbolically organized behavior" or "the behavior of anatomically modern humans." Holliday suggests dropping the term "modern" and replacing it with "fully cultural," but it is possible for a hominin to be fully cultural without being modern. We suggest "fully symbolic *sapiens* behavior." While Neandertals may display the rudiments of behavioral modernity (see comments by Holliday and Zilhão and our response below), these do not amount to fully symbolic *sapiens* behavior. The rare and relatively unspectacular finds associated with Neandertals that are interpreted by some as evidence for behavioral modernity were probably inherited from an ancient shared ancestor and were the building blocks for fully symbolic *sapiens* behavior in modern humans. Furthermore, the behavioral evolution of *H. sapiens* and that of Neandertals were probably separate evolutionary trajectories, and the tendency to conflate the two (as in the extension of the European model to Africa) is counterproductive.

Most archaeologists agree that the origin of modern behavior lies in Africa even if the date for this event is disputed. Most would also agree that *H. sapiens* were behaviorally fully modern when they arrived in Europe. Even if Neandertals after about 60,000–50,000 years B.P. were showing signs of behavioral modernity (for a review of the evidence see d'Errico et al. 2003, d'Errico 2003) it ended in an evolutionary cul-de-sac. We deliberately concentrated on the origin of modern behavior in Africa and contended that primary evidence from this continent should be the basis for the construction of any alternative modern-behavior model. Clearly, if *H. sapiens* were already behaviorally modern when they got to Western Europe, then we should not look to that continent when constructing models for the origin of behavioral modernity in Africa.

Finally, we stress "fully symbolic"; only when anatomically modern humans fully implement an inbuilt capacity for symbolically driven behavior (a capacity that may have developed over tens or even hundreds of millennia) can they be considered "fully modern." That some elements of symbolically driven behavior—for example, the use of ochre (see McBrearty)—may have appeared much earlier is clear, but does this constitute fully symbolic behavior? We see fully symbolic *sapiens* behavior as the culmination of a long line of developments toward modernity. The point at which we recognize it archaeologically must be when artifacts or features carry a clear symbolic message that is exosomatic—for example, personal ornaments, depictions, or even a tool clearly made to identify its maker. Symbols change through time because of remodeling of the original concepts. Individuals play a major role in this process, either stimulating changes in the meanings of symbolic representations or experimenting with novel material expressions of those representations. We may expect to find these mechanisms of cultural innovation operant even among early behaviorally modern societies, since they too must have been able to transmit arbitrary systems of beliefs and innovations. In the archaeological record this should result in representations that are identifiable as instances of the concept. It is the ability to store or display data external to the human brain, not the technology itself, that defines all extant humans as modern.

Gamble agrees that the current trait-list approach is fundamentally flawed, noting that he has argued against it as well. We agree that working toward definitions is not enough to achieve a scientific explanation, but it is just as clear that poor definitions stop scientific progress in its tracks. Debate on these issues, as many of the commentators agree, is in its infancy. Gamble refers to our approach as "Afrocentric," presumably as a riposte to our critique of the Eurocentric approach and a recognition that we both work in Africa, but the analogy fails for a simple reason. The prior approach was Eurocentric because the European record was and is so much richer and was therefore projected as a worldwide model, not because its main proponents worked in Europe and not because it saw Europe as the center of human behavioral evolution. While we believe that Africa is the core area for human behavioral and biological evolution, the record there is still so sparse and patchy that it is unlikely anytime soon to be able to serve as a model.

We reject Gamble's notion that our focus on symbolic behavior as the basis for modern human behavior is essentialist and no better than a focus on punch-struck blades. The most fundamental pattern in human behavioral evolution is the symbolically organized behavior made possible by encephalization. Explaining how, why, and when this capacity evolved and reached its current position in our species is not a goal tied to changing epistemological tastes. Rather, it is an "origins" question targeting the most significant bio-behavioral evolutionary event in the history of our species.

