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REVIEW

The evolution of human artistic creativity

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Abstract

Creating visual art is one of the defining characteristics of the human species, but the paucity of archaeological evidence means that we have limited information on the origin and evolution of this aspect of human culture. The components of art include colour, pattern and the reproduction of visual likeness. The 2D and 3D art forms that were created by Upper Palaeolithic Europeans at least 30 000 years ago are conceptually equivalent to those created in recent centuries, indicating that human cognition and symbolling activity, as well as anatomy, were fully modern by that time. The origins of art are therefore much more ancient and lie within Africa, before worldwide human dispersal. The earliest known evidence of 'artistic behaviour' is of human body decoration, including skin colouring with ochre and the use of beads, although both may have had functional origins. Zig-zag and criss-cross patterns, nested curves and parallel lines are the earliest known patterns to have been created separately from the body; their similarity to entopic phenomena (involuntary products of the visual system) suggests a physiological origin. 3D art may have begun with human likeness recognition in natural objects, which were modified to enhance that likeness; some 2D art has also clearly been influenced by suggestive features of an uneven surface. The creation of images from the imagination, or 'the mind's eye', required a seminal evolutionary change in the neural structures underpinning perception; this change would have had a survival advantage in both tool-making and hunting. Analysis of early tool-making techniques suggests that creating 3D objects (sculptures and reliefs) involves their cognitive deconstruction into a series of surfaces, a principle that could have been applied to early sculpture. The cognitive ability to create art separate from the body must have originated in Africa but the practice may have begun at different times in genetically and culturally distinct groups both within Africa and during global dispersal, leading to the regional variety seen in both ancient and recent art. At all stages in the evolution of artistic creativity, stylistic change must have been due to rare, highly gifted individuals.

Key words body decoration; likeness modification; mind's eye; out of Africa; pattern.

Introduction

Art, in its many forms, is practised by almost all human cultures and can be regarded as one of the defining characteristics of the human species. In all societies today, the visual arts are intimately intertwined with music, dance, ritual (marking life landmarks, death, religion and politics) and language (poetry, song and story-telling). Vocalization, ritualized movement and visual display are part of animal courtship and dominance competition as well as human ritual and communication, so it is likely that the roots of music, dance and body decoration lie deep in the evolutionary history of the animal kingdom. Nevertheless, with the evolution of human cognition, they were deployed in new ways, with complex symbolic meaning becoming attached to them.

There is good evidence for a neurological relationship between visual creativity and language. Stout et al. (2008) studied the brain activity of subjects who had become expert in Early Stone Age tool-making. The tools were of the Oldowan and Acheulian types, representing a period of some 2 million years during which time the brain of our hominin ancestors expanded and tools became more advanced. The brain activation detected by positron emission tomography during tool-making included both visuomotor and language circuits, suggesting that tool-making and language share a basis in the human capacity for

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complex goal-directed manual activity. As this includes artistic creativity, evidence of the increasing sophistication of tool technology, as well as evidence from crania of increasing brain size, suggests that our ancestors had the ability to create art or proto-art much earlier in evolution than is suggested by current knowledge of art-related artefacts.

There is no consensus on how to define art, although most definitions emphasize aesthetics. Layton (1991) wrote: 'we identify art works in a formal sense because we find them aesthetically pleasing and we find that they enhance our perception of the world around us through the apt use of images'. Haselberger (1961) defined works of art as objects produced with the intention that they be aesthetically pleasing and not merely pragmatically functional. A broader definition would include the decoration of useful objects such as tools and weapons, and allow for the possibility that most early art may have had a ritual or religious significance. We simply cannot know whether any prehistoric art was created simply for the sake of providing aesthetic pleasure, although there must surely have been an element of this on the part of both artist and viewer. It is also generally accepted that art incorporates a symbolic element (e.g. Gombrich, 1960; Layton, 1991) but, even where symbolism was not intended, a pattern or animal shape may have a totemic function; a particular pattern or animal form may be specific to a group or tribe and may mark their territory or clothing. The cross-cultural views of Morphy (2007) of what can be categorized as art in the European-Australian context are also relevant to the prehistoric perspective. Until recently, aboriginal art was considered as being of only ethnographic interest; a more open-minded and informed view has resulted in the inclusion of this category of art in mainstream galleries.

In this article I take an inclusive view of art, to encompass: (i) the use of colour, applied to the body, another natural or created 3D object or a flat surface; (ii) pattern, whether or not made with symbolic intent; (iii) the modification of naturally occurring forms; (iv) the *de-novo* creation of 2D or 3D images. The first three of these probably arose independently but the fourth synthesizes elements of all of them as well as representing a fundamental cognition-related change. I present evidence that the origins of art lie within Africa and that the oldest known European art was already recognisably characteristic of this region some 30 000 years ago. Although few in number, artefacts from older excavations in Africa and the Levant (the strip of land forming the eastern border of the Mediterranean Sea) suggest some of the possible stages in the evolution of human artistic creativity preceding the stage at which the evolution of technical skills, combined with the evolution of modern cognition, enabled humans to make representations of living beings in two or three dimensions.

The periods of human evolution to be covered, and some of the artefacts mentioned in the text, are summarized in the time-line shown in Fig. 1.

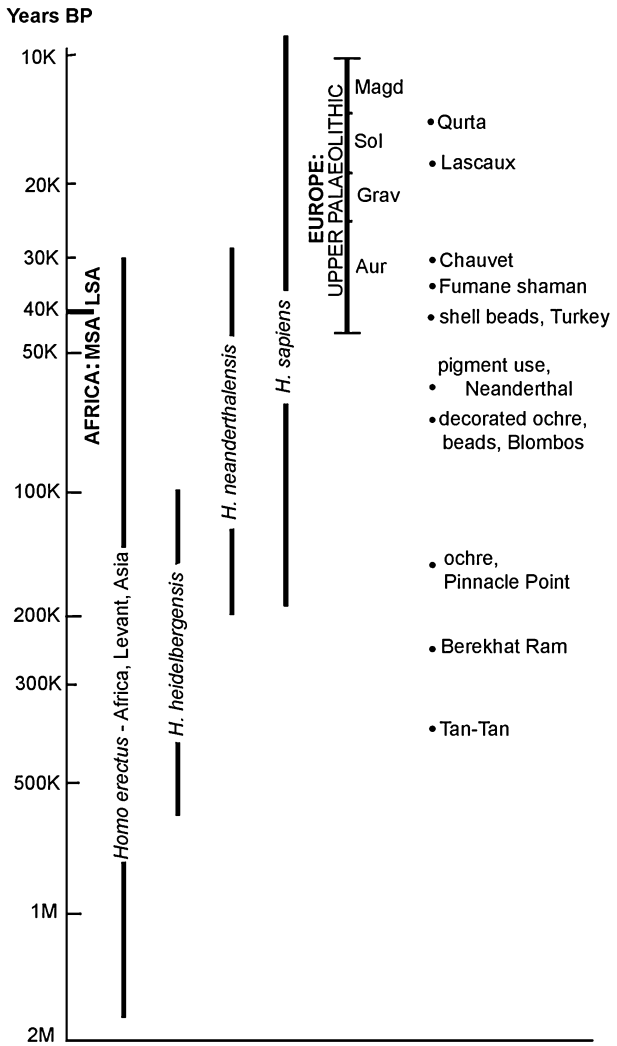

Fig. 1 Periods of time and species of *Homo*, and some of the artefacts mentioned in the text alongside their dates (right column); the vertical axis is log scale. *Homo* dates are taken from Wood & Lonergan (2008). The African Middle Stone Age (MSA) dates from at least 285 000 BP, based on the earliest use of stone point technology and hafted tools in East Africa, succeeding the use of Acheulian stone technology characterized by cleavers and handaxes (Tryon and McBrearty, 2002). The transition to the Later Stone Age (LSA) does not coincide precisely with the beginning of the European Upper Palaeolithic (UP). The UP periods (Aurignacian, Gravettian, Solutrean and Magdalenian) are named after tool technology characteristic of key sites but the actual dates show geographical variations. The European Middle Palaeolithic is divided into Mousterian and Châtelperronian, after Neanderthal tool types made before and after the arrival of modern humans.

How, when and where was art first created?

Much has been written on the origin or 'birth' of art. Most of these articles and books are mainly or entirely concerned with the European cave art of the Upper Palaeolithic and 3D artefacts such as the fertility doll-like 'Venus' figurines (see below). The long-held view that modern human behaviour, including art, only began when *Homo sapiens* migrated from Africa to Europe around 45 000 years before present (BP) is based on the idea that there was a rapid evolutionary change in the human brain and hence cognition at this time, which is referred to as the 'Upper Palaeolithic Revolution' (e.g. Bar-Yosef, 2002; see also references in McBrearty & Brooks, 2000) or the 'Transition' (e.g. Lewis-Williams, 2002). Is it possible, or even plausible, that the first real drawings and paintings were those created by Cro-Magnon man 30 000 years ago on cave walls and that the first real sculptures and clay models were those of Upper Palaeolithic Eurasia? Surely not – as Gombrich (1956, 1960) emphasized, art is tied to tradition, so there cannot be an 'innocent eye' or an 'original genius'. He proposed that art develops through a dialogue between artist and viewer; although based within its cultural context, it develops a life of its own and influences the formation of taste.

