

Why Neanderthals hate poetry: a critical notice of Steven Mithen's *The prehistory of mind*

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ABSTRACT *The significance of historical advances in human development has been widely debated within cognitive science. Steven Mithen's recent book, The prehistory of mind (London: Thames & Hudson, 1996), presents an archeologist's attempt to explain the details of cognitive development within the framework of modern anthropology and cognitive psychology. We argue that Mithen's attempt fails for a number of different reasons. The relationship between the archeological evidence he considers and his conclusions is problematic. We maintain that it is difficult to draw biological conclusions from strictly behavioral artifactual evidence. To buttress his claims, Mithen borrows heavily from the very cognitive science literature to which he hopes to contribute. As a consequence, his analysis of the archeological evidence cannot promote a particular cognitive theory, since his interpretation is only as strong as those theories from which he borrows. We are also concerned that the specific details of Mithen's program are equally problematic. Mithen's claim that modular intelligences did not exist outside of hominid evolution is likely false and unwarranted. As a consequence, we argue that the central component of his claim that the uniquely human feature of our development, the move from modular to fluid minds, depends on poorly defined distinctions between a wide range of mental processes. Whether we can accept Mithen's characterization of these claims will depend, we argue, on how he chooses to clarify these terms. We suggest that the various choices will be difficult to reconcile with his theory. Moreover, we suggest that the phenomena that Mithen hopes to explain in human development cannot be explained strictly in terms of analogical reasoning. We nevertheless find Mithen's attempt at answering these questions to be both a constructive and fascinating foray into what is an under-explored topic.*

Introduction

The received view of human origins stresses relatively long periods of behavioral stasis, punctuated by brief yet crucial periods of innovation. True bipedalism, for instance, which might be the seminal hominid behavioral adaptation, probably arose abruptly between 6 Ma and 5.7 Ma, with slight modifications occurring over the

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next few million years. The first manufactured Oldowan stone tools appear fully-formed *ex nihilo* about 2.6 Ma, with little subsequent modification for almost a million years. The ensuing Acheulian industry was likewise static. The archaeological evidence suggests this technology survived for nearly the same amount of time. It would appear that for the vast majority of our lineage's history, next year's tool model was very much like last year's model—indeed, very like the model of the past tens or hundreds of millennia. It appears, however, that around 50,000 years ago the pace of human behavioral and technological development markedly quickened. Not only are new toolkits developed, they are often replaced wholesale. We begin to see evidence of rituals and the blossoming of artistic traditions. Bodies are buried, and tombs elaborately decorated and populated with artifacts. What's more, new developments began to follow in tens of thousands of years, rather than in hundreds of thousands and millions. The pace has not slackened, of course. Within the span of the last century we have gone from horse and carriage to moonwalks and supercomputers. But if our technological and intellectual achievements are perhaps more marked than they have ever been, it is difficult not to ascribe a similar significance to that juncture in our development when the pace of change began its remarkable acceleration.

The fact of these changes has brought considerable attention to this period not only from archeologists and anthropologists, but also from the broader cognitive science community. The depth and breadth of the behavioral and developmental changes of this period have led many to speculate about the growth of the cognitive abilities that accounts for them. Perhaps the most striking attempt to grapple with these changes in recent years has been Steven Mithen in his book *The prehistory of mind*. Covering a broad swath through the literature from archeology to philosophy, Mithen argues that the importance of this period cannot be defined solely in terms of the new behaviors that emerged, of religion, poetry and agriculture, for example. Instead, what is most significant about this period are the cognitive changes that are taking place, what Mithen calls the final reorganization of the faculties of the human mind. It is at this point in our development, Mithen claims, that the modern mind takes shape. We have crossed not a simple technological divide, but rather a extraordinary physical one.

It is because of this thesis that Mithen's interest in the period is not strictly speaking (pre)historical. While he is concerned with tracing the development of the modern mind through the archaeological record, his emphasis is on how this development has worked itself into the structure of our modern cognitive capacities. The changes that we witness in the archaeological record represent for Mithen real changes in the mental capacities of early humans—changes that underlie our modern intellectual and technological abilities. In this respect, Mithen maintains, and to a large degree renders plausible, the view that the transformations in our behavioral and cultural capacities in prehistory can be mapped onto modern models of mental function. As a consequence, Mithen shows not merely that archeology has the potential to contribute to modern cognitive science, but that historical changes in our cognitive capacities operate as a constraint on acceptable theories of mental function.

