The Prehistory of the Mind

The Cognitive Origins of Art, Religion and Science

By Steven Mithen

Reviewed by Andy Gorman

Why ask an archaeologist about the human mind?

Mithen begins his book by first posing and then answering the question, "Why ask an archaeologist about the human mind?" As he describes, there are many fields of study that can contribute to the discussion of the human mind. These include psychologists, philosophers, neurologists, primatologists, biological anthropologists, social anthropologists, and computer scientists. Mithen argues that people from all of these domains can, and indeed should, contribute to the discussion. So how does the archeologist fit into the discussion? What can they contribute?

Mithen responds with the following answer: "We can only ever understand the present by knowing the past. Archeology may therefore not only be able to contribute, it may hold the key to an understanding of the modern mind." (p. 10) By studying the archeological record of our ancestors and understanding the selective pressures that our ancestors faced, Mithen reconstructs the evolution of the human mind. Of course, archeology alone can not solve the mystery. Mithen draws from the work of an assortment of experts from many fields, but uses archeology to ground these diverse viewpoints.

Architecture of the mind

Many people have proposed models to explain the construction of our minds. In trying to explain the architecture of the modern mind, Mithen explores some of these different popular theories. From these theories he develops a blueprint for the modern mind.. Once he has a blueprint to work with, Mithen uses it to deconstruct the components of the mind and understand how it was constructed over time. This is analogous to the way an archeologist develops a blueprint for a building that is being excavated. In doing this, the archeologist can determine the sequence of events that led to the building's current structure. Mithen uses this analogy throughout the book to describe the how the architecture of the mind evolved over time.

Different points of view

The mind as a sponge, the mind as a computer

Common metaphors used to describe the mind include that of a computer or perhaps a sponge. In these metaphors, bigger is better. For example, the bigger the sponge, the more water it can soak up or "learn". If soaking up water is analogous to learning, than by extending the metaphor, one might say that ringing out the sponge is analogous to memory recall. Using this metaphor to describe evolution is tempting; as brain size increased, more information could be learned and recalled. The computer metaphor can be even more useful. In this example, the mind is running a general-purpose program that we might call learning; a faster computer with more memory could learn greater quantities in a shorter period of time.

Mithen argues that while these analogies are appealing, they are also too simplistic. He explains, "The mind doesn't just accumulate information and then regurgitate it. And nor is it indiscriminate in the knowledge it soaks up. My children – like all children – have soaked up thousands of words effortlessly, but their suction seems to lose its power when it comes to multiplication tables." (p. 35) Furthermore, he argues that the mind is not as simple as a computer, processing information it encounters. The mind, as he explains, creates and imagines. These are things that a computer can not do.

The ideas of Thomas Wynn and Jean Piaget

In 1979 an American archeologist named Thomas Wynn proposed that the modern mind had been fully developed by 300,000 years ago. As Mithen explains, this was before anatomically modern humans as well as Neanderthals and early humans. Wynn supports his argument by using a controversial theory known as "ontogeny recapitulates phylongeny." This theory claims that the phases of cognitive development in children mirrors the phases of cognitive evolution in the species. Wynn pointed out the symmetrical handaxes made by early Homo existing 300,000 years ago. To use this argument, Wynn needed to know about the development of human children so he looked to the work Piaget, the leading child psychologist of the time.

Piget believed that the mind was like a computer running several general-purpose programs. These developed and restructured the mind through a series of phases until it reached a phase he called "formal operational intelligence" at about the age of 12. Formal operational intelligence was characterized by the ability to think of hypothetical objects. This enabled the formation of mental images, which was required to create handaxes; an image of the appearance of the finished handaxe was needed before the

creation process begun. Therefore, Wynn concluded, early Homo had formal operational intelligence.

As the archeological record shows, the anatomy and behavior of our ancestors continued to evolve from early Homo to anatomically modern human. Mithen concludes that while Wynn's logic may have been sound, the theories borrowed from Piget may have been wrong. He points out that during the 1980's many psychologists believed that the mind did not run general-purpose programs, as Piget suggested. Instead it was made up of a collection of specialized modules. The new analogy used to describe the mind was that of a Swiss army knife.