The concept of a rapid revolution that characterized the Middle to Upper Palaeolithic transition has been challenged by McBrearty & Brooks (2000), on the basis of a reassessment of the archaeological evidence of modern behaviour from Middle Stone Age Africa. Recent excavations, most revealingly in South African caves, have provided significant insight into symbolling activity including the use of colour, engraving of patterns, bone technology and bead-making, dating from up to 164 000 years ago (Henshilwood et al. 2001, 2002; d'Errico et al. 2005; Jacobs et al. 2006; d'Errico & Henshilwood, 2007; Marean et al. 2007).

These finds confirm that European Upper Palaeolithic paintings, engravings and carvings, many of which are mature works of skilled craftsmanship, have a long history in terms of human evolution and culture behind them. The unrivalled wealth of European material, which clearly indicates a highly developed artistic culture, may indeed be due to a sudden flowering of a more sophisticated symbolic creativity. Alternatively it may be a historical artefact arising from a change in the use of locally available sites, materials and traditions, e.g. from rock surfaces exposed to the elements to the protected environment of enclosed caves for painting. Sculpture probably began with wood carving; even today, the favoured material for sculpture in Africa is wood, which is a perishable material unless fossilized. The few centuries-old African stone carvings that have survived are sophisticated in representational skill and aesthetic sensitivity, indicating a long-established creative tradition there (Koloss, 2002; Willett, 2002). One traditional element of Yolngu art in Arnhem Land, Australia, is the creation of symbolic patterns in sand, whose temporary nature is part of their ritual purpose (Morphy, 2007). We simply cannot know how much art was created in perishable materials and has therefore been lost to the archaeological record. Any discussion on the origins of art is therefore inevitably biased towards consideration of the evidence from materials that have endured to the present day.

Human evolution and the origin of art

Evidence for a pre-hominin origin of colour appreciation and enjoyment of the creative process

Many captive chimpanzees enjoy painting with colour – their 'art' resembles the paintings that young children make with pots of colour applied with fingers or brushes. Congo, an exceptionally intelligent chimpanzee resident in London Zoo, was encouraged to paint by the zoologist/anthropologist Desmond Morris in the late 1950s. Three of Congo's paintings were sold at auction for a high price in 2005 (http://www.telegraph.co.uk/news/1492463/Art-world-goes-wild-for-chimpanzees-paintings-as-Warhol-work-flops.html). Between the ages of 2 and 4, he completed more than 400 drawings and paintings. He had a real involvement in his work and could not be persuaded to stop before, or continue after, arriving at his own conviction of having completed a painting. Examples of his 'art' were acquired (and admired) by Picasso and Miro, and are quite pleasing to the 21st century human eye, schooled as it is to enjoy abstract work. Comparison of Congo's enjoyably attractive paintings with those of other chimps (http://stores.ebay.com/ChimpArt) suggests that the creative gift is not uniform among chimpanzees, as it is not among humans. Since the evolutionary divergence from the last common ancestor of modern humans and chimpanzees occurred 4–8 million years ago (Bradley, 2008), we can be certain that the potential for some individuals to enjoy applying colour to a surface is at least this ancient. It is, however, important to note that chimpanzees in the wild do not exhibit any behaviour equivalent to painting – there is a vast gulf between the cognitive ability to use colour and the initiation and cultural assimilation of this behaviour.

Body painting and decoration – the earliest form of art?

The human love of body decoration also involves the application of colour. Modern cosmetics and tattoos have a long history, probably originating with the use of ochre for colouring the skin hundreds of millennia ago. The oldest known use of ochre is $\sim$ 164 000 BP from a South African coastal site, Pinnacle Point, where 57 pigment pieces were found (Marean et al. 2007). At least 10 of the pieces had been ground or scraped; these had been deliberately selected as the most intensely red pigments. The possibility that they were used for body colouring has been accepted

on the basis of this colour selection, as none of the other possible functions of ochre would require this (McBrearty & Stringer, 2007). Body decoration, whether with pigments or with beads made from pierced shells such as those found in the Blombos caves of South Africa (Henshilwood et al. 2002; dated to ~ 100 000 BP by Jacobs et al. 2006), suggests highly developed cognitive functions and symbolling activity. The people who made these beads were anatomically modern humans: the earliest African skulls identified as *H. sapiens* are those from Kibish, Ethiopia dated to 195 000 BP (McDougall et al. 2005), those from Herto, Ethiopia date from 160 000 BP (Clark et al. 2003; Stringer, 2003; White et al. 2003).

Body decoration is likely to have been an important precursor to the creation of art separate from the body. The use of colour to decorate skin, bones and beads suggests enjoyment of form and colour. The practice of piercing teeth, shells and bones, and stringing them, singly or multiply, to make a pendant or necklace is the oldest known form of personal decoration after body painting. This behaviour required recognition of the potential of these objects to be modified by piercing, strung together and worn, and recognition of a symbolic importance in the wearing. The individual wearing a necklace would have been enhanced in some way that could include some aspect of status related to social structure; and or it could give status to the creator, who may or may not also have been the wearer.

There are of course alternative, non-symbolic explanations for the origin of face painting and bead use. Hunters to this day use face paint as camouflage when stalking their prey; face painting could also be group-specific, enabling group recognition at a distance. Among the !Kung of the Kalahari, strung ostrich-eggshell beads similar to those found in a Kenyan site dated to >30 000 BP are used in times of food scarcity as a means of exchange with other groups whose food production is in surplus (Ambrose, 1998). Hence the ritual and decorative functions of body decoration could have arisen secondarily to their survival-enhancing functions.

It is possible that the use of colour for body decoration was not unique to *H. sapiens* and may have arisen independently in Middle Palaeolithic Europe. Soressi & d'Errico (2007) describe evidence for the use of manganese dioxide for body decoration in at least 70 European Mousterian (Neanderthal) sites, in which blocks of this black pigment were found (over 500 at one site alone). Many of the blocks had markings consistent with intentional abrasion (scraping) or had been polished; they were discovered together with grindstones and flint tools consistent with these functions. Although this indicates preparation of powdered pigment, which was probably mixed with a binding agent before use, some pieces had been formed into points bearing traces of use as crayons. Blocks of red and yellow ochre were also found but in smaller numbers and, in contrast to the manganese dioxide, did not show clear evidence of use. Neanderthals also used charcoal in a similar manner. These observations suggest the use of pigment for body decoration or camouflage by European Neanderthals at least 60 000 years ago, apparently with a preference for black.

The use of pigment by both early African *H. sapiens* and European Neanderthals suggests that the cognitive ability and symbolling behaviour inherent in body decoration predates the last common ancestor of these two species. The date of this split is not known but 28 skeletons of archaic *Homo* discovered in a cave at Sima de los Huesos in Atapuerca, Spain (Bermúdez de Castro et al. 1997) have been dated to ~ 600 000 years ago, which places them at the beginning of the Neanderthal evolutionary lineage (Bischoff et al. 2007). These skeletons share features with both *H. erectus* and *H. neanderthalensis*, and were considered to be a new species, *H. antecessor*, a strong candidate to be ancestral to both *H. neanderthalensis* in Europe (Bermúdez de Castro et al. 1997, 2003) and *H. sapiens* in Africa (Harvati, 2007). Body painting may have begun later than this split, originating independently in modern humans and Neanderthals, although the large cranial capacity of *H. antecessor* and its close relative *H. heidelbergensis* (1125–1450 cm^3, see below) suggests the possibility of a relatively high order of cognition and some symbolic behaviour. It is not impossible that body painting was practised by these earlier species.

One important prerequisite for body painting was the loss (or great reduction) of body and facial hair. The fossil record does not tell us precisely when this occurred but we do know that the hair keratin gene *KRTHAP1*, which is functional in chimpanzees and gorillas, was inactivated in the line leading to modern humans within the past 240 000 years (Winter et al. 2001; Bradley, 2008).

Body painting is still used by peoples whose traditional way of life has not yet been entirely swept away by the inroads of Western modernity, as well as the tattoos and cosmetics of many modern cultures. It has multiple ritual functions, e.g. henna skin decoration for weddings and ash for mourning. The use of colour for body decoration, as well as beads and perishable items such as feathers or plant-derived items of which there is no archaeological record, is, however, conceptually a long way from the creation of patterns and representational art separate from ourselves.

Pattern: the first art form separate from the human body

The earliest known decorative patterns include the zig-zag patterns on a 77 000 BP ochre block from the Blombos caves, South Africa (Henshilwood et al. 2002) and the rainbow-like nested curves and parallel lines etched on a piece of flint from around 54 000 BP in the Levant (Marshack, 1996) (Fig. 2). Bednarik (2003b) and Soressi & d'Errico (2007)

Fig. 2 The Quneitra artefact, a flat flint cortex (7.2 cm) incised with nested semicircles and vertical lines (Levantine Middle Palaeolithic, ~ 54 000 BP) (from Marshack, 1996).

document several other examples of parallel lines, nested curves and zig-zag patterns on bones and bone implements from the Lower and Middle Palaeolithic of Europe; these are associated with Neanderthal and older *Homo* remains. Engraved cupules of Lower Palaeolithic (Acheulian) origin in India are the oldest currently known deliberately made rock markings (Bednarik, 2003b and references therein).