Gamble misunderstands our invocation of population pressure. We do not argue that population pressure explains the appearance of symbolically complex material culture. Rather, we make two points. First, several traits that are considered signs of behavioral modernity can equally well be attributed to population pressure alone, and currently the two explanations cannot be separated. For example, Gamble (1994) has argued that the move into extremely harsh environments points to the origin of modern behavior. We argue that it is equally likely to have been due to increased population pressure in higher-return areas and therefore we cannot use "harsh environments" as an indicator of behavioral modernity. Second, population pressure, through intensification, acts on the capacities of hominids for complex symbolic thought. For example, there is no doubt that Neandertals faced extreme pressure from glacial and periglacial environments, yet their technology remained fairly simple and there was very little fusion of symbolic expression with utilitarian items. When modern humans arrive in the early Upper Palaeolithic, we see a burst of elaboration and symbolic-utilitarian fusion. This is a clear difference and suggests that modern humans arrived with symbolic abilities. The same modern humans in Africa did not face the European stresses that stimulated these developments, and thus we anticipate a patchier expression of symbolic thought in material culture.

Davidson argues that we use brain size as a key marker for the emergence of behavioral modernity. Brain size is certainly one factor, but the neural organization within the brain must be more important. Neural reorganization within the human brain over millennia rather than as a punctuated event may have led to periods of rapid innovation or stasis, depending on selective criteria that favored or disfavored novelty and change, up to and beyond the period when humans became fully symbolic in their behavior. We therefore maintain that one cannot entirely separate biology from any modern-human-behavior argument—some linkage seems inevitable.

We agree with Davidson that bone tools in the Middle Stone Age indicate the conceptualization that arises from language use but caution that not all Middle Stone Age (or, for that matter, Later Stone Age) bone tools carry an implicit symbolic meaning. If we can recognize that a tool was made with symbolic intent or even that the marker employed a style that clearly distinguished that tool from others, we may then argue that it carries symbolic meaning. Language would have been essential to encode and transmit its meaning and very probably integral to the initial conceptualization of its manufacture.

Holliday notes that Neandertals have been subject to a long-standing bias: that modern humans, who replaced them, were intellectually superior. He points out that other animals regularly supplant each other but not because of intellect. When a species replacement occurs, as in the case of wolves replacing coyotes, it is because one species out-competes the other for the available niche space. Continuing Holliday's analogy, wolves outcompete coyotes by being more effective hunters (thus depressing the food available to coyotes), by direct predation as a result of their larger body size and larger group size, and by usurping kills. The difference between wolves and coyotes in anatomy and social structure are the key variables here. The fundamental adaptation of modern humans is culture and technology, and both are heavily conditioned by intellect. Therefore we believe that intellect must be considered an important potential explanation for the replacement of Neandertals by modern humans.

Klein's comments focus more on the specifics of the empirical record as a defense for his "neural advance" model. He disputes our argument that the Klasies seal data are difficult to compare with the Later Stone Age data because the Klasies data sample 50,000 years while the Later Stone Age data sample much shorter intervals. He argues that if sampling across longer time intervals increases variability, so should sampling across wider spaces, and rebuts by pointing out that Later Stone Age sites from opposite sides of South Africa show similar patterns. The logic here is flawed. Seal breeding patterns are a function of weather and physiology. The reason samples from a long span of time might show variation is that the dramatic climatic shifts and changes in sea level during the Middle Stone Age would have had impacts on animal mobility and breeding. Modern seals haul out and breed during the same seasons across South Africa, so for Klein's argument to hold they would need to show variability spatially today—and they do not.

It is useful that Klein presents his seal data separated by layer. They show two interesting patterns. The first, stressed by Klein, is that Middle Stone Age people took a wider range of seal age-groups than Later Stone Age ones. The second is that Middle Stone Age people focused on older seals, for the most part well above 9 months—a pattern first noted by Binford (1986). There are many ways to interpret the Klasies pattern; Middle Stone Age people may have had access to a rookery, and/or sea level and oceanic conditions may have been different from later ones, mandating a different strategy of seasonal mobility (Marean 1986). Klein chooses to interpret it to mean that Middle Stone Age people were not intelligent enough to map onto seasonal changes in animal abundance. As we argued in the paper, this is the least persuasive of arguments for this pattern, since numerous species of mammals have no problems mapping onto seasonally shifting food resources. It is interesting that Klein uses the hunting of dangerous terrestrial ungulates as a marker for modern behavior and implies that because Middle Stone Age people did not hunt large, dangerous animals they were not modern. Both Shea (2003) and d'Errico (2003) present good evidence that Neandertals were extremely successful and regular hunters of animals equally as large and dangerous as those found in Africa. Could it then be argued that this ability in Neandertals indicates their behavioral modernity, at least on this one count? Klein's published trait list (2000) does not suggest this to be the case, as it is derived specifically from the perceived behavioral differences between Cro-Magnons and Neandertals in Europe and he does not consider Neandertals behaviorally modern.

