
Decoding the Blombos Engravings, Shell Beads and Diepkloof Ostrich Eggshell Patterns

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The debate regarding the status of the Blombos ochre engravings and shell beads for gauging the timeline of when cognitive abilities and symbolic intent appeared has been controversial. This is mainly due to the fact that what is referred to as symbolic is often too loosely defined and is therefore attributed to artefacts in an indiscriminate way. Recent evidence from various concurrent sites in southern Africa, including Blombos, provide the opportunity for a more nuanced analysis of the probable level of symbolic intent and how this relates to neuro-cognitive precursors. In what follows, it will be shown that, although some of the southern African artefacts do indeed demonstrate particular kinds of 'symbolic' intent, others need to be approached with caution. Data from the visual brain is presented that provides crucial evidence as to the appropriate level of intent suggested by the engravings and shell beads from the southern Africa context.

Modern human behaviour is claimed to have appeared abruptly around 50–40,000 bp related to a neuro-cognitive event (Klein 2000; Mellars 2005; Wynn & Coolidge 2007), whereas others favour a more gradual accumulation of traits that began during the Middle Pleistocene eventually leading to what is regarded as behavioural modernity (Hodgson 2000; Hovers & Belfer-Cohen 2007; McBrearty & Brooks 2000). Some of these changes, however, may have appeared autonomously in different groups and places (Barham 2007; Hodgson 2000; Hovers & Belfer-Cohen 2007) irrespective of whether the perpetrators were anatomically modern (d'Errico 2003).

There has been much discussion as to the how the Blombos engraved ochre blocks and shell beads as well as the Diepkloof eggshell patterns relate to this discourse. As some of these objects date up to 100,000 bp, they have become crucial to understanding the timeframe of cognitive evolution. Confirming that the ochre and eggshell engravings, as well as shell beads, are symbolic could potentially provide evidence that modern human behaviour occurred relatively early during the Middle Stone Age. It would also show that the purported delay in the fluorescence of material culture is unable to be fully

explained by a derived neuro-cognitive event. This delay is referred to as 'the sapient paradox' (Renfrew 1996; 2008) where the apparent late upsurge in complex material culture postdates the arrival of anatomically modern humans 200,000 years ago. Behavioural flexibility, which is reflected in socio-cultural behaviour, is thereby proposed as a way of accounting for this delay. However, and notwithstanding the problems of taphonomy that render the archaeological record/signal fainter over time, the fact remains that the ability to engage in socio-cultural activities necessarily relies on important neuro-structures that facilitate the behavioural flexibility and learning on which culture depends. The decisive point here is that the neuro-structural component involved will have set the parameters that allowed the transmission and accumulation of information. However, the nature of the putative underlying neuro-structural mechanism has been misconstrued in the sense that it has been regarded as a unique causative factor determining cultural fluorescence. An alternative, more nuanced but inclusive approach suggests that the supposed neural systems dynamically interact with socio-cultural factors (Hodgson 2010; 2012a,b), especially population levels (Powell *et al.* 2009; 2010;

Shennan 2001), which promotes the production and exploitation of external storage systems. Thus, rather than a single (or several) neuro-structural component dictating the rise of socio-cultural complexity, it is the way that such components interact with population levels and socio-cultural factors at various levels of engagement that is crucial.

The evidence from Blombos

Recent finds from southern Africa dating to the Middle Stone Age have provided important material that can shed light on these issues. In this respect, Henshilwood and collaborators (Henshilwood 2007; Henshilwood & Dubreuil 2009; Henshilwood *et al.* 2009) suggest that the Blombos artefacts are fully symbolic in that they probably signal social allegiance. Based on this assumption, they propose ‘modern human behaviour’ appeared much earlier than previously surmised, at least as far back as 100,000 bp. The question then arises: if the Blombos artefacts are symbolic, what level of abstraction or arbitrariness can validly be accorded to such material? In fact, the Blombos engravings and shell beads are *a priori* assumed to be indicative of fully symbolic behaviour when there may be different levels of arbitrary reference accorded to such items. Having said this, although Henshilwood and associates regard the Blombos ochre engravings and shell beads as sufficient evidence of fully symbolic behaviour, the engravings are viewed as less secure than the shell beads. A further aspect of the Blombos engravings that requires explanation concerns their abstractness, as one would have expected the first preserved/recovered intentional marks to be iconic in the sense that iconicity is more obviously meaningful.

Criticism of Henshilwood and Dubreuil’s (2009) position has mainly centred on the fact that the Blombos artefacts simply had a unique personal meaning for the individuals concerned, and therefore are not relevant to signalling group norms (Malafouris 2008; Wynn & Coolidge 2007). Thus, Wynn and Coolidge (2007), as well as Malafouris (2008), suggest that there is no way of knowing whether the Blombos engravings were used symbolically and, in fact, they could well have had no referential meaning. Botha (2010) also draws attention to the ambiguous and often contradictory way in which symbolism is invoked by Henshilwood and Dubreuil to account for the Blombos marks (Henshilwood & Dubreuil 2009; Henshilwood *et al.* 2009). In order to assess the significance of the Blombos engravings, it is first necessary to consider evidence that might support or contradict a socio-cultural symbolic explanation.