The cognitive activity underlying pattern-making is complex, involving planning and intention, but the original idea of pattern may be a function of the brain: nested curves and zig-zag patterns are characteristic of entopic phenomena (Clottes & Lewis-Williams, 1998), i.e. images seen in altered states of consciousness such as that preceding a migraine, in a schizophrenic hallucination or induced by temporal lobe epilepsy or certain drugs (as utilized in the psychedelic art of the 1960s and 1970s). Although the examples of early patterns mentioned above have been taken to imply symbolling activity, this is not necessarily the case. Seeing an entopic image 'projected' onto a surface can lead to a desire to draw it, simply to make sense of seeing this unbidden pattern (I have done this with a pre-migraine-generated image).

It may be that symbolic meanings of engraved and painted patterns came after their origin, i.e. that patterns originating from within the visual system were only later harnessed for symbolic or totemic functions. The geometric patterns in European Upper Palaeolithic caves are in positions that clearly suggest symbolic meaning. Leroi-Gourhan (1958, quoted and illustrated by Clottes & Lewis-Williams, 1998) has suggested that geometric shapes and rows of dots are female and male symbols, respectively. Pattern is the dominant feature in the Yolngu art of Arnhem Land, Australia, and has a huge range of symbolic meanings (Morphy, 2007). Ancient petroglyphs (rock engravings) based on complex patterns have survived in many Australian sites but are difficult to date accurately; one example, in Malangine cave, South Australia, has been dated to > 28 000 BP by uranium series analysis (Bednarik, 2003b). Geometric rock engravings associated with habitation sites dated to 15 000–16 000 BP have been discovered in Upper Egypt; their meaning is unknown but mushroom-shaped designs among them have been identified as diagrams of fish-traps (Huyge, 2009), a reminder that prosaic rather than symbolic meanings are possible wherever we are unable to interpret intention.

Modification of suggestive forms to create images: the origin of 3D art?

Many sculptors feel that in working on a block of stone or other material they are releasing or revealing the form they create. This was graphically described by Michelangelo, e.g. 'I saw an angel in the marble and carved until I set him free', and is poignantly illustrated by his unfinished sculptures of slaves, on display at Florence's Accademia gallery. This approach requires the 3D form to pre-exist in the mind of the sculptor, which, even with the aid of 2D working drawings, involves a highly sophisticated cognitive ability that few of us possess. A precursor of this process, not requiring the final form to be held in the mind, is to recognize a natural form as loosely resembling something else and to modify it to create a better likeness. Modifying a wooden clothes peg (the old-fashioned type with a knob at the top and split shaft) to make a doll uses this simple approach, as does the recognition of an anthropoid form in an oddly-shaped root vegetable. Ernst Gombrich credited the Florentine Renaissance philosopher, humanist and art theorist Leon Battista Alberti (1404–1472) with the idea that sculpture originated accidentally from noticing contours in tree trunks or lumps of earth that looked like other objects and could then be adjusted by addition or subtraction to create a perfect likeness, 'not without pleasure' (from *De Statua*, quoted by Gombrich, 1960, pp. 105–106). There are indeed some candidate examples from pre-history that suggest that this proto-creative process may have occurred in pre-modern humans. Although the following examples are not universally accepted as evidence of proto-artistic behaviour, they deserve serious consideration.

The artefact illustrated in Fig. 3A was excavated at Berekhat Ram in the Golan Heights (Marshack, 1997 and references therein to Naama Goren-Inbar). It was found in association with late Acheulian lithic tools in a layer estimated to date from 250 000–280 000 BP. It is a 3.5 cm-long volcanically-ejected piece of red tuff consisting of a fine-grained agglomerate matrix whose natural shape has been modified by scraping, bevelling and grooving, probably using flake tools. The Acheulian tool technology and dating of the site classify it as pre-Neanderthal, suggesting that the modification was carried out by *H. heidelbergensis.* Marshack (1997) considered the modification to have had the express purpose of enhancing the pebble's suggestive shape

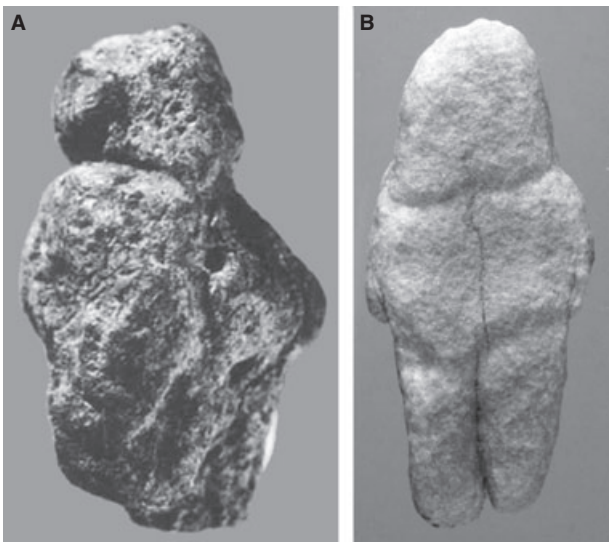

Fig. 3 Modified artefacts. (A) The Berekhat Ram figurine, a piece of anthropogenically modified volcanic tuff from a Levantine late Acheulian layer of estimated date ~ 250 000–280 000 BP (from Marshack, 1997). (B) Figurine-like piece of quarzite from Tan-Tan, Morocco (from Bednarik, 2003b).

of the head and torso of a woman. In particular, the groove that forms the 'neck' has been deepened and the shape of the right 'arm' altered (there is no clear left arm). This interpretation was not widely accepted until the more rigorous study of d'Errico & Nowell (2000), which used a variety of microscopic methods on the artefact itself and carried out experimental carving of similar pieces of tuff found at the site. The discussion by six other archaeologists included with their article indicates general acceptance that the modification is anthropogenic but there is still some controversy concerning whether the modification was purposely representational, i.e. the product of symbolic thought in the mind of the carver. This debate is important because the status of this artefact, including whether or not it should be regarded as a 'figurine', is relevant to the question of the evolutionary origin of art beyond body decoration.

The likelihood that a *H. heidelbergensis* individual was capable of perceiving and improving upon a suggestively-shaped stone raises questions about the evolution of brain structure and function. Measurements of cranial capacity are rather crude indicators but they are all that we have. Anatomical studies of *H. erectus* crania suggest a much lesser cranial capacity (850–1290 cm^3) than those of Upper Palaeolithic *H. sapiens* (1302–1600 cm^3) and *H. neanderthalensis* (1200–1689 cm^3) (Cobb, 2008), with only a short period of post-natal brain maturation (Coqueugnio et al. 2004). The difference here is sufficiently great that it seems unlikely that the cognitive skills of *H. erectus* were sufficiently advanced for complex symbolic behaviour, although those of *H. heidelbergensis* and/or *H. antessessor* (both 1125–1450 cm^3) could have been. The possession of a level of cognitive intelligence that is less than that of *H. sapiens* does not rule out the possibility of recognizing something that 'looks like' something else, in this case an anthropomorphic form, and wanting to enhance it without using it for a symbolic purpose. Recognition of likeness, or 'visual ambiguity', is common in the animal kingdom and much studied by ethologists, e.g. a robin defending territory will attack a stuffed robin or even a bundle of red feathers (Lack, 1943). Human perceptions of visual ambiguity are related to conscious processes in the visual brain and can range from alternative perceptions of simple objects and drawings to higher levels of ambiguity such as the interpretation of facial expression in a painting (Zeki, 2006). It is not the idea of an early human seeing a likeness in a stone that is at issue but the acceptance of this particular artefact as evidence of deliberate symbolic modification.

Likeness recognition in natural objects and the idea of image creation

The discovery of an even earlier figurine-like artefact in a fluvial terrace deposit south of Tan-Tan, Morocco in 2001 reopened this debate (Bednarik, 2003a,b) (Fig. 3B). This piece of quartzite, bearing a strong resemblance to a simple doll, was found within a layer containing an assemblage of typical Middle Acheulian stone tools including handaxes, cleavers and flakes. The Tan-Tan deposits have not been dated but Middle Acheulian tool assemblages elsewhere have been dated to between 300 000 and 500 000 BP. The form of the stone, some 5.8 cm long, is almost entirely natural but minimal percussive modification has enhanced five of the eight grooves that suggest the hairline, body/legs border and position of the eyes (not shown). Furthermore, traces of colour, analysed as containing iron and manganese, are present in minute depressions on the front, suggesting that, on this side at least, it could have been intentionally coloured (Bednarik, 2003a). It is not just the modification that suggests that this piece of stone was recognized as resembling a human form but the fact that it was found in an undisturbed deposit within centimetres of the nearest handaxes. Its position, and the evidence of percussive modification with a sharp tool, is compatible with the interpretation that it had been spotted as an interesting shape, picked up and its potential understood and enhanced by the brain, eye and hand of an early human, probably *H. heidelbergensis*.

There is one even older example that suggests likeness recognition but without modification. Oakley (1981) described a dark red jasperite pebble found at a South African archaeological site (Makapansgat Member 4) dated to around 3 million years ago. The pebble has a shape that is reminiscent of a humanoid face and was transported far from its site of origin, suggesting that it was valued by the (probably) Australopithecine hominin who found it, perhaps because of its suggestive form.