Fodor's two-tier architecture for the mind

In 1983, the psycholinguist Jerry Fodor proposed a two-tiered architecture of the mind. According to this, the mind was made up of an input system and a cognitive system. The input system was made up of specialized modules, like the blades of a Swiss army knife. One controversy Mithen highlights in Fodor's input model is Fodor's idea of encapsulation: input systems were independent and had no access to each other. Fodor's model of the cognitive system was very fuzzy. He only knew that it contrasted the properties of the input system: it was slow, unencapsulated, and domain-independent.

Gardner's theory of multiple intelligences

At the same time that Fodor's ideas emerged, Howard Gardner proposed his theory of multiple intelligences. Gardner does not distinguish between input and cognitive systems, as does Fodor. Instead, Gardner proposes that the mind is made up of several specialized intelligences. This is essentially the Swiss army knife analogy to

which I previously eluded. These specialized intelligences, or blades, included linguistic, musical, logical-mathematical, spatial, bodily-kinesthetic and two form of personal intelligence, one for reflecting on the self and one of reflecting on others. In this model, the individual intelligences are autonomous, but tightly coupled. As Gardner states, "in normal human intercourse one typically encounters complexes of intelligences functioning together smoothly, even seamlessly, in order to execute intricate human activities." (p. 41)

Evolutionary Psychologists

Mithen draws extensively from the work of the two evolutionary psychologists Leda Cosmides and John Tooby. Cosmides and Tooby also believe that the mind is like a Swiss army knife. For this they have three major arguments. First, they argued that the mind evolved to solve a multitude of unique problems. To solve these unique problems using a single, general-purpose device would have been ineffective and error prone. Therefore, a mind with specialized modules to solve different kinds of problems would have had a selective advantage over any general-purpose tool. Their second argument was borrowed from the linguist Noam Chomsky and is known as the "poverty of the stimulus." This illustrates how young children learn so much about so many subjects that it is unbelievable that this could be accomplished without several specialized, pre-programmed modules. Cosmides and Tooby's third argument is known as the framing argument. According to this argument, general-purpose learning devices are too slow to enable the quick decision-making that was necessary for survival in the wild. In other words, slow decision-makers would have become victims of predation and less likely to pass on their genes.

The mind as a Swiss army knife

Mithen describes a dilemma that arises when we consider the mind as a Swiss army knife. The specialized modules that evolved were undoubtedly a product of the selective pressures that existed in the Pleistocene environment of our prehistoric ancestors. If this is the case, which it most certainly is, than how can this account for modern human's ability to accomplish tasks in domains that did not exist when the mind's specialized modules evolved. Mithen points out that our prehistoric ancestors had obviously not evolved a book-reading module.

Mithen argues that there must be some general intelligence at work and he concludes that this must co-exist with the specialized modules. To support this idea, Mithen considers the rate at which children learn mathematics. As he explains, children have a much more difficult time learning math than they do, say, learning language. This, he suggests, might be explained if language was being learned using some specialized learning, while math was being learned using some generalized learning. But, Mithen questions whether or not general intelligence could account for the prodigious examples that exist in fields such as mathematics, physics, and medicine. Is there something else at work?

To explore this paradox, Mithen looks to the lives of modern hunter-gatherers. Their lifestyles are most similar to that of our prehistoric ancestors. After examining the work of several social anthropologists, Mithen concludes that the evidence shows that the cognitive abilities used in all domains modern hunter-gathers lives are tightly coupled and integrated. In other words, their natural world of animals is intertwined with their social world of other humans, their use of clothing to meet physical needs also conveys

important social messages, and so forth. In an effort to resolve this paradox, Mithen looks still further, this time to the work of the developmental psychologists.

Developmental Psychologists

Development of infants

The evidence from developmental psychologists, such as Patricia Greenfield, suggest that up until the age of about two, children's minds are not like Swiss-army-knives, but instead are more like general-purpose learning tools. She argues that the capacities for language acquisition and object manipulation, for example, rely on the same cognitive processes. While there is general-purpose learning taking place during this early stage of development, it seems to be superceded by specialized, content-rich modules, as the child grows older.

