On the cognitive development of hominids

Robert G. Bednarik

Introduction

Before addressing the difficult subject of early cognitive development it is requisite to relate two antithetical concepts of reality. One is of the 'range of realities' as perceived by contemporary humans, with the perceptual and conceptual means available to them; the other concerns the idea or abstraction of an 'objective reality' (Kant's *'Das Ding an Sich'),* which has been speculated to exist, and which would have existed and would go on existing independent of human constructs. In the present context it is essential to appreciate that the former of these concepts is not necessarily a reflection of the latter, and that our examination of cognition or its epistemology is severely limited by the tools available to us: we can only study this phenomenon with means (conceptual constructs) that are its own, subjectively conceived products. This may hardly seem a scientific basis (and it should be understood before we proceed), yet it is no worse than that of most other areas of 'scientific' endeavour. Indeed, I have postulated that only one area of human consciousness can be studied objectively by humans: that which is called art. It is the only phenomenon in human experience that can possess no 'crucial common denominators of phenomenon category' that cannot be accessible to human perception (Bednarik 1994a).

'Biological intelligence' does not necessarily lead to a better grasp of objective reality for the species concerned. On the contrary, its development follows evolutionary laws that render this unlikely, as they tend to lead an intelligent organism away from, rather than towards reality. While it is true that intelligent forms of life must participate in a process that inevitably leads to the evolution of more intelligent forms of life, the improvements will always be in terms of their ability to enhance access to energy and nutrient resources, and to promote procreational potential, never in terms of facilitating a better grasp of reality. Genotypes determine the sensory faculties of an organism and changes only occur within the confines of phenotypic plasticity. These abilities determine which material stimuli an organism can detect. Genes can also form neural circuitry that allows cross-referencing of sensory information, but the ability to construct conceptual models of reality, which defines 'intelligence' biologically (Jerison 1973), is not itself genetically determined. Among highly advanced life forms, selection will favour organisms capable of the conceptual and behavioural innovations from which new behavioural modes can be constructed: the mental faculties, not their constructs, are the selective determinant.

Some years ago I proposed that 'the evolution of our sensory facilities and intellect can be assumed to have only equipped us with adequate faculties to make them useful; they were not selected on the basis of their suitability in defining the reality of the cosmos—in fact *there was no survival value in that ability'* (Bednarik 1984). I argued that because of the limitations of the genetically based sensory systems of organisms there could not be a direct correlation between humanly perceived reality and objective reality, and that this lack of relationship is the reason for the discrepancies between these realities. This, however, is not the only reason for the formulation of an anthropocentric world. There is at least one other, albeit more complex factor.

Human knowledge is derived from applying concept-building cognitive processes to external stimuli, i.e. sensory information, thus accumulating percepts. It is self-evident, I have suggested, that human knowledge has a tendency to reinforce itself through its own products, because it is continually validated and augmented by our material and cultural achievements (Bednarik 1985). But this interdependence becomes rather more sophisticated and complete when we involve the role of culture. In the sense used here, the term 'culture' does not refer specifically to human culture, but to the biological concept of culture: the individually acquired system of 'understanding' which reflects the distinctive life trajectory of the organism in question (Handwerker 1989). In this sense, cultural dynamics refer to the processes by which the intelligent organism alters its perceptible environment through its dialectic participation in the processes shaping it. Selection in favour of increased levels of 'intelligence' is the inevitable outcome of such interaction among percepts, concepts and behaviour patterns, but at no stage of this autonomous process is there any need for the concepts to be in tune with objective reality. Provided that the internally consistent logical framework is not challenged by it, there is no reason to assume that an entirely false, cultural cosmology or epistemological model could not be formed and maintained indefinitely by an intelligent species. Once again it is obvious that evolutionary success is irrelevant to the objective merits or validity of such models.

One can conjecture about the possible shortcomings of a cosmological construct, for instance by comparing them to those of scientific constructs that are based on confirmation (Tangri 1989). Indeed, the comparison appears to be valid, and quite illuminating. Just as the basic error in confirmation or induction is the inability of the inevitably subjective observer to identify the one variable of the phenomenon category that determines the common characteristics we perceive as crucial (the 'crucial common denominator'; Bednarik 1994a), the deficiencies of conceptual models of reality cannot possibly be explored from within such a model, which is the only way in which we have been able to proceed so far as a species. In an anthropocentric system of reality, ideas or mental constructs must adhere to its inherent order not only to be acceptable, but even to be liable to be conceived—even though they comprise elements relating to material stimuli, i.e. elements that must be assumed to have some form of objective validity. This is because they can only be generated by involving memory traces based on the same system, and one could argue that the inherent order might simply be a reflection of neural hierarchies, so we cannot even speculate whether there is any such order in objective reality 'out there'.

