Chapter 4
Joining Forces: Neuroaesthetics, Contemporary Visual art and Archaeological Interpretation of the Past

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Introduction
Archaeological research has brought to our attention two strands in the interpretation of the past. The first is linked with processes and patterns that transcend time, human communities and the material culture that people used to express the world that they were part of. The second focuses on individual expression via material culture as a reflection of being part of a wider community, while at the same time negotiating one’s own place in that community. By combining those approaches, I propose a new understanding of human visual expression as a timeless form of communication where neuroaesthetics creates a platform that cross-cuts time and space, and where the cultural and historical integrity of the creative context in which the visual metaphor is executed is a guide for how to look at material culture. In particular, I concentrate on the idea of the corporality of the human body and visual art. Examples presented include some of the earliest cases known as well as contemporary art. These are, however, not to be understood in terms of one being more complex than the other, but rather as expressions of the same neurophysiological capacities of being human, in particular the social, ritual and symbolic contexts of the cultures of which the artists were part. Such an approach allows us to go beyond the constraints of the nineteenth and twentieth century evolutionary schema where ethnographic analogies provided the basis for comparing the visual expression of small scale societies in the past and which supported the notion of the idea of an evolution from simple to complex.
Neuroaesthetics

One of the pioneering works in the field of neuroaesthetics is Zeki’s (1999b) *Inner Vision: an exploration of art and the brain*. Zeki (1999a, 1999b) explains which parts of our brain are responsible for making sense of what we see and how this influences our visual priorities. Zeki illustrated this by showing works of art ranging from traditional paintings to kinetic art by making the reader aware of how the workings of the brain influence our implicit appreciation/understanding of visual arts, which in turn, he argues, allows artists to create the art objects we appreciate the most. In subsequent years, this approach has been explored by a number of scholars in response to growing advances in neuroscience and continuing interest in visual arts. Although some attempts have been made to address this (e.g. Zeki 2008) the major missing element is the failure ‘to explain complex concepts such as ideals and beauty’ (Minissale 2012, p. 43), which for me is one of the most interesting aspects of art. Looking for the cultural contexts in which our neurophysiological abilities have been moderated and explored by both past and contemporary artists. As archaeologist, we have the advantage of overview of 100,000 years worth of art. While acknowledging the conceit of universalism, but adopting a critically reflective stance, we can begin to understand how archaeological study of art can contribute to our view of the diverse spectrum of what constitutes being human. To illustrate this approach, examples drawn from different archaeological periods as well as contemporary visual art in the UK will be included. These comprise images found in Blombos Cave in South Africa, dated to over 100,000 years ago, Upper Palaeolithic figurines from the Russian Plain dated to over 30,000 years ago, and contemporary sculptures by Antony Gormley and Jim Bond dated to the late twentieth and early twenty-first centuries.

In discussing the corporality of the human body used by artists in their creation of visual metaphors for conveying specific meanings on the one hand, and what we as viewers use in understanding the art on the other, two concepts from neurophysiology are useful: one is the recognition of self and the other; the second is the conceptual perception of art as a function of the brain. These concepts can be illustrated through the description of the J. de Bellange painting, *Lamentation upon the Dead Christ* by Nalbantian and Changeux, which emphasises the cognitive and neural process involved in art, including re-creation, recognition and reasoning, as well as the symbolic and affective aspects of art. They also make point that what they term ‘the mental synthesis’ stimulated by the art in the viewer is an interaction between ‘long-term cultural memory’ and ‘inherited memes’. All of this is brought together in the neural processes of the frontal cortex of the brain, assembling all of the various points of reference, resulting in a ‘mental reconstructions’ (1994, p. 38; 2008, pp. 359–360).