Mithen's argument pivots around the claim that at different points in the evolution of hominids distinct intelligences emerged. An intelligence in this sense is a subject or domain specific cognitive capacity that permits complex reasoning with respect to a particular task or set of tasks relevant to the subject in question. Mithen claims, for example, that insofar as other animals possess intelligence at all, it is restricted to what he calls a "general intelligence." Apes, for example, bring the same set of cognitive skills to their abilities to locate fruit that they bring to their social interactions. It is, in Mithen's terms, a trial and error sort of learning, as opposed to a cognitively enriched capacity associated with a distinct or modular intelligence. The first of two fundamental changes in human cognitive architecture is given over to this move away from a generalized intelligence towards more task specific structures in the early members of the hominid lineage. Hominids, he avers, have minds that become increasingly modular through time. Thus, *Australopithecus* is less modular than early *Homo*, which is in turn less modular than later hominids such as the Neanderthals. Mithen sees these modules as chapels within the cathedral of the mind, the walls of which are solid (the chapels are closed to each other), trapping within them the thoughts and knowledge of each specialized intelligence. With the advent of modern humans, Mithen perceives another architectural novelty. Whereas our antecedents were characterized by discrete, encapsulated modules, the walls between our modules collapsed, allowing for commerce between previously isolated mental municipalities or chapels. This allowed thoughts and knowledge in the chapels to flow freely around the cathedral—or perhaps within one "superchapel"—harmonizing with each other to create patterns of thought that could never have existed within one chapel alone. This is his "big bang" of human culture—where barriers between chapels are razed [1]. Thus, according to Mithen, was the creative imagination born, resulting in analogical thinking, art, religion, and increasingly complex inventions such as steam engines and Slurpees. In contrast, Neanderthals and their antecedents (possessors of non-fluid minds) were incapable of analogical thinking, art, and other nifty modern things—they would have entirely deserved their current reputation as brutish thugs, neither understanding, nor appreciating, the metaphorical flourishes of poets.

So Mithen's tale is essentially one of two opposed changes in cognitive architecture. Our early evolution is distinguished by a tendency towards the development of modular systems. These are characterized by the growth of specialized mental substructures that gain speed through inflexibility and efficiency at the price of generality. For Mithen these structures were not only the source of our early technological advances, but also the primary reason why we could not build on these discoveries. Our tool-making capacities were, in effect, cordoned off from, for example, our cognitively localized understanding of the physical world, or a similarly modular structure that subserved our capacity to enter into social interactions. However, insofar as these capacities were isolated, human capacities could not develop. But Mithen turns this on its head. He claims that once the modular systems were established they began to take a progressively greater interest in the workings of the other modules. His second change puts the power of the localized or modular structures into a more general mental conversation. It is this coming together

of modular systems that underlies our capacity for invention, analogical thinking and art, for metaphor and development [2].

Whether or not Mithen can have it both ways is unclear. Can he, for example, claim the cognitive benefits of a modular system, in terms of processing speed and efficiency, while integrating these systems into a relatively flexible and open-ended mental conversation? Modular systems develop as specific solutions to cognitive problems with particular demands. Consider an example. Rather than develop a generalized capacity to discriminate flies from other sorts of things, flying or not, the perceptual system of frogs responds selectively to anything in its environment which is small, black and airborne. The advantage of this system is that the frog avoids the expenditure involved in developing a more refined sense of what constitutes their prey, but they pay for it in biology labs where they are fed an unrelenting diet of small flying black non-flies. The ensuing indigestion is part of the price of the modular system. They are inflexible, but quick and the trade-off appears to have been largely a good one for frogs. But it is not clear that Mithen has factored in the trade-off between the fast and inflexible modular systems of the early hominid brain and their subsequent re-entry into the broader mental conversation. The problem is that the very capacities that would enable a mental module to enter into this conversation would have likely been sacrificed in their creation.

