

Introduction. The sapient mind: archaeology meets neuroscience

The turn of the twenty-first century has seen a new era in the cognitive and brain sciences that allows us to address the age-old question of what it means to be human from a whole new range of different perspectives. Our knowledge of the workings of the human brain increases day by day and so does our understanding of the extended, distributed, embodied and culturally mediated character of the human mind. The problem is that these major ways of thinking about human cognition and the threads of evidence that they carry with them often seem to diverge, rather than confront one another.

What is presently missing, and urgently needed, is a systematic attempt to bridge the analytic gap between those defining trends in the study of mind. This was the principal challenge for ‘The sapient mind’ meeting that took place in the McDonald Institute for Archaeological Research, Cambridge between 14 and 16 September 2007 and which forms the basis of this special issue. Our aim was to channel the huge emerging analytic potential of current neuroscientific research in the direction of a common integrated research programme targeting the big picture of human cognitive evolution, both before and most importantly after the so-called speciation phase, i.e. the period when biological and cultural coevolution worked together to develop the genetic basis of the human species, as we know it (Renfrew 2008).

Following that, a good way for the reader to approach and conceptualize the contributions that make up this volume is to view them as the component parts of a broader cross-disciplinary experiment. The aim of this experiment is to enable archaeology, anthropology and neuroscience to bring together, under the same general working hypothesis, the neural, behavioural and material correlates of human cognitive becoming. There are many factors that indicate or contribute to a good experimental design but a key feature probably lies in the central question. The question that lies at the heart of this volume is rather straightforward, i.e. *the sapient mind*: what makes the human mind unique? What is the sapient mind made of? What is less simple and straightforward, however, is how precisely should this central question be approached or understood.

Up to now, working in isolation, both archaeology and neuroscience have made a number of important contributions to the study of human intelligence. Archaeology, for instance, can now give us a good idea about *where*, and an approximate idea about *when*, *Homo sapiens* appeared. The place is Africa and the

time somewhere between 100 000 and 200 000 years ago. Recent DNA studies can now confirm the out-of-Africa human dispersal hypothesis of approximately 60 000 years ago, whereas new archaeological discoveries, like the findings from the Blombos Cave in Africa, have changed our understanding of when and where the emergence of most behavioural features usually associated with modern human intelligence first appeared (Renfrew 2008). Neuroscience, on the other hand, based on a quite different scale of spatial and temporal resolution can also give as a good indication about where in the human brain these modern human capacities (e.g. language, symbolic capacity, representational ability, theory of mind (ToM), causal belief, learning by teaching, ‘we’ intentionality, sense of selfhood) can be identified and the possible neural networks and cognitive mechanisms that support them.

The challenge facing us then is how do we put all these different facets and threads of evidence about the human condition back together again? Naturally, the attempted cooperation and cross-fertilization is not an easy task given the different kinds of information, procedures and analytic scales that define the ways the human mind is approached and understood from different disciplinary perspectives. However, if our attempted cross-disciplinary experiment is to add something new and important to our current knowledge then it needs to move beyond the logic of the ‘localizer’ and tell us something about the *why* and *how* rather than simply the *where* and *when* of human cognitive becoming. Knowing when and where things are happening in cognitive evolution is important and interesting but does not explain much. Focusing on the interface between brain and culture, the papers that comprise this special Theme Issue struggle to define, reframe and identify some crucial aspects of the human condition, which we think could facilitate this attempted partnership between archaeology and neuroscience.

Consider for instance what Renfrew calls the ‘sapient paradox’ (2008): if the biological basis of our species has been established perhaps for as much as 200 000 years, then why have the novel behavioural aspects of our ‘sapient’ status taken so long to emerge? Why is it that all major evidence in the archaeological record indicating important changes in human intelligent behaviour came long after the appearance of modern anatomy? An interesting observation that archaeology allows us to make, and which also poses a great challenge to the neuroscientist, is that many of the crucial and enduring aspects of the human condition (symbols, value, religion, literacy, etc.) appear relatively recently in the archaeological record and can certainly be seen as the emergent products of

One contribution of 14 to a Theme Issue ‘The sapient mind: archaeology meets neuroscience’.

various cultural developmental trajectories, rather than innate biological capacities. Could it be then that brain anatomy and the biological endowment of our species *H. sapiens* as this emerged between 200 000 and 100 000 years ago is only part of the story? Moreover, would it be more productive, especially from a long-term perspective, to explore the assumption that human intelligence ‘spreads out’ across the body–world boundary, thus extending beyond skin and skull into culture and the material world?

