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THE NEUROPSYCHOLOGY OF 'ANIMISM': IMPLICATIONS FOR UNDERSTANDING ROCK ART

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Abstract. Animism has had a long and controversial history that has led to the topic being avoided as a subject of concern amongst scholars. Recently, however, there has been renewed interest in the subject, thanks both to a re-evaluation as to the significance of the concept and a redefining of the core principles involved. By assimilating this reappraisal with some recent insights with regard to neuropsychology, the authors show how the concept can be further supported and expanded, especially in relation to understanding how animism can help in the understanding of rock art.

Overview

This paper is technically complex and integrates a great deal of interdisciplinary information. Thus we initially provide this overview for the convenience of the reader. Most conventional explanations of rock art take either an ethnographic or inferential approach to understanding the archaeological record. Although both these methods will be used in this analysis, an alternative, which has shown potential for understanding the origin of artefacts, will also be considered: namely, the neuropsychology of perception and corresponding response systems. The encyclopaedic database available on this topic includes evidence regarding the underlying neuropsychological mechanisms that provide insights as to the invisible behavioural determinants relating to 'art works' (Ingold 2000). The behavioural expression of neuropsychological capabilities is based upon the fundamentals of visual perception, emotional and cognitive abilities of the human brain, and more importantly upon the behavioural expressions that transform these abilities into material form as evident in the archaeological record. In this paper we will focus on the origins of the visual system with respect to visual perception, especially in relation to emotion as elaborated in the limbic system, as this first evolved in mammals and eventually culminated in the higher cognitive abilities of hominins. As these skills were evolving from the earliest primitive organisms capable of responding to light, motor responses and motoric skill potential was also evolving in synchrony with the visual-perceptual abilities that reached an apex in *Homo sapiens sapiens*. The evolution of cerebral and cognitive development as discussed in this paper is associated with what Tylor (1871) first described as a core of early religious beliefs referred to as animism. Through this approach, and in conjunction with previous analyses that have taken a similar line, we seek to present new evidence that will push the debate towards providing a more sound footing on which to understand the manifest complexities of the *production* and *interpretation* of 'religious' tendencies and related artefacts.

Thanks to the many examples of animism and artefact production embedded within a tradition deriving from both contemporary and historical traditional cultures, the ethnographic, inferential and neuropsychological approach adopted here will provide a means of gaining insights into how material artefacts became meaningful commodities to those responsible for their production. From such a range of cultures it may be possible to deduce interesting correspondences that can potentially be applied to long-past societies. To achieve this, it will be necessary to assess how the human brain processes and responds to visual information as well as how cognitive and emotional factors influence such processes. Primordial animistic beliefs will thus be considered by way of the deep elemental roots of evolutionary biology in relation to perception/response systems. In conjunction with an understanding of how the production of artefacts by corporeal, embodied agents can supplement more conventional modes of interpretation, this paper will, therefore, seek to present specific examples of an approach based on neuropsychology and related disciplines. Examining animistic beliefs in this way may thereby help to understand and interpret the archaeological record by way of a more reliable and evidence-based paradigm**.** Finally, we will introduce two original concepts that we believe will assist in

analysing and interpreting rock art imagery and other artefacts, namely, *hyperimages* and *hypersounds*.

Introduction

A continuing problem with the invisibility of archaeological items concerns the thought processes of the individuals and groups responsible for extant artefacts, i.e. how a community might have related to and reflected on the range of objects produced. In other words, in what ideational milieu might an artefact have been created and what was the nature of the ceremonies that were practised in relation to production and use? Artefacts are the behavioural manifestations of neuropsychological events relating to *perceptual processes; associational mediation systems (including memories, beliefs, and emotional factors) and the associated responses* that have developed throughout evolutionary time. By appealing to such criteria, one may attempt to render the underlying intentions implicit in artefacts visible. Understanding how visual processes function has already been shown to be a way of connecting humanly-made and/or enhanced objects with mental processes linked to meaning whereby memory recall is enhanced that is subsequently recreated or reinterpreted by a cultural group. The making and perceiving of such objects necessarily requires the involvement of visual channels that may, in terms of behavioural expression, have had a constraining *and* boundary-breaking effect on how artefacts were made and interpreted within the context of a complex religious-ideological system. Visual recognition and memory are thought to be based on fragmentary information encoded in neural micro-networks and for this reason are prone to error (Schacter 1996) — this, however, is not so marked as to interfere with effective functioning as natural selection would have ensured a near optimal level of performance. Although the ability to produce artefacts would have facilitated a more lasting storage of cultural information, the initial motivation for their creation will have been dependent on actual memory that includes transitory memory aides, such as marks made in sand etc. As memory of a past event can influence present concerns, current memory therefore becomes an interaction of two inputs arising from the past and present (Schacter 1996).

Just as memory for past events can bias how the world is currently viewed, so can how the world is interpreted at any given moment bias memory for past events. It is the dynamic interaction between the two criteria that may determine the form of an artefact. Moreover, it is the success of the artefact in performing the 'function' for which it was created that will determine whether or not it becomes an enduring part of a culture that dictates how that culture *might* have related to that artefact.

How visual images are interpreted

Retrieving an image from visual memory often makes a person feel as though they are *recalling the actual details of a real event*, but memory is biased by present concerns, and the remembered image may thereby be distorted. This may, in part, be due to the fact that the same brain regions are often involved in both remembered visual imagery and in the initial visual perception (Kosslyn 1994; Kosslyn and Thompson 2003). Thus, a current external image stimulates areas correspondingly involved with the visual memory of that image (internal representation) and with the *accompanying emotional and cognitive components* associated with past memories pertaining to that image.

This may account for the fact that people from many different groups, if asked to destroy a photographic or other image of kin, often feel great unease at the prospect — because the photo conjures up all the associations, emotional and cognitive, linked with the actual person. In a sense, the response to this kind of photograph is premised on the notion that the representation is imbued with the spirit of the person concerned. For example, indigenous groups tend to imbue photographs of dead kin with the actual soul of the departed, making the photograph much more than a simple visual representation; a tendency that is also to be found in communities with no tradition of pictorial representation (Deręgowski 1989). Yet, even a photograph of a living person is held to contain the essence/soul of the individual portrayed. This effect is all the more surprising considering a picture is obviously a representation of the individual and not the actual person. An examination of the processes involved may help in understanding the reactions of traditional cultures which are less rationally and emotionally distanced from photographic or other images than are members of more highly objectified (no value judgment intended and see below for more on this) Western civilisation. The attribution of a spirit or soul to an inanimate object is part of a broad-based, primordial system of beliefs referred to as animism of which some of the key aspects will be reviewed first before returning to a discussion of visual and perceptual processes.

Defining animism

Animism is a very broad-based term covering a number of different but related beliefs, that Eliade suggested formed the ancient foundational matrix of most, if not all, world religions (Eliade 1964). Students of animism accentuate different aspects of these assorted beliefs and we will discuss the views of a number of different scholars of animism presently. In this respect, differences between Bird-David (1999) and Guthrie (1993) on animism will be discussed as well as how Hallowell (1975) developed the concept of 'other than human persons', in order to illustrate some of the differences existing among scholars of animism. The anthropological concepts associated with the definition of animism to be followed in the present

context were first systematically elucidated by E. B. Tylor in 1871 (reprinted 1958) — though later criticism led to the concept being generally condemned mainly due to the notion that early forms and tribal ways of thinking were held by Tylor to be more primitive than so-called civilised Western modes of thought. Most anthropologists, whether regarded as scholars of animism or not, consider animistic beliefs to be the earliest manifestation of 'religion' that may have a very archaic provenance in relation to the biological and cultural evolution of *Homo sapiens*, although speculations with regard to its earliest origin tend to vary. The definition favoured in the present paper is consistent with criteria identified by both Tylor and Hallowell, as well as Bird-David (1999) and Guthrie (1993), whereby animism is taken to be based on the idea that all human beings, which are believed to be possessed of a soul or spirit, live in a community with others, labelled 'not-human-beings', that also possess a soul or spirit. To animate (endow with movement) is thus to 'make alive'. Indeed, a recent study by a biologist considers the perception of biological motion to be a manifestation of a perceptual 'life' detector (Johnson 2006). And, the most fundamental category that divides the 'living' from the 'non-living' appertains to *movement*, the perception of which, in humans, is multi-faceted, especially with regard to discriminating the animate from inanimate. The ability to perceive animate objects, however, can also be modified, or transferred/projected onto inanimate objects that are perceived as moving (Barrett 2004). In addition to animal and human movement, other aspects of the natural world 'move' and thus may be endowed with spirits, such as wind, plants, rocks, clouds, thunder, water, fire, volcanic action, and assorted other natural processes.

From as early as 1919, Gilmore suggested that animism should be regarded as characterised by a vast interconnected community of 'beings' as set out in the maxim 'Each for all and all for each' (Gilmore 1919). This general idea can be rephrased such that, just as all fellow humans are regarded as being imbued with vitality, so animists believe the entire universe is 'alive'. As will be discussed further, some contemporary writers on animism, however, believe that such early accounts failed to place enough emphasis on certain reciprocal social relationships that exist between human and 'other than human persons' in terms of how various communities interact with the perceived universe.

Some of the many concepts associated with animism, both historically and contemporaneously, include the idea that, in all cultural systems, people experience phenomena such as dreams, visions, sudden insights, out-of-body experiences, and trances that simultaneously conjoin perceptions of being 'elsewhere' with the knowledge of being 'here'. In this regard, in some cultures everything is deemed to have a soul, including inert matter, though of a lower order due to a lack of 'liveliness' (Kingsley 1899).

Other beliefs and practices characteristic of animism include the idea that what is human is not separate from animals and the other objects of the universe. For example, it has been observed that '[a] central Australian pointing to a photograph of himself will say, "That one is just the same as me, so is a kangaroo" (his totem, or sacred animal). We say the central Australian "belongs to the kangaroo tribe"; "he knows better, *he is a kangaroo*" ' [our emphasis] (Harrison 1912; see Ingold 2000, for a detailed discussion of the differences between totemism and animism). Such concepts give rise to the belief that humans and animals can exchange forms or merge together (as in therianthropes), and that there are many varieties of shape-shifting, including animals that contain attributes of two or more different species. Moreover, any physical similarity between objects may give rise to the notion that the same essential essence and identity is shared. For example, a recent study of the Baka (forest Pygmies in the north-western Republic of Congo) and their neighbours, a Bantu-speaking group of farmers, demonstrates how, because the Baka observe similarities between gorilla behaviour and that of their Bantu neighbours, the Bantu are therefore referred to as gorillas. In contrast, the Bantu view the Baka's behaviour as similar to chimpanzees and label them accordingly (Kohler 2005).

Another fundamental animistic belief concerns the idea that the soul exists both prior and subsequent to death. Because the soul of the dead is believed to survive, various funerary practices result in favourite objects being placed in the grave with the deceased person and food and drink may be located near the dead individual for use in the afterlife. In addition, the soul may inhabit specialised regions varying from a shadowy afterlife, to one where the best things of worldly life, which have been experienced during an individual's lifetime, are made readily available. The soul is thereby held to be capable of travelling from life in the existing world to other realms or to ancestral souls of the dead, to heaven *per se*, occasionally to and from an underworld, or can take extended flights to other locations and relocate in animals or other people, rocks, pools and the mountains of the real world. Moreover, a common word characterises both soul and breath in many languages whereby the soul is associated with the breath of the living (Latin, *spiritus, anima, animus*; Sanskrit *atman*; Greek *psyche, pneuma, thumos*; German *Geist*; English *ghost*; Hebrew *nephesh, ruah*; Sumerian *zid*; Egyptian *ka* etc.).This linguistic evidence also suggests that the terms 'living' and 'breathing' with regard to humans and animals can be regarded as synonymous.

Animal and ancestor worship, as well as reincarnation, can also be viewed as animistic, as can beliefs that free 'spirits' (which are not characterised as dead humans or animals) also exist and inhabit the world of humans. Such spirits might consist of the spirits of the forest, a lake, springs, caves etc., and may be

beneficial or malevolent as in black magic, witchcraft or sorcery, but must be both attended to and respected. In many animistic communities, death is not believed to be a natural phenomenon but rather is thought to be caused by evil spirits and sickness and is also believed to be a punishment for some unknown 'crime' against conspecifics or the spirits, which may require the services of a healer in order to discover the cause and provide the necessary treatment.

Irving Hallowell (1975) carried out a number of ethnographic studies of the Ojibwe — investigations that were later to have important implications for understanding animism. Many scholars of animism had previously assumed that the prevailing 'spirits or souls' of the cosmos were identical to human souls,[1] but Hallowell augmented that view and maintained that the Ojibwe recognised a universe composed of both human and other-than-human persons, including animals, plants, trees, rocks, clouds, thunder, stars and other inanimate structures or processes. These other-than-human persons were relational, intentional, conscious and communicative beings and possessed of a soul or spirit. Ethnographer Thomas Blackburn reached a similar conclusion in relation to the Chumash Indians, whose cosmos was said to be composed of an 'interacting community of sentient creatures' (Blackburn 1974).

Hallowell stressed that other-than-human persons could be helpful, harmful, callous, malicious, indifferent or tricky, as is the case with living humans. Furthermore, Hallowell reported that it may be helpful or necessary to enter into personal relationships with such entities that could lead to comforting, demanding or dangerous experiences. To what extent these other-than-human persons possessed traits that were human (i.e. anthropomorphous) or other-than-human — e.g. an animal might possess its own personhood different to that of the human equivalent — is, however, beyond the scope of this paper. Hallowell stated that the Ojibwa did not necessarily believe that a 'person' had to have anthropomorphous traits, although most spirits inhabiting non-human objects did, suggesting that in some instances, at least, personhood in non-human persons was not 'human'. Moreover, the Ojibwa believed some stones had spirits whereas others did not. Thus, only certain stones possessed spirits, namely those that had been seen to move or seemed to possess other animate qualities, i.e. some resemblance, whole or in part, to humans or animals. Interestingly, Bird-David (1999) documented a similar phenomenon in relation to the Nayaka of southern India

In this regard, Guthrie (1993) sees a very close relationship between beliefs in animism and anthropomorphism, which are held to be universal. Thus, animism and anthropomorphism are understood as stemming from the ancient fact that hominins had an evolutionary disposition that gave rise to a profound interest in both animals and humans. According to Guthrie, 'because our species has evolved in environments where we have to deal with both predators and prey, our cognitive systems have evolved so as to work on a "better safe than sorry" principle that leads to "hyper-sensitive agent detection" '. The human form along with its qualities (such as agency) tends to be attributed to a *wide range of objects*. Guthrie considers that anthropomorphising is a good bet because the 'world is uncertain, ambiguous, and in need of interpretation', and suggests that 'the most valuable interpretations usually are those that disclose the presence of whatever is important to us' (Guthrie 1993). This idea is supported by research into how fundamental aspects of categorisation are related to innate criteria (Barrett 2004).

Recently, Bird-David (1999) has emphasised that animism consists of a large network of social activities and relational personhoods that operate between humans, humans and animals, humans and rocks, hills, forces of nature etc., that is referred to as *devaru* by the Nayaka, a hunting-gathering people of south India. To Bird-David *devaru* is a Nayaka concept that 'objectifies' the relationship between human persons and other-than-human persons as defined by Hallowell. In this respect, Tylor's conception of animism is criticised as failing to take account of the sociality and relational nature typical of humans and other-than-human persons that has given rise to numerous examples of *devaru* in the Nayaka. Bird-David also criticises Guthrie for 'reducing' animism to a perceptual error of biological evolution.