Another form of likeness recognition that delights young children and fascinates adults is the discovery of stones containing fossils. This enjoyment is clearly very ancient. Fossil coral, gastropod and brachiopod molluscs have been found at the Arcy-sur-Cure (France) Neanderthal site more than 30 km from their sites of origin (Soressi & d'Errico, 2007 and references therein). Otte (1996, p. 177) considers that their choice and transportation might indicate a talismanic or similar symbolic function. It is clear that the selection and keeping of these objects indicates that Neanderthals were able to recognize the fossils as similar or identical to their living counterparts. Feliks (1998) speculates that by comparing the invertebrate, plant or fish fossils that he saw in rocks with living forms, early man would have learned the same lesson that modern children learn when looking at photographs: 'that iconic images of living things can exist in non-living materials'. Feliks (1998) also points out that some fossils, e.g. ferns, look almost identical to their living forms and, like a shadow of the same form on a flat surface, supply the experience of seeing the image of a familiar object in another medium and in two dimensions.

Art from a blank template: evidence for an African origin

One can envisage a continuity of progressive creative sophistication beginning with the recognition, collection and cleaning of fossils, through the modification of suggestive anthropoid shapes, through choice of an oddly-shaped block or uneven surface with creative potential, perhaps also the outlining of silhouettes, culminating in the use of a 2D or 3D 'blank canvas'. These stages, although progressively more complex, are not mutually exclusive, e.g. the use of surface features coexisted with 'flat surface' painting (Fig. 4A). Each stage would have required an incremental increase in the ability to hold an image 'in the mind's eye' before starting work but it is only the 'blank canvas' stage, in which the artist works entirely from imagination and visual memory, for which the 'mind's eye' is an absolute requirement. Some evolutionary changes in cerebral structures governing visual consciousness must have been involved, together with cultural inheritance (tradition) as the practice became established. The neural changes required for this fundamental shift in artistic potential must have pre-dated both practice and the cultural incorporation of artistic tradition. Their origin and evolution may have corresponded to the origin and increasing sophistication of tool-making; between 1.6 million to 300 000 BP, changes in the shape of Acheulian tools reveal an increasingly complex sense of symmetry, which is a function of the visual brain (Hodson, 2009, and references therein).

Gowlett (1984, 2009) has discussed the necessity of the Acheulian tool-maker to see the outline of the tool 'in the mind's eye' or to use a 'visuospatial sketchpad'. The creation of an Acheulian biface (a handaxe worked on both sides) by *H. erectus* in East Africa (and, after 600 000 BP, by *H. heidelbergensis*) involved, first, the choice of a stone with a correctly curved surface, followed by a series of actions that followed a defined set of instructions – a 'virtual manual', memorized by demonstration and repetition. The instructions involved the formation of separate planes along different axes, minimizing the computational complexities required to create the 3D finished product. Gowlett (2009) points out that the normal process of human

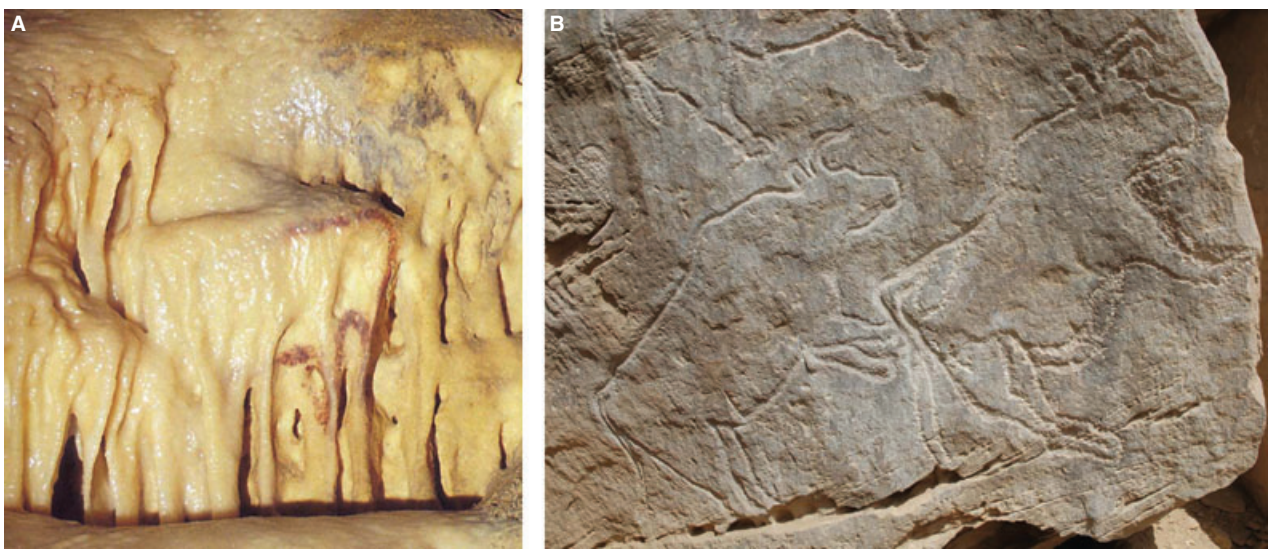

Fig. 4 Outline drawings. (A) Calcite-covered drawing of a mammoth in red ochre (Chauvet cave, Ardèche; Aurignacian, ~ 29 000–32 000 BP), using natural features of the stalactite-covered wall as a partial outline of the head and trunk (right), legs and back (from Clottes, 2003). (B) Engraved bovids from a 1.7 m block at Qurta II, Upper Egypt (probably 15 000–16 000 BP); the double belly line is common in these drawings. Note the nicely observed relationship between the root of the tail and the haunches (from Huyge & Claes, 2008).

vision begins with 2D images on both retinas that are combined through neural processing to perceive a 3D image; this suggests that the brain may have a predisposition to revert to 2D concepts through a kind of mental 'reverse engineering'. His analyses of biface construction methods suggest that the cognitive abilities required for creating 3D objects from promisingly-shaped stones evolved in the context of tool-making and were only later deployed for aesthetic purposes. The concept of a defined set of instructions could be equally applicable to standardized 3D art pieces such as figurines; although there is no evidence that *H. erectus* or *H. heidelbergensis* created sculptures, evidence of modification of the Tan-Tan 'figurine', together with the ability to make complex tools, suggests early stirrings in the conceptual direction of sculpture.

With the exception of the creation of patterns that may have originated from entopic phenomena, there is no evidence that any species of *Homo* other than *H. sapiens* was capable of seeing potential in a non-suggestive piece of stone or a flat, unmarked surface. As the old archaeological saying goes, 'absence of evidence is not evidence of absence'; nevertheless, the conclusion that only anatomically modern humans were capable of creating art *de novo* seems inevitable. The earliest known examples of art created on a flat surface date from 30 000 BP or later, from the Later Stone Age of Namibia, the Late Palaeolithic of Egypt and the Upper Palaeolithic of Europe. Seven stone slabs with animal figures found buried in a cave in Namibia are of unknown date but the time of their burial (i.e. the time of collapse of the cave) has been radiocarbon-dated to 26 000–29 000 BP (Wendt, 1974; Bednarik, 2003b; Masson, 2006); these images are similar in style to more recent and better known examples of South African rock art (e.g. Le Quelle, 2004). Recently, engraved (hammered and incised) drawings have been discovered in the Nile Valley, attributed to a 15 000–16 000 BP culture (Huyge et al. 2007; Huyge & Claes, 2008) (Fig. 4B). They comprise naturalistic images of animals – aurochs (primitive cattle), hartebeest, gazelle, hippopotamus, birds and fishes, and stylized or partial images of humans, randomly orientated and without an imaginary ground line. The similarity of these African images to some of those of Upper Palaeolithic Europe confirms an African origin of naturalistic art on a flat surface. They are no less conceptually sophisticated than the European engravings and should not be unfavourably compared with European cave paintings since drawing by engraving a rock surface cannot reproduce the subtleties of painting with pigments or even of finger-drawing on a soft surface (see below).

Out of Africa

Anatomically modern humans are thought to have emigrated from Africa to populate the rest of the world over a long period of time. Settlements on the Red Sea coast dated to 125 000 years ago have been linked to a migration route across the mouth of the Red Sea and along the coast of South Asia, eventually reaching Australia either 60 000 years ago (Thorne et al. 1999; Stringer, 2000; Walter et al. 2000) or 45 000 years ago (O'Connell & Allen, 2004). This migration (according to the dates of Walter et al. 2000) took place at a time when low sea levels would have enabled people to reach Indonesia without crossing the sea. It was only the crossing to New Guinea and Australia that would have required the use of boats or rafts, although this, too, could have been accomplished by land (via the Sahul landmass) if the later dates of O'Connell & Allen (2004) are correct. Genetic data support the idea that the migration out of Africa took the form of serial exodus events by genetically different populations (Deshpande et al. 2009). This view is also supported by studies on neurocranial morphometrics of fossil skulls in Africa and geographically dispersed and extant human groups (Gunz et al. 2009) but is disputed on archaeological grounds by Mellars (2006), who prefers the interpretation that a single dispersal event took a southern route around Asia to arrive in Australia around 45 000 BP, with a branch that led north from Western Asia to Europe.

It is clear that the neurological potential to create art, and probably the creation of art, was established before *H. sapiens* left Africa but we cannot know whether regional stylistic differences were already established within each emigrating group or were acquired *en route* or in their final destinations. The archaeological record is more generous in information on tool-making and it is beyond doubt that all of these *H. sapiens* groups left Africa with an accomplished ability to create 3D tools with a great variety of forms and applications, and that they were more advanced than *H. erectus* and *H. heidelbergensis* in manual dexterity and cognition.