Elsewhere, I have presented an understanding of prehistoric imagery of the rock art of the White Sea in similar terms, which took into account the perception of vision, the experience of the carver and the cultural meaning of the depicted hunt as (Janik et al. 2007). Metaphor is central to art: and through the use of metaphor art can often enhance our experience of the world through encounters with the unexpected. Furthermore, if we look at the meaning of Christian iconography in the visual arts, those of us brought up in the Christian tradition rely on our implicit understanding
of meaning rather than the picture per se (Janik 2012). This in turn points to cultural preferences structuring the meaning of what is understood and in what way. Making relations between visual clues relies on already stored memories, what they could be and what they can be associated with, and this is due to the process of knowledge acquisition (Palmer 1999; Ratey 2002). This knowledge is acquired through being part of the world in general, and also as being part of a particular culture or community at a specific time, and is being mediated the viewers’ own experiences, emotions and personal histories. Further, the existence of neural links between the aesthetic and the emotional values given by particular cultures to specific images and subjective emotional experiences while creating and observing, provides images with emotional influence over both the maker and the viewer (Cinzia and Vitttorio 2009). The images that have been considered congenial and that evoke within us the physiological reaction of pleasure, e.g. an increase of endorphins in our body, opening the pathways of neurological connections in our brain related to pleasure, fulfilment and positive feeling, do not need to be the same through time and space. Looking at images of women we can see that the sense of ‘beauty’ or ‘desirability’ has changed: pictures by Rubens are now considered ugly, creating the opposite feelings and physiological reactions to those they induced in the early seventeenth century viewer. Further the appreciation of visual art cannot be extracted from the emotional evolvement of the viewer and the creator (Nalbantian and Changeux 2008), and so the visual stimulation as understood through neuroaesthetics and the cultural categorisation of meaning.

The Body as a Visual Art Object

The earliest visual expression is linked to the human body and its decoration, which allows archaeologists to reach into the deep past within the understanding of contemporary art. From a neuroaesthetics perspective, while the body is conceptualised it is at first referenced to the corporality of self (Arzy et al. 2006a; Ruby and Decety 2001). It has been argued that the areas of the brain responsible for visualising the body are located primarily at ‘the right inferior parietal lobe and the precuneus, the temporoparietal junction’ (Ruby and Decety 2001, p. 548). I suggest that this neuroaesthetic property of our brain allows artists to explore the body in a way we explicitly relate to, and creates positive or negative affinity towards it.

Postmodernism has shaped contemporary art (Harrison and Wood 2003; Fineberg 2010) and the constraints on what is a work of art and the aesthetic status quo have become very flexible. There is no preferred aesthetic: all approaches are equally valid, from ‘old-fashioned’ paintings, to crumpled pieces of paper and an artist’s head made from frozen blood. Furthermore, Conceptual Art, where a particular idea is presented via the use of objects, texts, photographs and so forth, breaks the straightforward relational link between the image, the material it is made from and meaning per se. I suggest that the postmodern sense of aesthetic is more embracing, allowing us to search for the past visual expression without constraining what is and what is not art in the traditional sense based on the Renaissance understanding of visual arts. Although there are other precursors to the use of the body in to create visual impact,
it was in such environment, that what is known as Body Art developed, where the body of the artist was used and recorded in particular performance or static contexts (Lucie-Smith 1995; Smith 2003, p. 257). This is also known as Living Sculpture (Lucie-Smith 1984, p. 32). The body is additionally understood in terms of a ‘canvas’ to be painted, pierced or modified.

*Then*

The idea of modifying the body in creating visual impact is seen in the earliest examples of visual art. These come from Blombos Cave in South Africa, where 41 intentionally pierced beads of *Nassarius kraussianus* shell were found, 39 dated over 70,000 years ago and two to over 100,000 years ago (d’Errico 2005; Henshilwood et al. 2004). The presence of numerous pieces of ochre, a few of which were decorated, has been established. The analysis of use wear patterns on the shells suggests that they were strung and used as beads (d’Errico 2005). Further, the presence of ochre indicates the use of pigment possibly to alter the colouring of the body’s appearance or body modification, including clothing or jewellery. Other examples indicating the use of visually noticeable body modification come from northern Africa (Bouzouggar et al. 2007; d’Errico et al. 2009). The examples from Blombos Cave, however, remain the oldest. The use of pigment and beads was also used by our ancient cousins *Homo neanderthalensis*, whose mitochondrial DNA we share (Hublin 2009; Zilhao et al. 2010). Around 50,000 years ago in Cueva Antón, Spain, the perforated shell *Pecten maximus* shell was found in the context of a Neanderthal habitation. Inside was intentionally coloured by a mixture of orange/yellowish material obtained from ogoethite and hematite, while the outside surface was left in its natural red condition.

