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ORIGINAL PAPER

About the Origins of the Human Ability to Create Constructs of Reality

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Abstract

The competence of humans to create and apply constructs of reality far exceeds that of any other animal species. Their ability to consciously manipulate such models seems unique, but it remains unknown how these abilities were initially acquired and then developed. Most individuals hold strong, culturally-anchored beliefs that their particular reality is true, a viewpoint challenged by the observation that all such constructs are different. They reflect not reality, but each individual's life experiences. Collectively they facilitated the development of hominins to unprecedented cultural and cognitive complexity. However, it remains entirely unknown how the human brain manages to create a model of the external world from the signals provided by sensory equipment and proprioceptors. This paper examines the roles of exograms in this development, as they are considered to be the only tangible connection between the brain, the faculties of sentience and the external world. Competency in exogram use became a crucial natural selection factor for humans and even overcame the human brain atrophy of the final Pleistocene and the Holocene. Under favourable conditions, some forms of exograms are capable of surviving from the deep time of human evolution. The paper follows their trail back in time to gain some insights into the developments that gave rise to human awareness, self-consciousness and Theory of Mind as we understand them. Specific archaeological finds and notions about sentient capabilities of hominins are presented in a search for exogram use in the course of human evolution. It results in a model that explains with clarity not only the course of the human journey but also the underlying reasons for the human condition as such: why we are the way we are.

Keywords Human evolution · Ontology · representation of reality · External memory trace · Exogram · Palaeoart · Autopoiesis

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1 Introduction

The issue we wish to address here is not so much how humans construct concepts, but how they create constructs of reality. This issue happens to be the most significant conundrum in science, which so far has seemed impossible to solve. In the close to 2400 years since it was first expressed so eloquently by Plato, in his simile of the cave, science has made no progress in explaining this fundamental metaphysical issue. We now know a good deal about the processes governing the transformation of specific properties of the real world, such as detecting variations in the wavelengths of reflected light, into neural signals as our sensory equipment converts them. However, we have no inkling of how these signals plus those provided by our proprioceptors create an image of reality in our brain. This individual construct of reality provides the framework of everything we know or believe, yet we do not understand how it comes into being. This places everything we are capable of thinking in a precarious state: our entire reality is provisional because it needs to be prefixed with the epistemological proviso '… depending on how much of it is valid'.

This is a significant problem because most of our conspecifics exist in the belief that the world is precisely as they experience it. That is hardly possible, considering that there are as many different autopoietic reality constructs as there are individuals. Each one reflects individual life experiences, and there are no two persons of identical sets of experiences. Indeed, the greater the cultural differences, the more significant the gaps between various life experiences and hence between individual realities. For instance, literate and illiterate conspecifics possess significantly different brain structures and chemistry (Helvenston 2013). These variations, attributable to neuroplasticity, not only derive from established circuitry: for example, the hippocampi of London taxi drivers differ considerably from those of other people (Maguire et al. 2000). Just as no two brains are identical, there are no two identical constructs of reality. Therefore, it is legitimate to assume that the *broad* similarities of such constructs applying within specific cultural realms are unlikely to extend to very different cultural contexts. Since we began working with Aboriginal elders in the 1960s, we observed that they appeared to exist in a reality significantly different from that of non-Aborigines, having been isolated from the rest of humanity for many millennia. Much the same applies to other traditional societies, and in all colonisations, the colonised's epistemological realities were always debased and crushed by the colonisers.

Numerous factors need to be investigated in a quest to consider the origins of the human ability to create constructs of reality. This includes the question of differences in individual realities and how hominins prevailed over their brain atrophy, which derived from the domestication syndrome. These various factors will be investigated below in Chap. 4 and will lead to discovering what it was that helped create individual autopoietic realities. However, we will first explore the topic of exograms.

2 Exograms

We may reasonably assume that the human ability to adopt constructs of reality did not arise at a specific point in time—such as, for instance, at the first appearance of the mythological 'Moderns'. It formed gradually in millions of years. Fortunately, we are not entirely bereft of information about this process. Exograms (Bednarik 2014a) are entities of memory storage external to our brains, and some of them are archaeologically recoverable. Their name derives from 'engrams', memory traces that have been searched for in our brains for much of the 20th century. Named by Semon (1904, 1921), engrams were thought of as persistent biophysical or biochemical protoplasmic alterations of neural tissue occurring upon stimulation of the brain. Despite the labours of many researchers, they have never been identified. For instance, Lashley spent much of a lifetime endeavouring to locate engrams in rodent brains (Lashley 1923a, b, 1924, 1930, 1932, 1935, 1943, 1950). Instead, he succeeded in demonstrating that there is no single biological locus of memory, but many. Among them are the cerebral cortex, hippocampus, amygdala, visual cortex and auditory cortex, while associations are stored in the associative cortices (Churchland 1986; Squire and Zola-Morgan 1991; Hooper and Teresi 1992; Kandel and Pittenger 1999; Squire and Kandel 1999; Christos 2003). Penfield's (1958; cf. Gregory 1970) investigation into the engram generated the notion of storage of memory traces external to the brain, and Goody (1977) and Carruthers (1990, 1998) developed the idea of a 'surrogate cortex'.