Method: archaeology and mind

Archaeology is the study of behavioral residues. At its best, archaeology can descry a moment in time preserved in bone, ceramic, or stone through the ages. At its worst, it is a meticulous and *sui generis* accounting of ancient trash. The line between these antipodal archaeologies is perilously thin and rests primarily on the degree to which a set of material residues preserves meaningful behavioral data. But even at its best, can archaeology really tell us about the developing mind, or rather, can such behavioral data tell us anything about mental adaptations? The computer used to type this paper is far more complex than any tool produced 10,000 years ago: its manufacture required a tremendous amount of planning (hundreds of parts needed to be created and assembled), the production of materials not found in nature, and the ability to recognize and use phenomena (such as electrical currents) that are not visible. A computer represents a quantum leap compared to anything in the toolkit of an early Holocene hunter-gatherer. Despite this, is there any reason to believe that our minds are more sophisticated than theirs are, or for that matter more sophisticated than Plato's (whose technology was likewise simple by our standards)? Indeed, few would argue that we are mentally superior to these forebears, which leaves us with a crucial problem. Changes in behavior do not necessarily issue from changes in biology, and since archaeology bespeaks behavior, it cannot *ipso facto* be used as evidence of biological change. This does not mean, of course, that biological changes could not engender observable changes in the archaeological record, but only that archaeological changes are not sufficient to demonstrate changes in hominid biology. Thus, it would appear that Mithen's attempt to ascribe the evolving archaeological record to mental adaptation is in trouble from the start.

Mithen attempts to ameliorate this problem by employing a number of guides (e.g. Fodor, Karmiloff-Smith, Gardner), some within mainstream cognitive science and psychology, and others from philosophy and evolutionary psychology. What he hopes to retrieve from these guides is some sense of the cognitive architecture of the modern mind that should be observable in the archaeological record. In this respect, his understanding of the relationship between the mind and archaeology is only as strong as the theories from which he derives this understanding. Moreover, it casts into doubt his claims that archaeology can effectively contribute to this discussion, for if the behavioral consequences of hominid behavior can only be read relative to a correct theory of mental architecture; his account appears to import the very information about mental structure that it purports to supply.

Furthermore, Mithen treads in dangerous waters by using modern developmental psychology as a buttress to support his ideas about the developing hominid mind. In so doing, he appears to commit himself to the controversial idea that the development of a modern human passes through, in broad outline, the various stages of the development of the species (ontogeny recapitulating phylogeny). While this enables him to avail himself of the psychological doctrines of Carey, Spelke and other developmental psychologists, it commits Mithen to the unsupported view that the pattern of infant psychological development can be an effective guide to the study of human evolution. We will not pursue this question here, but it is worth noting that very little that Mithen says actually depends on his commitment to this claim. Whether infants go through a process of increasing or decreasing modularization and cognitive fluidity has little bearing on the truth of his claims about our evolution. This material is suggestive at best, and as such supplies little positive evidence for his conclusions [3].

Of modules, intelligences and Swiss army knives

Whether in fact development in children reflects the growth and eventual subsidence of modular systems is unclear, and as such whether ontogeny recapitulates phylogeny seems, as a consequence, to be beside the point in this debate. However, it is undeniable that modules play the starring role in much of the narrative of human development that Mithen describes. It is the change from the generalized intelligence of our hominid precursors to a modular one that leads to the blossoming of individual skills that are ultimately reintegrated in the modern mind. The voyage home for Mithen is this process of opening a mental conversation between our pre-established modules. Before examining the prospect of this reintegration, it may be worthwhile to examine the development of the fragmented mind that precedes it and in particular one respect in which Mithen adopts an unusually anthropocentric picture of evolutionary processes.

Consider, for example, Mithen's claim that modular processes and structures he envisages are unlikely to be present not merely in the majority of other creatures, but also our nearest phylogenetic neighbors. The advantage of this position should not be underestimated for Mithen and perhaps this is the source of its appeal. Suppos-

ing, against this view, that apes and other primates have modular capacities ultimately begs the question as to why humans are unique in developing the mental space for their collaboration. Certainly whatever advantages accrue to the integration of modular capacities in humans would also benefit other creatures with similar architectures. The apparent absence of these creatures thus suggests that they did not have modules to integrate. However, if this explains why humans appear to be special, it merely pushes the key questions a little further down the road. On what grounds can we suppose that only humans have modular structures in their minds?