No artistic style is static, so the passage of time and generations, with different cultural and environmental influences, changes in climate, different available materials and technological skills, not to mention specific highly-gifted individuals, must have been important factors influencing stylistic development, culminating in the regional variety apparent in world art today. Regional variety of artistic style is apparent within Africa as well as around the world; the rock paintings of the Khoisan groups of South Africa have more in common with Upper Palaeolithic European cave art than with the large ceremonial items and smaller sculptures in terra cotta, wood and ivory dating from the late 10th century to the present day that are on display in ethnological museums such as the exceptionally fine collection in Berlin (Koloss, 2002) and the Pitt Rivers museum in Oxford. One can also see, in the formalized animal and 'abstract' pattern combinations portrayed in some of the cloth artwork of Southern Africa, a resemblance to some of the traditional art of North Australia (personal observations). These examples are intimations that, like the genetic differ-

ences, there is (and/or was) at least as great a variety within Africa as in the world as a whole.

It was not until the Upper Palaeolithic, 45 000 years ago at the earliest, that anatomically modern humans populated Europe. This was a relatively late event, given that the earliest evidence of modern human occupation of Australia dates from this date or earlier. To claim that art originated *de novo* in Upper Palaeolithic Europe is to claim either that the early Europeans took their creative impulses and skills back to Africa or that art within Africa developed later than that of Europe and wholly independently of it. Both seem unlikely.

Early European art

The richness of Upper Palaeolithic discoveries in Europe, compared with the rarity of African examples, as well as the long history of excavation and academic study, go a long way towards explaining why the Eurocentric view of the origins of art is still prevalent (e.g. Lewis-Williams, 2002, 2004). In Europe we have an amazing resource of cave paintings (95% of which are, for unknown reasons, in France), carved objects, reliefs and engravings, not to mention skeletal material in defined burial places and settled sites that were inhabited for several millennia. We know from the excavation of domestic hearths that, during the Upper Palaeolithic, reindeer were a major source of protein (the last ice age was from 75 000 to 10 000 BP) but there was also a broad spectrum of dietary protein sources including mammals, birds, fish and shellfish (Richards et al. 2005). It is intriguing that only a subset of animal food sources is represented in cave art. Manual dexterity is witnessed by evidence that skins were sewn together with bone needles to make clothing and tents, and that over the course of 35 000 years, tool-making became ever more refined and specialized (Delluc et al. 1990). No other part of the world can yet rival the range of securely dated artefacts or the depth of archaeological knowledge that Western Europe has accumulated. This article can only discuss a small number of examples, in an attempt to give some insight into the humanity behind the creative process.

Humans, like animals, have two major drives: preservation of the individual and preservation of the species. Preservation of the individual (and the social group) is inherent in images related to hunting or to animals (and, more rarely, fish) that are important food sources. Preservation of the species, which involves sex and fertility, nurturing and group protective behaviour, is inherent to many images, both overtly in pubic triangles and phallus-like objects and more covertly with images of rutting or combative animals. Unlike animals, and from an unknown stage in our evolutionary history, humans also became concerned about where we came from and what happens when we die. This third concern is the basis of religion. Ethnographic observations during the past two centuries have shown that shamanism is an important element of religion in hunter-gatherer cultures around the world. The cultural specifics differ in all groups but in general shamanism is a magico-religious phenomenon that may co-exist with other forms of magic, healing and religion but is distinguished from them by the technique of ecstasy (Eliade, 1964). The shaman is able to induce a trance state through which his (or her) soul is able to leave the body and ascend to the sky in magical flight, or descend to the underworld. The shaman can communicate with helper spirits and, through them, with the dead. The ecstatic shaman may inhabit the body of an animal and perceive himself in animal form or with an animal head. It is now clear that there are strong indications of shamanism in the subject matter of some prehistoric art (Clottes & Lewis-Williams, 1998). These insights originated with the work of the philologist Wilhelm Bleek and his sister-in-law Lucy Lloyd, who transcribed the oral traditions of the /Xam, !Kung and other South African tribes.

Art relating to sex and pregnancy

In both human and animal representations, fertility is the dominant theme in both portable and parietal (cave wall) art. The 'Venus' figurine is a relatively common type of portable art object that has been found in Upper Palaeolithic sites throughout Eurasia. These figures, dating from up to 27 000 years ago and typically around 10 cm tall, have in common that they appear to be a caricature of a multiparous woman, well-fed and possibly lactating and/or pregnant (Fig. 5). Another common feature is the lack of feet, which suggests that they were designed to be held in the hand. One possible explanation for this is that these iconic representations of successful pregnancy might have been used to reassure young women during (especially) their first labour – a hazardous and frightening experience. These figures may well have had the same function as present-day African fertility dolls, which are believed by many cultures to symbolize a fertility goddess who will ensure the conception and safe delivery of a healthy child, if the household believes in their effectiveness. For more examples and other interpretations of Venus figurines, reliefs and engravings, see Cohen (2003).

A newly-discovered figurine from Hohle Fels cave, southwest Germany, puts the earliest date of European female fertility carvings back to at least 35 000 BP, although calibration of the measured radiocarbon date suggests that it may date to as early as 40 000 BP (Conard, 2009). It is made from mammoth ivory, a hard material that would have been difficult to carve with Aurignacian tools. The breasts and vulva are greatly exaggerated but there is no suggestion of a current pregnancy, rather, with its enlarged vulva and raised, taut breasts, not to mention the abdominal striations, it resembles a female body that has recently given birth. Although the legs are incomplete stumps, they do not seem to have been designed for holding in the hand;

Fig. 5 Venus figurines. (A) 'Venus of Vestoniche', the oldest known ceramic, from 25 km south of Brno, Czech Republic (Pavlovian, ~ 27 000 BP). (B) 'Venus of Willendorf', a limestone sculpture from Lower Austria (Gravettian, ~ 24 000–26 000 BP). Both are ~ 10 cm high.

Fig. 6 'Venus à la corne', originally carved on the wall of Laussel rock shelter, Dordogne, France (Gravettian, ~ 25 000 BP; 46 cm high).

the head is represented only by a loop that has been smoothed by use, suggesting that the figurine has been suspended on a string. Unlike the later examples described above, it lacks any pretence to beauty but it would be no exaggeration to describe its sexual symbolism as blatant. The context of this find is important; the Swabian Jura of south-west Germany was a key area of cultural innovation in the early Aurignacian. Excavations from this region have revealed many early examples of figurative art (including the Vogelherd horses), personal ornaments (beads and pendants), new forms of tools made from bone, ivory and stone, and the earliest known musical instruments (bone flutes) (Conard & Bolus, 2003; Conard et al. 2009), indicating a well-established and sophisticated culture.

Figure 6 shows the relief carving from a rock shelter in Laussel, Haute-Garonne, France. It represents a female figure that is at first glance similar to the Venus figurines but is unique in having originally been fixed in place and in being 46 cm high, with rudimentary feet. More significantly, this is not a stylized figure: the pattern of fat distribution suggests that it is a representation of a real woman, celebrated for her fecundity. The pendant breasts have carefully carved, well-suckled nipples. She holds a horn with 13 notches, perhaps indicating the number of her children (was this the original meaning of the 'horn of plenty'?). It has also been suggested that the 13 lines represent the 13 lunar months and hence the number of menstrual periods in a year. This seems unlikely for a woman whose pregnancies and periods of lactation would have spanned most of her reproductive lifetime. The position of her left hand on her rounded belly has been taken to suggest a current pregnancy (Delluc et al. 1990), although an indication of past pregnancies is just as likely. She looks like a woman whose reproductive achievements have raised her to cult, or even goddess, status in her society.

One of the earliest known types of carved image is the female pubic triangle (Fig. 7). Female sex and/or sexuality has been reduced to a triangle for the mons pubis and an engraved line to represent the vulva. Nothing could be simpler or more instantly recognisable for what it is. The clear symbolic nature of this simple iconic form represents an enormous advance on the process of likeness enhancement. The example shown has been dated to 32 000–34 000 BP; many other examples, engraved and drawn with charcoal, are found on the walls of Chauvet cave, dated to about 32 000 BP (Clottes, 2003; Cuzange et al. 2007).

The most astonishing portrayal of a pubic triangle, unique in being set within an elaborate composition, is shown in Fig. 8A. A natural projection from the ceiling of the cave has been decorated with a charcoal drawing illustrating a pubic triangle with vulva, set between thighs that continue down through bent knees to the ankles. Above the pubic triangle is a bison's head with horns; only the

Fig. 7 Pubic triangles are common symbols of female sexuality; these are carved on a limestone block (56 × 40 cm) from La Ferrassie, Dordogne (Aurignacian, ∼ 32 000–34 000 BP).

head is covered with fur, the rest of the body, represented by a back curving around the surface of the projection and an arm with fingers lying over the woman's left thigh, is human. The resemblance of a Picasso Minotaur composition to this drawing is uncanny (Fig. 8B). Both suggest a fantasy that is ancient and deeply embedded in the psyche of (at least some) human males. In addition to the print illustrated, two others are relevant here, '*Le viol*' (rape) and '*Minotaur assaulting girl*', both made in 1933. Picasso (who died before the discovery of Chauvet cave) is known to have identified with the Minotaur, recognizing it as the beast within. It is interesting that the Chauvet drawing and the myth of the Minotaur are both located in the environment of a dark cave. Picasso's acknowledged recognition of a part of himself in the Minotaur may offer some insight into the mind of the Chauvet artist who created this strikingly similar image. On seeing Lascaux, Picasso is reported to have said 'Nous n'avons rien appris'. How, I wonder, would he have reacted to Chauvet if he had lived to see it?