The indexical, iconic and symbolic

One of the main criticisms of Henshilwood and colleagues concerns the rather loose way ‘symbolic’ is referred to, not least because defining what should be symbolic is, in itself, problematic. For example, one could take a Peircean or a Saussurean perspective on this issue. A Saussurean (1983 [1969]) interpretation of the Blombos artefacts would make it difficult to identify the level of symbolic inference involved — mainly because such an approach regards any mark or object as potentially arbitrary as decided by the ongoing social context set by what is commonly agreed should constitute structured meaning. Saussure’s semiotics derives mostly from speech — a highly abstract and arbitrary mode of communication that is favoured by Henshilwood and Dubreuil (2011).

Perhaps a more useful way of understanding symbols can be found in Peircean semiotics (Peirce 1974), which has been invoked by archaeologists and anthropologists to account for the Blombos finds mainly because Peirce’s system, unlike Saussure’s, accepts the importance of ‘objective reality’ as a referent. Peircean semiotics is tripartite involving ascending levels of arbitrariness and conventionality between the signifier and the signified beginning with the iconic (where obvious qualities or similarities are shared between signifier and signified and may be based on a convention) followed by the indexical (where there is an observable and direct link between the signifier and the signified), and, finally, the fully symbolic (Deacon 1997). Pertinently, Peirce (1974) regarded the indexical sign as directing or focusing attention to particular objects through ‘blind compulsion’. However, although many archaeologists and anthropologists, (see for example Deacon 1997; Rossano 2010) follow such a progression of increasing interpretive referential complexity, some linguists regard the division between the indexical and iconic as suspect with some even claiming the indexical takes precedence. In this respect, Deacon (2012) has recently stated that there is no simple compositional relationship between the three modes in that icons are not made of indices and symbols are not made from indices. Similarly, some biosemiotic linguists regard the indexical as more fundamental due to the fact that it has a direct link to the object concerned (through blind compulsion) in that the semiotic alternatives are restricted to the singularity of the particular object referred to (Nöth 1995, 246). In addition, although icons depend on resemblance or similarity, they involve an added level of complexity in requiring to be similar to the referent. The production of icons can therefore be more difficult than indexes. Moreover, the relationship between an indexical sign

and its referent does not depend as much on social conventions compared to the iconic (for example, as in a picture) rather it relies on a direct link with the invariant properties of matter and, therefore, in one sense, is more elemental to cognition than iconicity (Nöth 1995; Schwartz 1998).

Despite the utility of this hierarchical approach, Peirce, along with Saussure, regard any signifier (including the indexical and iconic) as *potentially* able to become fully arbitrary symbols as it is how an interpreter projects meaning onto the signifier that finally determines meaning. In assessing the archaeological record, however, a pragmatic stance is necessary because we are not privy to the minds of those from former times. In this sense, Peirce's tripartite system provides a framework for the minimum competence required for achieving a particular level of semiotic capability. A parsimonious approach to Peircean semiotics would therefore dictate that a higher level of arbitrariness/conventionality should not be accorded if the artefacts under scrutiny obviously suggest the primacy of a 'lower' less-arbitrary level. In this way, available evidence is not over interpreted and the materiality of the object is preserved and emphasized.

A related way of approaching South African artefacts, and which similarly focuses on the materiality of the object, concerns denotative and connotative modes (Abramiuk 2012; Chandler 2001). Denotation refers to meaning derived from a material signifier that does not drift too far from the essential nature of the actual material. The meaning derived therefore remains concrete and is fairly transparent and can be regarded as akin to indexical and iconic modes. With connotation, meaning is arbitrary and opaque and cannot easily be inferred from the original signifier, which makes for greater variability to the extent that considerable knowledge of cultural context is required before the underlying meaning can be discerned, which seems more in line with the arbitrariness of speech and Saussurean semiotics. These categories, however, are not mutually exclusive as one can dominate or impact on the other. In the present context, it is prudent to regard the Blombos engravings and shell beads, as well the Diepkloof ostrich eggshell patterns, as denotative in the sense that they remain tethered to materiality in a way that will be described in detail below.

Although Henshilwood *et al.* (2009) allude in passing to Peircean semiotics by stating that *some* of the Blombos engravings may lack a resemblance to the referent, and may therefore be fully symbolic, this implies the engravings are completely arbitrary in a way that does not take account of the levels of arbitrariness outlined above. More specifically, Henshilwood and Dubreuil (2011) refer to Peirce's

semiotics in relation to the Blombos shell beads as possibly indexical, but ultimately prefer an analysis based on Saussure's semiotics, especially when this is linked to perspective taking and theory of mind. Henshilwood's and Dubreuil's preference for Saussure seems to derive from an acceptance that speech was in place during or before the Blombos timeline. This may or may not be the case, but ascertaining when and how speech arose is problematic due to the fact it leaves no obvious archaeological markers; we therefore have to rely on extent material remains that can potentially provide evidence for symbolic behaviour that does not necessarily depend on oral language. In other words, materially realized external communication systems involving various levels and types of information transmitted between sender and receiver, as defined by Donald (1998), Henshilwood and Marean (2003) and Wadley (2001). The decisive question, however, remains as to the level of 'symbolic' intent that is to be inferred by such external storage systems. As stipulated, from a biosemiotic perspective, the indexical may take primacy over the iconic. This seems to be reflected in the way signs and symbols turn up in the archaeological record with the indexical *tending* to predate both the iconic and fully symbolic; a proclivity that can explain why geometric marks are more widespread and predate iconic depictions by a considerable period, especially when Peirce's notion of 'blind compulsion' for the indexical is taken into account. This observation is important because the iconic has often been assumed to be the first rung on this hierarchy, which is not consistent with the fact that fully iconic depictions (Upper Palaeolithic representations of animals) appear much later than indexical signs (geometric patterns).