Guthrie's perspective on animism posits an evolutionarily adaptive, perceptual-action error, where it is more advantageous to perceive and respond rapidly to that which appears animate, than to fail to respond — a view similar to that proposed by Hodgson and Helvenston (2006). We concur with Guthrie that such a response, while possibly an 'error' in a technical sense, may have had an adaptive role in protecting an organism from various predators and in signifying prey. We also view Guthrie's ideas as complementing Bird-David's belief that animism is a mechanism by which social relationships between humans and non-humans can be understood. However, Bird-David's explanation tends to ignore the importance of evolution with respect to how animistic beliefs may have been

1 Although some authors make a distinction between spirit and soul, most tend to use the terms interchangeably. In this paper the terms are generally referred to synonymously, although we acknowledge that some animists, including scholars of animism, consider spirits to have souls but the distinction between the two concepts is often extremely vague. Others, however, do make a distinction and generally consider spirit to be more abstract, eternal and intellectual or rational, whereas the soul is often viewed as containing human and animal attributes and passions, such as lust, anger, hunger, but the soul too may be eternal. These latter distinctions were elaborated in medieval England and Europe. In some societies, even spirits and souls can die or be killed.

mediated by selective determinants, whereas Guthrie formulates a biological evolutionary substrate upon and within which the perceived sociality of human and animal culture is intermeshed. Moreover, contrary to Bird-David and Ingold (who suggested that Guthrie did not take enough account of the social dimension of animism), Guthrie recurrently highlighted the importance of the social dimension with regard to the perceptual error hypothesis (Guthrie 1993) (see below for neuropsychological evidence and speculation as to how the two approaches can be assimilated).

The basic beliefs encompassed by the term animism are considered by psychiatrists and psychologists in highly literate, industrialised Western countries as arising from *magical thinking*. This term was first used by Bronislaw Malinowski (1954) to describe a type of thinking engaged in by the Trobriand Islanders when they faced a situation-bound condition of high ambiguity or uncertainty. For example, the islanders did not resort to 'magic' to explain phenomena when fishing in well-known, shallower waters, yet, in more distant and deeper, unfamiliar seas, a variety of magical rituals aimed at appeasing or pleasing assorted spirits were appealed to. Also, when occupied in agricultural activities or building boats — where there was a certainty as regards cause and effect in relation to actions — magic was generally not a factor. However, in situations where garden pests needed to be eradicated, accidents at sea prevented, sickness countered or personal accidents avoided — all conditions of high uncertainty — magical thinking and practices again became important. Similarly, the ancient Egyptians did not use magic when aims could be achieved using a more 'scientific' or practical approach, a view that is summarised in the following statement:

> Only when science and rational technique broke down would magic be invoked. For example, Egyptians might resort to magic in an attempt to cure a disease they did not understand, but they would never depend on magic for the construction of a pyramid, which they did understand (Gordon and Rendsburg 1997).

Malinowski's findings were subsequently confirmed by Subbotskii (1984) under experimental conditions where both magical thinking and naturalistic assessments (based upon logical reasoning a propos cause and effect relationships) co-exist and develop simultaneously in young children. Subsequently, and particularly in literate Western culture, children, as they mature, begin to think more in terms of basic cause and effect relationships, i.e. thinking comes to be dominated by naturalistic understanding. When children are presented with familiar situations deriving from daily experience, they demonstrate logical thinking by around two to three years of age (Pines 1983). In some areas of a child's life experience, however, animistic modes of perception and understanding may continue to dominate, e.g. in the realm of fairy tales, fantasy and art — all ancient patterns of thought, a fact that was previously established by Piaget (1929). These findings were succeeded by a long line of researchers who agreed with or revised Piaget's findings (see, for example, Inagaki and Hatan 1987). Although Piaget's work and related research is cited in support of the theory presented here, a lack of space restricts a more extensive review of the appropriate literature.

As is also the case even with 'objectively' disposed Western individuals (where there tends to be a reliance on a sense of detachment and impartiality), those from traditional non-literate cultures also resort to magical thinking, especially when this is related to certain neuro- or psychopathological conditions, or when events become alarming, ambiguous and uncertain. For example, during the 1920s and 1930s highly literate German people tended to become overly superstitious in response to prevailing insecure economic events (Padgett and Jorgenson 1982). There can be no doubt, however, that oral cultures are much more prone to magical thinking than literate cultures (Ong 1982). Moreover, in industrial societies, magical thinking in the form of superstitions is more frequent in occupations where chance prevails and the outcomes of one's actions are less predictable. For example, such individuals as gamblers, soldiers, sailors and actors have been found to employ superstitious rituals more frequently than members of other professions (Zusne and Jones 1989). In addition, prior to the rise of the scientific method, magical thinking was dominant throughout the Middle Ages. Animistic beliefs, it appears, are therefore deeply rooted within the human psyche as a consequence of the aforementioned enduring evolutionary factors.

The neuropsychology of animism

How visual images are interpreted

Having considered some of the fundamental characteristics of animism, the way in which visual images are interpreted can now be examined. To address this issue it is first necessary to identify the underlying perceptual mechanisms pertaining. In this respect, the inclination to view photos or images as containing the soul of the imaged person involves two main criteria:

Representations (signifier) are interpreted as actual objects, i.e. human beings (signified), while, at the same time, not wholly accepted as being real objects, i.e. the photo contains the soul of the imaged subject, even though the viewer knows the image is not the actual person (hereafter referred to as Point 1). But, the image is so close a resemblance to the actual person that the sentiments associated with memories of the individual concerned are aroused in the viewer who comes to invest the *photograph* with emotions and attributes of the actual person. Thus the photograph is animated and the image comes to posses a soul. This reaction is largely automatic, i.e. reflexive, suggesting an inborn tendency, but not ruling out the influence of cultural and individual learning.

There is also a marked tendency to imbue *representations* with agency (which is similar to regarding a *real object* as possessing agency) even in highly literate cultures as will be demonstrated in relation to *hyperimagery*. In other words, a representation is viewed as a human 'object' that can possess similar characteristics and that is able to behave as such in the wider world (hereafter referred to as Point 2).

The processes described in Point 1 appear to be closely tied to enduring evolutionary events that have had an influence on how humans perceived the world. One example would be the discovery by early hominins that hunters *disguised as animals* were able to approach prey with a greater measure of safety, thus leading to more successful hunting outcomes (Hodgson and Helvenston 2006). This has obvious survival advantages for those hunters employing such camouflage (a technique whereby the hunter, represented as an animal, could deceive the prey's ability to detect the human predator). In fact, what differentiates humans from animals in this regard is that the latter tend to mistake a representation for the real thing, whereas the former have the ability to inhibit such an automatic response in order to manipulate and exploit this propensity and thereby gain an advantage.

Evidence for this also comes from the fact that human infants, up to about the age of two, tend to mistake a representation for a real object (Winner 1982) and this fact suggests that sometime during the evolutionary history of humans, a shift occurred whereby the automatic response of mistaking a representation for a real object came to be inhibited to the extent that humans were capable of making a more discriminating and measured response, i.e. cognitive factors associated with inhibitory frontal brain regions could increasingly be employed to mediate instinctive responses, thus facilitating greater behavioural flexibility. The exterior morphology of the frontal lobes has remained essentially the same for approximately 300 000 years BP (Bookstein et al. 1999) — although internal changes in connections and the enhanced development of inhibitory neurons probably continued, especially in Area 10 (Semendeferi 2001a).

One illustration of the processes discussed in Point 2 can be found in the fact that young infants tend to confabulate (make up stories about) and imbue representations with meaning if not a soul. As mentioned, this is referred to by mental health professionals as *magical thinking*, and it is a characteristic of animistic thought in general. This process may be related to the fact that infants also seem to attribute non-human objects with agency — that is, they relate to things in the world as if these were infused with an animate spirit or essence (Piaget 1929; Inagaki and Hatano 1987). This tendency persists into adulthood, even in situations not involving much uncertainty, as has been demonstrated by a study where a cartoon depicting two different sized triangles and a circle were interpreted as having moved around on a screen (Heider and Simmel 1944). Adults viewing this array interpreted the geometric forms as having intention and even made up stories whereby the abstract motifs became individual humans vying with one another. The sense that objects have human or animal-like intention as well as a soul may therefore be a universal trait that seems easily aroused in response to minimum cues. Such minimum cues seem to particularly concern the detection of *movement*, often associated with humans or animals, and which palaeontological evidence suggests is a deeply embedded evolutionary phenomenon.

Animism and the evolutionary depth and significance of movement detectors

Movement, the ability to respond to a stimulus, dates back to the earliest multi-cellular organisms that possessed the ability to sense chemicals, light, perhaps temperature, and to move towards or away from such stimuli. This fundamental stimulus-response (S-R) mechanism originated some 2.5 billion years ago, dating to the palaeoproterozoic where microscopic worms (e.g. *C. elegans*) have been found in the fossil record (Hofmann 1994). This basic S-R mode subsequently became more elaborate with enhanced receptor-detection devices and motoric responses; and, with the arrival of invertebrates and primordial vertebrates, an increasingly large association area (or areas) began to serve as intermediaries.

An important illustration of such biologically determined intermediaries in relation to the direct connections linking perception/association/motor areas may be found in the fact that humans can act upon visual stimuli that are not overtly perceived, i.e. visual perception is not always mediated by conscious awareness. Blindsight in humans is the most obvious example, whereby certain regions of the visual cortex may have undergone damage to the extent that blindness ensues in response to consciously perceived visual input. Interestingly, the fact that individuals experiencing blindsight can often respond appropriately in certain situations suggests other pathways, mediated by subcortical connections, can provide inputs to the motor cortex, thereby allowing an appropriate response to occur (Binsted et al. 2007; Grossman et al. 2000; Rajkai et al. 2008; Grossman et al. 2000; Farrer et al. 2008; Eickhoff et al. 2008; Kelly et al. 2008; Hinds et al. 2008; Saygin and Sereno 2008; Whitney et al. 2007; Mars et al. 2007; Watson et al. 1993; Babiloni et al. 2006; Trujillo et al. 2007; Van Oostende et al.1997).[2]

The evolution of S-R networks and the links formed with multiple association areas culminates in the brains of higher primates and hominins. Here, the enhanced elaboration of the above three neural systems, in

2 The proposed subcortical pathway in question is believed to extend from the superior colliculus of the mid-brain, through the pulvinar of the thalamus to the parietal motor regions, thus by-passing the primary visual cortex (see Christensen et al. 2008).

addition to the development of the limbic system (of which the earliest development began with mammals) that modulates emotion and motivation (based upon inputs from the hypothalamus), is highly developed. The subjective *experience* relating to these feeling states in humans was also accompanied by objective measures in both humans and other animals, such as increased blood pressure, blood flow directed away from internal organs and the skin to the skeletal muscles, rapid respiration, release of epinephrine into the blood stream, piloerector response etc., which can alter the basic S-A-R (stimulus-arousal-response) pattern. Moreover, evidence from functional neuroimaging of the human brain indicates that information about salient properties of an object (stimulus detection, perception and recognition) and the response, i.e. movement and usage, is stored in specific sensory and motor systems active *when that information was acquired* in the form of a memory trace consisting of a specific S-A-R event which is stored in a specific neural micro-circuit (Martin 2007). As a result, object concepts belonging to different categories e.g. animals and tools,[3] are represented in partially distinct, sensory and motor property-based neural micro-networks.

Some sensory-motor, property-based areas, however, also have a hierarchical and category-based organisation (Martin 2007) with specific domains in assorted regions of the cortex for different objects. In other words, perception-action specific networks that are activated in response to a given object such as an animal depend on the perceptual and motor sequences in play while *viewing and responding to that animal;* but there are also specific domain areas that rapidly categorise basic objects such as conspecifics, prey, predators, plant foods, perhaps tools and animate versus inanimate objects. It seems evolutionary pressures have resulted in domain-specific areas that respond reflexively to highly significant categories of objects encountered in the everyday life of various species, which applies to a wide range of organisms from birds to higher primates and humans.

The situation is somewhat more complex in humans in that colour and motion seem to follow parallel tracks in one fasiculus, whereas form tends to be mediated by a different pathway (Meissirel et al. 1997). Moreover, recent studies have indicated that the human visual system tends to integrate colour signals along a motion trajectory (Nishida et al. 2007). In primates the neocortical visual system becomes increasingly complex and studies in Old World monkeys, apes and humans indicate the existence of several visual cortical areas that are dedicated to the detection and response to movement (Watson et al. 1993). A recent study also demonstrated that two-day-old human infants could discriminate between biological and non-biological motion and biological motion was preferred when the animated figure was oriented in an upright position (Simion et al. 2008), again demonstrating an innate dimension for the detection of biological movement. The dedication of numerous cortical areas in humans, which are involved in the detection of and response to movement, indicates the importance of this particular stimulus attribute to visual perception, associations and responses.

Recent research has additionally revealed how the cerebral motor systems in higher primates and humans are more highly developed compared to that of lower primates. For example, the primary motor cortex contains a rostral (forward) section that is evolutionarily relatively recent, wherein motor neurons in the cortex directly innervate the shoulder, elbow and finger muscles, contributing to a much more highly sophisticated response system. The caudal (rear) primary motor area is mediated by corticospinal efferents from 'old' cortical neurons that utilise the integrative mechanisms of the spinal cord to generate motor neuron activity and motor output (Rathelot and Strick 2009). This pattern of anatomical connections underscores the significant evolutionary development in hominins and humans of refined, highly developed, response systems that convey information at a rapid rate.

Because perceptual-response systems are so fundamental, other neural substrates have usually gained more attention from neuropsychologists, archaeologists and anthropologists, the exception being the recent work of Hodgson who has focused upon various attributes of the visual system, including perception and the relationship between the properties

3 We include tools in this discussion because of their seminal importance in hominin evolution. Also many archaeologists consider some tools as both functional and as art objects (for a more detailed discussion of the neuropsychological encoding of tool use in the cerebral cortex, see Wynn et al. 2009). Taçon (1991) presents evidence that links ancestral beings who created the world, as described in Australian Aboriginal myth, with rock art, where the beings that are depicted on the surface, whereas the spirits reside within. One such ancestor, referred to as Lightning Man, is depicted with a stone axe tied to each hand. In Aboriginal culture, stone tools have great social significance in that stone axes are 'owned' by older men and younger men but both women and older children have to ask permission to use them. Other lithic tools, referred to as Kimberley points (a small, serrated spear point requiring great skill to produce), were used in ceremonial activities, primarily after European contact. There were special quarries that had high prestige due to the fact that the stones there were believed to have mystical properties that enhanced a warrior's armoury. The Worora made Kimberley points composed of chalcedony in assorted colours; orange, red, yellow and white, which were usually employed in rituals. One wonders if these points were invested with special powers, and whether each colour may have signified a different spirit or power (Bostrom 2004). Perhaps the colour was simply one aspect of the aesthetics of the tool that made it more appealing to collectors. Nevertheless, the connection between animistic beliefs, rock art, myth, tools, as well as the social and gendered meanings is striking.

of the visual system and Palaeolithic rock art (Hodgson 2000; 2003a; 2003b; 2005; 2006; 2008).