Four domains of intuitive knowledge

As Mithen shows, the evidence from developmental psychologists suggests that infants use general-purpose learning. However, what happens after infancy? Mithen continues to look to the developmental psychologists. He cites overwhelming evidence that suggests that by the age of two or three, children seem to be using specialized, content-rich modules. This evidence further suggests that there are at least four knowledge domains that seem to be intuitive. As stated earlier in Mithen's reference to Noam Chomsky, children seem to have an intuitive ability for language acquisition.

Mithen then cites Andrew Whiten's work that suggests that children by the age of three have what he calls an, "intuitive psychology." By this age, children have developed

the ability to attribute mental states to other people and understand that others have beliefs and desires.

Another domain that seems to be intuitive is biology. As Mithen says in a reference to Chomsky's "poverty of the stimulus" theory, "Just as the experience of young children appears inadequate to account for how they acquire language, so too does their experience of the world seem inadequate to account for their understanding of living things." (p. 52) Children by the age of three can understand that living things and inanimate objects are fundamentally different. Furthermore, Mithen explains that all cultures have similar classification scheme for objects in the natural world. According to Mithen, this is analogous to the way that all languages share the same grammatical structures.

The next "intuitive" knowledge domain found in children is an intuitive understanding of physics. Here again, the evidence from the developmental psychologists is overwhelming. As Mithen explains, "From a very early age children understand that physical objects are subject to a different set of rules from those which govern mental concepts and living things." (p. 54) Again, Mithen points to Chomsky's "poverty of the stimulus" theory to discount the child's experience as an explanation. Furthermore, "Concepts of solidity, gravity and inertia appear to be hard-wired into the child's mind." (p. 54)

Generalized to domain-specific to cognitive fluidity

Mithen now turns to the developmental psychologist Annette Karmiloff-Smith in an effort to tie some of these ideas into a coherent theory that will explain how a mind

that evolved to solve the problems that our prehistoric ancestors faced, could meet the needs of present-day humans. Karmiloff-Smith agrees with Garner and others and accepts the notion of intuitive knowledge domains. However, Karmiloff-Smith believes that these simply provide a "kick-start." In her model there is a "plasticity" of the mind during development and that culture plays an important role in determining the types of domains that develop. So, according to Karmiloff-Smith, our prehistoric ancestors did not develop a mathematical domain because their culture did not require it, but modern-day humans may develop a mathematical domain. Furthermore, this mathematical domain may get a kick-start from an intuitive domain such as physics. In Mithen's words, "The mind is still a Swiss army knife; but the types of blades present may vary from person to person. A man who uses a Swiss army knife to go fishing needs a different assortment of blades from one who goes camping."

This is only the beginning of the story. According to Karmiloff-Smith, after modularity occurs the modules begin to work together. She calls this "representational redescription" (RR). She further describes this as "multiple representations of similar knowledge." Mithen ties this idea to Susan Carey and Elizabeth Spelke theory of "mapping across domains" and begins to reveal a common thread connecting other theories previously outlined. Recall that Fodor described the cognitive system as "non-encapsulating" and Gardner describes how, "one typically encounters complexes of intelligence functioning together smoothly, even seamlessly, in order to execute intricate human activities." Fodor further claims that the wisest people are those who are most able to connect knowledge domains. Also, Mithen explains how Margaret Booden offers the, "transformation of conceptual spaces" and Arthur Koestler describes, "the sudden,

interlocking of two previously unrelated skills or matrices of thought" to account for human creativity. All of these ideas appear to be describing a set of mental modules that are interconnected to create what Mithen calls, "cognitive fluidity."

The mind as a cathedral

Mithen brilliantly uses the metaphor of a cathedral to describe the architecture and evolution of the mind. This is analogous to actual cathedrals he has excavated. These building have undergone multiple stages of development, perhaps starting with a main area and then later adding on chapels to the existing structure. In this metaphor, Mithen likens general intelligence to a nave or the central part of a cathedral and specialized intelligences to chapels that are built around the nave.

Three phases of development

1. The mind is dominated by general intelligence.
2. Domain-specific modules supplement general intelligence, each working independently and in isolation.
3. Domain-specific modules are working together with a seamless flow of information across domains.