Lines of evidence

There are two main factors that can lead to variation in artefacts over a prolonged period that apply to the Blombos marks, drift and socio-cultural influences (see, for example Lycett 2008; Newson *et al.* 2007). Drift refers to the accumulation of accidental events and, along with imperfect copying, can accumulate over the 25,000-year timescale during which the Blombos artefacts were produced (from 100,000 bp to 75,000 bp approx.). However, as Henshilwood *et al.* (2009) point out, single lines occur during the earlier phase whereas multiple, more organized, lines *tend* to occur later, which suggests an inclination towards complexity (compare, for example, M3-10 and M3-7 from the earliest phase with M1-6 and M1-5 from the later phase), which is not consistent with the power law distribution associated with the neutral stochastic

selection processes of drift (Lycett 2008; Mesoudi 2011). As this trend appears to be too systematic for drift, socio-cultural determinants have been proposed as an alternative explanation that, together with biased preferences (Shennan & Wilkinson 2001), can give rise to a tradition. However, in cases where socio-cultural factors relating to symbolic intent prevail, a distinct variation in artefact type occurs over relatively short intervals (Carr 1995; Richerson & Boyd 2000; Sackett 1999; Wadley 2001; Wynn 1991) — especially where environmental conditions change rapidly as was the case from 100,000 bp onwards in southern Africa (Henshilwood 2008). The need for change and innovation would therefore have offset any conformist bias that sustains a stylistic trait within a group due to the need to remain open to influences from individuals of other groups as a means of coping with environmental instability (Bettinger *et al.* 1996). As the variation in the marks over the period concerned is relatively limited (d'Errico *et al.* 2012; Henshilwood *et al.* 2009), this also does not coincide with rates of change typical of symbolic behaviour. Moreover, and as Henshilwood *et al.* (2009) observe, as the marks span a period of approximately 25,000 years, this again suggests an explanation based on a socio-cultural tradition may be inappropriate. Interestingly, similar marks on ochre have been found at other sites in southern Africa some distance from Blombos (d'Errico *et al.* 2008; 2012), yet one would expect an obvious difference in the marks from these sites if socio-cultural influences were operating as such influences presuppose variation due to a divergence in priorities and outlook (Sackett 1990; Wadley 2001; Wynn 1991; 1996). A socio-cultural tradition is therefore unable to explain this resemblance as one would expect such marks to show considerable differences over such wide-ranging areas as a result of cultural variability.

A further aspect of the Blombos marks that needs to be considered concerns the fact most of the engravings are diminutive, with several difficult to discern. As a consequence, Henshilwood *et al.* (2009) suggest this implies the engravings may have been intended to be viewed only by the individual responsible for producing the motifs. The same can be said of related finds from other sites in South Africa, such as those from Klasies River Cave dated to between 85,000 to 100,000 bp (d'Errico *et al.* 2012). The fact that so many of the engravings are diminutive with several at detection threshold would have led to ambiguity which, similarly, tends to discount group affiliation or an emblematic explanation (see Cain 2006 who makes a similar point). Furthermore, in order to serve as a sign of group affiliation, marks need to be highly visible in order to avoid what could be a

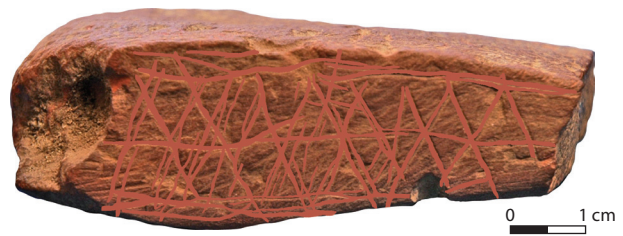


Figure 1. The Blombos ochre block (actual size) with intentional engraving as the colours might have originally appeared. Colours derive from a recent ochre block.

costly social indiscretion (Carr 1995, 154). In other words, the Blombos marks are far too weak a signal to act as a means of communicating social information. Figure 1 shows one of the more systematic Blombos engravings with the actual size indicated (most are smaller than this example being around one to two centimetres in length), which reinforces the lack of saliency. Henshilwood *et al.* (2009) attempt to discount this argument by stating that ‘when the incisions were freshly made, they would have stood out as vivid red against a dark background’. Figure 1 has been re-coloured to illustrate how the engravings might have originally looked, which shows colouration does not make a great deal of difference to the prominence of the engravings (mainly because the marks were made on a newly prepared surface). Ultimately, the size of the marks is the most important component for communicating social information, which suggests that the intention of those responsible for the engravings was not socio-cultural. This conclusion is bolstered by the fact that the Blombos engravings are extremely rare over the period concerned.