Many contributions in this volume argue precisely that (Gosden 2008; Hutchins 2008; Jordan 2008; Malafouris 2008; Renfrew 2008; Roepstorff 2008) although they may differ on how precisely they conceptualize this extended anatomy of the human mind. However, despite these differences in perspective and theoretical presuppositions, a common thread that unites all papers in this issue is their agreement about the special roles that materiality, cultural practices and social interaction play in the shaping of the human mind throughout its long evolutionary and developmental trajectories. Two major consequences follow from that. On the one hand that an effective cooperation between archaeology and neuroscience must aim to provide a better understanding of the role of this constitutive intertwining of brains, bodies, things and cultural practices in the shaping and evolution of human cognitive capacities. On the other hand, that the hallmark of human cognitive evolution may not be based on the ever-increasing sophistication or specialization of a modular mind, but upon an ever-increasing representational flexibility that allows for environmentally and culturally derived plastic changes in the structure and functional architecture of the human brain.

Take for instance tool manufacture and use, a topic that has been the centre of archaeological discussion and debate for some decades now. Human brains and technology, in the form of intentionally modified stone tools, have been coevolving for at least the past 2.6 Myr, yet the relationship between them remains controversial and poorly understood. Thus, understanding the bases in the brain of complex tool use and toolmaking emerges as a key issue in human cognitive evolution. Tool-use abilities also constitute one of the most easily identifiable points at which neuroscience and archaeology meet, given that it is now possible using the new brain imaging methods to explore their neurological foundation in the modern human brain. In this context, Stout *et al.* (2008) present important new results from a PET study during experimental stone toolmaking, which support a coevolutionary hypothesis linking the emergence of language and toolmaking. In particular, their imaging data show that neural circuits supporting stone toolmaking partially overlap with language circuits, which suggests that these behaviours share a foundation in more general human capacities for complex, goal-directed action and are likely to have evolved in a mutually reinforcing way. This important link between complex tool use and language is also discussed in the contribution by Frey (2008). His paper presents new data from brain-injured patients and functional neuroimaging studies that indicate a possible brain network participating in

the representation of both familiar tool-use skills and communicative gestures. Although from an evolutionary perspective these correlations cannot demonstrate the direction of cause and effect, they constitute a significant development in the long-standing issue of the possible relations between language and tool use in human evolution. More importantly, they suggest new and important interactions between brain and culture, which may help us understand why it is that only humans have developed such an extensive and universal material culture.

Closely related to this issue concerning the difference that enabled human beings to develop complex technologies, is also the question as to why it took humans so long to ‘invent’ and accelerate innovation. Read & van der Leeuw (2008) identify two major phases in the coevolutionary spiral between brain and culture relevant to the human capacity for technological innovation. In the first phase it is biology, and in particular limited working memory capacity, which constrains technological change. In the second phase however, characterized by the ‘innovative explosion’ in the evolution of artefact technologies that we observe in the last 25 000 years or so, a very different dynamic is occurring between humans and the material world. The biological constraint seems to have been lifted. Technological change is no longer constrained by the capacities of working memory, thus enabling an acceleration in the pace of change in technology. It thus appears that to understand the coevolutionary spiral between brain, body and culture it is not sufficient to discern the possible causal correlations that the changes observed in one of them might effect upon the others. It lies also in discerning the possible ways that the actual nature of the relation between them might have changed in the course of human evolution.

Indeed, although separating biology from culture sometimes makes good analytic sense, relevant to some problems in human cognitive evolution, it should not obscure the more interesting issue of how they are combined. Integrating different analytic units and scales of time, the papers that comprise this Theme Issue seek to understand how different types of data, and the questions upon which those data are being brought to bear, are enmeshed and related as different aspects of a common phenomenon that we call ‘the sapient mind’.

To illustrate this central point let us use the example of Dauya discussed in the paper by Hutchins (2008). Dauya comes from the Wawela village on Boyowa Island in the Trobriand Islands of Papua New Guinea. Dauya is a preliterate magician/astronomer responsible for fixing the agricultural calendar of the village to a seasonal calendar. This is a difficult task, given that the weather patterns in the Solomon Sea vary from year to year, but also a very important task, since the correct timing of the preparations of the gardens relevant to changes in the weather is crucial for the crop production of the village. Dauya accomplishes his task by examining the sky searching for Kibi (what we call the Pleiades) among the stars that are visible just before dawn. When Kibi is visible in the pre-dawn glow, then it is time to begin preparing the gardens. This might look like a trivial task to the analytically

preoccupied modern western thinker but it is also a task that clearly involves some of the most crucial elements that make up a sapient mind.