Artefacts are therefore potentially capable of being understood because they reflect grounded contingencies — a concept that derives from a contemporary trend in psychological research where perception is held to be embodied (Barsalou 2008: 617). This theme is also taken up by philosopher Alva Noe (2004) who emphasises the fact that to perceive is not merely to have perceptions, it is also to have perceptions which are *understood*. Noe discusses what he refers to as the *enactive* approach to perception, according to which perception is not just based on the processing of sensory information or on the construction of internal representations, but is fundamentally *shaped* and determined by the motor possibilities of the perceiving brain/body, i.e. *the response systems*.

In short, perception is defined as something which does not function independently from moving around in the world, it *is* moving around in the world. Thus, perception and perceptual consciousness depend on capacities for motoric action, responses deriving from the endocrine and limbic system, thoughts as manifest in behaviour, as well as speech (Noe 2004). In this respect, the brain and body have evolved a perceptual-action apparatus deriving from long-term evolutionary events that have been crucial to human adaptation, i.e. social interaction and attention/response systems that dovetail with particular aspects of the natural world, such as predators and prey**.** The way the world is perceived is thereby determined by such factors and, in this sense, human cognition is said to be *embodied* (Barsalou 2008). Animistic thinking has thereby arisen out of such a biological matrix and has subsequently undergone refinement and elaboration thanks to the influence of human culture.[4] Perception, action, and emotional/associative determinants are, hence, fundamental neurophysiological/psychological criteria involved in both animistic perception and corresponding responses and thus there may be some visual characteristics of preliterate material culture that could be potentially identified, which might enhance understanding of the processes involved.

Ingold's (2000) criticism of the present accepted definition of 'art' is relevant here; namely that art continues to be viewed through the lens of 20th-century Western concepts, e.g. 'art for art's sake' that needs to be redefined in order to take into account representation as realised in specific cultural milieus. As will be demonstrated with examples, the 'making' of items presently viewed as 'art' from other times and cultures is actually embedded in rituals and myths with extensive emotional overtones (see Solomon 2008 for detailed examples).

Further support for the importance of perception/*response systems* is provided by the distributed network of 'mirror' neurons located in the posterior parietal, premotor cortices, and inferior frontal gyrus in monkeys, apes and humans. These specialised neurons are activated during the perception of other people's behaviour, which in turn activates corresponding motor representations in the observer, thus preparing the spectator for a response (Dijksterhuis and Bargh 2001). The intensity of the activation of 'mirror' neurons is enhanced during heightened motivational states such as hunger, mediated primarily by the hypothalamus (Cheng et al. 2007), and emotional states such as fear (De Gelder et al. 2004), mediated by the amygdala. These mirror mechanisms may subserve different functions, including action recognition (Gallese et al. 1996); understanding (Rizzolatti and Craighero 2004); empathy (Decety and Lamm 2006; Preston and de Waal 2002; Gallese 2003); imitation (Brass and Heyes 2005; Meltzoff and Decety 2003; Iacoboni 2005); action prediction (Blakemore and Frith 2005); action stimulation (Wilson and Knoblich 2005); and social interaction (Somerville and Decety 2006). Such behaviours are typically engaged during various rituals, artistic and artefact production, and in the recitation of myths that are instigated in ancient animistic beliefs.

With regard to the sensory abilities related to sound, the neural mechanisms for auditory detection and associated responses first evolved with the appearance of some insects, reptiles and birds, of which examples will be explored further in relation to the significance of sounds for the location and interpretation of intra-cave rock art.

The ambiguity of representation

Even though modern human populations may not regard a representation (seen as possessing a soul) as the same as the actual object portrayed (Point 1 above), at the same time the sense that a representation may

4 While enactive (grounded/embodied) cognition and perception have provided a new approach to understanding psychological processes in that the latter is tied to long-standing evolutionary events embedded in the world, the question as to how these events are encoded in the brain is just beginning to be ascertained. Certainly there are neural mechanisms for encoding representational or 'symbolic' information. The representational and enactive approach to understanding human psychology are therefore likely to be complementary rather than mutually exclusive and suggestive evidence exists to support this. As discussed above, evidence from functional neuroimaging of the human brain indicates that information about salient properties of an object (both perception, which might include movement or colour detection and recognition as well as representation as occurs in the association areas, as well as responses with regard to movement) is stored in specific sensory and motor systems in the form of a precise neural micro-circuit that becomes active *when such holistic information was acquired*, i.e. a memory trace consisting of a specific S-A-R event (Martin 2006). In other words, the entire perceptual/associational/and response event sequence is stored in a single specific cerebral microcircuit whereby activation by electrical, chemical or magnetic stimulation of such micro-circuits can re-create the experience of that event.

possess agency (Point 2 above) can be quite compelling. This is especially true when an observer possesses a strong emotional attachment to the person portrayed. In such cases, the emotional dimension in relation to an individual's sensibility will not be as discerning or discriminatory because cognitive capacities may have become overwhelmed by emotional reactions. A conflict can therefore arise between the two tendencies (Point 1 and 2) so that the observer may begin to regard a representation as having traits that would not ordinarily be countenanced. In this regard, special significance seems to be conferred to those animals and people with whom we have a close emotional affinity, and are perceived as sharing similar or identical traits to those of our own. This response, sometimes called 'identification' or 'self extension', differs from anthropomorphism in that a specific similarity is assumed to exist between our own individual traits and that of other people/animals with whom specific similarities are perceived; anthropomorphism, however, refers to the attribution of human-like traits (but not necessarily our own traits) to animals and inanimate objects. Viewed from this perspective, identification can be seen to be a special category of anthropomorphism.

As both Kosslyn (1994) and Schacter (1996) point out, intense (internally-produced) visual imagery, accompanied by powerful emotions, can sometimes activate the primary visual cortex (Area 17) which is usually only active when viewing the real world but relatively inactive during subjective imagery. When this occurs, and especially during heightened emotional stimulation, the individual can misconstrue internal *subjective* images for reality — such an intensely charged, subjective emotional image has a powerful salience when experienced and is referred to here as a *hyperimage*. Although related, this is different to what is termed *pareidolia*, which is simply seeing things in amorphous objects, e.g. faces in clouds.

Thus, the emotional intensity accompanying an image has a direct effect on the way it is processed by the visual system. In other words, depending on the emotional profile of an event, an individual could either be biased towards a subjective internal stimulus that serves to colour the objective image (i.e. hyperimage), or disposed more towards externally derived images deriving directly from stimulus input coming from the real world (Hodgson 2008). In response to extreme events, however, an individual can theoretically be totally consumed by subjectively experienced hyperimages, which are often regarded as real by the observer, and are invariably triggered by particular cues coming from the external world that helps to anchor the image in objective reality.

Cognitive domains and animism

The concept of cognitive domains now needs to be considered. Cognitive domains take two principal forms: proper and actual (Sperber and Hirshchfeld 2004; Sperber 1996). Stressful interaction with everyday objects or animals can put a strain on cognition such that the individual is obliged to concentrate on more immediate concerns that depend largely on *automatic* cognitive mechanisms (Malle and Pearce 2001). The dependence on automatic processes is an indication that evolutionarily defined domains are operative that tap into and are termed the *proper domain* — the naturally disposed cognitive mode that has been shaped by long-term evolutionary pressure such as the need to recognise a predator from incomplete and ambiguous visual cues. The recognition of such a predator will be accompanied by a variety of emotions, including fear, awe, admiration, veneration, and a rapid, largely automatic behavioural response such as fight or flight mediated, in human males, predominately by the right prefrontal cortex. In human females such responses are more strongly reflected in activity in the limbic system and its cortical counterpart, the cingulate gyrus, although there is considerable overlap in the patterns of activation in both sexes (Wang et al. 2007). As discussed earlier, chimpanzees possess innate cognitive domains for sorting an array of visual categories, i.e. predator from prey, stranger from familiars, dangerous animal from harmless animal, animate from inanimate and so on (Tomasello and Call 1997; Vauclair 2002). Humans possess the same abilities and it seems safe to assume that early hominins also did.

An *actual domain*, on the other hand, serves to stretch the boundaries of the proper domain through exploiting the latter's intrinsic properties, and is hence more artificially disposed in that it depends more on human imagination and corresponding cultural input. Utilisation of the actual domain involves planning as well as cognitive and behavioural flexibility in relation to delayed responses. For example, the ability to recognise familiar versus unfamiliar faces is an activity belonging to the proper domain, but the ability to exploit various facial features to portray a realistic image such as is the case with a portrait, or to deceive a viewer by creating masks, caricatures etc., constitute aspects that belong to the actual domain (Sperber and Hirschfeld 2004). Crucially, actual domains have been exploited and expanded by human culture leading to the making of diverse artefacts with all the benefits (and sometimes disadvantages) that flow from this.

We would argue that the human tendency to interpret and project meaning onto objects constitutes a cognitive contingency that resides within the proper (natural) domain that has been exploited by culture to create an actual (artificial) domain specifically for purposes to do with display, reinforcement of myth, the creation of art and artefacts, and the promotion of identity. All of these activities are accompanied by a variety of emotional reactions. In this respect, the question arises as to how the ability to perceive an object as having two states originates, as in hyperimages. As already hinted, the answer would seem to reside in an increasing ability to inhibit automatic

reactions to events in the world so that a more considered appraisal of a situation could be achieved to the extent that an individual was no longer obliged to depend upon the immediate stimulus (Hodgson and Helvenston 2006). Any natural feature of the landscape with a slight resemblance to an animal or human would therefore have been enough for that object to be seen as a representation. The proclivity for such objects to seem to exist simultaneously as different entities (as a real object and a hyperimage) may thus have inspired early communities to award such items special status. This also suggests that very early on in human evolution animism and similar tendencies, such as anthropomorphism, were a typical feature of the psychology of humans.

As discussed earlier, Guthrie (1993: 3, 61) suggests that there is a close relationship between anthropomorphism and animism in that both derive from an unconscious/preconscious perceptual strategy to quickly and automatically detect categories such as humans or animals that are highly animated, i.e. the proper domain. Tomasello and Call (1997), Vauclair (2002) and Martin (2007) have also shown how specific neural substrates are involved in sorting such categories that are part of the proper domain. Although this propensity can lead to many false positives, at the same time it increases the likelihood of survival in that there are more advantages to be gained from adhering to this strategy — hence we instinctively quickly 'jump to conclusions' in response to minimum cues rather than requiring more detailed information when events require a very rapid response.

A neural mechanism underpinning such rapid responses based on minimum cues was suggested by Ledoux (1994; 1998) where a fast track, preconscious pathway for processing visual information was hypothesised to exist, connecting the subcortical visual pathways to the amygdala such that visual information directly projects to the limbic system. More recent neuroimaging studies have shown that there are, in fact, dedicated circuits in the posterior temporal lobes, more so on the left, that respond to movement and animal categories (Martin 2007), an area which also receives complex visual information from visual association cortices. Also located within the temporal lobe can be found one of the most important structures of the limbic system, the amygdala. Importantly, Yang et al. (2005) have conducted studies *establishing that the human amygdala responds more to stimuli denoting animals* than tools, irrespective of how the stimulus is presented (through pictures, the written word, associated sounds and comprehended words), a tendency that possibly reflects the precedence for the perception of animals in human evolution.

These findings provide further evidence for a direct pathway from the visual areas via subcortical structures to the amygdala. This fast, reflexive pathway, however, is only concerned with those diagnostic cues that might help quickly identify an object, such as a predator; whereas the slower visual channels that project to association areas of the visual cortex may serve to 'flesh out' this template. It was therefore probably the direct and rapid pathway for the rapid discrimination of perceived animate forms in preference to other objects that led to a pre-adapted cognition that tended to constantly scan, in a subconscious way, the environment for the presence of living things. As humans are also classified under the category of living things, this would have led to the socialisation of animals, natural processes and inanimate objects according to hominin understandings of conspecifics. This process enabled hominins to 'think' they were capable of comprehending and controlling 'non-human persons' that served as a crucial mechanism through which the development of animistic beliefs came to be realised. This socialisation tendency would therefore have not only been projected onto animals but also animal-like attributes would have been projected onto inanimate objects, especially in situations involving danger or where an individual was in a state of high arousal. *This scenario provides a neuropsychological mechanism whereby Ingold's and Bird-David's emphasis on the social aspects of animism and Guthrie's perceptual theories can be assimilated into a more integrated explanatory framework.*

This hypothesis is supported by experimental data from a study of a patient suffering from bilateral amygdaloid damage (Heberlein and Adolphs 2004). When this patient viewed a film that presented similar animated shapes as in the Heider and Simmel study already mentioned, the shapes were regarded as no more than geometric forms lacking in social attribution. The patient concerned possessed normal visual perception and did not suffer from a global inability to describe social stimuli. The authors therefore concluded that this finding extends the role of the amygdala to the social attributions made by humans, even to those stimuli that are not explicitly social, such as storms, fire, inanimate objects etc. Thus, the evidence demonstrates that the amygdala is involved in the human capacity for anthropomorphising and draws on some of the same neural mechanisms as do basic emotional responses (Heberlein and Adolphs 2004).

Having set out the neuropsychological and cognitive factors on which animism depends, the various ways in which this can be applied to understanding the archaeological record, especially with regard to rock art, will now be examined.

Animism from a neuropsychological perspective as manifest in the archaeological record

The Ute Indians provide a typical example of how these processes can help to understand the archaeological record. In the U.S.A., about 30 miles south of Salt Lake City, Utah, there is a high mountain that is referred to as Timpanogos, or sleeping maiden, by the Ute Indians. When this mountain is viewed from the west looking east, the full outline of a sleeping

Figure 1. *Mt Timpanogos looking east with head, breasts, arms and hands folded on chest, legs and feet to the left. An outline profile drawing of the mountain is depicted above.*

Figure 2. *The 'Heart of Timpanogos'.*

maiden's body can be observed including the head, breasts, folded arms and legs (see Fig. 1). According to Ute lore this maiden was once a sacrificial victim who supposedly jumped to her death from one of the high cliffs in order that the spirits would look favourably on Ute people. This interpretation of Mt Timpanogos can be regarded as an example of hyperimagery as the outline of the maiden involves a subjective, imaginative projection of a human body onto a collection of stone cliffs, the perception of which was deeply affected by mythology. Underlying this subjective projection are to be found emotions of wonder, awe, sorrow, empathy, that were aroused in response to the knowledge surrounding the myth of Timpanogos. At the same time, those viewing the mountain continued to remain aware of the fact that the mountain existed as a real assembly of rock outcrops and escarpments. An observer unfamiliar with the legend of Timpanogos, however, would have regarded this feature of the landscape as no more than a mountain as such. Near the summit of the mountain, three caves are to be found, in which there are numerous speleothems (see Fig. 2). One such rock formation, which is shaped and coloured reddish-orange, was said to be the actual heart of Timpanogos. It is thus obvious that the legend has imbued this rock formation, by way of a hyperimage, with the human properties of a 'heart' — the heart of a long dead princess. Interestingly, Ute lore claims that the Timpanogos caves were once a place of ritual and many artefacts have been associated with the caves and the mountain itself.