Shamanism and parietal art

The representation of a human body with an animal head suggests shamanism. Some Upper Palaeolithic figures of this nature (therianthropes) are known, both carved and painted. Perhaps the best known is the 30 000–34 000 BP lion-headed man carved in mammoth ivory, from south-west Germany (Dalton, 2003; also illustrated in Clottes, 2008). The oldest known example painted on rock is a 32 000–34 000 BP red ochre representation of a man with either an animal head or horned head-dress, from Fumane

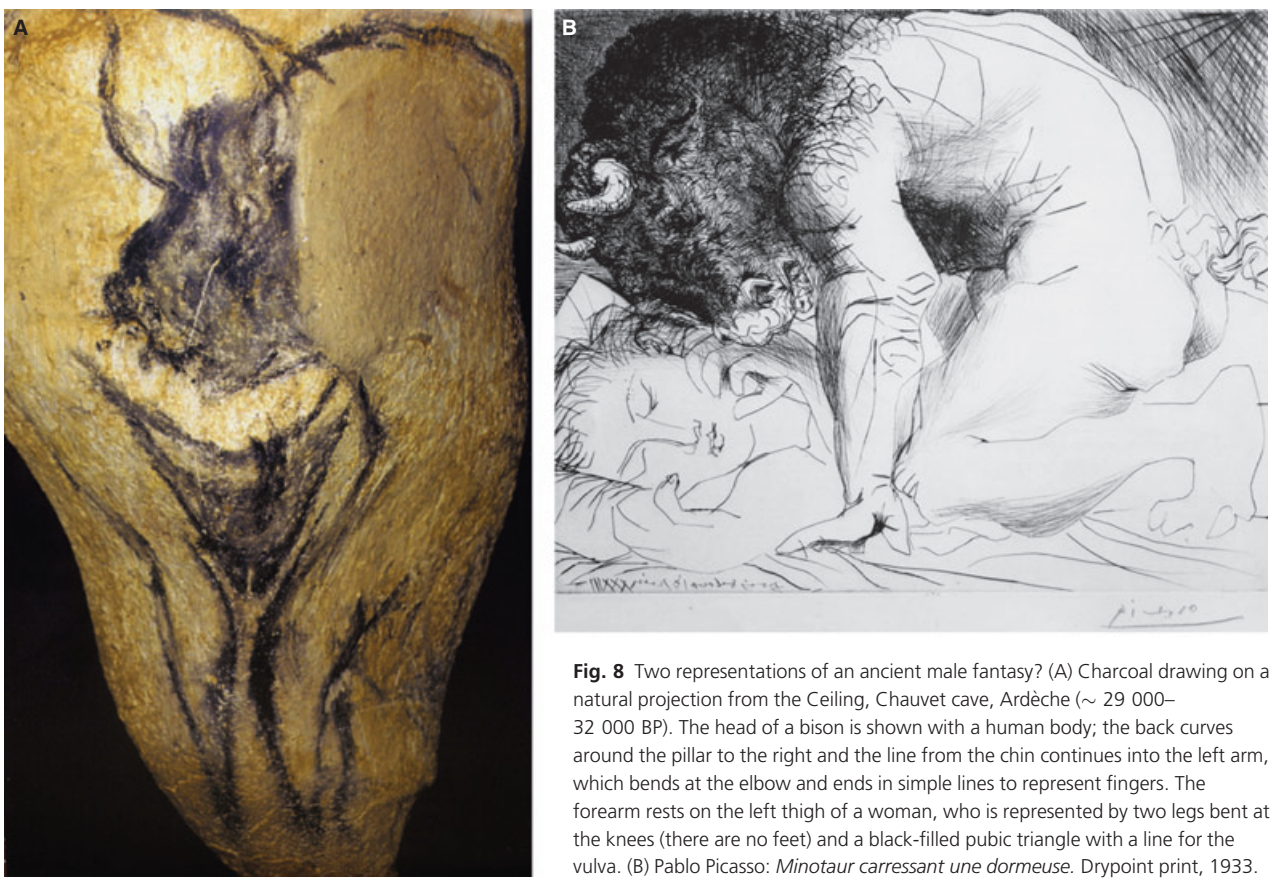

Fig. 8 Two representations of an ancient male fantasy? (A) Charcoal drawing on a natural projection from the Ceiling, Chauvet cave, Ardèche (∼ 29 000–32 000 BP). The head of a bison is shown with a human body; the back curves around the pillar to the right and the line from the chin continues into the left arm, which bends at the elbow and ends in simple lines to represent fingers. The forearm rests on the left thigh of a woman, who is represented by two legs bent at the knees (there are no feet) and a black-filled pubic triangle with a line for the vulva. (B) Pablo Picasso: *Minotaur carressant une dormeuse.* Drypoint print, 1933.

Fig. 9 Red ochre drawing on a stone found in Fumane cave, Italy (Aurignacian, 34 000–35 000 BP), thought to represent a shaman because of the head shape, which suggests either an animal head with horns or an elaborate head-dress.

Fig. 10 The wall as a veil. (A) Charcoal drawing of a rhinoceros with red ochre marks possibly signifying a shamanistic nose-bleed; the head of a bison (bottom left) seems to be emerging from a crevice in the wall (Chauvet cave, Ardèche; Aurignacian, ~ 29 000–32 000 BP). (B) Engraving suggesting a horse emerging from a hole (Gabaillou cave, Dordogne, France; Solutrean/early Magdalenian, ~ 17 000–19 000 BP).

cave, Italy (Fig. 9) (Balter, 2000; Clottes, 2008). Interestingly, one of the arms of that figure is holding a stick-like object that may be one of the common features of the shaman's 'kit' (Eliade, 1964). The Upper Palaeolithic examples of therianthropes in French caves (e.g. at the Volp caves, Ariège, at Gabaillou and Lascaux, both in the Dordogne Department) have one important factor in common- they are all in the deepest, most inaccessible parts of the cave, where no natural light penetrates. Although the most common interpretation of these composite figures is that they represent shamans or 'sorcerers', an alternative (or additional) possibility is that they represent a god who was 'master of animals' (Clottes & Lewis-Williams, 1998).

The interpretation that therianthropes represent shamans has a sound basis in recently-observed societies. Even today, animal (and grossly caricatured human) masks are used for ritual purposes in many parts of Africa, including medicine, divination, the combating of dangerous witches (only visible to the mask-wearer) and to reincarnate ancestors (Koloss, 2002). They are also used by dancers in festivals of the dead (recorded on film on view at the Ethnological Museum, Berlin). In many of these uses, the mask-wearer is driven to the point of ecstasy by the dance and subsumes his personality to that of the mask, which of itself has great authority.

There is one other painting in Chauvet that may well have a shamanic element, the rhinoceros illustrated in Fig. 10A. The animal is outlined in black but the horns are filled in red: red curved lines extend from the nose and mouth, as if bleeding from the nose. South African San shamans sometimes suffer a nasal haemorrhage when in a trance; nasal bleeding is illustrated in several rock paintings, including that of an antelope-headed human figure, and indicates that 'the being is a San shaman who has entered an altered state of consciousness and thus travelled to the spirit world where people assume animal features' (Lewis-Williams, 2002). There are other signs that the Chauvet rhinoceros is particularly significant: the wall on which it is painted was prepared by scraping to create a clean, flat surface and it is in a dominant position, being more than 2 m from the floor, in contrast to the paintings made from floor-level. It faces a cleft in the wall, from which, just below its head, a bison appears to be emerging and, on the other side of the cleft (not shown), a rhinoceros. It seems to me to have been painted by a man with a strong conviction of his own power, both in relation to the spirit world and within his community. There is considerable evidence that the cave wall (or rock surface in the case of rock art in other parts of the world) was regarded as a membrane between the human and spirit worlds (Clottes & Lewis-Williams, 1998). The bison and rhinoceros of this group of images may thus represent spirits enticed from the other side of the wall/membrane by the shaman-rhinoceros. Another image that has been interpreted as an embodied spirit being enticed across the membrane is the engraved horse's head and neck in Gabillou cave, Dordogne, that appears to

be emerging from a natural depression in the wall (Fig. 10B).

Symbolic contact with the spirit world can be made by placing the hands on the wall. Negative or stencilled hand prints, produced by placing a hand on the wall and blowing pigment around it and between the fingers, are found throughout world rock art, in European caves and on rocks from Australia, America and South Africa (Clottes, 2008). Lorblanchet (1991) placed his hands onto those on a replica of the Peche-Merle horses (illustrated in Lewis-Williams, 2002, Plate 19) and found that this brought his face so close to the horse images that a person doing this would have been breathing (his/her life) onto the wall, 'transforming himself into the horses'. Lewis-Williams (2002) considered that the pigment making the prints was most likely to have been blown by a second person. This would separate the act of communion with the spirits from the act that sealed the hands onto the membrane, enabling total concentration on the part of the communicant, possibly as part of a ritual act. The prints themselves would remain as a tangible record of that act.