Another example is the oldest-known ‘powder box’, from Cueva de los Aviones in southern Spain. This was made from *Spondylus gaederopus* shell stained with the residue of an orange/yellowish pigment. Thus, the use of the body as a ‘canvas’ is not only linked with the oldest evidence of the visual arts, but also that it was not restricted to *Homo sapiens*.

The use of colour itself relates to neuroaesthetics. According to Zeki (1999), it is linked with three stages: first where the V1 area of the brain is prioritised; secondly with the assessment of the light spectrum wavelength located in area V4 and the last phase correlated to ‘making sense’, relating to a variety of areas of the brain with a focus on the inferior temporal cortex, the hippocampus and the frontal cortex. Colour in turn is an additional stimulus that carries visual information where the body itself becomes the object that evokes not only an aesthetic impression but also emotional responses to how it looks like. Modifying the body can be seen in the process of performativity as proposed by Butler (1988) where social identities are constructed via visual appearance and particular ways of acting upon those identities. So the use of particular visual stimuli can lead to the creation of visually recognised metaphors that are specific to, or even transcend, particular communities. In such a way, the body itself becomes a medium, a canvas of artistic transformation of the body into social and artistic entity.
The human body is not only modified or used in the context of performance, but it can also be used in the autogenous sculptures as done by Antony Gormley (Fig. 4.1). He translates the neurophysiological capacities of being human into the autogenous representation of self that is a vehicle for him to ascribe the human condition in the world. He uses casts of his own body, ‘body-surrogates’ as a metaphor for communicating issues and concerns of the time and space he occupies in the world he lives in. These include the place of gendered role models, the need to move beyond appearance of things, exposure, vulnerability, what it means to be human, our vertical (bipedal) nature, the dark side of the human nature: all of these for Gormley justify the expense of making artworks that investigate the collectivity and singularity of human experience (Powell 2011).

How can this help us in trying to interpret prehistoric visual art? First, we need to clarify what we mean by visual art. I regard visual art as the engagement of metaphor based on the creative aspects of being human, metaphors which modify and transform material culture in the act of nonverbal communication. Two different but interrelated categories of visual art can be defined. The first is visual expression,
part of the physiological capacities of the human body. The second is a culturally moderated understanding of the world around us that allows us to make sense of and give meaning to the material culture we create and see, through visual expression.

By being an inspiration to think outside the box, and look for the past artists’ concerns and ideas they were capturing in the visual art they produced. Then by moving from the scale of the individual into the cultural, social and symbolic trajectories they embody in the sculptures they created, so the body of the self becomes a metaphor of concerns/ideas that were part of the world they lived in, just as Gormley describes in his interview with Powell (2011).

Now and Then

Gormley’s idea of ‘Resistant to time but in dialogue with time’ sums up very well the autogenous sculptures that are gendered in contemporary understanding of the concept of human female and male. Gormley follows the notion of the creation of gender as a construct rather than a given, in a similar way to Butler (1988). For him, nakedness is of importance but, as I will show later, nakedness and the lack of displaying the most recognisable part of our body to the other, the face, also has a neurophysiological basis. The materiality of the substance of which the sculptures are made plays an important role for Gormley, which is also the case for the prehistoric art discussed here. I go further in the interpretation of Palaeolithic sculptures than previously (Janik 2012; see also Jones this volume), looking at different aspects of figurines as well as in the way I engage with the voice of the contemporary artist whose sculptures conceptualises the concerns and ideas we share today in the UK and beyond.

The artwork can be interpreted as a representation of the time and space in which it was created, influencing the community of which it is a part. This representation changes: for instance in the twentieth century so-called Venuses figurines were used to represent the evolutionary development of human societies, where women were fertility symbols, life-giving beings and objects of male desire (Régnault 1912; White 2006). In the late twentieth century, they became objects that allowed us to question those assumptions and reinterpret the place of women in the past, which can be best illustrated in the focus of the way they are written about, where ‘autonomous figurines’ replaces the vocabulary of ‘Venus figurines’ (Janik 2012; McDermott 1996; Morriss-Kay 2012). However, in the past they were probably active instruments in the constitution and reconstitution of the social and symbolic realities of Upper Palaeolithic Eurasia. The processes of how they were made, what they were made from and how were they treated is essential in our understanding of the past as an independent historical and cultural identity very different to ours (Janik 2011, 2012).