About science and reality

To summarise what has been said so far: the concepts of reality that have evolved in the course of hominid and human history have led to the one apparently held by all extant human populations. There is no reason to assume that these concepts could be particularly useful in exploring objective reality. What we can state categorically is that anthropocentrism governs all human consciousness, and that this knowledge has been with us for over two millennia at least: it is quite clear from Plato's simile of the cave that he, for instance, understood the concept of anthropocentrism. Developments in the twentieth century, in philosophy and theoretical physics, have begun to erode beliefs in the common-sense world epitomised by Newton and Euclid. The transient, ever-evolving nature of anthropocentrism has become more apparent since we have realised how many of even the supposedly most solid tenets have fallen by the wayside. As we approached the third millennium we realised at last the scientific enlightenment humans thought was within their grasp turned out to be a mirage, while the horizons of knowledge seem to be forever retreating from us. Science itself continues to occupy a position that is for the most part within the human model of reality. It is therefore fundamentally subjective, many of its rules may be valid only within its own frame of reference. This is of course quite adequate in terms of the demands make of it, as long as science is not expected to lead us to objective reality.

Progress towards more realistic knowledge will probably not be in the form of sudden, major breakthroughs, but will occur in the course of continuing intellectual and cognitive evolution. Malik's (1989) eloquently argued proposal that a conscious effort on the part of individuals would expedite this process is most relevant. Mental constructs or ideas are ephemeral elements, being continually re-formed, modified and re-cast in the creative learning processes of individuals. It may not be realistic to expect a significant change in human cosmology over the next few centuries, even though over the last century we have gained an unprecedented understanding of the influence of certain factors on the phylogenetic processes of cognitive evolution, on how the continual reshaping of world view and heuristic history has prompted an acceleration in the production of new conceptual and behavioural innovations, and on the roles played by identifiable elements in generating cultural dynamics. Yet even this significant broadening of the perceptual base will not by itself suffice to elicit more than a gradual development towards better understanding, as it will still be within the parameters of anthropocentrism.

One potential course is to attempt to explore the early development of human consciousness, focusing on the period during which the cognitive niche might have been established. If valid information about the underlying processes could be secured this might lead to the formulation of hypotheses about the origins of our anthropocentrism. While this would of course not by itself provide any access to objective reality, it might permit realistic inferences about the articulation between anthropocentric and objective reality. That some form of such an articulation does exist seems likely, it is difficult to see how there could be none at all. If one could explain the mental and cognitive processes involved, one might not only find it possible to consider the neural developments required and the biochemistry to account for them, but one might also find it possible to tackle the ultimate challenge: to explore reality outside that which is perceptually and conceptually accessible to humans.

While it is likely to take us thousands of years to achieve this, I feel that the formula as such might be quite simple. If one could explain how the cognitive basis of our world view was acquired—by quantifying, or at least defining, the processes involved—one ought to be able to speculate about the selective forces involved, how they contributed to the outcome, and how others would have altered the same. Such random forays into extra-human reality would lead to a fading of the boundaries separating it from anthropocentric reality.

The question of how much do we know about the cognitive development of hominids, the subject of this paper, is obviously the starting point of any inquiry into these profound matters. How much do we

actually know about the intellectual evolution of early humans, how reliable is it, what is it based on, and what are the reasons for the gaps in our knowledge?

Archaeological studies, especially of the second half of this century and in the Western countries, have concentrated almost entirely on what are believed to be valid interpretations of the ecological responses of humans, on how they may have adapted to changing environments, how they may have extracted their subsistence, how they are thought to have survived in their physical environment. Their intellectual environment has been almost completely ignored in the heuristic dynamics of this discipline. Herein lies one of the reasons why archaeology finds itself in its present cul-de-sac, although not the most important one: the inaccessibility of its interpretive models to scientifically valid methods of testing (Tangri 1989). It has in effect tried to define pre-History in terms of deconstructing culture, yet the development of humanity is based on cultural and cognitive factors, not on genetically determined abilities to improve access to resources. Ecological negation of this self-evident truth has led to many unrealistic and unscientific constructs. In the specific area of intellectual evolution, ecological archaeology has provided us with only fragmentary, unreliable and sometimes downright irrelevant evidence. Much of the discussion has centred on the human capacity to possess advanced language (itself an ethnocentric notion), and the present situation shows to what a vast range of incompatible ideas an inappropriate research program can lead. For instance, in respect of the Neanderthals we have the extreme views that on the one hand they were totally incapable of reflective language (e.g. Davidson and Noble 1989; Noble and Davidson 1996), and on the other that they were capable of well-structured grammar and syntax (Falk 1987), and there are of course intermediate views (e.g. Lieberman 1984). So in practical terms Neanderthal's linguistic ability must lie somewhere between that of an animal and a modern human! One does not need archaeologists or anthropologists to arrive at such a view. Similarly, the beginnings of complex language could be anywhere between 35 000 years and some millions of years ago, according to the various competing theories!