Domain-Specific intelligences existing during phases 2 and 3

1. Technical intelligence used in tool making
2. Social intelligence used for interacting with others and managing social relationships

3. Natural history intelligence use in understanding the plants and animals existing with in their environment

4. A forth possible domain-specific intelligence is one supporting linguistic ability. However, at this stage of the book Mithen is unclear if this is actually a separate module. As he points out, "people did not talk about grammar for it's own sake." If it did exist, its relation to the other modules is unclear. It was probably connected to other domains including general intelligence.

Major stages of human evolution

Once Mithen has outlined his theory architecture of the mind, he progresses through a detailed account of the archeological record. By doing this, Mithen creates a clear picture of how our ancestors behaved. Along the way he matches up behavioral evolution with the architectural evolution describe above. At each step he describes the selective pressures that existed at various stages of the Pleistocene era and how they worked to shape the evolution of mind.

The common ancestor

Mithen starts the exploration into the development of the human mind by looking back 6 million years -- to what is believed to be the common ancestor between ape and man. Unfortunately there is no archeological evidence of this common ancestor. Looking at the development of apes, however, Mithen explains that there has been no significant increase in the size of their sculls. Therefore, he suggests that looking at modern apes can tell much about the cognitive abilities of the common ancestor living 6 million years ago.

Outlining the technical, social, and natural history abilities of apes, Mithen makes the following points:

1. Chimpanzees have a very limited ability for tool use and it takes them a considerable amount of time to learn how to make and use them. From this evidence, Mithen concludes that chimps probably do not have a dedicated technical intelligence; their behavior can most likely be explained by general intelligence.
2. Chimpanzees show a considerable ability for goal-directed and efficient foraging, however this ability is very inflexible. Furthermore, they have the ability to create elaborate mental maps of their environment. Mithen concludes that they must have some partially developed natural history intelligence.
3. Chimps have a considerable ability for social interaction. Their Machiavellian behavior, as demonstrated by their ability to deceive each other, suggests that they have some level of conscienceness. This behavior suggests that they use models of their own minds and beliefs, which they then project on to other. This enables them to form beliefs about other's beliefs. From this, Mithen concludes that chimpanzees have a considerable amount of social intelligence.
4. Determining the linguistic abilities of chimpanzees has been hotly debated subject for many years. Chimps and Gorillas have been taught modest vocabularies using sign language, but the sentences they construct with this vocabulary have a very simple structure. Furthermore, Mithen points out that this ability does not extend beyond the laboratory walls; chimpanzees do not spontaneously use language in the wild. Mithen sees this ability as being similar to their ability for tool use and therefore attributes it to fairly developed generalized intelligence.

Recapping, Mithen believes that our common ancestors from 6 million year ago, like modern chimpanzees, had developed some specialized social intelligence. This is clear from their ability to manage social relationships. They also had some limited natural history intelligence as can be seen in their significant, yet inflexible foraging habits. They also have a significant amount of general intelligence. This is characterized by techniques such as trial and error and associative learning. This gave them the ability to use tool in a limited way, but since general intelligence is slow, tool use came only after years of learning. Likewise, Mithen attributes any linguistic abilities to a powerful general intelligence, not to any latent linguistic intelligence.

H. habilis

Mithen explains that there were likely to have been several spices of early Homo, but for the sake of brevity I, like Mithen, will refer to them all as Homo Habilis. Along with the oldest skeletal remains of H. habilis, the archeological record shows the advent of stone tool use. This occurred around 2 million years ago. Now, as pointed out earlier, the common ancestor was likely to be making limited use of tools 6 million years ago. What is significant about these new tools? Mithen points out two distinctions. First, some of the tools found at Olduvai Gorge, a site where an abundance of these stone tools have been uncovered, were likely to have been made to facilitate the production of other tools (i.e., a sharp stone used to sharpen a stick). Secondly, when a chimpanzees makes a termite stick, it is clear from the nature of the original material (i.e., a branch) what needs to be removed (i.e., the leaves). This is not true in the case of the in the production of Oldowan tools. As Mithen states, "To detach the type of flakes one finds in the sites of Olduvai Gorge, one needs to recognize acute angles on the nodules, to select so-called

striking platforms and to employ good hand-eye co-ordination to strike the nodule in the correct place, in the right direction and with the appropriate amount of force. Members of H. habilis were working modules in a fundamentally different manner from the way chimpanzees work their raw materials." This, according to Mithen, requires more than the "trial and error" methods supported by general intelligence. Early Homo seems to have developed the beginnings of technical intelligence.