Prehistoric female figurines with exaggerated attributes of the female body due to the deposition of fat tissue and generally known as ‘Venus’ statuettes has been reinterpreted by McDermott (1996) as self-representations made by the women themselves, so-called autogenous sculptures. The foreshortening projection creates for the viewer
Fig. 4.2 Willendorf figurine, original 11 cm, limestone. (Photograph of a cast by author)

a distorted image since it has been created by the women herself: if she looked down on her breasts and carved what she saw—they looked different and bigger than if someone else looked at the woman and carved her body. McDermott proposed ‘at least five or six primary vistas: (1) head and face, (2) superior anterior or upper frontal surface of body, (3) inferior anterior or lower frontal surface of body, (4) inferior lateral or lower side surface of body and (5) inferior posterior surface of body, including (a) under-the-arm views and (b) an over-the-shoulder view (McDermott 1996, p. 237). So the figurines once argued as reflecting very overweight women were reinterpreted as portraying pregnant females of medium size, in the case of the Willendorf statuette, akin to a 6-month-pregnant Caucasian women with the breast size of 34, cup C (Fig. 4.2; McDermott 1996, p. 240).
What is interesting here is the lack of a face, which in the neuroaesthetic context creates an important distinction between being recognised in visual communication via facial expression and recognition of a generic body (Haxby et al. 2000). It is interesting that Gormley makes a similar point: by not showing his face he moves beyond his own place in the world by being not recognised by the other, and transcends a self moving from egocentric to the allocentric perspective (Sudo et al. 2012). This is linked with the higher-cognitive functions of the brain, where the use of the term embodiment to refer to the capacity to understand or re-represent the states of others by linking them to states related to one’s own body, either at the embodiment level directly, or via a representation of one’s own body at the embodiment level (Candidi et al. 2012, p. 110). Although of course when these figurines were produced, there may not have been the skills to work the materials to create faces that would have been readily identified as specific individuals: rather they would have been generalised or abstracted. This means that we cannot be certain about their intent. Gormley on the other hand, has access and training in working many materials and could create veristic faces, so the conceptual importance of his decision not to rely on a critical engagement with the technical abilities of art making as tekhne, honed over many years and generations.

Then Once More

Autogenous figurines have been recovered from several areas of Europe not covered by glaciers (Fig. 4.3) and are dated to between 30,000 and 20,000 years ago.

A contextual approach looks at the relationships between who made the objects, what they were made from, and processes of manipulation and deposition. These give us a small window on to the past and the role of material culture in bringing different strands of being together. I focus here on finds from central Russia, a location which has some of the best known Upper Palaeolithic sites in Eurasia: Kostenki 1, layer 1, complex 1 (Abramova 1962), dated between over 24,000 and 19,000 years ago (Svezhentsev 1993, p. 28); Avdeévo (Gvozdover 1995), dated between over 22,000 and 15,000 years ago (Svezhentsev 1993, p. 27) and Gagarino (Tarasov 1979), dated between 30,000 and 18,000 years ago (Svezhentsev 1993, p. 27). Being part of the Pavlovian–Kostenki–Gravettian archaeological culture, despite the diversity of figurines, there is an underlying relationship between them in terms of the materiality of the substance of which they were made, and the visual communication via the presence of the face.

Material Culture

What we can see here is the relationships between the material the figurines are made of and what they represent. This is at the centre of understanding the materiality of the substances selected by prehistoric artists for their representations. As an example, from the data summarised in Table 4.1, we can contrast the material chosen for autogenous figurines and depictions of mammoth, used for objects which will be...
broken and for those which are left complete. The autogenous figurines made of mammoth tusk and are almost always not broken (though they could easily be) and the representations of mammoth are made of marl (a very easily broken material), but again are always complete. Representations in marl of other animals are always broken, as are the autogenous figurines when made of marl rather than mammoth tusk. Examining these material metaphorical associations requires further interpretation which is beyond the scope of this paper. Here, I would just like to suggest that the role of the mammoth in past societies was probably versatile depending with whom it was associated, and in which contexts the relationship took place, for example in social relations between different beings it could take the form of a particular shape, while in symbolic terms it could be visible via substance (Table 4.1).