This worry is amplified when we consider the potential cognitive benefits that the evolution of these modular structures would have in other creatures. General intelligence is a slow and unreliable beast—one that munches up both a creature's computational capacities and its time. As a consequence, insofar as modular processes sidestep the inherent drawbacks of a flexible, but inefficient cognitive process, shouldn't we expect to see them manifested in other creatures? Consider again our poor frog. If he had to use a generalized intelligence to calculate the speed, direction, and palatability of insects on the fly in order to strike in a split second, chances are flies would be more abundant and frogs few and far between. The fact that frogs respond automatically to flying black dots of any sort suggests that they are not applying any basic program of trial and error learning. In this respect we can suppose that the frog's perceptual system is hardwired to produce a particular response. This short cut around general intelligence is valuable for many reasons. Outside the lab there are few flying dots in their environment that aren't good to eat and thus the development of an effective discriminatory capacity is both unnecessary and inefficient. A modular strategy saves resources for the frog in terms of developmental and computational complexity. It appears these advantages are not limited to human evolution, nor does Mithen offer any suggestion as to why humans are anomalous in this respect.

Moreover, it appears that we aren't, in any particular way, special in this regard. Birds can reliably create complex nests without any architectural training—and some birds perform phenomenally complicated mating dances without spending a moment on the windowsills of the American Ballet Theater. It seems unlikely that we can attribute these capacities to something like general intelligence if only because bird aptitudes tend to flag once the nest is completed—and the dance has lured a mate. The relative inflexibility of these behaviors suggest that they both have specific purposes and depend on dedicated neural structures. It hardly requires mentioning that there is little room for learning to fly by trial and error: general intelligence is a poor guide for finding your way aloft.

The truth appears to be that if these structures exist, there is no reason to believe that they are not found in all vertebrates, and not just in human beings and their immediate ancestors. This is not to say, however, that different taxa might not have different modules, or that modules for similar tasks might be constituted in different ways in different lineages. There appears to be no basis for Mithen's claim that non-hominid taxa have a primarily generalized intelligence.

If this renders Mithen's claims about human modularity rather suspect, it is not

clear to what extent they cast doubt on his entire project. The modern mind only comes into view, on his theory, once the walls between these modules begin, in some sense, to disintegrate. Supposing that other animals have mental modules or specialized intelligences does not suggest that they have humanlike capacities. However, it does beg an important question—for if demodularization has proven a valuable process for humans, it seems it should be no less valuable for other creatures. Are there other examples of demodularization? Have dolphins combined what appears to be a fairly robust social intelligence with their natural history intelligence? (For example, do they fish in teams?) What counts as an example will obviously depend on what we count as modular processes, but clearly Mithen is suspicious of any alternative.

But it is not clear how we can ground these suspicions. Mithen envisages a remarkably simple model of mental modules where each chapel in his cathedral shares equal access with the knave of analogical reasoning. However, it seems clear that how much commerce a mental module has with the other chapels will depend importantly on the tasks that module performs. Modules have been postulated to perform very distinct roles within cognition, from basic perceptual processing (as in Fodor) or in terms of discrete intelligences (of the sort that Gardner imagines). These are likely to be very different machines. The predictable advantage of Fodorean modules is that they are inherently inflexible and stupid. They are automatic processes; they are more like reflexes than intelligences—and from this they gain advantages in terms of speed and computational simplicity. It is the function of these modules to convert the raw data of our sensory organs into the symbolic form that enables its exploitation by our higher faculties. Of course, this is no less true for cats or dogs than for humans, so we can't suppose that the open chapel theory is applicable for modules of this sort. Mithen clearly prefers Gardner's explication of intelligences in terms of domain specific capacities. He suggests, for instance, that humans have a technical intelligence module that gives them the capacity, for example, to envisage the necessary forms to be hewn out of stone or to calibrate the tautness of the string as it pulls on a bow. He also holds that humans have a natural history intelligence module which allows us to interact fruitfully with the non-social world—to memorize locations, weigh the value of particular materials, etc.

One advantage that accrues to Fodor's examples of modules is evidentiary. The existence of certain optical illusions suggests that visual capacities employed are cognitively impenetrable—they are not influenced by collateral information. Similarly, we can view examples of particular neural disorders which appear to locally disrupt the performance of individual modules. The development of some aphasias have been especially suggestive of the linguistic roles played by particular structures within the brain. Mithen has much less to go on. The fact that Gardner's intelligences can be grouped according to their subject matter no more implies the existence of specialized modules than the existence of health classes in high school implies a mental module for health.