Many have claimed that with H. habilis' increased brain size, a better quality diet was required; the brain is an expensive organ. Mithen suggests that the archeological evidence isn't so clear. While it is clear that H. habilis was eating meat, how much and how often is highly debated. Mithen cites the Paleolithic archeologist Lewis Binford who suggested that H. habilis was not merely a scavenger, but a "marginal scavenger." However, being scavengers in competition with deadly predators has some important implications. First they would need to have an increased ability to read visual cues from their environment such as footprints or circling buzzards. This would help them locate possible carcass sites. They would have had to have an increased knowledge of carnivore behavior, so as to be able to capitalize on their presence while avoiding predation. As Mithen describes, there is evidence that H. habilis was able to predict carcass location, by the distribution of partially worked tools. These resources were apparently stockpiled in locations not far from potential carcass locations. Not only did they transport raw tool resources to potential carcass locations, they also transported carcasses to tool locations and they also transported both to a third location. On the other hand, these locations seemed to be tied to certain natural resource locations, such as water banks. "The fact that these [tools and food] were repeatedly transported to the same type of environmental

context implies the absence of the behavioral flexibility of a full natural history intelligence," as Mithen explains. So while there appears to be considerable development in the natural history intelligence of H. habilis, it is still not fully developed.

H. habilis shows a marked development in social intelligence. This was fairly developed in chimpanzees and the common ancestor and it continues to grow, outpacing the other specialized intelligences. Mithen cites Robin Dunbar when he points out that H. habilis was living in larger group sizes. As Dunbar argues, larger group sizes require greater social skills. Larger group sizes in the open Savanna produce two selective advantages. First, there is safety in numbers; a group is more likely to be able to fight off a predator. Second, living in larger groups promotes greater food sharing; chances for finding a large meal to share are increased. However, Mithen argues that the use of the term "food sharing" to describe H. habilis may be misleading and that "tolerated theft" may be more appropriate.

There is no clear evidence that H. habilis had any linguistic ability from the tools they left behind. To explore this issue, Mithen looks to the neuroscientists. As he explains, language in modern humans is localized in two areas of the brain, the Broca's and Wernicke's areas. By looking at the fossilized remains of H. habilis, they have concluded that these two areas of the brain were developed for the first time by H .habilis. Looking again to the work of Dunbar, Mithen continues his search for language in early Homo. Dunbar argued that language evolved as group size increased. The effort to maintain large social groups through grooming, as chimpanzees do, would be too great. An alternate, more efficient means of communication would be need in order for group sizes to continue to grow. Dunbar's estimated threshold where grooming would no

longer be able to sustain a group and he compared it to the estimated group sizes of H. habilis. What he concluded was that H. habilis group size fell just short of this threshold. Being right on this threshold, Mithen believes, created the right conditions for language evolution. Those who could discern social information from the vocalizations of others or who could encode social meaning in their vocalizations, would gain a selective advantage. They would be able to spend less time grooming and more time sustaining themselves.

So, in early Homo there is a slightly increased knowledge of natural history. This enabled them to scavenge more successfully. There seems to be a co-evolution of technical intelligence. With better tool making ability, they can better capitalize on the carcasses they find. There is a significant development of social intelligence. This seems to have brought them to the brink of language, which in turn, reduced the time needed for social management.

H. sapiens and H. neanderthalensis

There is not much record of H. sapiens, the ancestor of modern human. However, they co-existed with H. neanderthalensis and their lifestyles were sufficiently similar to be used as model for the behavior of early humans.

Mithen considers the era from 1.8 million to 100,000 years ago to be the most puzzling. He explains that in many ways early and modern humans seem to have equivalent cognitive abilities, but in other ways they differ significantly. During this period there is a migration toward the north, in to Europe. In these higher latitudes the climate was more server and seasonal. In addition, conditions changed dramatically as

the global climate oscillated between global cooling and warming. While early Homo's brain was specialized for life in the savanna, early human's mind shows much greater flexibility and adaptability. Mithen concludes that in order to overcome their harsh environment, early humans must have had a sophisticated understanding of their environment and the animals with in it. In other words, they had advanced natural history intelligence.