The extent to which shamanism and an altered state of consciousness are associated with the creation of cave and rock art has been much discussed (see Layton, 2000 for analysis and references). Clottes & Lewis-Williams (1998) and Lewis-Williams (2002) proposed that images seen in a deep trance were later painted as if 'projected' onto the cave wall in a manner equivalent to the projection of entopic images, and that altered states of consciousness were the link between the evolution of higher states of consciousness and the origin of art. Lewis-Williams (2002, p. 252 and illustration) wrote of Lascaux that 'the way in which the images swirl around and over the ceiling of the Axial Gallery recalls the neurologically generated vortex with its surrounding images that leads into the deepest stage of altered consciousness and the most vivid hallucinations. This impression is strikingly heightened by the Falling Horse turning over at the focus of the vortex' (see Aujoulat, 2005 for illustrations) (see also Fig. 14, which is from this group of images).

Although the self-induction of trance states is well documented for many extant and recent hunter-gatherer communities, it is not clear that it is an essential preliminary to the creation of rock or cave art. Clottes & Lewis-Williams (1998) acknowledge this, citing the example of Lascaux's Hall of Bulls (Fig. 11) as a co-operative endeavour. The analysis by Aujoulat (2005) of the images of animals in this chamber concludes that they were painted in the following order: horses, aurochs and then deer, and that each species shows physical features characteristic of its breeding season – the horses have the thick coats of late winter/early spring, the aurochs have their summer coats and the deer have antlers and are represented in groups characteristic of early autumn. The decoration of the whole wall was thus carried out over a period of 6–9 months, assuming that it was completed in a single year. It may also be relevant that most of the animals depicted here are 'grounded' rather than ethereal, the exception being the horse located above the three stags, which appears as if surrounded by a low mist; this could well have been a real observation but seeing animals partially above a mist like this could also enhance the perception of them as spiritual beings.

Reindeer bones marked by human teeth were found on the floor of the Axial Gallery, suggesting that the artists were eating as they painted the ceiling, sitting on their scaffolding support (Leroi-Gourhan, 1982). Another factor to bear in mind is the extent to which an artist, with no shamanic intent, may experience trance-like states while painting. Anish Kapoor (1998) wrote 'I have always felt drawn towards some notion of fear in a very visual sense, towards sensations of falling, of being pulled inwards, of losing one's self'. Mark Rothko felt 'drawn into' his large (but not small) canvases as he painted (Baal-Teshuva, 2003). The

Fig. 11 Left wall of the 'Hall of Bulls', Lascaux cave, Dordogne (~ 19 000 BP). The frieze shows a fantastic animal (left), horses, aurochs and deer; another horse (middle) appears to float in mist.

relationship between altered states of consciousness and artistic creation seems to be more subtle than the shamanic trance interpretation implies.

Intention and perception: communication between artist and viewer

Painting with a conscious aim to portray symbolic content for communication with the viewer is inherent in the work of mature artists, in which category I include the artists of Lascaux and Chauvet (although Chauvet also contains many engravings and finger-drawings of lesser artistic skill, see Clottes, 2008). Rothko and his fellow artist Adolf Gottlieb, replying to a *New York Times* critic's comments on a 1942 exhibition of their work, wrote that art is 'the significant rendition of a symbol'; in their manifesto of aesthetic beliefs, they asserted that the point of a painting did not lie in an 'explanation' but in the interaction with the viewer, who must be persuaded by the paintings to see the world 'the artist's way', not his own way (Baal-Teshuva, 2003).

We cannot take on the mental framework of the intended viewers when we look at Upper Palaeolithic paintings but perhaps we should not be too concerned about the validity of our reaction to them. My predominant reaction to Lascaux was awe; whether the artists' intent or not, this must also have been the reaction of the non-participant contemporary viewers on entering this painted cave for the first time. Human biology has not changed since the Upper Palaeolithic and, if we attempt to divest ourselves of at least some of our own cultural baggage and open our minds to the paintings, the meanings that seem to speak to us may not be so far from their meanings for the original viewers. As Howard Morphy (2007) wrote, 'there is a dialectic between common humanity and particular ways of being human'. In looking at Upper Palaeolithic paintings, we need to bear in mind two concepts that may not be familiar: the experience of embodiment (of spirits in animals and the painter and/or viewer in the animal depicted) and acceptance of the wall as a membrane between ourselves and the spirit world. Embodiment is particularly important; not only can a shaman 'become' an animal through the trance state but for all individuals in hunter-gatherer societies the boundary of the self is fluid and the identification with spirits in animal form is of fundamental importance (Clottes, 2003). The idea of passing through a surface may be unfamiliar to Western adults but it is a normal part of our childhood world, in which children can pass through a mirror, the back of a wardrobe, a wall at King's Cross station, or a patch cut out of the air, to enter a realm in which animals can talk and children can fly (Carroll, 1872; Lewis, 1950; Pullman, 1997; Rowling, 1997). Finally, it is essential to remember to put aside the modern Western secular, scientific world view and attempt to look through the eyes of an acute observer of nature, for whom nature and the spiritual world are one and the same.

Looking at the Chauvet paintings with this freedom of mind, one can see the whole gamut of human emotions. Anger, aggression and conflict are embodied by powerful rhinoceros images. One remarkable portrait, the upper animal in Fig. 12A, has three extra body outlines and a total of seven anterior horns suggesting an animal tossing its head in a display of threat. This image, like the shaman-rhinoceros (Fig. 10A), has been drawn in a high position on a prepared wall, emphasizing the sense of dominance that it conveys. The conflict behaviour of male animals, as seen in the young rhinoceros's challenge to the older one (the alpha male?) in Fig. 12B, is easy to relate to human competitive behaviour. In these two examples, and in the possible shaman-rhinoceros of Fig. 8, the artist seems to be a dominant male member of the group. The minotaur-like

Fig. 12 Charcoal drawings of rhinoceros and cave lions, suggesting (A) threat, (B) aggressive competition and (C) organized purpose (Chauvet cave, Ardèche; Aurignacian, ~ 29 000–32 000 BP).

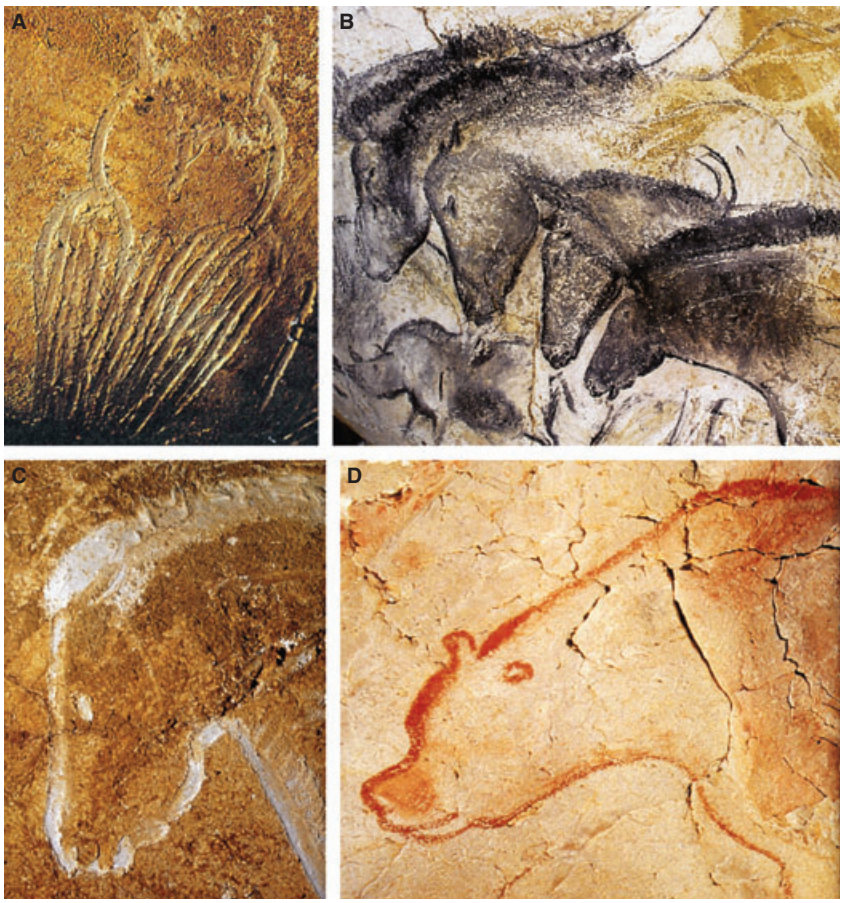

Fig. 13 Images from Chauvet cave. (A) Finger-drawing of a long-eared owl looking backwards; (B) charcoal and (C) finger-drawings of horses; (D) red ochre drawing of a cave bear.

shaman-bison of Fig. 9A is incontrovertibly male – as a woman I find that image threatening.