The question to ask then is what makes possible this unique cognitive accomplishment of Dauya's mind, namely, determining the seasons with great precision? Is it his brain size or the small differences in the DNA that separates him from our closest living relatives, the chimpanzees? Dauya's brain and body is an evolutionary product and thus different in important ways from the brains of any other present or past primates. However, although his biological endowment is certainly a crucial constraining or enabling factor it is not sufficient to generate an understanding of how Dauya identifies Kibi in the sky. To answer that question we need to situate Dauya in his social and cultural context. First we need to understand Dauya as a social animal. It is only then that Dauya's cognitive capacities can be fully appreciated and together help us to understand the uniquely human ways he looks at the sky and constructs his agricultural calendar.

However, what does human sociality really consist of? From the perspective of neuroscience one way to answer that is to look for the basic ingredients of social interaction. For instance, Knoblich & Sebanz (2008) argue in their contribution that the distinctive feature of joint action in humans is to be found in the way we are able to process other humans' intentions and to keep them apart from our own. They build their case around four different scenarios aimed at specifying the possible basic interpersonal mechanisms that support the type of intentionality required to engage in joint action, cultural learning and communication. From the perspective of archaeology, however, social interactions are dependent not only on face-to-face interactions between individuals but also on the active incorporation of material culture. Social and symbolic constructions with a clear material basis, like for instance the notions of value and property, constitute the very basis of social interaction (Renfrew 2008). It is this increasing engagement with material culture that enabled face-to-face interactions among humans to be scaled up in the course of human becoming (Coward & Gamble 2008). Human social life cannot be understood apart from its material entailments and that is why, according to Gosden (2008), we need to develop a kind of 'social ontology' that will enable us to look at the way human capabilities of mind and body are brought about through an interaction with the material world without attributing a causally determinant position to any one.

Meanwhile Bloch (2008) adds, from the standpoint of anthropology, a further dimension of human sociality. He proposes that in contrast to what we see in other social animals, human sociality is double in that it has both transactional *and* transcendental elements. What this means, more simply, is that the social position of Dauya as an astronomer in Trobriand society *transcends* the predictable achievements of the individual. The transcendental social element requires the ability to identify and interact with each other not in terms of how people appear to the senses at any particular moment but as if they

were something else: astronomers, magicians, priests or transcendental beings. According to Bloch, it is in those transcendental roles where the fundamental difference between human and, for instance, chimpanzee sociability lies. Moreover, the fundamental operation that underpins and makes possible this transcendental element of human sociality and by extension the phenomenon of religion is the capacity for imagination. Thus, it is only through understanding the neurological evidence for the development of this capacity and of its social implications that we will account for religious-like phenomena.

But where does the previous consideration leave our initial question about Dauya's cognitive accomplishments? The key point that seems to emerge out of most contributions in this Theme Issue lies in the recognition that Dauya's calendar is as much a cultural accomplishment as a cognitive accomplishment. It is an accomplishment orchestrated by a set of ways of seeing the sky and a way of being in the social and material world. The role of Dauya's brain is crucial but his unique ability to fix the agricultural calendar does not reside either in brain, body or culture. It resides instead where brain, body and culture conflate (Malafouris 2008), i.e. in the embodied processes by which Dauya as a social creature has been enculturated into the practices of Trobriand astronomy (Hutchins 2008).

Thus the crucial question we need to ask here concerns precisely these embodied processes that allow cultural practices to build upon the human biological endowment in order to produce cognitive accomplishments. This leads us to the theme that underlies in one way or another all the papers in this issue and constitutes also a possible conceptual bridge between archaeology and neuroscience, i.e. *learning*. If we are to identify a single process or capacity as the key behind the accomplishments of Dauya's mind then the place to look would be at the way sapient minds 'learn to learn'. Indeed, according to Frith (2008), there is something special in Dauya's ability to benefit from cultural learning and the accumulated knowledge of Trobriand astronomy. That special something which seems to be unique to the human race is Dauya's ability to recognize and learn from instruction rather than from mere observation. Without this ability to learn by instruction and deliberately to share knowledge, Dauya could never have seen the sky as a meaningful sign in the complex system of Trobriand astronomy. Dauya's task to read the sky and construct his calendar would have been extremely difficult, if not impossible, to fulfil by mere observation, imitation and 'affordance learning'. Prolonged apprenticeship and formal instruction into Trobriand astronomy as a cultural practice is the key.

Approaching these issues we should not forget, however, that much of the social signalling that enables us to learn about the world is not restricted to the dyadic engagement between humans but includes also various processes of material engagement. Inanimate objects, material arrangements and symbols can also be used as powerful deliberate social signals thus playing a crucial role in the extraordinary achievements of the human race during the last few thousand years. Thus, to approach the problems of learning and cultural transmission effectively a partnership

between neuroscientists and archaeologists working on different aspects and time scales of these processes is required. What is needed to make this partnership most productive is a series of ideas that allow us to think about brains, bodies and material things in combination and thus to understand the possible links between brain and cultural plasticity. We hope that this special Theme Issue will help clarify the ground and stimulate further research to this end.

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