While natural history intelligence seems to have advanced dramatically, technical intelligence for tool making seems to have equally advanced. The most striking examples are seen in the handaxe and Levallois points of this period. The making of both of these tools requires considerable planning and technical skill. There are no rote steps that can be followed – each nodule has its own unique properties requiring unique crafting. In addition, different types of rocks are being used. Mithen suggests that early humans appear to possess equivalent cognitive abilities for making tool to those possessed by modern humans.

While on the surface this seems to be true, he continues to point out several puzzling patterns of behavior that seem to sharply contrast those of modern human. He explains that, in contrast to modern human, early humans did not make tools out of bone or antler. They did not design special purpose tools – different tools for killing different kinds of animals. Furthermore, they did not create any multi-component tools.

The answers to these questions, suggests Mithen, lies in the architecture of the cathedral. While early humans had advanced technical and natural history intelligence, there was no connection between the two. Therefore, it was not possible for early humans to think of using animal parts to make tools. Likewise, making specific tools for

specific types of animals would require an integration of these two cognitive domains. The same is true for multi-component tools. In studying the use of multi-component tools in modern hunter-gathers, Mithen explains that each component has a specialized role in locating, killing, and retrieving and animal. If the early humans could not integrate these two domains, Mithen suggests, it is unlikely that they would have been able to fashion, nor conceive of, multi-component tools.

When looking at the social intelligence of early humans, Mithen once again turns to the work of Robin Dunbar, who demonstrates a strong correlation between brain size and group size. Mithen suggests that Dunbar's approach is simplistic, explaining that as brain size increased, not all new processing power went toward social activities as Dunbar suggests. Some of the newly acquired brainpower must have gone towards advancing technical and foraging abilities. Regardless of these criticisms, Mithen finds merit in Dunbar's conclusions – though perhaps not specific figures. Early humans are believed to have been living in large groups at times. This is largely for the same reasons attributed to early Homo: safety from predators and greater access to food. The selective advantage for cognitive abilities supporting social coordination remained intact. However, as Mithen describes, there are times when smaller groups are advantageous. As climate changed do to global warming and cooling, so to did the environment change, oscillating between open tundra and wooded forest. In open tundra being in a larger group is an advantage. Finding a large meal that can feed the group is more likely if larger numbers are searching. However, being in a large group has its price as well. It is harder to maintain the peace as conflicts and territorial disputes arise. Mithen believes that during the warmer periods, when heavily wooded environments prevailed, early

humans were likely living in relatively small groups. The safety advantage of the larger groups was reduced, as evading predators in the dense forest became easier. Also, with an abundance of vegetation, early humans relied less heavily on large meat packages. Mithen claims that, "The capacity for such social flexibility is at the heart of social intelligence." (p. 134) Furthermore, early humans showed evidence of caring for the sick and elderly members of their social groups.

While the evidence for sophisticated social intelligence is overwhelming, there are some puzzling questions. Mithen indicates that some of the settlements of early humans imply unusually small social groups. The distribution of artifacts suggests limited social interaction. The early humans, unlike modern humans, did not use artifacts as personal decoration. Also, there is no evidence of ritualized burial, even though they cared for their sick and elderly. As before, Mithen answers these puzzles by attributing it to a lack of integration between social and other intelligences.

Mithen answers the first puzzle by suggesting that the archeological evidence seem contradictory because it is being misinterpreted. Archeologists are assuming that social, technical, and natural history modules are integrated. Archeologists make inferences about social structure and group size based on the distribution of artifacts. Mithen points out that since social technical intelligence are not integrated, there is no reason to assume that social and technical activities would take place in the same location. This, he claims, contributes to the misinterpretation of the data. An even more compelling argument for the lack of integration between social and technical intelligence is the lack of artifacts for personal decoration. In modern humans, these are used to

convey social messages. Since there is no cognitive fluidity, it does not occur to early humans to convey social messages with technical artifacts.