The fact that the marks are obviously similar — as well as show a tendency towards greater complexity over 25,000 years, plus the fact that the majority of the ‘designs’ are quite small and infrequent, suggests some other explanation than drift, group affiliation or emblematic status is required.

The Diepkloof ostrich eggshell engravings

Texier *et al.* (2013) report engraved Diepkloof ostrich eggshell containers dating from 100,000 bp to around 52,000 bp, which overlaps with dates for the Blombos engravings. Moreover, the Diepkloof engravings suggest more of a continuous sequence than previously suggested, (Texier *et al.* 2010; 2013). These engravings are extremely valuable for gauging when and what kinds of symbolic behaviour occurred. As with the Blombos engravings (illustrated in Fig. 2), simpler patterns tend to predate the later more complex ones,

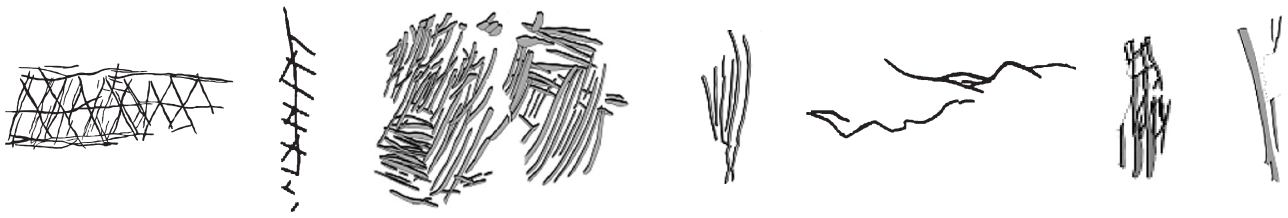


Figure 2. The main types of pattern from the Blombos ochre engravings with the simpler parallel lines dating to the earlier period.

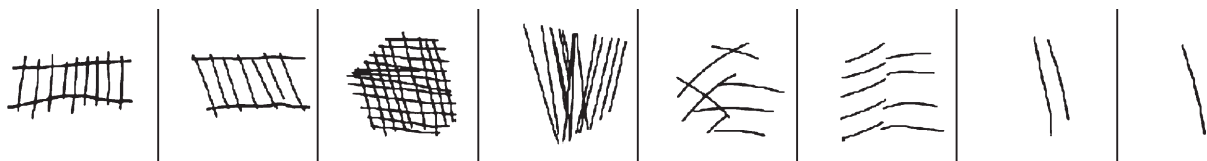


Figure 3. The range of engraved patterns on the Diepkloof ostrich eggshell containers. The patterns are dated from $109,000 \pm 10$ bp to $52,000 \pm 5$ bp with the single and double parallel lines from the earlier period and the more complex lines from the later intermediary period (from Texier *et al.* 2013).

as can be seen in Figure 3. Texier *et al.* (2013) regard the Howiesons Poort Diepkloof patterns as part of a much longer and more continuous tradition than originally surmised (though this continues to be debatable) where a ‘diversification of motifs’ occurs with single and sub-parallel intersecting lines predating the later more complex and more frequent examples. As Texier *et al.* (2013, 17) state:

Indeed, the sub-parallel and intersecting line motif is still present but from this time on we observe the presence of the hatched band motif, the curved sub-parallel lines motif, as well as the crosshatched grid motif.

It could be argued that these engravings served a purely functional purpose in that, on the surface of a shell container probably used to carry water, engraved lines would have helped to apply a firm grip. However, this can be achieved with less geometrically organized patterns. The systematic patterns suggest a function unrelated to grip, especially as fine motor control and intense concentration was employed to create the designs. However, although the Diepkloof engravings show similarities with the Blombos ochre marks, there are distinct differences concerning size and saliency. As can be seen by comparing Figures 2 and 3, the Diepkloof patterns are much more systematic and coordinated than those from Blombos. However, in the absence of good evidence to the contrary, the Diepkloof designs should be regarded in a similar way to the Blombos engravings rather than serving to mark group affiliation. Having said this, the ostrich eggshell containers would have been

incorporated into the daily practical activities of the group responsible and, as a useful and valuable object, would have been shared and thus served as a focus of group concern (Porraz *et al.* 2013; Texier *et al.* 2013). Nevertheless, although the Diepkloof patterns provide a more prominent signal and were utilized in a practical context compared to the Blombos engravings, it cannot therefore be surmised they served a wider social function. This is because they could simply have acted as a way of enhancing the appeal of an object for the individual responsible for producing the patterns. At best, the Diepkloof patterns should be regarded as having greater potential to act as socio-cultural signal and, in this sense, can be said to be more sophisticated than the Blombos examples. Wadley (2001) might similarly designate the Diepkloof patterns as a passive, rather than active, form of ‘style’.