The types of evidence brought to the task of solving the problem include the cortical development inferred from cranial casts (Falk 1983), and the still continuing, unproductive speculation concerning the fossil laryngeal structure
and the role of the hyoid bone (Marshall 1989), all of which is tenuous and far from unequivocal. But cortical or speech-related structures surely are results, not causes, of evolutionary selection favouring speech or intelligence: a selection criterion needs to be established before it can affect phenotypic selection of genes. The reasons for the type of cortical developments we are interested in are not to be found in secondary symptoms, and by utilising these in their hypotheses archaeologists have merely substituted symptoms for causes. What we need to ask is what could have been the true causes and dynamics in the cognitive developments that provided the new traits for selection, and which ones could have left detectable traces for us to discover? How would one find and identify such traces in the archaeological record?

A discussion of the evidence

Neurological research suggests an intimate relationship between speech and vision, and there appears to be a nexus between the level of visual taxonomising ability and linguistic ability (Marshack 1988). This is supported by different types of evidence, such as the means by which the human infant acquires language (Lock 1980), or the effects of neurological impairments (Vellutino 1987). A crucial contributing factor in creating the conditions for cognitive development must be the feedback relationship between a hominid and his environment: as he changes it and perceives the results of his actions, his awareness contributes to creating the basis of consciousness, establishing the potential for dialectic. The most obvious potential was in the area of visual stimuli. Having acquired a high degree of tactile proficiency during eons of tool making and tool use, the production of simple marks—possibly 'discovered' through the rhythmic manipulation of tools—would have resulted in a permanent, visually perceptible pattern which could be duplicated, examined and contemplated. Such marking behaviour would have a potential for expanding conceptualisation and the attendant proliferation of mental constructs, and the establishment of new mental structures.

I propose that of all the potential sources of information about the intellectual advances heralding human consciousness, very early intentional markings and other manifestations of human awareness are by far the most promising. Certainly, evidence of such advances will continue to elude us in cranial casts, laryngeal structures, figurative art production, implied social structures, or any other archaeologically inferred phenomenon often cited in this context (Chase and Dibble 1987). Not only should we treat archaeological interpretations with more scepticism in view of archaeology's declining credibility (Hodder 1986; Tangri 1989; Bednarik 1990a), such developments are far more a product of cognitive evolution than a source of it.

Figure 1. *One of the engraved forest elephant bone fragments from Bilzingsleben, Germany, c. 350 000 years old.*

It follows that the most archaic intentional marks may be key evidence in interpreting the early cognitive evolution of hominids. At this stage only a few Lower Palaeolithic examples of intentionally engraved objects have been published. They are the several specimens from Bilzingsleben, Germany (Fig. 1), at least two of which were engraved on bones of the extinct forest elephant (Mania and Mania 1988; Bednarik 1995); the notches on the ivory fragment from Wyhlen, also in Germany (Fig. 2); the engraved horse bone fragment from Sainte Anne I in France (Crémades 1996); the petroglyphs in Auditorium Cave, India (Fig. 3), and possibly also some other marks in Indian caves (Bednarik 1993); and the pecked grid pattern from the Blind River mouth in South Africa (Bednarik in press). Also to be considered in this context are the two stone figurines from Berekhat Ram in Israel (Goren-Inbar 1986) and Tan-Tan in Morocco (Bednarik 2001a) because they bear engraved grooves also (Fig. 4). All of the mentioned finds appear to be between 200 000 and 400 000 years old, most relate to occupation strata of the Acheulian tool tradition.