What is interesting, however, is that at Kostenki 1/1/1/ and Avdeevo shape was not broken but material was (Table 4.2) as if the visual representation of mammoth had to be intact, while at Gagarino the presence of mammoth is only visible via the material of female figurines. Mammoth as material is only preserved in one representation of a human female and in one case of a horse figure.
Table 4.1 Relationship between materiality of the substance used and unbroken sculptures from main Upper Palaeolithic sites in Central Russia (Kostenki 1/1/1, Avdeevo and Gagarino)

<table>
<thead>
<tr>
<th>Material</th>
<th>Kostenki 1/1/1</th>
<th>Avdeevo</th>
<th>Gagarino</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mammoth tusk</td>
<td>4 human female</td>
<td>10 human female</td>
<td>11 human female</td>
</tr>
<tr>
<td></td>
<td>1 horse</td>
<td>1 horse</td>
<td>9 finished or in</td>
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<td></td>
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<td></td>
<td>preparation</td>
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<tr>
<td></td>
<td></td>
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<td>2 (being carved from</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>one piece)</td>
</tr>
<tr>
<td>Marl/sandstone</td>
<td>10 mammoth</td>
<td>2 mammoth</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2 rhino</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3 mammoth/rhino</td>
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</tbody>
</table>

Table 4.2 Relationship between materiality of the substance used and broken sculptures from main Upper Palaeolithic sites in Central Russia (Kostenki 1/1/1, Avdeevo and Gagarino)

<table>
<thead>
<tr>
<th>Material</th>
<th>Kostenki 1/1/1</th>
<th>Avdeevo</th>
<th>Gagarino</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marl/sandstone</td>
<td>7 cave lion</td>
<td>15 human female</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1 rhino/horse</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2 horse</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>6 bear</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1 wolf</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>14 bird</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>68 human female</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mammoth tusk</td>
<td>0</td>
<td>1 human female</td>
<td>4 anthropomorphic</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>most probably</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>female</td>
</tr>
<tr>
<td>Mammoth joint or</td>
<td>0</td>
<td>1 human female</td>
<td></td>
</tr>
<tr>
<td>vertebra</td>
<td></td>
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</table>

On the other hand, the material from which mammoth representations are carved is shared with all other representations: cave lion, rhino, horse, bear, wolf, bird and human females (Fig. 4.4). I suggest that this relational link is a unique feature/category that allows us to distinguish between the female artists expressing their place in the world via autonomous sculpture and any other depictions. Unfragmented female figurines were created by female artists while the broken fragments come also from the statuettes that are made to look like self-portraiture. This in turn has important implications, since they could be made by others than the ‘self’ who can be defined in contemporary terms as other female or male artists. Therefore participation via the substance of marl/sandstone was open to other members of the community as well as pregnant sculptors.

Looking from the neuroaesthetic perspective the process of fragmentation has been exploited by Jim Bond, whose kinetic sculptures break the body up and bring it together in the process of embodiment and fragmentation (Fig. 4.5). This artistic undertaking of fragmentation can be referenced to neuroaesthetics and the extrastriate area of the brain (Astafiev et al. 2004; Arzy et al. 2006b). What is very interesting about this point when discussing the visualisation of self and the other is the transformation from an egocentric perspective to an allocentric one as is seen in Gormley’s...
sculptures, in which one sees oneself embodying ideas or concerns shared by a number of individuals, helping to create a collective identity. Further, the agency of self and other in the context of the sensorimotor system was studied revealing that through the motor capacities of body parts, the self/other body distinction is constructed (Ferri et al. 2012). This process can be traced/recognised in the interview with Gormley: it can also indicate the way to understand autogenous and nonautogenous figurines and their fragments (Table 4.1).