Another aspect of this setting that needs to be considered in the present context concerns that fact that the caves are dominated by an array of different sounds, such as the echoes of voices, water dripping, wind and animal noises, especially of bats, that give the place a supernatural, other-worldly quality that suggests the presence of spirits and similar entities. Clearly, this is an environment where animistic beliefs may well have been nurtured that came to be embodied in artefacts and associated rituals that were connected with the production of rock art.

The significance of 'hypersounds'

At this point, it may be informative to consider a related phenomenon to do with acoustic perceptual responses where the voice of spirits seems to be evoked. Indeed, the acoustic dimension has also figured prominently in both hominin evolution and everyday human interaction. Thus, certain *spirit-embodied* sounds, containing a strong emotional valence, and relying upon human interpretation for meaning, may be labelled *hypersounds*. This, however, is different to the term as employed by specialists of acoustics where the concept is defined as sound waves greater in frequency than 10 terahertz (we are grateful to Waller for bringing this fact to our attention in a personal communication). It is especially noteworthy how research has demonstrated that Palaeolithic rock art and musical instruments (bone flutes) have been found in caves where the acoustic properties of the cave appear to be most dominant, i.e. where reverberating echoes etc. seem to be especially striking. In addition, some of the stalagmites in these caves seem to have been exploited for their percussive qualities for producing reverberating sounds which have marks painted on them that are referred to as lithophones, e.g. Peche Merle (Morley 2003). The depths of the caves where the various art and artefacts are to be found were not places of habitation, however, and therefore were most likely sites associated with ritual activities (Reznikoff and Dauvos 1988; Reznikoff 1995; Waller 1993a; Waller 1993; Waller 2000; Waller 2002).[5]

5 In addition to contemporary people in 'advanced' Western cultures, who attribute souls or spirits to machines, automobiles, aspects of nature, and other inanimate objects, a striking illustration of animism is also to be found in the sphere of song, probably as a result of the fact that this has a strong emotional valence which is undoubtedly an evolutionarily ancient exploitation of the human voice. Furthermore, it has recently been shown that shortly after birth human infants posses an innate ability to detect 'beat', i.e. rhythm (see Winkler et al. 2009).

As Waller has shown, 'there are many legends from around the world that explain echoes as originating from supernatural spirits — another form of animism (Bonnefoy 1992 [Greek]; Jobes 1961: 490 [South Pacific]; Gill and Sullivan 1992: 79 [Paiute]; Encyclopedia Mythica 2001[Aztec])' (Waller 2003). In the same paper, Waller 'hypothesized that the rock art subject matter represents the images of the spirits that the artists envisioned to be causing the mysterious echoed sounds' (Waller 2003: 31). Confirmation for this hypothesis is to be found in Taçon's (1989: 1991) work with respect to Australian Aborigines that will be discussed in more detail presently. Similarly, Waller (1993a) has stated that, 'anthropomorphic figures may have been inspired by echoes of voices, and zoomorphic figures by percussive echoes regarded as hoof beats. Thus, acoustics may explain not only some of the locations of rock art, but also the subject matter as well'. Aside from the contribution of acoustics in determining the intra-cave location and perhaps subject matter, rock art is, nevertheless, primarily a visually-guided activity and therefore probably constituted the dominant modality in this regard (see Hodgson 2003b).

Waller (1993b) has also shown that, in the deep caves of Font-de-Gaume and Lascaux, the images of horses, bulls, bison and deer are located in regions with high levels of sound reflection, whereas feline art is found in those cave areas with poor acoustics (felines are quiescent — an aptitude that is utilised for successful predation, whereas herbivores travel in herds with thundering hooves and other associated sounds). Waller speculates that Palaeolithic artists produced the ungulate art in response to percussive sound reflections that were perceived as pounding hooves. This kind of hypersound could suggest the spirits of the specific game depicted, or attempts to magically hunt and/or replace killed game in order to appease the spirits of dead animals — all practices that are intimately associated with animistic beliefs. This, however, is not an attempt to resurrect the hunting magic theory in this context, as the proposal being put forward in this paper is much more complex and involves a variety of factors connected to the practice of animism.

Archaeological evidence supporting these ideas comes from the study of Maya caves and glyphs, where caves were considered to be sacred locales within which religious rituals were conducted. Many artefacts associated with the rituals of the Maya have been found in these caves. The Maya had profound associations regarding caves to the extent that actual or simulated caves were incorporated into their monumental architecture (Prufer and Brady 2005; Brady and Prufer 2005). Cave sounds were a major reason why spirits were thought to inhabit these particular sites. Indeed, Bruchez (2007) believes that natural sounds emitted from the underground have had a profound affect on human cultures. In Mesoamerica the landscape is littered with caves in which subterranean ground movements, water, wind and wildlife fill the caves with sounds, which, according to Bruchez, is one reason why residents of Mesoamerica perceive caves, water holes, limestone sinks and mountains as sacred. The sounds were conceptualised in Maya culture as anthropomorphised voices and music. Bruchez (2007) believes that these sounds should be seen as archaeological artefacts, and recorded and studied as such, and further proposed that a catalogue of such sounds might provide some insights into mechanisms by which certain Maya gained acceptance as priestly authorities.

Many French Palaeolithic habitation sites, especially those overlooking the Vézère river valley in the Périgord region, are located under large overhangs, often many metres above the river valley (Blades 2000). These sites afforded a panoramic view of the many herbivores grazing in the valley below, as well as stalking predators, which would have been a great advantage to human hunters. Most of Upper Palaeolithic cave art, however, is located in the depths of caves, such as Lascaux, not far from habitation sites. Grotte de Font-de-Gaume and Grotte de Rouffignac are especially places where the echoes may have suggested the presence of spirits. As Bahn concludes, 'caves were very special places in the last Ice Age' (1997: 47), and the intra-cave setting is fundamental to interpreting this 'art' (Bahn 2003). A contemporary study from Patagonia (Cardena 2008) has similarly shown how rock art depictions are strategically located near hunting sites and Rifkin (2009) has recently demonstrated, in the case of the pre-Historic South African sites, how rock art was associated with rock gongs, reverberating echoes and ritual. It therefore appears obvious that the ecology of the habitation sites and the associated rock art are intimately connected. Hypersounds may therefore have played a significant role in attributing anthropomorphous spirits to cave sounds, and when reinforced with hyperimages can lead to 'sacred' hunting sites becoming special places signified by rock art, often within the depths of a cave where the particular qualities prevailing would have given rise to a greater anticipation regarding the presence of spirits.

Hyperimages in context

One of the key attributes of a hyperimage is that it differs from the external, perceptually-mediated object on which it was originally based due to the fact that it is more related to the subjective correlates of the human mind that seeks to communicate a particular 'message', usually emotive in character, connected to religious, ritualistic, or totemic concerns etc., in a way that accentuates its distinctiveness. In this respect, it is probable that the objects ancient people 'saw' as hyperimages were those concerning emotional responses associated with myths to the extent that Point 1 (attributing a spirit to a representation) and

***Figure 3**. The 'Old Man of the Mountain' (photograph © robdebsgreen).*

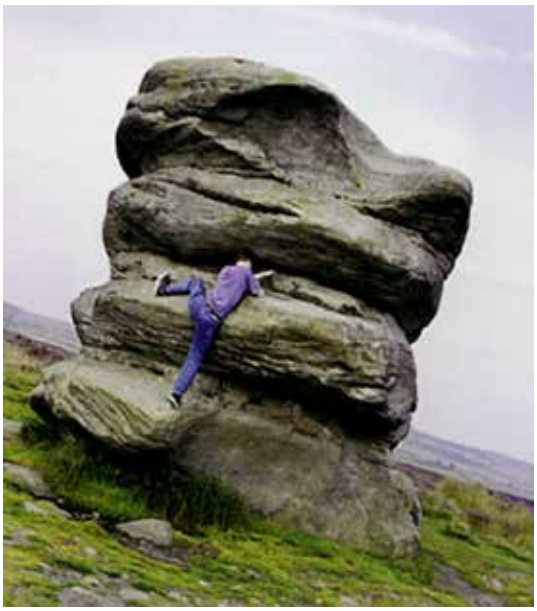

***Figure 4.** The 'Eagle Stone' (Peak District, England). The name is believed to have a Celtic origin (note how the face contains both human and bird-like features).*

Point 2 (attributing agency to a representation) became closely interwoven to the extent that the ability to see anthropomorphous or zoomorphic figures in a rock formation began to be used to create myths or interpret known myths important to the group concerned.

Another typical, but more contemporary example of a hyperimage comes from Cannon Mountain of New Hampshire, U.S.A., that consists of a rock outcrop resembling a craggy human face, referred to as 'The Old Man of the Mountain'. In modern times this image has resonated with some deep emotional well-spring in the human psyche as it has appeared on a US stamp, the reverse of the state quarter of New Hampshire, and has inspired numerous poems, the most famous being 'The Great Stone Face' by Nathaniel Hawthorne in 1850. Many photographs and artistic representations of this figure have been made and it has been a popular tourist site. Several of the rock formations comprising the 'face', however, collapsed in 2003, causing great distress to many as evidenced by the letters received by the forest service of New Hampshire. At present, a plan is underway to collect donations towards the considerable financial cost of reconstructing the face (note, the profile of 'The Old Man' face, near the top of a high, nearly vertical cliff as illustrated in Fig. 3).

Although modern neuroscience has provided an explanation as to why the visual system is prone to see animate objects in inanimate things, early people would have remained oblivious to this fact and therefore will have responded differently. This response will have been related to and reinforced by an animistic outlook that assumes an all-pervasive essence or spirit is to be found in animals, artefacts, art works, natural rock formations etc. This outlook may have stemmed not only from the tendency to project human qualities onto certain stones, but also an inductive outlook whereby one instance becomes a generalised category, e.g. one instance of seeing an animal or human features in a rock would be sufficient to confirm that beneath the surface living beings inhabited a hidden world that applies also to many other similarly shaped rocks. This theme will be discussed further in relation to the stone sculptures of Lepenski Vir.

Other examples of hyperimages

In the folk myths of various regions of the U.K., many strange outcrops of rock still retain a link with the past in that they are invariably named after humans or animals based on resemblance (i.e. similarity), and we would refer to these formations as hyperimages. The same phenomenon can be found throughout Europe (see for example Fig. 4), and two examples have already been described from the U.S.A. The initial tendency of apportioning agency to inanimate objects later became a question of *purposively changing the appearance of such objects in order to actively produce hyperimages, thereby emphasising the inherent iconicity of the manufactured object.* This can be found in Franco-Cantabrian cave art as well as during the Epi-Palaeolithic and Mesolithic. By the Mesolithic, however, in sites such as Lepenski Vir (a collection of some seven villages on both sides of the Danube in Serbia) dated to between 6400–4900 B.C.E. (Borić 2008), the cognitively disposed proper domain (evolutionarily dependent natural mode) had expanded to such an extent that boulder sculptures with human-engraved, fish-like features became much more emblematic and contextualised as part of a rich communal tradition. Many of the boulders already possessed a rounded, fish-like natural form prior to being deliberately modified. These objects have been described as the first monumental sculptures of Europe and are a good example of the exploitation of the proper domain by human imagination and enhanced response systems that led to the creation of objects illustrative of the actual domain.

Figure 5. *The 'goddess' of Lepenski Vir. Note the human-fish-like face, the internal skeletal features and a triangle between the ribs, possibly signifying the female gender of the statue.*

It is interesting to note that the Lepenski Vir community of hunter-gatherer-fishermen was dependent on migrating sturgeon (*Beluga, Huso huso*) caught in the Danube river. Clearly, this was an important source of food for the survival of the settlement in that a bounteous supply of such fish may have been crucial. Thus, fish appear to have become a significant ingredient in the myths and funerary practices of this community, as materially embodied in sculptures. These artefacts are also a good example of the shape-shifting that can occur where boundaries between proper domains for animal forms and humans are crossed. As we have seen, the morphing together of animal and human traits is typical of animistic beliefs. Interestingly, Bahn and Vertut (1997: 135) describe a number of Upper Palaeolithic cave art images where two or more animals appear to be combined into one. For example, one depiction at Pech Merle seems to be an amalgamation of a horse, ibex and megaloceros. There are also a few therianthropic figures, such as the famous composite image from Trois Frères. The Lepenski Vir community also created a therianthropic, human-fish hybrid, carved on fish-shaped boulders, that was then associated with burial sites. Borić notes that these hybrids would have been highly memorable and may have been imbued with ancestral spirits that were part of village lore. A core belief of animism, as discussed previously, is that there is an all-pervading life-force within the community of the world, wherein it is possible for one thing to change into or transmute into another, thereby crossing the divide that separates natural category boundaries. The crossing of boundaries is reflected in the fish-human hybridisation of the boulders and is further illustrated by the idea that such items may have signified the bridging of the worlds separating the living and dead.

This boundary-crossing tendency is confirmed in the association that seems to exist between the human-fish hybrids, river stones and the deceased. Moreover, the human/fish-like figures seem to emerge from the interior of the stone (in some cases the internal bony structure of the fish is depicted on the surface of the rock as can be seen in Fig. 5) to envelop the actual surface. Borić sees this as a response to the inevitable mutation and change of the body as it moves from birth to death, death being the more decisive transformation, and in death, the dead retain their spirit, a classic animistic belief. The carved stones may, in addition, have been regarded as possessing the soul of an ancestor human-fish.

Borić believes that identity, as socially constructed (which reflects Bird-David's approach to animism), is about trying to control and manage change by way of the fish-human stones where deceased humans metamorphose into hybrid beings by achieving a stage of human-animality in death not unlike that of human-animality convergence in the Dreamtime ancestors of all living beings embodied in Australian Aboriginal 'art' and myth (Watson 2007). In this example, we see the dual nature of representation helping, if not encouraging, the crossing of boundaries in a process that involves agency, within a context of animism and anthropomorphism, whereby the dead are thought to transcend the body by entering a spirit world that lies behind the ordinary, everyday world, which continues to exist as spirits in stone sculptures. The main aspects of Lepenski Vir's cultural lifeway can thus be seen as having become translated into myths concerning both the fish and the river. As Borić (2005: 64) states:

> What these artworks undoubtedly convey, regardless of the multiplicities of their immanent functions and meanings, is a universal and cross-cultural interest, shared by the collectivity at Lepenski Vir, in the instability of form, the transformational character of being, and the forceful potency that lies therein.

This is a very explicit formulation of one animistic belief, the possibility of the transmutation of various species into each other, humans to animals, and the living into the dead. These are preoccupations that seem to concern most traditional societies that refer to the constancy of form and being, in relation to what lies beneath the superficial world of appearances. In this sense artworks are not something simply painted onto a surface but an activity whereby, as in the Walbiri artists from central Australia, a material's inherent qualities *may become exposed* —including perceived spirits— through being painted (Ingold 2000: 121).

In this respect, Taçon notes that, according to Australian Aboriginal myths and traditions, ancestral beings during the 'Dreamtime' were responsible for shaping and forming the world.