Figure 2. *Ivory fragment from Wyhlen, Germany, bearing a series of engraved notches.*

Figure 3. *Cupule and meandering line engraved on quartzite boulder in Auditorium Cave, India, and found covered by undisturbed Acheulian occupation deposit.*

Figure 4. *Quartzite figurine from the Middle Acheulian of Tan-Tan, Morocco, thought to be about 400 000 years old.*

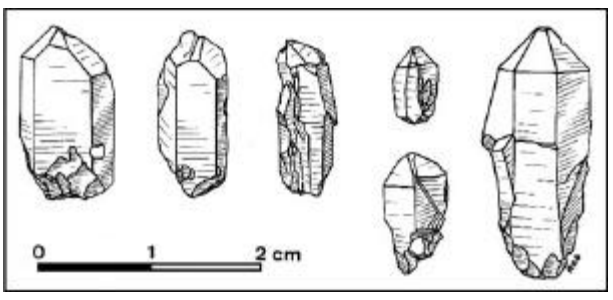

Figure 5. *Small quartz crystals collected by Lower Acheulian hominids at Singi Talav, India.*

There are, however, still earlier indications of nun-utilitarian, 'proto-artistic activity available. They include the discovery of ancient striations on one of the haematite pebbles from Hunsgi, India (Bednarik 1990b), which show that it was used crayon-like to mark a rock surface. The use of ochreous minerals during the Lower Palaeolithic period, the first era of human tool use, has also been observed at several other sites, including Becov, Czech Republic (Marshack 1981), Ambrona (Spain), Terra Amata (France) and Wonderwork Cave (South Africa) (Bednarik 1997).

Other very early palaeoart finds of this era are the numerous manuports, i.e. natural objects that were collected and carried by hominids because of some outstanding visual properties. They include the six quartz crystals (Fig. 5) from the Lower Acheulian of Singi Talav, India (D'Errico, Gaillard and Misra 1989); and quartz crystals at Choukoutien in China (Pei 1931) and at the Gudenus Cave in Austria (Bednarik 1988), as well as fossil casts. There is also a growing catalogue of disc beads from this period, now including several hundred specimens (Bednarik 2001b). Finally, the earliest palaeoart manuport currently known is very significantly older than all of the materials listed. The remarkable jasperite cobble from Makapansgat in South Africa (Bednarik 1998) was collected by a hominid almost 3 million years ago (Fig. 6).

Figure 6. *The jasperite manuport from Makapansgat Cave, South Africa, 2.5–3 million years—oldest known palaeoart object in the world.*

If we combine this evidence with the knowledge that hominids of between 840 000 and a million years ago undertook seafaring expeditions to colonise unoccupied land masses (Bednarik 1999) we begin to realise that all the indications of complex behaviour, including the use of symbolism and language, commence at about that time. This has remained entirely unknown to archaeology until now and is quite incompatible with consensus models of currency. Some of this evidence has been available for up to 150 years, but archaeology has simply ignored it in favour of a dogma stipulating that all early hominids were too primitive to have language, culture and cognition. This was a fundamental error because these faculties have been available to countless animal species, so archaeology appears to have been engaged in an unscientific pursuit of trying to maintain the traditional religious separation of the human from the natural.

So far only one set of hypotheses based on these finds has been advanced, my own. I have proposed, for instance (Bednarik 1994b), that the most archaic art in the world consists of 'responses to edges or surface aspects, enhancing them or making them more interesting'. I observed that selection would favour strategies providing optimal arousal, and that stimulus-seeking behaviour (Berlyne 1960) is therefore a biological imperative, providing cybernetic feedback and a more stimulating visual environment. 'This reshaping of salient aspects of the physical world not only resulted in an increasing consciousness of the physical reality and a feedback on the mark making behaviour, but inevitably also in an increasingly complex cognitive environment and in the emergence of new, taxonomising mental processes'. Such behaviour would seem to result in a proliferation of new neural pathways, in the establishment of new associative percepts, and therefore in a comparatively rapid enlargement of the conceptual base. Finally, I have proposed that the production of iconographic forms is simply the cultural and intentional creation of features prompting visual responses to a signifier; it induces visual ambiguity intentionally. Iconicity, in this explanation, expresses a 'managed', intentional use of visual ambiguity, and its rather late introduction in human culture, especially in its two-dimensional or graphic form, is not a significant measure of cognitive development.

This very preliminary (and certainly incomplete) model of the cognitive evolution of hominids remains without competing hypotheses. It is no more than a draft, requiring considerably more detailed explanation, and it needs to be formulated in such a manner that it becomes fully refutable. Nevertheless, it indicates that the subject is being addressed in a holistic fashion. But I stress that we are only at the beginning of a long and arduous road; where it leads no one really knows. But as we take this road we must first consolidate and rationalise all we know about the subject and try to increase our extremely small database. This, without a doubt, is the most pressing matter in the quest to find the origins of human cognition, intellect and human reality.

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Robert G. Bednarik
International Federation of Rock Art Organisations (IFRAO)
P.O. Box 216
Caulfield South, Victoria 3162
Australia

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President, International Federation of Rock Art Organisations (IFRAO), P.O. Box 216, Caulfield South, Vic. 3162, Australia
auraweb@hotmail.com