Another likely development of early humans is and ability for language. This ability, Mithen argues grew out of and in a co-evolutionary relationship to social intelligence. Mithen makes two intuitive arguments for the evidence of language in early humans. First, as he points out, it unlikely that early humans would have a brain size equivalent to modern humans without having the cognitive ability for language. Secondly, in reconstructing the anatomy of Neanderthals, it has been shown that they had vocal capabilities similar to modern humans. Mithen, continues, "… it would be a little odd if Neanderthals had the vocal structures but not the cognitive capacity for speech." (p. 141)

So what Mithen is portraying now is a brain with highly developed technical and natural history intelligence in addition to a highly developed social intelligence with an overlapping or integrated linguistic ability. However, these modules are still independent of each other and as Mithen suggests, this is the most significant difference between early and modern humans. Using his cathedral analogy, one would say that the chapels have become larger, but there are still no door or windows connecting them.

H. sapiens sapiens -- anatomically modern humans -- putting it all together

Mithen believes that the origins of modern human culture – the beginnings of art, religion and science – are a product of an increasing integration among the specialized modules. There are some major advances during this period from about 60,000 to 30,000 years ago. These include the manufacture of bone artifacts, the placing of animal parts

into human burials, and the emergence of and abundance of cave paintings. What we see here is, Mithen argues, is the integration of the cognitive domains and it opens up a world of new activity.

For the first time we begin to see artifacts that were designed for personal decoration. In other words humans are using their technical knowledge to convey social information. This further reduced the overhead required for communication and helped maintain social order.

Some of the new art was in the form of totems (e.g., and human body and an animal head). This demonstrates the integration of technical and natural history intelligence. This also indicates an ability for anthropomorphic thought. On the surface this may not seem like a significant step, but as Mithen points out, it has an enormous impact on the evolution of man. Our common ancestor had the ability to look into his own mind and form beliefs about the thoughts of others. This ability steadily increased throughout evolution – there was a selective advantage for enhanced abilities to read the minds of others. Until now, because of the barrier that existed between natural history and social intelligences, this ability did not extend to the animal world. With the integration of these two domains, however, humans could begin to "read" the minds of their pray (or predators). Naturally this became an even greater selective advantage.

Also, it appears that there was a joining of technical and natural history domains. Some of the artifacts seemed to record information by using symbols to represent animals and other things in their natural environment. The advantage of this was that it created the ability to track information over long periods of time.

Cognitive fluidity can also account for the development of religion. Judging by the burial rituals taking place and the art that was being created, modern humans had developed a belief in the supernatural. One way of viewing this early religion, as Mithen explains, is a "mixing up" of social and natural history. This information had previously been isolated.

According to Mithen, this integration grew out of social and linguistic intelligence. Language developed as a social tool, but over time, it became more and more general-purpose. Language provided a major selective advantage and therefore it evolved relatively quickly. This is the key to cognitive fluidity. As the cognitive and developmental psychologists pointed out, the key to cognitive fluidity is the ability to use information from one domain in a new and different context. Through random mutation, someone eventually began speaking about non-social things. This also created a selective advantage and started us down the path of cognitive fluidity. As Mithen explains, one of the properties of social intelligence was reflexive conscience, or the ability to predict the behavior of others. As non-social information was communicated through the social tool of language, a gap was bridged. Non-social information was now available for reflexive consciousness. Consciousness took on a new integrating role.

Mithen uses the word of the philosopher John Searle to sum up the significance of this step: "One of the evolutionary advantages of consciousness is the much greater flexibility, sensitivity and creativity we derive from be conscious." As Mithen explains, early human did not lack consciousness – their social abilities were very flexible. Now, however, modern human had this increased flexibility in all domains. This is the key to modern human intelligence.

In the epilogue of Mithen's book, he looks at the advent of agriculture 10,000 years ago. This is perhaps one of the most significant events of human history. However, in terms of cognitive abilities, Mithen questions whether or not any changes were required. He concludes that the answer to this question is no. The development of agraculture was simple a natural product of a changing environment. However, this change did have a significant impact on the minds of children growing up in this new environment. As the developmental psychologist Annette Karmiloff-Smith pointed out, our intuitive mental modules simply provide a "kick-start" for the development of our cognitive abilities. The context in which minds develops shapes the direction that this kick-start takes. So, with the advent of agriculture, the context for development changes significantly: the world of hunting and gathering was no longer the predominant force shaping the developments of our minds. And, with this change, new cognitive domains could emerge.