Humans living close to wild carnivores, such as the people of the Mongolian grasslands who lived in close proximity to wolf packs (Rong, 2009), have a sense of awe and respect for the organizational strength, social structure and division of labour that underpins the group's hunting success; the Mongolian nomads regarded the wolves as their mentors. European lions may have played a similar role for the communities associated with Chauvet. There are 72 drawings of lions in this cave, more than in all of the other French caves combined (Clottes, 2008). Like wolves, lions are successful co-operative hunters and the group portrayed in Fig. 12C suggests that the artist identifies with their power, sense of common purpose and concentrated intent. Their unidirectional movement, their heads held at the same angle and their pinpoint eyes all idealize the subsuming of individual egos into the hunting group for the good of all. The vivacity and accuracy of this drawing suggest that the artist spent long periods of quiet observation of these animals. Intentional portrayal of a group, rather than overlapping or superimposed individual animals, is unusual.

Alert watchfulness, stillness and patience are important both as a part of hunting skills (stalking) and for protecting the group from danger. These qualities are also embodied by owls, which are able to rotate their heads to look backwards (Fig. 13A); their hunting flight is near-silent.

Kindliness and good parental care are of prime importance for family life, social cohesion and human happiness. The horse portraits shown in Fig. 13B,C are clearly by different hands but both suggest these attributes. The near-vertical position of their long heads suggests a benign nature and their behaviour in the wild confirms this. Teeth and hooves, their only equipment for conflict, are rarely used and are not shown in the images. The human love affair with horses is well represented on many cave walls but it is in Chauvet that a sense of artist-identification seems to be most clearly inherent in the horse portraits.

The attitude of humans to cave bears suggested by the exquisite drawings in Chauvet is more difficult for 21st century humans to understand, perhaps because our history with them is complex. They amuse us by their occasional bipedalism and we have tamed their image to that of cuddly teddy bears, yet not so long ago we put collars round their necks and induced them to fight or dance for human entertainment. Bears are dangerous, unapproachable animals, which hibernated in Chauvet cave both before and after the two periods of human occupation. Some of the skulls left by bears that had died in the cave were

Fig. 14 'Second Chinese horse', right wall/ceiling of the axial diverticulum (Lascaux cave, Dordogne, ~ 19 000 BP; mixed pigments).

deliberately moved by humans, one being placed carefully on a ledge (Clottes, 2008). The bear images are unusual for Chauvet in being drawn in red ochre rather than charcoal. The one illustrated in Fig. 13D is mainly outline but enhanced by some shading; the left eye is not drawn but the position of the left ear establishes a 3D quality that makes the marking of the eye unnecessary. This exceptionally skilled drawing seems to me to embody real warmth in the artist's attitude to this animal that is at odds with its fierce nature.

These few examples offer a very selective glance into a cave that is rich with images, painted by Europeans of the Aurignacian period some 30 000 years ago. They combine simplicity and economy of line with a conceptual sophistication and come from such an early time in our history that some archaeologists are unable to accept their antiquity (Pettitt, 2008), in spite of repeated verification of the dates using several different methods in several different laboratories (Cuzange et al. 2007).

Lascaux cave (17 000–19 000 BP, Solutrean/Early Magdalenian), shows a much greater degree of sophistication in the sourcing, variety and preparation of pigments, in the use of multiple colours for single animals, and the use of scaffolding to reach high walls and ceilings (Leroi-Gourhan, 1982). It has a pastoral feel (e.g. Fig. 11) in contrast to the raw emotion of Chauvet and gives the impression of being a window into a gentler society. There is something joyful about the 'Chinese' horse (Fig. 14), leaping through ripe barley-like cereal grasses. [Although organized farming began 9–10 millennia later, the existence of pestles and mortars suggests that cereal grains could have been used for food. The earliest archaeological association of wild barley and human settlements is known from 19 000 BP in the Levant (Zohary & Hopf, 2000).] The meaning of the symbol above the horse is not known.

Discussion

Human artistic creativity clearly had a long history before the well-developed art of the European Upper Palaeolithic, which was created by anatomically modern humans whose brains, although not culture or tradition, were like ours. Linking this history to the evolutionary anatomy of cognition is impossible, for three reasons: (i) cranial capacity, and hence brain size, is only a crude indication of cerebral function, as illustrated by the fact that the similar cranial capacities of Neanderthals and anatomically modern humans are not matched by equivalent artistic creativity or flexibility in tool-making; (ii) the huge individual differences in artistic skills among humans in our own time make it plain that a study of brain evolutionary anatomy would be meaningless for this purpose, even if we had access to fresh material; and (iii) studies on brain-damaged artists have failed to reveal specific parts of the cortex that are essential for artistic creativity, which seems to use many different areas (Zaidel, 2010, this issue). We have only the artefacts and their archaeological context. Surviving art and putative proto-art artefacts have left a fragmented record that has encouraged the probably erroneous (or at least exaggerated) concept of a revolution at the start of the European Upper Palaeolithic.

Lithic tools, in contrast, are plentiful and provide a much more complete guide to the evolution of the cognitive ability and manual dexterity required to engineer defined shapes. Reference has been made in this article to studies indicating a link between tool-making and language (Stout et al. 2008), and to a possible link to the cognitive skills required for art (Gowlett, 2009). Both of these studies analysed relatively simple tools (bifaces) made by *H. erectus*. Further development of these promising avenues of research through analysis of the changing patterns of tool-making by *H. heidelbergensis*, *H. neanderthalensis* and early *H. sapiens* might shed some light on the evolution of artistic creativity. The analysis of Gowlett (2009) is particularly helpful in its insights into the closely related nature of 2D and 3D visualization.

Linking anatomy to the origins of art is impossible for a fourth reason: the cognitive machinery required for the creation of art *de novo* (as an advance on likeness recognition and modification) must have been in place well before the first exceptionally gifted individuals actually created what we now regard as art. Art does not exist in a vacuum but requires a social context, otherwise it is meaningless. To be fully 'seen' by a viewer, there must be some awareness of the symbolism being communicated. The social context of humans has universal elements. Those relating to survival, reproduction and religion have been alluded to in this article. The religious element is specifically communicated to us through parietal art but the spiritual aspect portrayed here seems to encompass limited aspects of life and death. The

paintings suggest that the ultimate discontinuity of body and spirit represented by death had been come to terms with through belief in the continuity of the human spirit with that of animals, but there is another basic element of the human need to explain where we come from that is either missing or not yet identified: a creation myth. This could be subsumed within the animal–human spiritual continuity, but extant human societies have origin myths that are distinct from explanations of death (Leeming & Leeming, 1994). Creation myths could have been communicated through story-telling and song but one would still expect some representation through visual art.

Although there is a great deal that cannot be known about the origins of art, some things are becoming clear. The virtually ubiquitous existence of art today suggests that the neurological potential to create art was established within all of the human populations who remained within and migrated out of Africa. European Upper Palaeolithic art, and the art of hunter-gatherer societies of all periods throughout the world, cannot have arisen fully formed but must have long traditions behind them that are mainly lost to us. Stylistic similarities between European Upper Palaeolithic art and Late Palaeolithic art in Upper Egypt suggest a cultural continuity between the two regions. There is a rich archaeological record of stone tool technology from the upper Nile Valley, whose styles and dates suggest a more rapid cultural advance than that of Upper Palaeolithic Europe (Midant-Reynes, 1999). A highly developed artistic culture in this region is a likely correlate of the sophisticated tool technology. In contrast, the artistic styles (and their inherent symbolism) of the descendants of the original inhabitants of Australia and the Americas are quite different from those of European and ancient Near-Eastern cultures, supporting the hypothesis that their respective ancestors left Africa independently and earlier than those who populated Europe, possibly taking different African regional styles with them.

The conundrum of a single or multiple origins of art will never be definitively known but a consideration of individual human development provides one clue. Babies, like human ancestors, are born with a greater or lesser potential for artistic creativity. As they grow older, some would never even try if not taught, whereas others are precociously gifted. The example of the chimpanzee painters described at the start of this article suggests that this individual variability is evolutionarily very ancient. The rarity of outstandingly gifted creative artists today suggests that, from Congo the chimpanzee to Turner, Picasso, Bacon and others of our own time, each human (and pre-human) population has produced exceptionally creative visual artists who have radically changed the way that art is made and hence changed how we see not only art but the world around us. At each evolutionary stage, the cognitive potential to create art must have preceded practice; special individuals at different times, in different regions and in genetically different populations must have broken through the cultural norms to create new forms of art, whether at the stage of likeness recognition/modification or creation *de novo*. The major stylistic differences in world art suggest that at least some of these breakthroughs occurred independently in different populations after emigration from Africa. Although the establishment of artistic traditions must have reflected pre-existing cultures, creative change generated by rare individuals may have contributed to cultural change, reinforcing regional differences.

One important question remains: art is a wonderfully enjoyable aspect of human culture but not essential to survival, so why did artistic creativity arise? A key phrase that has been used in this article, and which is commonplace in our description of everyday experience, is 'the mind's eye'. In addition to the functional application of this facility in tool-making, it would have had an important survival function in hunting. The long-distance runner Bernt Heinrich, in his book 'Racing the Antelope' (Heinrich, 2001), points out that when animals hunt they give up the chase when the prey disappears from view; humans, however, know that an animal that has disappeared over the horizon or behind a group of rocks is still there to be followed. The neural changes that provided our ancestors with the imagination to understand, through logic, the continued existence of something that is no longer visible, together with the anatomical attributes that enabled them to outrun prey over long distances, would have had a genuine evolutionary advantage. Without these survival-enhancing functional origins, it is unlikely that we would have the neural equipment to create art.

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