Shell beads

The Blombos shell beads have been suggested as serving an emblematic iconological/indexical affinity (Henshilwood & Dubreuil 2009; 2011); although the possibility they may have merely served some personalized decorative function cannot be completely ruled out (Dubreuil 2008; Malafouris 2008; Wynn & Coolidge 2007). In support of an emblematic function, some of the shell beads seem to have been deliberately coloured (Henshilwood & Dubreuil 2009) and several were strung on ‘necklaces’ that seem to have been worn for a year or more (Vanhaeren *et al.* 2013) with the shells (*Nassarius kraussianus*) sourced from a

number of locations up to 20 km away (Henshilwood & Dubreuil 2009). Shell beads, when strung together and worn as body ornamentation, would have produced a much stronger and prominent signal capable of carrying social information than is the case for the engraved ochre blocks or ostrich eggshell containers. It also needs to be borne in mind that *Homo sapiens sapiens* is a particularly social species where any object employed to enhance the body would almost certainly have become contextualized according to group norms — initially as an indexical sign and subsequently as a fully fledged arbitrary symbol signalling the nuances of group identity.

In addition to data from the shell beads, other evidence consistent with a socio-cultural affiliation comes from the ‘workshop’ where abalone shells were used as palettes for mixing pigments (Henshilwood & Dubreuil 2011; Henshilwood *et al.* 2011) that may have been used to colour beads. Moreover, shell beads from the Middle Stone Age, some covered in ochre, have been documented from Sibudu Cave and from Taforalt, Morocco, that also show evidence of being strung together for use as a necklace (d’Errico *et al.* 2008). With accumulating finds from Blombos and other sites in Africa, the weight of evidence now tends to support an emblematic socio-cultural function for the shell beads as Henshilwood and Dubreuil (2011) cogently argue both against Coolidge and Wynn and Malafouris (commentary on Henshilwood & Dubreuil 2011).

Patterns in the visual cortex

Previous to d’Errico *et al.* (2001) and Henshilwood *et al.* (2002) bringing the Blombos finds to the attention of the academic community, every geometric motif from Blombos (as illustrated in Henshilwood *et al.* 2009) and Diepkloof, was predicted to be present in Middle Stone Age (as well as the Middle Palaeolithic) archaeological layers as is illustrated in Figures 4 and 5 (see Hodgson 2000; 2006, for further illustrations and clarifications) and as quoted in the two following extracts from Hodgson’s (2000, 12) paper.

The gradual evolution of graphic primitives as an explanation has the advantage of being testable, the model allowing us to predict that the present gaps in the record, particularly between the combine/aggregate stage [simple geometric motifs] and representational stage, will be made up of further combines as well as subsequent aggregates [combinations of simple geometric forms] ...

If a computer database could be devised documenting a complete existing inventory of early mark-making ... according to date, and keeping in

mind how evolution can evolve haphazardly... the model allows us to make the further prediction that there would be a gradual drift toward complexity beginning with the earliest, simple marks of the L. P. [Lower Palaeolithic] through to the appearance of diagrams, then combines/aggregates ...

Henshilwood *et al.* (2009) identify four basic pattern categories: 1) parallel lines, 2) dendritic shapes, 3), right-angled juxtapositions, and 4) cross-hatched designs, which were predicted by Hodgson (2000; 2006) to occur during the Middle Stone Age and before as shown in Figures 4 and 5. The explanation for the appearance of such marks was set out in ‘The Neurovisual Resonance Theory’ according to how the early visual cortex functions (see Hodgson 2000; 2006). Since first presenting extensive neuroscientific evidence to support this theory, research from neuroscience has continued to provide corroboration, particular with regard to Gestalt perception relating to early feature extraction and the corresponding neuronal synchrony in primary visual areas (Figueiredo *et al.* 2005; Gilbert & Li 2012; Harrison & Tong 2009; Murray *et al.* 2002; Qiu & von der Heydt 2005; Sasaski *et al.* 2006; Shibata *et al.* 2011; Supèr *et al.* 2003; Tong 2003; Wagemans *et al.* 2012; Wannig *et al.* 2011). The fact that a link has been confirmed between the way the early visual cortex processes incoming visual form information and Gestalt principles is crucial, as the Blombos engravings conform to the same principles, e.g. contiguity, grouping, symmetry, order, regularity etc. It is worth mentioning here that the Gestalt principles of perception have received considerably empirical support over recent years from a number of disciplines including neuroscience (see Wagemans *et al.* 2012 for a review). Importantly, as early visual perception is characterized by Gestalt principles of organization, such as proximity and contiguity, it has much in common with indexicality in that the latter similarly depends on such factors (Sonesson 1989a).

This tendency seems to derive from the fact that similar patterns have been found in the early visual cortex that are tuned to important sensory cues for disambiguating the visual array. Parallel lines, intersections, and right angles exemplify the crucial non-accidental properties to which the early visual system is tuned in the initial perception of form.¹ For example, particular patterns may suggest a unitary source belonging to a coherent object or organic form (Pinker 1997), which is reflected in the Gestalt rule that similar items group together and is realized in the early visual cortex by synchronized neural responses, i.e. what fires together goes together (Hebb 1949). It is in this sense that such responses and associated patterns can be regarded as pre-semantic proto-indices (Sonesson