These beings include the Rainbow Serpent; Bula, the first barramundi; Gulinj, the flying fox-man and, Namarrgon the lightening man; and there are rock art depictions of the internal organs (the x-ray motif) in these and other figures, in rare instances predating 8000 BP (see Taçon 1989: 320). These continue to be popular motifs for Aboriginal artists today, but were common between 3000–1500 BP. Similar to Borić, Taçon sees these x-ray depictions as having a great potential for expressing complex meaning due to their multi-layered, manifold form and structure. Moreover, these ancestral spirits were believed to have entered stones, predominantly in caves or huge overhangs, where their spirits continue to presently reside. Thus, depictions at these sites, in the form of ancestral beings, simply make manifest their form on the surface of the rock in which they are believed to dwell. In other words, an x-ray view of the external and internal dimensions of the spirit's 'body' may be intended to represent the idea that beneath the surface of the rock there is another dimension wherein the spirits of ancestor beings reside (Taçon 1989). This example demonstrates the direct connection between animistic beliefs, rock art, and 'knowledge' of ancestral beings as elaborated in myth.

In parallel to Lepenski Vir, Lahelma (2008) has found that the Saami people of Finland worshipped anthropomorphous rock outcrops known as *sieidi* by sacrificing a share of hunted animals or fish to the rock which, to them, seem to magically promote future hunting exploits, health, and safe travel etc. Again, these are examples of what can be regarded as hyperimages, embedded within an animistic context, and imbued with imaginative meanings. In fact, rock outcrops with prominent human or animal-like features were considered especially sacred or powerful by this culture. Of the 220 rock cliffs worshipped by the Saami, 28 appear to have human-like and 25 have zoomorphic features, most of which were believed to be inhabited by people from the underworld. And, as Lahelma (2008) states, some of the rock art may be closely related to anthropomorphous or zoomorphic idiosyncratic features of the landscape. Similar rocks have been considered animate by people worldwide including, for example, the Ojibwa of North America (Hallowell 1975) and the Nayaka of south India (Bird-David 1999), as discussed previously.

The universality of animism seems to be connected to enduring aspects of cognition that are common to humans (Boyer 1998; 1999), as was discussed in the earlier section on animism. In this sense, belief systems cannot vary infinitely but are obliged to conform to cognitive demands related to problems of survival. 'Religious' ideas, however, *may appear to* run counter to rationally held beliefs, although the earlier discussion of animism belies this sentiment, because animistic responses are based upon some very basic functions relating to S-A-R networks, deriving from long-term evolutionary adaptive events. Thus they make a kind of 'sense' that may not, in our highly objectified and literate culture, be viewed as rational. Anthropomorphous and zoomorphic rocks not only violate natural categories as in Sperber's sense, but are also supported by specific categories of knowledge which enables them to be seen as either having agency or simply as just stones. The idiosyncratic nature of such rocks, especially when they conjure up hyperimages, makes them a prominent vehicle for the transmission of cultural knowledge to future generations.

There is the added advantage that by 'labelling' rocks in this way early people would have had at their disposal useful navigational aids in the form of distinctive landmarks. As discussed in relation to Patagonian rock art, landmarks used to identify rock art sites, springs, lagoons and habitation sites from the mid-Holocene are still in use today. From this perspective animism becomes a means of relating to the environment by focusing on aspects of how things might be connected together in a social sense. In this regard, animism has been replaced by the term 'relational epistemology' by Bird-David (1999) who sees the ways in which people related to their environment as a means of making sense of the world by creating what appeared to be a consistent worldview of interlocking relationships in the face of an often unpredictable and threatening environment. In other words, animism constitutes a socialisation of the environment because humans are fundamentally social creatures and, as described in relation to neuropsychological evidence, tend to project a socialised sense onto both animals and inanimate objects.[6] Such a definition implies that humans believed

6 Dowson (2007) has recently stated that animism might be a more appropriate paradigm for understanding the archaeological record and has therefore downgraded the importance of shamanism in this regard. This repositioning falls in line with a view that has long prevailed amongst those who have criticised the over-reliance on shamanism as a model of understanding rock art (see Bahn 2001; Helvenston and Bahn 2003a, 2003b: 2004a; 2005; 2006; Hodgson 2006; Le Quellec 2001; 2004; 2005; 2006a; 2006b; Solomon 1994, 1997; 1999; 2000; 2006; 2007; 2008; Thackeray 2005). In this respect, a 12 000-year-old burial of a female, accompanied by assorted animal remains, has been recently found in Israel that the excavators referred to as a 'shaman' (Grosman et al. 2008). Surely this is an inappropriate label, given the time frame involved, as the earliest written records for shamanism only date to the end of the 17th century in relation to the archaeology of Siberia (Hamayon 2001) — although ancient documents, such as those discussed by Eliade (1964), reveal *some traits* that may be characteristic of shamanism in the case of the ancient Greeks, Mesopotamians, and assorted Indo-European cultures, as well as in Australian Aboriginal rituals, ceremonies of North American and Arctic Native Americans and other indigenous peoples. The main characteristic of shamanism consists of ecstatic states, such as in dreams or trance, and as Eliade points out, these constitute the originating experience (long predating complex

they could understand human behaviour and perhaps exert a measure of control and thereby, by projecting human qualities onto nature, could understand, and perhaps wield some influence over those forces otherwise perceived as immeasurable.

Conclusion

The foregoing analysis and examples demonstrate how an understanding of the perceptual factors, cognitive processes and response systems can help to make tangible the invisible aspects of meaning a community might apply to artefacts. We have also shown how visual recognition/memory is closely linked to such artefacts, especially in relation to representation of animals, humans, or therianthropes, as they may be inherently or deliberately depicted in rock art or sculptural artefacts, and how the potency of these various forms of representation can be increased by way of an imagination steeped in emotional associations. We have termed the emotionally imbued, subjective image that can be perceived as containing anthropomorphous or zoomorphic qualities as a hyperimage. We have also suggested that certain embodied sounds might be referred to as hypersounds because their meaning is over and above that of simple auditory perception and is dependent upon human imagination for interpretation. Increased emotional arousal and its influence on the interpretation and production of images have also been shown to be consequential for understanding the processes by which meaning was accorded to material culture. The close interaction of emotion and representational imperatives may have been crucial to anthropomorphosis that led to the apportioning of human and animal-like hyperimages to distinctive landmarks within an ideological matrix of animistic beliefs. Finally, by using various examples, we have demonstrated how hyperimages eventually came to be realised in carvings and paintings on rocks designed to 'bring out' the resident spirit, and how this process can lead to the creation of hybrid forms.

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religious ideologies), which stretch far back into human pre-History as Hodgson and Helvenston (2006) have previously proposed. Many complex religious beliefs over the past 2000–3000 years, however, form a cultural matrix surrounding the practice of shamanism, which is a specific array of techniques for the purpose of healing and not a religious system in and of itself. Such healing takes place while the shaman is in an ecstatic state, and is assisted by animal helpers whose presence is often symbolised by assorted body parts of actual animals. While in a trance state, the shaman may ascend to the heavens or descend to the underworld, encountering various spirits there who may assist in the spiritual healing of the patient. Without explicitly stating the fact, Eliade (1964) therefore described the main traits involved in animism that predated the very complex type of shamanism first observed by Western travellers. Thus, we argue that the 12 000-year-old 'shaman' was probably a 'spiritual healer', perhaps using trance, but in a more loosely organised system of beliefs such as animism, rather than the highly syncretic religious beliefs and shamanistic practices of central and northern Asia of the late 17th century. As Eliade clearly stated, the practice of shamanism does not occur alone, but is always embedded in a system of organised religious beliefs. Clearly, it appears that the shamanism of the past few hundred years developed out of a corpus of preceding animistic beliefs and primordial ecstatic experiences dating back many thousands of years that subsequently became embedded in many different organised religious traditions.

COMMENTS

Animism and the psychology of perception

By J. B. DERĘGOWSKI

This paper is a brave attempt to construct a significant theory incorporating data drawn from a range of disciplines. This attempt can be likened to that of composing a mosaic using tesserae drawn from distinct sources.

The scientific value of such a mosaic, its cohesion apart, depends not only on the tesserae used, but also on the tesserae overlooked or rejected. The commentary presented below concerns only one element of the large picture presented; it concerns psychology of perception. It is therefore, by comparison with the paper, very limited in scope.

The paper states, on the evidence provided by Winner's (1982) book, that 'infants up to about the age of two tend to mistake a representation for a real object', and speculates that this is a telling phenomenon which is related to changes which took place in the course of evolution. The empirical evidence contradict-

ing Winner's observations and therefore questioning these notions is not considered; it is a neglected tessera.

The manner in which perceptions of objects and pictures by infants are studied inevitably involves presenting them with these stimuli and observing their responses. When identical responses are made to both kinds of stimulus, the percepts entertained are assumed not to differ. Probably the most inherently convincing form of response is that of grasping or attempted grasping. However, grasping is not an unambiguous response, a child may attempt to grasp an object and it may also attempt to grasp a picture; a picture is independent of what it portrays and is also an object. Yonas et al. (2005), in their ingenious experiment, show that grasping movements made by nine-months-old infants to the two types of stimuli differ, and that those made in response to pictures are appropriate to pictures as physical objects, not to the depicted objects. Pictures of objects are not therefore seen as objects. This finding questions the manner in which much of the data obtained in earlier experiments was interpreted.

The result observed by Yonas et al. was adumbrated in several earlier studies concerning older children. Thus, for example, Sigel and Cocking (1977) found that nursery children showed considerable differences in the manner in which they handled objects and pictures of objects when these served as stimuli in a Piagetian task. A child, it appears, may be able to label both an object and a picture of an object correctly and yet be unable to use it equivalently in a cognitive task. This effect, incidentally, is not found only in children. Deręgowski and Jahoda (1975) observed analogous differences in the performance of adult women, who were required to learn locations of domestic items and photographs of these items.

Another omitted tessera is that of anthropological studies. The difficulties of recognition of pictures by observers from 'non-pictorial' cultures have been noted by several anthropologists (Herskovits 1948; Barley 1986). These difficulties, as Forge (1970) found, can be rather specific, photographs of individuals in traditionally established poses being more readily recognisable than photographs of the same individuals in non-conventional poses. This suggests that an element of acquired skill is involved in pictorial recognition, a theme on which Serpell and Deręgowski (1980) dwell at some length. The need to acquire the skill of pictorial perception does not preclude the possibility that some pictorial elements may act as ethological *sign stimuli* or releasers; eye spots are likely to belong to this category. (The problem of inter-population differences in pictorial perception is examined in Deręgowski 2006.)

A tessera of conceptually convenient description of phenomena, without necessarily implying animalism, is by Jahoda (1970) who provides an excellent example of this in his book on superstition: the Steinbeck Principle. The principle which is used in connection with electric discharges in gases states that an electric charge remains at a temperature sufficient to keep itself going. The principle thus implies intentionality — the arc endeavours to keep itself alive, but the use of the principle does not imply that its users are at the third Piagetian stage of animism in which signs of movement on its own accord (not merely of movement) are taken to indicate consciousness of the moving object.

Consideration of these issues falls outwith the realm of pure perception, but is relevant to the theme of the paper.

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Animated animism: what does it actually tell us?

By PAUL S. C. TAÇON

Helvenston and Hodgson's paper on the neuropsychology of animism is a fascinating exploration of the concept of 'animism' in relation to neuropsychology, ethnography, landscape and, to a certain extent, rock art. However, the particular implications for rock art research could have been better articulated and listed. Indeed, this is a problem with much research on neuropsychology in relation to rock art. There is always lots of discussion about how the human brain works and then conclusions that this explains the prevalence of such and such. In many ways human artists appear more like robots responding in set ways rather than independent agents with the freedom of choice. Neuropsychology may be able to describe the hard wiring of human brains to account for frequent occurrences of beliefs and art designs but it can have difficulty when it comes to explaining variation, subtle differences, exceptions and the impact of things like culture contact, environmental difference and change, and so forth, in relation to rock art. Often such variation and exception is dismissed or used to further support the grand theory. Of course, this also is a problem with shamanism, entoptic theories, Freudian psychology, recent out-of-Africa evolutionary models and current debates about climate change. Debate is boiled down to singular, uni-dimensional explanations. Occam's razor is used to provide the simplest explanations because simple is seen as more probable. But humans are highly complex creatures and the human story is much more convoluted than we imagine.

To their credit, from the outset Helvenston and Hodgson do not restrict themselves to purely the neuropsychological but adopt an 'ethnographic, inferential and neuropsychological approach'. Indeed, this is one of the refreshing aspects of the paper and the ways in which they have used the inferential links their work to semiotics and other areas of discourse. Their review of ethnography allows them to demonstrate that aspects of neuropsychology do have wide applicability in terms of belief, ritual and art practice, as well as responses to certain landscape features that resemble things of interest to most humans, past and present. One of their most valuable contributions is that their research may allow us a way out of the increasingly tedious shamanism debate. Animism, something with a common human neuropsychological basis but ethnographically demonstrated to be widespread, important and varied in detail, might well underlie the production of not only some belief but also some rock art previously ascribed to shamanism.

Without diverging into the shamanism debate in great detail, the crux of the matter is that some researchers have strongly argued that a classic form of shamanism was practised globally and that much of the world's rock art resulted from this practice — an Occam's razor type of explanation. But the world is more complicated and I have always argued that many factors, motivations and intentions can be found to explain the occurrence of rock art, both within particular cultures and cross-culturally. We should be careful using shamanism to explain most rock art, portable sculpture from archaeological contexts and Historic/ethnographic art of hunter-gatherers. At the very least we should make a distinction between 'shamanic' and 'shamanistic' art objects: '… the term shamanic should only be used with objects that derive from or are of or pertaining to an act of a shaman (specific) ... the term shamanistic should be used to describe those objects that pertain to or derive from the cosmology or world-view of shamanism (general)' (Taçon 1983: 56). A major problem I highlighted in 1983 was that these terms were used interchangeably and for many researchers this continues to be the case. Perhaps, following Helvenston and Hodgson, we should replace 'shamanistic' with 'animistic'. However, this still allows us to have the category 'shamanic', which is now a distinct and much more culturally and geographically restricted explanatory tool. For me, this is one of the biggest implications for rock art coming out of Helvenston and Hodgson's paper. It also does not preclude other motivations for rock art, including secular and totemic (see Sauvet et al. 2006, 2009).

A second implication is that it is very common for humans of different cultural and ethnic backgrounds to 'see' or recognise human, animal and other figures in geological features of landscapes. There is a neuropsychological basis that is well explained although Helvenston and Hodgson's discussion would have benefited from mention of figure-ground relationships, and the importance of outline forms in terms of conveying a maximum amount of information in an expedient manner. The work of Halverson (e.g. 1992) and others could have been used to beef up their discussion as what humans are doing when they see a geological feature is reading its outline as well as its general form. Often it is first the outline that is recognised as a human face, a giant lying down or some animal form. If we were to look at Figure 4, for instance, one sees a piece of geology that resembles the head of some creature because of its outline. For the traditional Kuninjku of central Arnhem Land the geology might be read as a Rainbow Serpent head and neck turned to stone. For people of other cultural backgrounds it might be read as a fossilised dragon, a mythical eagle turned to stone (as in Celtic England) or some other culturally meaningful being. But what is really interesting follows on from this — that, as Helvenston and Hodgson emphasise, for many people things do not stop with the shape but continue with a belief that beings live inside stone, that geology is animated.

There are many globally distributed ethnographic examples of this and countless rock art sites where aspects of geology have influenced, inspired or been incorporated into rock art designs. That this needs further exploration is a key implication of Helvenston and Hodgson's paper but it has to be followed up with caution so as to not fall into the trap of explaining most rock art in this way. In this regard I think Waller's (1993b) sound reflection theory has to be taken with a dose of salt, even though some sites undoubtedly do have important acoustic components.