Lastly, I suggest that through the process of fragmentation the women themselves, or other members of the prehistoric communities, go through the emotionally charged act of breaking that reinforces the neuroaesthetic properties of the figurines. In the end, in the process of nonverbal communication based on the properties of our bodies’ neurophysiology, the application of colour into some of the autogenous figurines, creates one more element that implicitly focuses attention on the objects themselves,
and by breaking them the surface colour of red or black becomes white, reinforcing the act of breaking through creating a new visual quality. The significance of colour in these figurines merits further research, as has been done in other areas of archaeology (cf. Jones and McGregor 2002).

Discussion

Returning to the topic of the relationship between contemporary and prehistoric visual art, at the first glance we might not see the connection, but if we look at the form in which the artists engage their bodies in their artistic practice, and how these bodies are used in social or symbolic contexts, we begin to see the conceptual links. Further, the materiality of the substance or material from which the figurines are made is as important to Gormley as to the artists of the Upper Palaeolithic. What is constant is the relationship between substance or material and representation: whereas for autogenous figurines mammoth is the most significant, in the case of Gormley’s self-sculptures it is iron.

What also unites different times is the use of human body beyond the self reaching from an egocentric to an allocentric perspective in neuroaesthetic terms, creating a visual vocabulary based on being human, in which meaning can be shared across a particular time and space, and can be shared again between us and our distant ancestors via our neurophysiology.

Subsequently, the images themselves become active agents in the symbolic and social life of the communities who create and appropriate them. Even if they lose their original meaning through their visual presence/the way they look either reinforces or challenges our own status quo: both in the Palaeolithic and today, people are simply moved on the emotional level, where their ‘feelings do the talking’.
This paper is offered as an attempt to deepen our appreciation of the physical faculties of our bodies, in particular our emerging appreciation of the physicality of thought manifested in the brain’s structure and chemistry. Although beyond the scope of the current paper, future research will engage with studies of affect and phenomenology, to further develop our understanding of the shared human heritage of engaging the body to create art, as well as the differences in bodily artistic engagement through place and time.

Inspired by the pioneering work in neuroaesthetics, this paper adopts a neuroaesthetic approach to the interpretation of some of the earliest representations inspired by the human form, including the probable body ornaments from Blombos Cave in South Africa and Palaeolithic figurines from Kostenki, Avdeevo and Gagarino in the Central Russian Plain. Drawing on current art historical approaches to Renaissance Christian iconography, and moving on to key examples from contemporary art, ranging from the body art of Antony Gormley and the fragmentary art of Jim Bond, the paper argues for a realignment of archaeological interpretation of some of the most ancient art known, a realignment that develops a clearer understanding of the relationship between the artist’s choice of materials and what it is they are attempting to represent, whether that be an expression of their own corporality, gendered relationships, or their place in the world, or all of these. The paper proposes a bold new approach to ancient visual art, an approach that is effectively informed by current thinking about how the brain processes visual information, and the significance of that for the development of human expression.

Acknowledgments I would like to thank Andrew Cochrane and Ian Alden Russell for inviting me to participate in this volume and for their thoughtful comments on an earlier draft: some of which I have incorporated, others which I have decided to save for later. My gratitude goes also to Jim Bond for giving me permission and sending me the picture of his sculpture as well as Mark Sapwell for permitting me to use his photograph of Gormley’s sculpture. Special thanks go to Simon Kaner and for his help with the paper. All errors remain my own responsibility.

References


AQ1. Following references are cited in the text but are not given in the reference list: Zeki 2008; Naibantian and Changeux 1994, 2008; Janik 2012; Cinzia and Vittorio 2009; Ruby and Decety 2001; d’Errico 2005; Henshilwood et al. 2004; Bouzouggar et al. 2007; d’Errico et al. 2009; Zekki 1999; and Abramova 1970. Please provide full references or delete the citations.

AQ2. Should it be "goethite" here in place of "ogoethite"? Please suggest.

AQ3. Please specify whether the year "1999a" or "1999b" is valid for the citation "Zeki 1999".

AQ4. Following references are not cited in the text: Brown et al. 2011; Changeux 1994; Nadal 2008; and Naibantian 2008. Please provide citations or delete entries from the reference list.