Moreover, given the broad compass of the modules Mithen does identify, one is certainly tempted to classify them as part of a larger generalized capacity. His

natural history intelligence module, for instance, is instrumental in our ability to find our way around, predict animal behavior, and predict the fracture mechanics of bone. We would be hard pressed to say what these have in common, except for the relatively benign suggestion that they are about the natural world.

If Mithen is to establish the claim that this distinction is not simply arbitrary, then he must argue that the intelligences he posits are in some way limited in how they process inputs and outputs. They must be informationally encapsulated. What this suggests is that the computational processes of one module were not available to other modules, nor influenced by them. Mithen attempts to justify the discrete nature of the technical intelligence and natural history modules by noting that Neanderthals and other non-moderns did not frequently use them in tandem. Certainly, he argues, it would have made sense for Neanderthals to use bones and other animal parts for tools (such as antlers and ivory) since they provide a workable and abundantly available local raw material. The fact that Neanderthals failed to take advantage of these materials suggests to Mithen that they “could not think of using such materials for tools” because they were once parts of animals which put them within the domain of natural history intelligence—it is only when such information was allowed to travel from the natural history intelligence module to the technical intelligence module that bone and antler tools could be made. But the fact these intelligences were rarely exploited in combination by Neanderthals does not suggest that they were fundamentally subsumed by distinct biological structures any more than the usual lack of collaboration between philosophers and anthropologists implies specific philosophy and anthropology modules.

Perhaps it is so difficult to make sense of Mithen’s thesis here because it is simply not clear how we are to read his claims about the nature of these intelligences or modules. What is a natural history of intelligence? How does this allow one to better manipulate the environment? Indeed, he almost seems to suggest that the natural history of intelligence amounts to innate knowledge about which berries are good to eat. A more plausible suggestion would be to suppose that the domain specific intelligences he discusses really correspond to conceptual or representational abilities of very specific kinds. What is innate is not special knowledge about how the world works, but rather a series of assumptions about how the world can be divided into meaningful constituents. The evidence for natural history intelligence suggests that what is being employed is a means of distinguishing between those sorts of things which have their natures essentially and those that have them in terms of their function or provenance (see e.g. Atran, 1995). This distinction is very useful because it provides an individual with a means of tracking those properties in his or her environment in terms of those features which are most relevant to their continued exploitation.

The availability of these conceptual capacities does not necessarily suggest that they form part of a modular cognitive system. Instead, one might suppose that particular concepts or sets of concepts are innate and these permit the rapid accumulation of knowledge about specific cognitive domains. These would give the appearance of informational encapsulation because the rapid acquisition of knowledge or abilities with respect to a specific endeavor might convey a sense of cognitive

specialization. Despite this, however, it is not clear that the operative intelligence was not a general one, but merely that its operation was iterated over a set domain of primitive conceptual capacities.

Overall, it appears that Mithen's ideas about modularity are on shaky ground. There is no evidence for his claim that modularity is more or less reserved for the hominid lineage, his notions of modularity are vague, and he provides little evidence that his modules represent discrete biological substrates. For the moment, however, let's grant that the modules he posits do indeed exist, and let's examine his claim that fluid information exchange between these modules is the hallmark of modern humanity.

Does a fluid mind do the trick?

According to Mithen, the cognitive big bang, the change from a modular to a fluid mind, happened about 50,000 years ago. There is a very real difference in the archaeological record at that time. Toolkits do tend to express more regional variation, more exotic raw materials are used, and obvious art and body decoration begin to appear. Even though these are not absolute changes (e.g. exotic raw materials are sometimes used before 50,000, but they are relatively rare) the overall patterns in the archaeological record after this date begin to have a distinctly different and more modern flavor. But can this archaeological transformation be explained simply by increasingly fluidity? Let's pursue this by analyzing one of Mithen's examples. He claims that bone tools only emerge after the fluid mind does, after 50,000 years ago (this is not really true, as bone tools are known as early as 1.8 million years ago, but let's overlook this at present). He further claims that they are made possible by increased communication between natural history intelligence (which "knows" about animals and their bones, etc.) and technical intelligence (which "knows" about tool-making) modules. While it is not necessary that these modules encode information in such a way that they could inform one another, let's assume they do. Does having access to these kinds of information lead to the creation of bone tools? This notion is highly problematic because it suggests that the simple juxtaposition of knowledge content should lead to useful rather than absurd ideas. But how could this be? One might know about tool-making, and might know about hyena scat, but few would probably try to make tools out of them. The mind is clearly not entertaining every possible conflation of the knowledge contained in the modules (this would be highly inefficient and impractical), but how does it know which knowledge can be successfully conflated? This remains quite mysterious, and yet it is precisely this ability to recognize those analogies which are productive and useful and to discard those that are not (not analogical thinking itself) that is so impressive about modern minds. Mithen offers us no account of the structures of the brain that are responsible for these capacities, yet if anything marks us as distinctive from other animals it is the power to discriminate amongst these kinds of alternatives. Thus, it is this enigmatic ability, and not fluidity in and of itself, that is more likely to explain the archaeological changes manifested within the last 50,000 years.