Finally, I wish to clarify an aspect of my own research referred to in the paper. There was a misreading of my statement about x-ray art production, perhaps because in the original I was unclear (Taçon 1989: 318). What I meant was there was a florescence in x-ray art production from at least 1500 years ago, and as much as 3000 years ago, to the 20th century rather than between 1500–3000 years ago. The x-ray art of western Arnhem Land, Australia, by its layered nature, certainly hints at hidden worlds that lie beneath surfaces, including the world of the Mimi spirits within stone, but the production of particular subjects, such as barramundi fish, emus or macropods, resulted from other motivations. The true story is a complicated one and this is likely so for most rock art worldwide.

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The neuropsychology of animism and implied motion in rock art

By BEN WATSON

Helvenston and Hodgson's timely paper follows a long history of scholarship on animism and rock art. For the sake of historical interest it is worth noting that in his book *Totem and taboo* ([1913] 1918), Sigmund Freud commented briefly on Palaeolithic art in a discussion of animism and narcissism (Watson in prep.). Freud understood Palaeolithic art as an expression of the human mind's fundamental structuring, and following Reinach (1905), believed that it was produced through magic intention — what he referred to as a 'technique' of animism (Freud [1913] 1918: 151). Following a much more recent tradition of research on the topic and the 'new animism' currently theorised in anthropology, Helvenston and Hodgson are successful in further demonstrating how the concept of animism can help in understanding rock art of the deep past. The paper is well researched, although at least two important recent studies have been overlooked, including Janik's (2007) examination of animism in the rock art of Lake Baikal in Siberia, and Wallis' (2009) discussion of animic ontologies in relation to rock art landscapes.

Combining neuropsychological and ethnographic data, Helvenston and Hodgson present an original and provocative theoretical framework for rock art interpretation. But despite a greater understanding of underlying neuropsychological processes, animistic interpretations still rely largely on ethnographic analogy or the location of rock art in relation to certain geomorphological features of a landscape. Discerning indicators of animistic beliefs or how animism might be encoded in rock art remains problematic, and is an aspect of the authors' examination that deserves further attention. One way in which the problem might be approached is by considering the relevance of neural networks involved in the perception of motion. The relevance of these neural networks is discussed to some extent by the authors, but may be explored further in terms of understanding the attribution of meaning to certain forms of rock art imagery.

The types of natural human responses to certain visual stimuli (perception/response systems) discussed by Helvenston and Hodgson may be increased by the exaggeration of certain characteristics in their depiction, so that perceptual mechanisms underlying supernormal responses become activated (e.g. Ramachandran and Hirstein 1999). A common example is the exaggeration of aspects of the human form in art, where the resulting distortions stimulate the brain's 'aesthetic' response to the body. This is a natural tendency for humans because, as the authors explain, the brain has evolved predispositions to give more attention to objects in the world that are particularly important, such as conspecifics and nonhuman animals. In relation to animism, it is important to note that similar effects (i.e. supernormal neurological responses) may be achieved by the depiction of the human body in motion. Motion is portrayed in rock art in similar ways cross-culturally, and may be achieved by using graphic devices such as multiple images in sequence, repetition of parts of an animal's anatomy, superimpositioning of multiple images, or the positioning of limbs in certain ways (Apellániz 2006; Azéma 2005, 2007). For example, anthropomorphs depicted in overly 'dynamic' postures strongly suggestive of 'vigorous movement' appear in very similar forms in the rock art of Saharan Africa, northern Australia, eastern Spain and elsewhere (Brandl 1977: 225). Human bodies are particularly good at conveying the illusion of movement in static depictions, and may even imply a state of motion to the extent that predictions about that motion can be made (Reed et al. 2006: 243).

Importantly, animism is commonly defined not only in terms of the attribution of characteristics of animate objects to inanimate objects, but also the making of predictions about inanimate objects based on knowledge about animate objects (Wilson and Keil 1999: 28). The perception of the illusion of movement in static graphics is dependent upon regions of the brain (particularly the medial temporal [MT] and medial superior temporal [MST] areas) specialised for the detection of human motion as well as motion more generally (Kourtzi and Kanwisher 2000; Proverbio et al. 2009). As Helvenston and Hodgson point out, mirror neurons in the brain are important to perceptual/response systems, including those involved in action recognition, prediction, and social interaction, and these systems are employed during the production of art, amongst other perceived actions. Although the authors note that 'The ability to perceive animate objects [can be] transferred/projected onto inanimate objects that are perceived as moving', they relate this to aspects of the natural world rather than rock art itself. It is important to point out that mirror neurons are also involved simply in the *perception of pictures*, particularly pictures of anthropomorphs that convey an illusion of movement (Urgesi et al. 2006).

Figures depicted in motion may inherently communicate the presence of 'life' in a similar way that it is perceived in living beings, because the perception of implied motion involves the same neural networks involved in the perception of biological motion. This has important implications for understanding the attribution of animistic beliefs to rock art. Because perceptual responses afforded have their basis in shared human neurophysiology, implied motion may be conveyed and perceived by all 'normal' humans. A certain level of meaning encoded in depictions with implied motion may thus be readily communicated

and understood. (Specific animistic beliefs attributed to any one figure will of course differ and remain unknown to us in most instances.) In addition to extending onto depictions any number of human or other animal behaviours, further implications might include an understanding of notions such as the 'bringing out' of the resident spirits of a site by depicting them. Concerned with basic social cognition, perception of motion as it relates to rock art may also help in understanding the relationships and communications between humans and depicted nonhuman agencies. In addition, pictures with implied motion may be particularly susceptible to hyperimagery, or capable of actively producing hyperimages, especially if representations were in the past also identified as actual people, or incorporated into myths or stories and associated with complex, emotionally-laden beliefs.

The depiction of implied motion serves as one example of how animistic concepts or beliefs might be expressed in rock art, and a form of imagery that may have more commonly been associated with animistic meaning by people in the past. Although there may not be a crossing of boundaries between proper domains in such depictions, like therianthropes, anthropomorphous figures with implied motion (particularly those with exaggerated features) may be considered expressions of animism because they involve aspects that belong to the actual domain and exploit automatic and supernormal response mechanisms associated with the perception of conspecifics. Of course, figures depicted with implied motion may also be therianthropic, creating perceptually and cognitively more 'powerful' images. In any case, there is undoubtedly a degree of interrelationship between the neurophysiological mechanisms involved in the types of phenomena that might lead to animism. The crossing of boundaries between proper domains for animal and human forms found in therianthropes is indeed typical of animistic beliefs, but it is not restricted to forms of subjective imagery that are misconstrued as reality, as in hyperimages. It is also a characteristic of dreams and pseudohallucinatory phenomena (which are also often associated with strong emotions), as well as processes underlying creative aspects of cognition such as those involved in imagination. These are factors that need also be considered carefully in an examination of rock art and animism.

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Conclusions in response to minimum cues

By ROBERT G. BEDNARIK

Both authors of this paper have previously presented outstanding and original work in subject areas that seemed better connected with palaeoart. Although this is a rather ambitious thesis, it does not quite match the breadth and persuasive eloquence of previous work by both Patricia Helvenston and Derek Hodgson. The paper's vigour is in its first half, its erudite introduction and discussion of animism. The presented connection between animism, anthropomorphism and pareidolia certainly comes across as a well-articulated case, and it is one of considerable importance to the discipline that does need to be developed further. The article falters somewhat in the second half, especially in the presentation of a few rather trite pareidolic examples and the endeavours of enhancing the topic's relevance to rock art studies. The discussion of the untestable speculations about the Lepenski Vir material could have been replaced with better documented examples. For instance the use of pareidolia or therianthopic imagery in Upper Palaeolithic art would be more relevant to the paper's broad scope, as would be pareidolia of the Lower Palaeolithic, apparently extending back almost three million years. A scientific discussion of pareidolia is in fact long overdue in this journal.

The discussions of 'hyperimages' and 'hypersounds' prompt a desire for clarification. A hyperimage, according to the authors, is what occurs when a subject misconstrues a subjective, emotionally charged internal image for reality. A 'hyperimage' is therefore an internal image experienced as reality. Could the authors explore the relationship or fundamental difference between a 'hyperimage' and a hallucination? On their use of the term 'hypersound', I fully side with Steven Waller: the term already has a distinct meaning. Waller's perceived spatial separation of carnivore and herbivore images in Franco-Cantabrian cave art, however, applies only in some locations, but certainly not in all such places. The two kinds of depictions are often seen virtually side-by-side, which negates this hypothesis.

Concerning the notion that cave art had 'ceremonial' roles, this is as much a red herring as the idea of it all being shamanic or shamanistic. This would require the falsification of the hypothesis that most of it is the work of children and teenagers (Bednarik 2008). Taçon is cited as dating Arnhem Land x-ray depictions to greater than 8000 BP; I believe that, apart from beeswax pictograms, no rock art of that region has been credibly dated. The ontogenic recapitulation explanation for the contention that 'human infants, up to about the age of two, tend to mistake a representation for a real object', is unconvincing and probably false. Similarly, Einstein may have said that all scientists should be cobblers by profession, but the cobbling together of the ideas of

Ingold, Bird-David and Guthrie has not as yet resulted in 'a more integrated explanatory framework'.

Indeed, of particular importance to rock art studies appears to be the authors' observation that 'we instinctively quickly "jump to conclusions" in response to minimum cues rather than requiring more detailed information when events require a very rapid response', because it can also apply, *and often does*, to the mental efforts of rock art scholars (even though a rapid response is not needed in such cases). However, I note that the 'better safe than sorry' principle the authors attribute to Guthrie (1993) was expressed earlier in Bednarik (1986), as well as the role of camouflage:

> Humans perceive objects by scanning their memory stores for analogous forms. In practice, this process is usually cut short because in a given context a few characteristics of the observed object suffice for a reasonably reliable identification. This … ambiguity of perception would have had survival value during the Pleistocene. In the neuropsychological sense it is the opposite of being deceived by camouflage: whereas the disguise of a predator or quarry, to be effective, requires that the deceived subject perceive an insignificant object in place of a significant one, in the effect considered by Davis a significant (e.g. threatening) object is seen where in fact an insignificant one exists. … The dominant subjects of the subsequent Upper Palaeolithic art periods were large animals, and … we can assume that Aurignacian man was also preoccupied with large animals. They epitomized for him survival: violent death or a full stomach. Thus his very first figurative images depict simple animal contours nor merely because he was preoccupied with these subjects but because, when he misidentified natural features as objects, it would have been as the mental images that dominated his visual system: objects that evoked in him profound fears or desires (Bednarik 1986).

There are various other relevant ideas in the paper by Davis (1986) and in its subsequent discussion of the origins of image making which Helvenston and Hodges could engage profitably. Further manifest omissions in their referencing are especially the pioneering work of Lya Dams on the issue of stalactite lithophones (Dams 1984, 1985), or that of Andrea Stone (1995, 1997) on the Mayan caves.

The neuropsychology of the paper is in need of more comprehensive neurophysiology. How is this process envisaged that 'enabled hominins to "think" they were capable of comprehending and controlling "non-human persons" that served as a crucial mechanism through which the development of animistic beliefs came to be realised'? Chimpanzees are said to 'possess innate cognitive domains for sorting an array of visual categories, i.e. predator from prey, stranger from familiars, dangerous animal from harmless animal, animate from inanimate and so on'. That is hardly relevant: myriad animal species, including even invertebrates, possess the neural connections required for 'rapid response' action. Consider, for instance, the response of small animals to the shape of a raptor; or, at the upper end of the scale, the modulated responses reported for vervet monkeys (Seyfarth et al. 1980). Why then did these innumerable species not develop the kinds of neural structures being attributed to very recent humans? The answer, surely, is that something rather different from other animals, including nearly all primates, has occurred in humans, which brings us to the key elements not addressed by the authors: the neurological differences between humans and other primates. These suggest unambiguously that distinctive neurophysiological changes must have taken place during the course of hominin evolution.

These changes, as far as I can see, are the only qualitative difference between extant humans and all other extant primates — archaeological fantasies notwithstanding. Specific neurons, called VENs (von Economo neurons), occur in both apes and humans (Nimchimsky et al. 1999; Watson et al. 2006), but they are larger and far more numerous in the latter, occurring in humans in the anterior cingulate cortex and the frontoinsular cortex. These structures are thought to be involved in complex social emotion and cognition. Nerve cells in extant humans, e.g. in the primary visual cortex, are arranged in far more complex patterns than in apes (Preuss and Coleman 2002). The minicolumn, the mammalian brain's basic information processing structure, in the left *planum temporale*, is significantly enlarged in the human, relative to the chimpanzee or rhesus monkey (Buxhoeveden and Casanova 2002), containing the axons, dendrites, and synapses that make neural connections (Sherwood et al. 2009). Significantly, the *planum temporale* is involved in language production. Ullian et al. (2001) found that synapses form between neurons only in the presence of astrocytes, neuroglial cells constituting almost half the cells in a human brain (see also Ullian et al. 2004; Barres 2008). These cells secrete the protein thrombospondin, which triggers synapse formation (Christopherson et al. 2005) and of which the human brain produces about six times as much as that of chimpanzees or macaques (Cáceras et al. 2007). It also produces about twice as much of THBS4 and THBS2 messenger RNA (mRNA), respectively, in the human cerebral cortex. (Importantly, ribonucleic acids, like DNA, can carry genetic information — there goes another archaeological fantasy out the window.) Thrombospondin expression differences were observed in the forebrain (cortex and caudate), whereas the cerebellum and most non-brain tissues exhibit similar levels of the two mRNAs, in humans and chimpanzees. Increased expression of thrombospondins in human brain evolution could result in changes in synaptic organisation and plasticity, and contribute to the distinctive cognitive abilities of humans, as well as to the vulnerability to neurodegenerative disease that seems unique to humans (Walker and Cork 1999; Olson and Varki 2003). It is from this direction Helvenston and Hodgson need to begin their quest, rather than by cobbling together different untestable notions derived from social

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REPLY

Rock art and flexibility in animism as informed by neuropsychology

By PATRICIA A. HELVENSTON and DEREK HODGSON

We are grateful to all the commentators for their perspicacious and useful remarks regarding our paper. We consider these comments to have been extremely supportive and helpful in refining our ideas in relation to the very broad topics covered in both this and previous papers. The pointing out of errors and omissions with tact and sensitivity has enabled us to more fully embrace the few criticisms communicated. One of the most basic truisms of all scientific endeavours is the crucial importance of methodology in determining empirical results and interpretive insights, as Deręgowski reminds us. Truisms are such because of their essential validity and Deręgowski's textured comments on problematic areas regarding human perception are an excellent example of this. One area of research that is especially contentious is the study of human infant behaviour and perceptual capacity, as emphasised by Deręgowski. We urge any reader interested in the detailed example cited by Deręgowski to read Yonas et al. (2005).

As Deręgowski points out, in this ingenious experiment Yonas et al. show that grasping movements made by nine-months-old infants to two types of stimuli differ. Three different types of stimuli were presented in order to demonstrate this: photographs of objects, the actual object, and a non-representational black-grey-white series of block designs on a flat surface, i.e. a picture of a white-black gradient of blocks. In contrast to Winner's experiment, the addition of the non-representational picture and the resultant behavioural response to it showed that infants *may* view the object as different than the photo of the object as they behave quite differently to the object than to the photo of the object or to the non-representational picture. In other words, the infants behaved similarly to the photo of the object and to the non-representational picture but differently to the actual object. Thus the infants do *appear* to distinguish the object from the pictorial representation of it. Deręgowski concludes, '[t]his finding questions the manner in which much of the data obtained in earlier experiments was interpreted'.