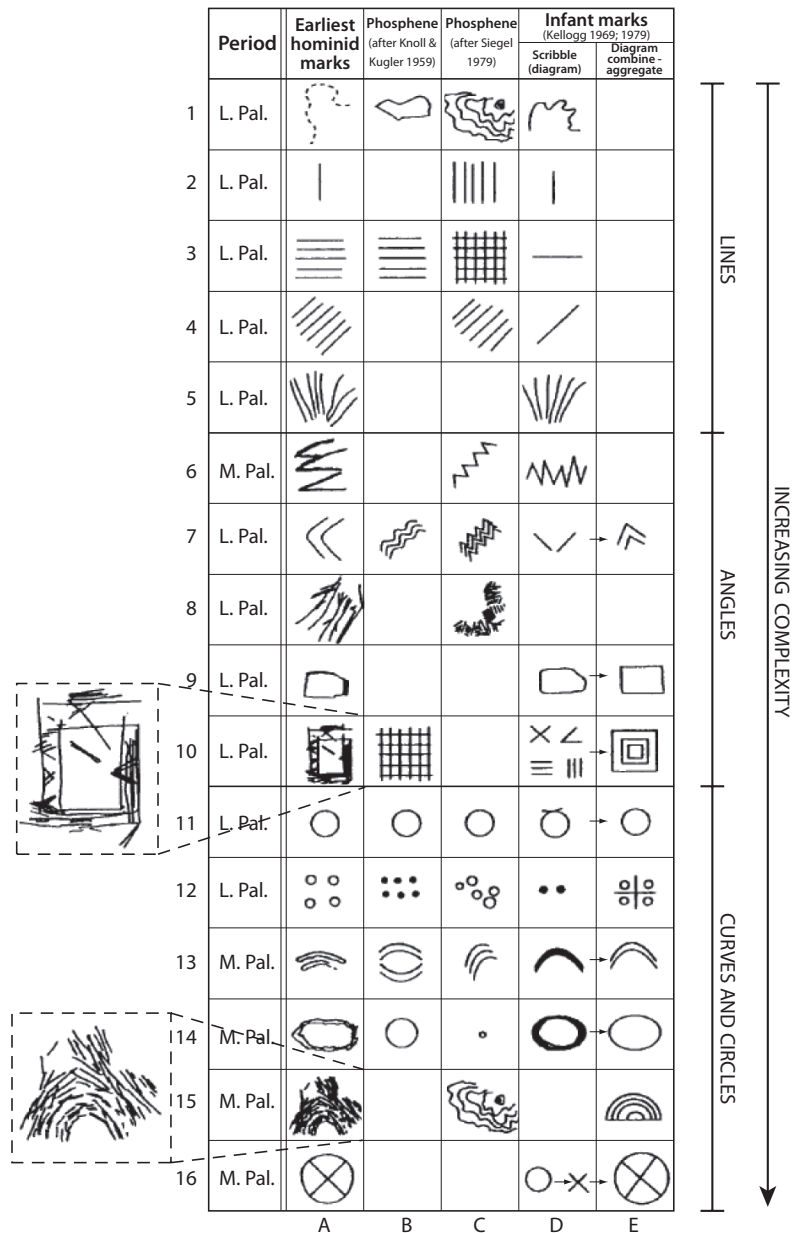


Figure 4. Marks identified and predicted to occur at an early period during the Palaeolithic progressing through time from straight lines and angles to more curved forms that correspond to neurons in early visual cortex tuned to such features (from Hodgson 2000).

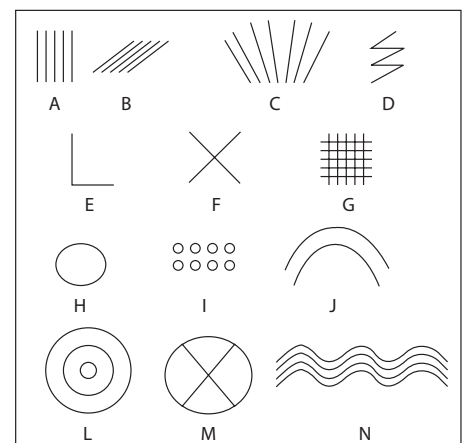


Figure 5. Marks predicted to occur during Middle Stone/Palaeolithic Age. The upper marks tend to predate the lower curved forms (from Hodgson 2006 based on simplified version of illustration from Hodgson 2000). All the simple and complex motifs employing straight lines (A, B, C, D, E, F, G) are represented in the Blombos engravings (as well as those from Klasies River Cave). Only one curved form is represented at Blombos namely M1-5 that arguably displays a resemblance to motif N.

1989b). Reber (2012) refers to this as perceptual fluency defined as the ease by which perceptual information flows through the visual system. Perceptual fluency, however, interacts with familiarity whereby an initial preference for simple geometric shapes, through repeated exposure, is superseded by a preference for slightly more complex shapes and so forth. This procedure is reflected in the tuning of neurons in the early visual cortex where it has been established that attention to the fine detail of simple geometric lines and patterns leads to enhanced response properties of neurons in the early visual cortex, especially V1, which increases discrimination to such lines (Jehee *et al.* 2012; Tong *et al.* 2012).

The pleasure derived from creating patterns therefore derives from the fact that artificially produced geometric forms serve as an externally derived supernormal correlate of the patterns processed by the early visual cortex leading to a sense that the world is being disambiguated correctly, which forms the basis of a proto-aesthetic awareness. In sum, when viewing repetitive-like patterns, the early visual centres become hyper-stimulated leading to an undifferentiated sense of arousal, which results from the fact the early visual areas are pre-tuned to respond to such lines because they play such an important role in the discrimination of objects in the world. Interestingly, certain implicit (preconscious) processes have been linked to the predilection for geometric forms to the extent that observers are not always aware why they prefer such motifs, which is referred to as preference without inference (Kunst-Wilson & Zajonc 1980; Voss & Paller 2010).