There are other reasons to believe that the 50 Ka increase in cognitive fluidity

does not have the explanatory power Mithen would like it to have. For one, Mithen's chief argument against Neanderthals having had fluid, modern minds is that they did not create the art or tools that characterize "modern" toolkits (barring perhaps the Chatelperronian Industry). If they were capable of making such tools, he reasons, they would have since they would have been highly beneficial. Of course, we really have no basis for such statement: the Neanderthals tenure on this planet was far longer than ours has been, and we know little about the causes of the disappearance of the classic Neanderthal morphology. To state that bone tools, for instance, would have staved off extinction of the Neanderthal morphology even briefly is pure speculation. But even if such tools would have increased Neanderthal efficiency, does that mean that they would have made them? After all, why did modern humans not invent the wheel until the 4th millennium BC? It is ironic that at precisely the time that many humans were moving towards less nomadic existences, they invented the tool that would have made those lives much easier [4]. Necessity may be the mother of invention, but true needs (as opposed to things that would make life easier) are notoriously difficult to ascertain. Having the cognitive capacity and use for a given construct is by no means a guarantee that the construct will become available.

Moreover, the availability of technological advances does not mean that they will be inevitably adopted. The old ways are not always the best ways, but historically communities have often held to this maxim. Better technologies do not always replace weaker ones for reasons that have nothing to do with their effectiveness. There is no shortage of examples where communities have opted for less than optimal practices in the face of technological innovations. Some would say Microsoft's predominance over Apple is one such example. However, a less fraught example might be the case of pastoralist tribes living on the banks of Lake Turkana. These tribes have historically rejected fishing as a source of protein, despite abundant opportunities, in favor of domesticated animals—even in times of hardship. This is particularly unusual since they are within trading distance of many tribes who do employ fishing technologies. Thus, contrary to Mithen's claims, maladaptive strategies exist within communities even when there is knowledge of potential alternatives. Fishing is regarded with suspicion in these communities. It is perhaps a unique feature of human evolution that we can reject adaptive solutions for *cultural* reasons.

This problem is compounded by the fact that prior to 50 Ka anatomically modern humans and Neanderthals produced more or less identical toolkits. But according to Mithen's logic, modern humans should have been making "modern" toolkits at least 100 Ka, when we first have evidence for our species. This leaves us with two alternatives. Either we must abandon the argument that such "advanced" tools are inevitable given the capacity to make them since modern humans took at least 50,000 years to get around to it (thus giving Neanderthals a reprieve from non-fluidity), or we must posit a neurological change in modern humans about 50 Ka that is not visible osteologically. The latter possibility cannot be excluded, but is alas currently untestable. We can only hope that it is not true, for if it is, it means that this issue will likely remain forever insoluble. We prefer the explanation that

despite the explosion of new technologies and behavior—an explosion which appears to be gathering steam rather than subsiding, this does not betoken any major neurological change.

The details of Mithen's story simply do not come together. A non-hominid generalized intelligence cannot be substantiated, the evidence for increased fluidity in modern humans is questionable, and Mithen's use of modularity and fluidity is problematic. Yet there are still many problems evident in his story of the evolution of hominid modularity that we have given short shrift that probably deserve more attention. For example, he claims that *H. ergaster* had a more developed natural history intelligence than *H. habilis* because it inhabited a wider variety of environments. But even if these habitat disparities really existed (and this is based on precious little evidence), one cannot make claims for a more highly developed natural history intelligence based upon breadth of habitat. For instance, baboons inhabit far more diverse environments than chimpanzees, though we have no reason to believe they have a more developed natural history intelligence. Indeed, most people would argue just the opposite. Similarly, armadillos have begun to expand their range by invading new northern habitats in the United States, but few would argue for a sudden blossoming of the armadillo natural history intelligence module.