We would add it certainly provides empirical evidence that Winner's conclusions *may have been* erroneous. However, Yonas et al. critique their own experiment by bringing attention to the fact that 'it is not necessary to invoke theoretical concepts to explain 9-month old infants' response to photographs' (p. 164), as their responses may be more parsimoniously explained by the fact that 'when a photograph is viewed with two eyes the binocular disparity provides information that the photographic surface is flat and thus lacks the three dimensions of the actual object' (p. 163). The three-dimensional object is graspable, whereas the photo is not and it seems safe to conclude that the infant can detect the disparity and responds accordingly. Thus the question as to whether nine-months-old infants regard pictures of objects as different to the object concerned is still not settled, which raises the possibility that infants may still be unable to understand the dual nature of pictures. Such are the pitfalls of inferring theoretical concepts from observations of infants' behaviour. We are very grateful to Deręgowski for pointing out Yonas et al.'s study, which provides an excellent example of the difficulties inherent in such research.

Interestingly, in the context of attempting to assess human infant thought processes concerning how pictures are responded to versus objects, a similar experiment was conducted on marmosets (a New World monkey) wherein they were tested with two-dimensional displays of real three-dimensional objects (Emile and Barron 2009). The question was whether or not they could recognise 2D representations of potential threat. Thus, the behavioural responses of adult captive black tufted-ear marmosets (*Callithris penicillata*) toward an unfamiliar motionless snake model and its photograph were assessed. Pictorially naive subjects were randomly divided into two groups and given two trials. Group 1 was initially exposed to the 3D object and after one week to the corresponding photograph. Group 2 was first presented with the picture and only tested with the real object one week later. In the presence of the 3D snake object, regardless of its presentation order, the frequency of direct gazes, head-cocks, tsik-tsik alarm/mobbing calls and genital displays increased significantly. The photograph induced a similar response, although only when the object had been previously presented, as significantly higher levels of these behaviours were seen in Group 1 than Group 2. Thus, the marmosets recognised and responded appropriately to biologically and emotionally relevant 3D and 2D stimuli, but the aversive/fearful reactions toward the photograph were only seen after the snake object had been presented, the former therefore seems to be essentially a learned response. In conclusion, with some prior learning, marmosets react similarly to both a 3D object and a 2D stimulus.

We are pleased with Deręgowski's metaphor of a

mosaic, usually a highly coloured artistic work, often containing subtle and sophisticated perspectives which have been rendered interpretable through countless decisions of what colours and objects to depict and what to omit, by individuals or teams of individual artists. We chose to focus upon a broad perspective, more the forest aspect of animism, rather than the trees as specific and unique figures. Thus many of the trees are more abstract and 'elemental' than we would have liked. In our own defence, it should be noted that our artistic and archaeological examples (the trees) were contained in the second half of the paper, but space concerns prompted the editor to request some reductions and cuts in specific examples. This seems to have rendered the second half of the paper the appearance of not being as well thought out and communicated as effectively as the first half, as Bednarik has pointed out and Helvenston agrees with that conclusion.

Taçon perceptively notes the omission of a discussion on figure-ground criteria in our paper. In this regard, we hope that he or *RAR* readers may wish to pursue the pertinent issues he raised. We also would like to thank Taçon for raising the issue of neuropsychology and 'hardwired' deterministic linkages between brain and behaviour. This is a topic we have previously addressed (Helvenston and Hodgson 2006) and fully agree that the computer analogy of a 'hardwired brain' and experience ('software') makes the reduction of brain behaviour relationships to strictly deterministic connections between the two virtually inevitable, a fact that we deplore and hope to begin to correct. This egregious deterministic linkage between brain and behaviour is particularly evident in the 'neuropsychological' or 'shamanistic' model proposed by Lewis-Williams and acolytes. We hope Taçon will be proved correct that our current paper will assist in overthrowing the 'one size fits all' shamanistic model as it pertains to rock art and it was certainly our intention that this would be so. Clearly the study by Sauvet et al. (2009), in which Taçon is one of the authors, also puts one more nail in the coffin of the obligatory shamanistic model that can be universally applied to virtually all rock art across time. These researchers carried out a unique study comparing Palaeolithic art to art known to be shamanistic, totemic, or 'art for arts sake' in the contemporary world. They found that no distinct pattern of contemporary art classified into the three categories listed above was characteristic of Palaeolithic art, not a surprising finding in our view. In fact, the entire issue of *CAJ* 19(3) is devoted to papers discussing animism that the interested reader may wish to consult. This series of papers demonstrates how the concept of animism can provide a more appropriate and productive model for interpreting rock art. Bahn (in press) has written an excellent summary chapter critiquing the shamanistic model entitled 'The emperor's new clothes' to which readers are referred, that can be found in *Prehistoric rock art: polemics and progress* (a book available from Cambridge University Press in 2010).

As we tried to explain in the first part of our paper, strictly deterministic S-R connections only characterise the most basic physiological functions mediated by the brain, but even these are subject to influence from 'higher', i.e. more evolutionarily advanced, areas. The brain appears to squander little thus, earlier structures are built upon, modified and elaborated, sometimes resulting in such early structures eventually serving quite different functions. For example, the superior colliculi of the midbrain are prominent in birds and serve as a crucial mediator of visual-perceptual and motor responses. They also serve higher-level functions such as categorisation. These structures are still crucial in mammals and primates but subsequent forebrain structures and a primitive cortex began to exert more downstream influence, which increases even further during primate and hominin evolution. Finally, in humans the superior colliculi are only involved in what are prominently reflexive responses to a visual stimulus, which for some functions can be modified by higher structures, including the cortex (Butler and Hodos 2005).

Indeed, it is high time to exorcise the 'computer' analogy from archaeology. This approach has long been consigned to the garbage bin of neurobiological research. As mentioned, in the computer analogy, 'hardwired' refers to the neural structures and connections of the brain and spinal cord as determined by hominin evolution, whereas the software is analogised as individual experience in the world interacting with the biological brain over a person's lifetime. This metaphor of how the brain functions virtually dictates that an overly deterministic linkage will accrue to the biological brain whereas individual experience in the real world will receive less attention. This represents a fundamental error, because the 'hardwired' brain can be significantly modified by the experience of the individual, as the following examples will de-monstrate. Again this is a topic Hodgson and Helvenston (2006) have addressed before. Computer software, to our knowledge, seldom if ever modifies the hardwiring of the computer, which renders the computer analogy extremely deficient in interpreting the relationship between the experience required to create archaeological artefacts and the innate capacities of the human brain.

It has long been known that following stroke, brain injury or amputation, there is a reduction in the cortical sensory and motor fields associated with the damaged area. Through daily experience of the remaining body and brain, neurons serving the undamaged areas invade the damaged area and these new neural innervations change formerly existing neural patterns. Thus experience leads to re-organisation of the brain (Schwartz and Begley 2002) that has been termed 'use dependent cortical re-organisation.'

As an example of such use dependent brain re-organisation in normal humans, Maguire et al. (2000) studied London taxi drivers using MRI scanning

devices to image the hippocampus (an area of the brain instrumental in learning and memory). In taxi drivers as compared to non-taxi drivers, the posterior hippocampus became much larger than the anterior hippocampus, and the size differential was directly correlated to the length of the driver's experience. Thus, experience had altered the brain structures and their connections in adults. These changes are made possible by an ongoing process of brain neurogenesis. Until the 1990s it was believed that once neurons were formed, little or no neurogenesis occurred from adulthood to death. This has been shown to be false. Adult stem cells are present in the brain and make ongoing neurogenesis possible throughout the lifetime of an individual (Erickson et al. 1998). Not only is the brain capable of reorganising existing networks, it is also capable of producing new neurons. Even just thinking about moving can fire the motor neurons that are involved in the actual movement imagined. Thus thinking can alter brain function.

One of the differences between *Homo sapiens* and the great apes appears to be the propensity of humans to develop and suffer from a wide variety of mental disorders. Many of these result from the interactions occurring between brain and experience, whereas others seem primarily experientially based, such as in personality disorders; while some disorders, such as schizophrenia and bipolar illness, have a significant biological component. One particularly distressing illness is Obsessive Compulsive Disorder or OCD where insistent thoughts and images and incessant urges to perform puzzling rituals are experienced, often to such a degree that ordinary living is completely disrupted. A persistent feeling of dread or that something is wrong pervades the sufferer's consciousness. This disorder has recently been effectively treated, using specific cognitive behavioural techniques that modify both behaviour and the underlying neural substrates involved in causing and alleviating the disorder. We will present only a simplified discussion of these substrates and refer the interested reader to the excellent discussion of this topic in Schwartz and Begley (2002: 54–95). Three structures and the interconnections among them are overactive in OCD patients. These structures are the inferior prefrontal cortex; the striatum (includes the caudate and putamen), both subcortical forebrain structures and part of the basal ganglia; and the anterior cingulate gyrus. Interconnections between these structures are known as 'the worry circuit'.

The specific cognitive behavioural therapy utilised in these studies for the treatment of OCD patients is termed 'mindfulness'. Eighteen OCD patients were given PET scan imaging studies before and after they underwent a ten-week therapeutic regimen. After treatment the PET scans showed significantly diminished metabolic activity in both the right and left caudate with the right-side decrease particularly striking. All of the 18 patients showed major reductions of symptoms. Therapy had altered the metabolism of the OCD 'worry' circuit and the severity of the symptoms (see also Heimer et al. 2008 for an extensive discussion of the forebrain neuroanatomy and neurophysiology of frontal and prefrontal structures and mental illness in humans).

The fact that individual experience can modify brain structures lends support to those who maintain that artistic creation is not just a product of neurobiology and neuropsychology, but is an amalgamation of biology and individual human experience, thus accounting for the creativity, historicity, particularity, individuality and originality of individual artistic productions. Whereas biologically innate connections may form the basic template of mind, human individual experience constitutes the means by which these traits are manifested in individual artistic behaviour. The biological template of the human brain, plus the modifications to that template by human experience, therefore makes up the human *mind* according to this formulation. Moreover even though brains appear similar, the world of pre-Historic *Homo sapiens* was so different to that of the modern world that the *mind* of moderns and pre-Historic ancients must surely be quite dissimilar, a hypothesis which has been previously put forward by Helvenston and Bahn (2004) and Hodgson and Helvenston (2006). For example, Ong's (1982) pioneering work on the difference between the minds of people living in oral versus highly literate cultures makes this conclusion inevitable. This is not to say that the minds of people who have the opportunity to move from an oral into a literate culture cannot change by virtue of experience in the latter. Such fortunate individuals may indeed retain minds attuned to the various attributes of both types of culture.

We are pleased with Watson's interesting comments which are so thorough that little remains to be added except that his discussion of the techniques and forms used to depict motion in rock art is excellent and highly relevant to our paper. It certainly extends the relationship between rock art and motion as embodied in many animistic beliefs beyond what we drew attention to. We therefore hope that Watson will continue to explore this topic especially with regard to those factors. We find it particularly gratifying that he pointed out several research papers based upon the hypotheses we proposed that would profit from future study, for that was one of the main reasons why we favoured the current paper being published in *RAR*. *RAR* provides an excellent forum for the sophisticated study of rock art and the many related pertinent topics because of the extensive comments sections, thanks to the editorship of Bednarik.

We agree with Watson's view regarding the major importance of mirror neurons for many motoric and perceptual processes (we will discuss mirror neurons subsequently). We also appreciate Watson's reference to the importance of the temporal lobes in picture identification and the response to pictures. Indeed, we would note that specialised neurons (but not mirror

neurons) have been found in various regions of the temporal cortex, which are selectively activated by the sight of biologically important stimuli such as faces, hands and bodies (Gross et al. 1972) in the macaque monkey. Perrett et al. (l982, l984, l985) found that cells in STS (superior temporal sulcus) respond selectively to different views of the head in both humans and macaques. Moreover, it was also found that a fraction of the cells discriminate between different species or between individuals of the same species, i.e. here we have one neuronal substrate for categorisation of stimuli as discussed in the current paper and more extensively in Hodgson and Helvenston (2006). STS in macaques corresponds to human STS. Hasselmo et al. (1989), for example, revealed cells that were disproportionately responsive to the full facial and profile views of the head in contrast to other views. And Perrett et al. (1991) found that cells in the STS responded to different perspective views of the head, i.e. the coding of percept was tuned to 'characteristic views of the head'. This was an experiment recording the reaction of single neurons to different views of the head: 110 cells were found to be viewer-centred, responding to the stimulus only if it presented a certain view; and a further five cells showed 'mixed' properties, responding to all views of the head, but also discriminating between views.

Even more sophisticated functions have been discovered (Iacoboni et al. 2001) that relate to the extremely complex phenomenon of imitation. Again, neurons in the STS become active both during hand action observation and during imitation, even in the absence of direct vision of the imitator's hand. The mirror system, on the other hand, seems more associated with the fronto-parietal circuit than with the more purely visual areas of the STS which, in humans, seem to be a function of an expanded inferior parietal area for higher order imitation of actions, an ability that appears to be limited or absent in chimps and monkeys (see Rizzolatti and Craighero 2004 for a detailed review of the mirror neuron system). Thus, motor-related activity is greater during imitation than during the control of motor tasks. The above-cited newly identified regions possess all the requisites where observed actions, and the re-afferent motor-related copies of actions made by the imitator, interact (Iacoboni et al. 2001: 13995).

We do not, however, share Watson's opinion that Wallis (2009) is that relevant to our topic and think the reader would be better served by focusing on *CAJ* 19(3). Wallis strikes us as quite off-putting in that he appears to deliver a polemical tirade against 'Western' archaeologists and the notion of human agency in marking and attributing meaning to certain features of the landscape (in minds which we can only speculate about) or physically by producing actual artefacts. Indeed, Wallis seems to maliciously give precedence to deconstruction (an approach that has virtually destroyed the social sciences in the U.S.A.). Those who may not be so concerned as to the inadequacies of this kind of approach may find more to admire in Wallis, which is one of the reasons we omitted to cite this particular study; one of the many options that were eliminated as tesserae from the mosaic of the paper, as Deręgowski would phrase it.

On the other hand, Janik (2007) is highly relevant and we thank Watson for this citation of which we were previously unaware. Janik presents another distinction between soul and spirit that we find highly relevant to our paper. She states that in animism souls are believed to inhabit not only humans, but animals and inanimate nature in agreement with our definition. However, she notes that when these souls existed outside the material entity that once contained them, they then became spirits (Janik ibid.: 192).

Janik also argues that even in the rock art sites of Siberia, close to Lake Baikal, which are ethnographically and artistically related to shamanism, there is a suggestion of the importance of animism, which she speculates is thousands of years old. However, she cites no examples but infers animism because of the presence of rock art on white cliffs in a cove. As we have shown in our paper, animism is deeply hardwired into the human brain as a result of extremely ancient processes regarding biological evolution and can thus be conceptualised as the world's earliest religion. Again, such 'hard wiring' in the brain in no way implies a simple S-R response in *Homo sapiens* which is not modifiable through life experience.