It is likely that the Blombos marks initially derived from the sense of arousal elicited (or proto-aesthetic sense) when viewing accidentally made scratches (either on the original ochre blocks or in the making use of tools etc) that served to prime the early visual cortex through implicit preconscious processes. This subsequently gave rise to an 'intentional' response leading to the production of geometric forms, which can be defined as an auto-cued, self-induced reward. Interestingly, perceptual priming (which is preconscious and automatic) for simple line stimuli precedes conceptual priming for shapes with a semantic component (Voss *et al.* 2010). Moreover, the early visual cortex is particularly sensitive to fine detail even in the absence of conscious awareness. In sum, the reason perceptual factors are important to understanding why repetitive patterns were made is that the early visual cortex is highly tuned to such patterns for detecting form in the visual array, which is facilitated by perceptual fluency (Reber 2012) leading to a proto-aesthetic sense.

The precise mechanism by which the Blombos engravings were realized is therefore likely to be as follows: during the process of acquiring ochre the individuals concerned will have noted — through the aforementioned resonance — that the accidentally made scratches on raw ochre created unintended patterns the instigators will have attempted to either reproduce or improve upon. In this sense, the accidental scratches served to scaffold the intentional engravings through neurovisual resonance, which conforms to the notion that behaviour is structured by embodied processes in that a previous active motor behaviour, which gave rise to the accidental scratch marks, led to a 'passive' perceptual response that facilitated a further motor activity for producing the intentional patterns. In other words, passive perceptual factors became engaged with active motor procedures in a way that had not occurred before.

The similarity of the unintentional scratches made for procuring ochre with confirmed intentional motifs on ochre blocks has been noted by d'Errico *et al.* (2012) for the Klasies River Cave engravings. In fact, the intentional marks appear on the same pieces of ochre as accidental scratches made for acquiring ochre at both Klasies River and Blombos (d'Errico *et al.* 2012; Henshilwood *et al.* 2009). In this way, the accidental scratches made for procuring ochre (or in other scenarios) stimulated those areas of the early visual cortex specialized for detecting and processing lines of various orientations that led to a vague sense of arousal leading to attempts to replicate both the scratches and the sensation in a distilled form. The fact that the existing accidentally produced scratches served as a cue for the intentional marks would therefore explain the preoccupation with certain kinds of repetitive motifs, i.e. straight parallel lines. Moreover, as a result of the founder effect, subsequent types of motifs would have been constrained and derived from the originally made marks, which is suggested both by the chronology and increasing complexity of both the Blombos and Diepkloof engravings. The tendency towards producing slightly more complex patterns also accords with the interaction between perceptual fluency and familiarity in that becoming accustomed to simple lines leads to the production of incrementally more complex shapes known as the inverted 'U shape' effect (Reber 2012).

In this respect, Davis (1986) has proposed that such motifs can be regarded as 'self-sufficient marks' in that there was a self-sustaining reciprocity between the perception and making of such lines. Davis, however, makes the added point that these marks would have *eventually* signified something beyond the original determining mechanism. It is therefore likely

that the Blombos and Diepkloof engravings initially had no explicit communicative value for their makers and may have been restricted to some unspecified personal use—probably relating to the aforementioned proto-aesthetic sense. This analysis suggests repetitive marks originally arose through resonance with the early visual cortex whereby the appeal was based on a non-specific sense of arousal leading to an implicit proto-aesthetic engagement. This appeal, however, will eventually have been exploited for personal/individual decorative use at some later date (e.g. for patterns used in body decoration), which was then exapted for wider socio-cultural purposes involving group affiliation. As Coolidge and Wynn state in their commentary in Henshilwood and Dubreuil 2011, ‘personal meanings were undoubtedly a precursor to collectively shared meanings’ which mirrors the last two observations. Due to the above-stated reasons, the Blombos and Diepkloof engravings do not seem to have signified personalized decorative use or social status rather they were sustained by an individually based iterative neurovisual response.

The Blombos and Diepkloof engravings were, therefore, initially contingent on how particular parts of the visual brain functioned that subsequently became significant for the individual producing the marks but which were not exploited for wider social purposes. At best, such marks might be viewed as personalized markers arising out of an inquisitiveness that stems from a feedback mechanism involving the perceptual system/visual cortex that generated arousal. This inevitably produced Gestalt-type configurations that conform to the laws of grouping (or *Prägnanz*) where sense experience is structured accordingly. This is in contrast to an ‘emblemic iconological style’ that is consciously and actively engaged, and which expresses an intentional message about social identity (Carr 1995; Wiessner 1983). As the Blombos and Diepkloof marks do not appear to be a part of a socio-cultural tradition or emblematic, the explanation may thereby be found in the functional derivatives of the early visual cortex as described. However, as the Diepkloof eggshell engravings appear to go slightly beyond the individually based iterative resonance of the Blombos motifs they, consequently, were endowed with a greater *potential* to indicate group identity.