This seems to be a case of Mithen trying to make every piece of the archaeological and paleontological record fit within an increasing strained theoretical framework. Every change in the archaeological record (culture) seems to be indicative of biological change by his reckoning. What makes this odd is that in many ways the advent of culture is taken to be the mark of humanity—the idea that we have been able to build cultures that are passed down independently of our native biological capacities. Certainly, the broadest changes in human technological capacities have not been correlated with underlying physical advances. The digital revolution is but one example, though it is no less true for advancements in the bronze and iron ages. But suppose we argue that these changes were in fact responses to evolutionary pressures, that physical changes in our neural structures accompanied or preceded Turing's work on the computer. Not only would this be implausible on the face of it, it would be tremendously difficult to prove—and in this proof the only evidence that Mithen can use in his defense are the very phenomena he wishes to explain. That is, it is the changes in the material cultures which are at once what needs to be explained and the sole reason for adopting the explanation of physical change. And herein lays the weaknesses in his approach, because any independent verification of his thesis must come from the very cognitive science literature to which he hopes to contribute.

This is not to say that we could not find physical evidence for the processes that Mithen envisions. If ontogeny does broadly recapitulate phylogeny, then we might see mental illnesses that correspond to a failure to open the appropriate windows between cognitive chapels. Some have argued that autism is perhaps an example of a lesioned or otherwise damaged social intelligence (or theory of mind module), but what we have not seen are examples of illnesses where the windows have not opened while the chapels remained intact [5]. In these cases of arrested development, perhaps we could call it *neanderthalism*, individuals would retain their social intelli-

gence but find themselves unable to engage this intelligence with Mithen's other putative modular capacities. While we doubt that there are illnesses that would correspond to these particular problems, we must admit that psychologists and neuroscientist have only recently begun looking to diagnose illnesses in these terms.

Despite the problems outlined above, we believe that the archaeological literature can contribute to our understanding of how and when human minds came to be the way they are now. In fact, we are partial to many of the views that Mithen endorses. We accept that the mind is likely to have exhibited the sorts of modularity he considers necessary to human evolution. Where we disagree is more a function of how he develops the mechanisms and relationships that typify their interaction than the fact of their existence. We do not believe that different toolkits need imply broad differences in human cognitive capacities, nor do we believe that he has appropriately characterized the nature of the intelligences characteristic of early human minds. Nonetheless, we do not believe this is a bankrupt project, but a rather difficult one, where the sources of evidence are often at odds with each other. *The prehistory of mind* is an ambitious and scholarly work. It is creative, erudite, well written, and will no doubt serve as a model for those enamored of interdisciplinary work. This does not mean, of course, that the book is without deep flaws. In its ambition to do everything, it has fallen short with regard to many of the philosophical, psychological, and biological issues it engages.

Notes

- [1] Howard Gardner has complained that Mithen's cathedral metaphor is an unfortunate one since the growth and development of cathedrals does not reflect the processes embodied in this description of cognitive development. He notes, "[c]athedrals such as Chartres were conceived and created by purposeful human beings as unified projects" (Gardner, 1997). Nevertheless, the synchronic nature of Mithen's metaphor is clear, and, we would argue, useful in developing his position.
- [2] It would be unfair, we think, to compare Mithen's work with Julian Jaynes' *Origins of consciousness in the breakdown of the bicameral mind* (1976), but it is worth noting that Jaynes imagines a somewhat similar process. The unique features of mind, in this case, consciousness, emerge from a burgeoning conversation between the two, in this case physically distinct, lobes of the human brain. Development is located in the deterioration of barriers between various elements of cognition.
- [3] See Jerry Fodor's review of Mithen in his *In critical condition* (2000, pp. 153–160) for a more detailed discussion of this issue.
- [4] It does not help to suppose, as some anthropologists have suggested, that the wheel was not necessarily as beneficial as we might suppose nowadays. While it is true that without roads wheels offer only a marginal advantage in many environments and add considerable problems of production and maintenance, the same considerations applied to wheels here can be applied to roads and other conveniences. The simple point is that innovation is more than the product of need.
- [5] For a discussion of this theory as it pertains to autism, see Simon Baron-Cohen (1996).

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