We are also indebted to Watson for the discussion of supernormal stimuli, a topic that Hodgson (2003b) has previously dealt with at some considerable length and that has recently received empirical support from Cheyne et al. (2009). Helvenston has long thought that the 'Venus' figurines and some of the phallic rock art and statues from the Palaeolithic into the Neolithic may have not served simply as fertility symbols (see Cuesta and Diez 2006 for a discussion of sexuality during the Palaeolithic), but rather were designed to evoke strong sexual responses, perhaps for a *hieros gamos* or 'sacred marriage' ceremony such as those cited in the literature from Mesopotamia, the earliest literate culture. In Sumer, the King of the city would mate with the high priestess of the goddess Inanna. The citizens of the city would also mate, thus timing births to the winter months when there was more time to care for the infants (Kramer 1969). In other words, these supernormal stimuli (i.e. stimuli that exaggerate certain aspects of the body, thereby eliciting a greater than normal response) are similar to *innate releasing mechanisms* (brain structures responsive to the exaggerated stimulus properties of an animal's environment that 'release' an instinctive response to the stimulus) as identified by European ethologists, especially as elucidated by Tinbergen's corpus between the 1950s to 1970s (see also Hodgson 2003b).

We know from some of the research of ethologist Eckhart Hess that human pupils dilate considerably when looking at an appealing image of the opposite sex in heterosexuals, whereas same sex attraction

is characterised by pupil dilation for the same sex (Andreassi 2007: 221–227). In many such cases, pupil dilation is also accompanied by self-reports of sexual arousal. Whether similar physiological responses could be induced by 'sexualised' rock art would make an interesting experiment. According to Bahn (pers. comm. 2009), vulvas are far more common in Palaeolithic art than the phallus, but the Venus figurines seldom possess a marked vulva, although vulvas constitute a significant percentage of cave art. The rarity of such figurines may argue in favour of their unique importance to the people who created them because often rarity leads to these items becoming highly valued. It seems therefore safe to assume that Palaeolithic artisans, who were highly skilled in the creation of these artefacts, were atypical, thereby insuring the limited availability of such objects. A more modern example would be uniqueness of an artist like Da Vinci with respect to the replication of the human form in two-dimensional art.

We are most appreciative of Bednarik's laudatory comments and agree that the second half of the paper requires more empirical examples. We did not include an extensive discussion of Upper Palaeolithic therianthropes because these are so well known to our readers to the extent that the association with our central thesis seemed obvious, but we should, nevertheless, have elaborated this body of evidence. If our paper is useful, it is, to paraphrase Newton, because we stand on the shoulders of giants and indeed, Bednarik has been the first to mention all manner of ideas that have been later elaborated by others, including himself, not least of which is the now generally accepted idea that Neanderthals may not have been that different to modern humans in their behavioural repertoire and cognitive abilities. We cited Bednarik's work on camouflage in our 2006 paper in *RAR*, but failed to include the suggestion in the present paper that was also previously proposed by Bednarik, which predated Guthrie, that rapid instinctive responses to some key stimuli may exemplify the 'better safe than sorry' principle of human evolutionary processes.

With respect to the Lepenski Vir discussion, we acknowledge that the speculations by the excavator of the site as to how Mesolithic humans may have viewed changes to the body, especially after death, are not empirical, rather they constitute a hypothesis. However, one area we cut to make the paper shorter contains further empirical evidence of the importance of the relationship between the fish-human hybrid, death and burial among the peoples of Lepenski Vir.

For example, Borić's speculation is supported by the fact that a number of the burials involved the body being placed parallel to the river, with the disarticulated skull pointing downstream where the sturgeon migrated to the sea during the autumn, perhaps signifying deprivation and death. The skull was also turned so that it faced the Danube to the east of the village. It is not clear whether the skull was directed toward the sunrise, reminiscent of numerous other cave sites, or merely the river, which was itself a source of life for the villagers and may have become a symbol similar to that of the east related to the rising sun. The placement of the skeletons and skulls appears very deliberate and the speculation is the burials were linked with the seasonal absence of the sturgeon, and death. In some of these burials fish/human hybrids carved in stone accompanied the burial. Whether or not one accepts the details of the hypothesis Borić suggests, the empirical evidence does suggest a relationship between burials, fish/human hybrids and death.

Bednarik seeks clarification regarding the differences between hallucinations, hyperimages etc. We therefore include here a chart that should help to elucidate the continuum from a complete lack of awareness of reality due to the subject being overcome with hallucinations, to pseudo-hallucinations where the subject knows the hallucination is not real, to hyperimagery and normal human perception (the interested reader is referred to Hodgson 2008 for a detailed discussion of this phenomenon in relation to parietal art). Hallucinations may occur in any of the five senses, so visual, auditory, gustatory, haptic and olfactory hallucinations are all possible. We should note, however, that the concept of a pseudo-hallucination is currently poorly developed

Hallucinations	**Pseudo-Hallucinations**	**Hyperimage**	**Realistic perception**
Image completely subjective and experienced as totally real and seen as part of the real world.	Image seems real but the subject knows it is a hallucination.	Image is influenced by subjective emotional factors but subject can perceive the real object as well as the hyperimage.	Near objective perception of the object.
Characterised by mental illness such as schizophrenia or bipolar illness or must be induced by extreme deprivation of food, water, sleep, sensory input etc., or induced by hallucinogenic drugs. May also be induced by electrical, chemical or magnetic stimulation of the cortex.	Experienced in some temporal lobe seizure disorders and by some persons with bipolar illness or in some drug-induced states. Some cortical stimulation experiments yield this result.	Normal person under the influence of high emotion, myth, ritual or ceremony, can see both the hyperimage and the real object.	Normal human perception of the real object.

Table 1. *Continuum of perceptual experience of 'reality' (Helvenston 2009).*

(van der Zwaard and Polak 2001) but based upon Helvenston's clinical experience as a neuropsychologist, this is probably the most common use of the term (see also Berrios and Denning (1996).

We certainly agree with Bednarik that not all cave art is 'ceremonial' but surely some must be regarded as such — how to distinguish between what was associated with ritual and what was not is of course the crux of the problem (cf. Bednarik 2008). We are familiar with Guthrie's (2006) book and his conclusion that adults, teens and children of all ages and both sexes made the numerous hand stencils. Guthrie's conclusion that the hand stencils 'represented a primitive incarnation of the contemporary family' is, however, mere speculation. The lifespan of Palaeolithic people came to about 32 years of age (Prioreschi 1990). It therefore seems safe to assume that such people began to mate virtually as soon as physiologically possible as primates and some humans are also inclined to do today. Thus, teenagers were likely active in rituals and ceremonies and were probably considered adult by around age 14–16, if not younger. The concept of adolescence is, after all, quite modern. Another interesting hypothesis would be that the ubiquity of hand stencils suggests that they may have been associated with some archetypal coming of age ceremonies (Hodgson [2008] refers to this as a 'quest'), which is equally as likely as the 'family portrait' hypothesis put forward by Guthrie. Indeed, one of the most frequently practiced ceremonies of the Native American tribes was some version of this kind of ritual (see Kroeber 1925 for a detailed discussion).

Bednarik is correct in stating that we did not address the differences between humans and other primates. In our 2006 *RAR* paper, however, we discussed those differences extensively, so the reader may wish to consult that document accordingly. One of the biggest cortical differences between humans and apes is in Area 10 in the pre-frontal lobe, which appears much more highly developed in humans compared to chimpanzees (Semendeferi 2001a, 2001b). This region subsumes higher cognitive abilities, such as the extraction of *meaning* from ongoing experience, the organisation of mental contents that control creative thinking and language, artistic creation, initiation of, expression of, and planning for future action (Damasio 1985). We would suggest that Area 10 is one of the most likely substrates for the expansion of complex, sustained and focused human consciousness, which is one of the major differences between humans and apes.

We completely agree with Bednarik's erudite discussion on some of the differences in the neuroanatomy and neurophysiology of the human brain existing between *Homo sapiens* and chimpanzees, such as with VEN (von Economo neurons), multiple and complex minicolumns, proliferation of glial cells, use of thrombospondin etc. The development of these and related topics in a highly systematic fashion requires at least one separate paper and we thank Bednarik for these perspicacious and timely suggestions. When we mentioned that chimpanzees categorise, as do birds, mammals and primates, it was not to suggest that the chimpanzee has a unique ability to do so, rather this was to show that many species possess this ability, which suggests an origin deep in evolutionary time (about 150 million years ago), since birds also possess this ability and their superior colliculi are highly involved in the process, along with a rudimentary cortex. Indeed, it would be interesting to see if the superior colliculi in humans still retain categorisation functions or whether higher structures have completely subsumed this.

In the target paper we discussed the major differences between the pyramidal system in apes and humans, wherein there is a direct cortical link between neurons in the cortex and neurons innervating the shoulder, arm, hand and fingers of humans. Furthermore, extensive consideration regarding the role of the hand in relation to anatomy, innervation and control by the brain etc. is provided in Wilson (1998; also see Achrati 2008 for more discussion on the importance of this singular body part for making fine motor responses characteristic of *Homo sapiens*). Indeed hand and finger responses are a prerequisite for producing detailed, small artefacts that are associated with rock art and sculpture. As Donald (1991) has noted, it is the extensively developed ability to respond motorically to the environment, far beyond the capacity of higher primates, that characterises humans. In this respect, far too little attention seems to have been paid to the differences that exist between non-human primates and humans. But this difference is absolutely fundamental as a key factor that enables the production of material artefacts beyond the capacity of apes. Thus, we are increasingly coming to realise that primates possess many cognitive, sensory, associational and motivational-emotional neural substrates that in chimpanzees do not differ significantly from humans (Helvenston, speaking as a neuroanatomist as well as a neuropsychologist). Yet humans also possess distinctive capacities to do with how motor and perceptual abilities become integrated that are not available to non-human primates that seem also to apply to the unique capacity of humans to respond to pantomiming activities that may or may not involve goal-oriented behaviour using actual objects (Rizzolatti and Sinigaglia 2006).

Indeed, a recent study shows how some primatologists have been studying the use by chimpanzees in Guinea, of stones to smash nuts placed on top of rocks in a hammer and anvil-like fashion (Haslam et al. 2009: 330–44) which, the authors speculate, may help in understanding early hominin tool use beginning some 2.6 million years ago, during which members of the human evolutionary family are known to have used and made stone tools of increasing complexity and refinement. For example, Oldowan artefacts are distinguishable from the rock outcomes produced by bonobos, where one of the latter did not employ rocks for the purposes of a nutcracker or hammer and anvil; rather the rocks were thrown onto a flat stone surface thereby sometimes producing sharp flakes. Thus, individual chimps

appeared to utilise different methods for cracking nuts and breaking stones. As a result, Haslam et al. refer to the study of non-human artefact assemblages as 'primate archaeology'.

Carvallho (in Haslam et al. ibid.) describes composite tool use by the chimps of Guinea in an experiment where seven piles of nuts and several dozen stones of various sizes, shapes and types were placed within a clearing. Over five field seasons 14 of the 17 chimps that regularly visited the clearing consistently reused the same pairs of stones for the purpose of manufacturing a nutcracker! Capuchin monkeys also use two stones as a nutcracker, or as a hammer and anvil. Elementary tool use seems to be a very ancient primate propensity as it is found in capuchin monkeys (Platyrrhini, New World) a species that diverged from other primates around 35 million years ago. Capuchin monkeys also have an elementary kind of mirror recognition of self that suggests a very gradual evolution that began long before the split between Old World monkeys (Circopithecoidea, 25 million years ago) and the great apes. Interestingly, the capuchin monkeys, as do many Platyrrhini, have a cortex that is richly folded in sulci and gyri as we see in the great apes and humans, but is rare in the Circopithecoidea.

We could not agree more with Bednarik concerning the propensity of humans and animals to respond to just a few salient characteristics of their prey or of those predatory animals who prey on them. Davis (1986) has much to contribute to a discussion of the earliest outlines, deeply engraved, during the earlier Upper Palaeolithic, as Bednarik points out. In this regard, Hodgson (2003a, 2003b) has written extensively on those aspects of the animal profiles that are portrayed in Palaeolithic art which seem crucial for the recognition of animals as predators by humans. In fact, the profile of prey or predator animals may in itself constitute a supernormal stimulus as pointed out by Watson which can lead to an emotional response relating to fear, awe, veneration and anticipation of a meal, as Bednarik suggested and as proposed by Hodgson and Helvenston (2006). These stimuli certainly stimulate complex hunting responses in humans today, as they probably also did during the Palaeolithic.

Bednarik poses many other excellent questions, for example, he asks 'How is this process envisioned that enabled hominins to "think" they were capable of comprehending and controlling "non-human persons" '? The 'mirror' neuron system is clearly one of the neural substrates underlying imitation, a strategy used by some higher primates, although this may depend on a basic form of emulation rather than true imitation (Rizzolatti and Sinigaglia 2006). In a recent study, capuchin monkeys were seen to prefer experimenters who imitated their movements and this is one mechanism of social bonding among conspecifics in this very social species (Paukner et al. 2009). As we discussed in this paper, humans throughout the world have a tendency to project their own attributes onto animals and inanimate objects — which is a process that has been shown, with the development of psychoanalysis, to be largely unconscious. As noted in our 2006 *RAR* paper, the 'mirror' neuron system in the ventral pre-motor cortex also suggests that chimps can, in a limited way, envisage the viewpoints and intentions of others (this is inferred by imitation/emulation behaviour related to perhaps level two intentionality) and that chimps often set out to deceive one another (Rizzolatti and Fadiga 1988). They can thereby influence or control a conspecific's behaviour by deception or bluffing. It is not unlikely that early hominins shared these abilities and even the capuchin monkey has an elementary recognition of itself in the mirror (de Waal 1986; de Waal et al. 2005), suggesting it too may be able to discern motives of others of its species as mirror neurons have been found in many monkey species, though such mirror neurones seem to be more connected to 'action understanding' than imitation per se but may nevertheless have served as a substrate for true imitation as is found in humans (Jeannerod 2006; Rizzolatti and Sinigaglia 2006). Such non-human primates are all highly social animals, living together in groups and their social interactions are complex — attributes that will also have characterised early hominins. Interestingly, one of the main reasons put forward for human brain expansion may reside in the demands of a social brain (Dunbar 1998).

As these abilities developed over hominin evolution some hominins may have come to perceive spiritual life in both inanimate objects and animals, if they were aware that their behaviour could sometimes influence conspecifics, why would they not exploit the same strategies to control either animal or inanimate objects? Indeed, societies possessing rituals aimed at controlling nature are ubiquitous, demonstrating the near universal presence of animistic and anthropomorphic beliefs. As we discussed extensively in 2006, and in the present paper, the amygdala is one of the limbic structures that is responsive to fear-inducing stimuli, social and visual inputs and is the most likely and fundamental neural substrate mediating perception of life in inanimate objects. In this respect, the emotional dimension serves to 'colour' an experience so that meaning can be attributed to what would merely be a more neutral cognitive event. Inherent to this process is the empirical fact, as already highlighted, that humans project their own intentions, motivations and attributes onto animals and inanimate objects as a way of not only relating to them socially, but also as a means of exerting control. For a discussion as to how anthropomorphism is concerned with meeting two basic human needs, of social contact and effective competence in controlling and understanding animals and nature, see Epley et al. (2008).

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