McBrearty notes that new finds in Africa show that the Acheulian and the Middle Stone Age overlap in time and that several species of hominids likely did as well. Her discussion highlights the critical importance of more fieldwork in the core area for the evolution of modern humans, Africa. As it now stands, we have a better record for a side branch, Neanderthals, than we do for our own evolution.

McBrearty suggests that our focus on external symbolic storage and the use of style to negotiate group identity may be too restrictive, and she would incorporate technological complexity. We agree with her reasoning here. Complex technologies cannot be easily learned, and their transmission requires years of concentrated effort. However, as we noted, the expression of complex technology is also subject to other processes often related to environment rather than intellect. It is likely that hominins in tropical Africa prior to 40,000 years ago had these capabilities but rarely expressed them in the form of complex technologies until they entered Europe, where the environmental and possibly social conditions added the stress needed for their appearance. This means that technological complexity will be a rather blunt instrument for identifying behavioral modernity in the Tropics, since its occurrence will be rare and patchy.

We differ from Zilhão and agree more with McBrearty and Brooks that the changes at 40,000–30,000 years ago were not a worldwide revolution, though they may have been a revolution in Europe. Africa shows a pattern of continuity across this boundary stretching back to 100,000 years B.P. at least. Both Zilhão and Holliday note that the criteria used to define modern human behavior, derived from modern people, are present among nonmodern people such as Neandertals. That is a matter for debate. While there might be evidence for symbolic behavior, it is so distinct from the record associated with modern humans that to us it suggests a fundamental behavioral difference. In contrast to the situation in Africa, the sample of Neandertal sites is huge, but the sample of symbolic material culture is tiny. Once modern humans enter Europe in the early Upper Palaeolithic, there is a dramatic expansion in the record of this symbolic expression. Furthermore, we know that modern hunter-gatherers inhabiting these northern environments have elaborate material culture with regular external symbolic storage. While there are a few isolated finds that suggest some symbolic activity among Neandertals, there is a difference in kind here that is impossible to deny.

Zilhão also notes that material cultural expression of external symbolic storage is sometimes absent among modern people. We agree, and this is central to our point about the European record's being a poor comparison to Africa. Clearly, tropical hunter-gatherers have far less complex material culture than upper-latitude hunter-gatherers. The result is that expressions of this type are rare, but this is not because these hunter-gatherers lack the ability to produce them. Rather, it is because the environmental conditions—pressure and the resulting labor intensification—that stimulate expressions of external storage are not there on a regular basis. However, when those same modern Africans enter Europe, with its colder conditions, there is an explosion of this sort of activity.

Zilhão argues that the model for an African origin is unscientific if the only proposed mechanism, Klein's neural-advance model, is untestable, but hypotheses for the occurrence of an event do not require that the mechanism be known. For example, hypotheses for the timing and occurrence of climatic shifts can be put forth and tested without any mechanism's being proposed. We know that farming occurred in the past, but we do not know (or do not agree) on the mechanism that stimulated it to occur. The problem with Klein's model is that the proposition itself is untestable (though that may change); the mechanism (mutation followed by differential selection) is widely accepted theory.

There is no single paradigm, and there may never be one, for defining exactly when, where, and how humans became behaviorally modern. As pertinent new evidence becomes available, the modern-behavior model will continue to be rebuilt and redefined. We believe that we have laid the groundwork for an alternative way of approaching the origin of fully symbolic *sapiens* behavior.

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