Thus, the relationship between the different kinds of artefacts in southern Africa varied according to prerogatives; at Blombos the shell-bead necklaces signalled socio-cultural affinities whereas the engravings depended on individual induced resonance, with the Diepkloof engravings lying somewhere between these two modes (though closer to the latter than the

former), which shows that a different emphasis was employed according to the nature of the particular material employed.

Discussion

The above analysis suggests that a ‘higher order’ symbolic explanation based on a socio-cultural tradition should not be invoked with respect to the Blombos and Diepkloof engravings when a ‘lower order’ account based on specific perceptual mechanisms of the visual brain is sufficient. The uniqueness of the Neurovisual Resonance Theory to understanding the Blombos engravings and Diepkloof patterns lies in the fact that the theory predicted that such marks would emerge from ongoing archaeological investigations and the configuration of such marks even before these finds became known. Although, on the one hand, these patterns can be explained without the need for accounts based on group affiliation or emblematic/symbolic functions, on the other hand, the shell beads seem to depend on more sophisticated socio-cultural factors for signalling status or group affinity. This suggests different kinds of relationships existed with various artefacts during the Middle Stone Age in southern Africa in that some reflected more complex patterns of ‘symbolic’ engagement than others. Although the Blombos shell beads may have been a manifestation of personal ‘self exploration’, their high visibility to others in a social group makes it highly likely they entailed a wider social significance. This stands in contrast to the Blombos ochre engravings and Diepkloof ostrich eggshell designs that derive from more liminal/embodyed processes. The fact that indexicality is characterized by ‘blind compulsion’ and has much in common with Gestalt principles of organization that is reflected in the neural processes occurring in the early visual cortex, suggests the southern African engravings derive from these contingencies. This, however, is an indexicality limited to the individual that depended on an auto-cued response, whereas the shell beads, as salient objects, suggest a more socially mediated indexical awareness.

The variation in the use and exploitation of various materials in southern Africa can similarly be observed in the use of ochre as a binding agent in adhesives for hafting tools and in the mosaic appearance of relatively advanced technologies during the Middle Stone Age in sites such as Sibudo cave (Lombard 2006; Lombard & Wadley 2007). The variation emerging from the Still Bay and Howiesons Poort finds, however, rather than being symptomatic of a change to neuro-cognitive components, may be

a consequence of fluctuating population rates that impact on the ability to accumulate information over a sustained period, as has been suggested by a number of commentators (Henrich 2004; Powell *et al.* 2009; 2010; Shennan 2001). Similarly, Lombard has referred to the sporadic and inter-digitated occurrence of artefacts and various kinds of tools in southern Africa as symptomatic of a rugged fitness landscape that reflects the acquisition and loss of skills as a result of demographic, socio-cultural and climatic factors (Lombard 2012). These findings suggest that the crucial neuro-cognitive component underlying such variability may relate to a capacity to respond flexibly. This has been allied to associative cognitive factors relating to the ability to imitate (through mirror neurons) and empathize (by way of theory of mind) that dovetails with a range of cognitive abilities (including working memory) according to prevailing circumstances by way of co-evolutionary factors (Hodgson 2012a;b). The 'sapient paradox' may therefore simply be one late but enduring manifestation of flexible human behaviour that is a function of increasing population rates and neuro-cognitive plasticity where information is able to be exchanged and accumulate.

Conclusion

The present analysis demonstrates that the Blombos ochre and Diepkloof eggshell 'designs' need to be considered in a different way to the shell beads in that the beginnings of mark-making derived from an auto-cued feedback mechanism involving the early visual cortex, perception, active sensory motor procedures, as well as actual mark making. This provided a 'template' out of which more complex symbolically mediated designs could potentially be formulated. The Blombos engravings and Diepkloof engraved ostrich eggshell designs constitute evidence of such a template whereas the Blombos shell beads can be regarded as a socio-cultural phenomenon. These observations indicate that various levels of symbolic arbitrariness coexisted that included pre-semantic 'pre-indexical' proto-marks (what Soneson [1989b] refers to as proto-indices) deriving from neurovisual resonance as well as indexical signs for signalling socio-cultural identity. Although in southern Africa these activities coexisted, it is probable that pre-indexical marks predated indexical signs as suggested by similar marks from other parts of Africa (Beaumont & Bednarik 2013).

Note

1. Lewis-Williams (2004) refers to 'entoptics' in relation to the early visual cortex that is concerned with promoting

a shamanistic approach to the interpretation of geometric marks. As such marks appear in contexts where shamanism obviously does not exist, Lewis-Williams approach is unable to be applied to the wider context and time depth of southern Africa.

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Author biography

Derek Hodgson has published numerous papers showing how insights from neuroscience and perceptual psychology can help understand palaeoart and has recently published a paper on the origins of art in an edited book entitled *Origins of Pictures*. He is at present an associate researcher at the Department of Archaeology at the University of York carrying out research in palaeoart, palaeoneurology and cognitive evolution.

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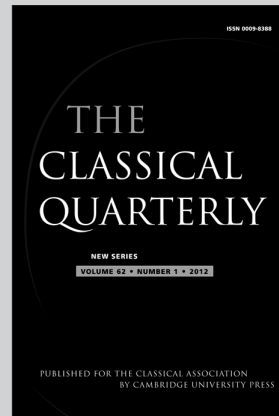
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