The first concrete proposal of identifying specific phenomena as engram-like externalised and permanent forms serving as repositories of memory was very early rock art patterns (Bednarik 1987). We interpreted them as cognitive reference frameworks accessible to the sensory perception of conspecifics, projections of neural structures and projections of neural systems perceptible to the senses. We also emphasised the significant communication potential of such externalised, engram-like phenomena, because conspecifics would have possessed resonating neural systems (cf. also Bednarik 1990). Donald (1991, 2001) then created the term 'exogram' but seemed unaware of both Semon's and our work (just as Richard Dawkins seemed unaware of Semon's 'mneme' when he invented his 'meme'). The observation of externalised memory's existence goes back in history as far as to Plato (in *Phaedrus*, 274e–275a), and much later was considered by Neo-Kantians and Husserl. Clark and Chalmers (1998) proposed that even non-exogrammic objects within the environment function as a part of the mind. 'Extended mind studies' remain controversial, but as Rowlands (1999) notes, exograms support cognitive processes not accessible to creatures restricted to purely biological memories. Their storage systems facilitate visiting memory locations at will, extracting and manipulating their information contents. In stark contrast to internal memory traces, exograms have been thought of as semi-permanent, unconstrained and reformatable (depending on their exact nature). They can be of any medium, have virtually unlimited capacity and size, and be subjected to unlimited iterative refinement. The processing power needed to recall locations and specific items is economical and flexible (Sutton 2008). Once securely internalised, the virtual architecture could be used highly effectively, and the adept's mind becomes the equivalent of random access memory (Carruthers 1990, 1998). Donald's account of exograms has been subjected to much criticism (e.g. Brace 1993; Cynx and Clark 1993; Adams and Aizawa 2001; Sutton 2008, 2009) and his adherence to superseded models flawed his attempts to place it within the framework of the evolution of humans and their language. He subscribed to the replacement hypothesis (cf. Bednarik 2013a) and the very late language acquisition model (*contra* Falk 1975; Arensburg et al. 1989, 1990; Bickerton 1990).

Any object, mark or feature in the physical world can effectively become an exogram if the human brain can use it as a memory prompter; or if it can elicit brain reactions like emotions or thoughts; or if it can express concepts; or if it can act as a symbol or mnemonic device, moral code, semiotic expedient or any other external agent capable of storing traces of memory. Millions of factors can carry referential information stored in them to which the brain's internalised virtual architecture can connect effortlessly and recall meanings previously deposited in them. Today, our entire world would be unthinkable without exograms, but other animals seem to lack the neural facilities to create and manipulate them in the way we do. Therefore, we should assume that our ancestors also lacked that faculty at some point in time and that it began to appear at a specific stage in our evolution.

This immediately raises the question: at what point in our evolution, or when did hominins begin to use exograms? It is impossible to answer, not only because few types of exograms can be preserved in the archaeological record, but also because that record is subject to so much taphonomic distortion (Bednarik 1994). However, we can re-phrase the question: when can we detect the earliest indications that exograms were used?

3 Exogrammic Phenomena in Hominin History

By far the richest source of archaeologically detectable exograms is palaeoart, which consists of phenomena that resemble art and occur in very early periods of human history. Palaeoart, which may or may not be 'art' in the conventional Western sense, and may or may not be symbolic (involving representation, representant and interpretant; Barrett 2013), is found in several forms. It includes beads and pendants, petroglyphs, pictograms, portable plaques and 'decorative' objects, figurines and proto-figurines, and manuports (natural objects collected for their intrinsic and novel properties) and the use of pigment materials. Although readily demonstrated by archaeology, the last-mentioned is not necessarily proof of exogram use because some utilitarian uses of pigment are also known. Most pigment use, however, is exogrammic in ethnographically known societies.

Perhaps the most useful of these ancient exograms are *beads and pendants*. Their identification presents none of the ambiguities that can be encountered with other of these classes. A centrally perforated archaeological object that is too small or fragile to have been used as quanging or pulling handle tends to be a bead, especially when it occurs in large numbers. Second, beads cannot exist without having complex cultural meanings. Pendants or beads might indicate rank or status; protect the wearer from evil spirits or ward off other dangers; advertise availability for marriage, or wealth or any other condition; signify affiliation with an ethnic entity, in-group, alliance or faction; or convey any number of other meanings known to the emic insider. Those meanings are always inaccessible etically (as opposed to emically), however (i.e. archaeologically), but there can be no doubt that they were complex, nuanced and exogrammic.

Beads and pendants occur in significant numbers in Upper, Middle and Lower Palaeolithic traditions. Just two of the three human burials at Sungir, Russia, of an industry transitional between Modes 3 and 4, the Streletskian, contained 13,113 ivory beads and more than 250 perforated fox teeth (Bader 1978; Bednarik 2008b). Of particular interest in tracking the early development of exograms are those of the Lower Palaeolithic. They include the hundreds of perforated stone beads from a series of French and English sites, made from *Porosphaera globularis* Phillips 1829, a Cretaceous sponge (Bednarik 2005). Many of these beads display traces of anthropogenic modification and extensive wear suggestive of very prolonged use (Fig. 1). Other Lower Palaeolithic beads are the 43 Acheulian ostrich eggshell specimens from El Greifa in Libya, c. 200 ka old, and those from Kathu Pan in South Africa, c. 290 ka old (Bednarik 2017, p. 40, 51). Ostrich eggshell disc beads have been made ever since and in massive numbers, from southern Africa to southern Siberia, by peoples of the Middle and Upper Palaeolithic as well as in Holocene times. Another form of disc beads used in the Acheulian is the crinoid fossil casts from Gesher Benot Ya'aqov in Israel, one of which is heavily rubbed from having been worn on a string for a long time (Goren-Inbar et al. 1991). Two perforated objects from the Repolust Cave in Austria have also been touted as being of the Lower Palaeolithic (Mottl 1951), but

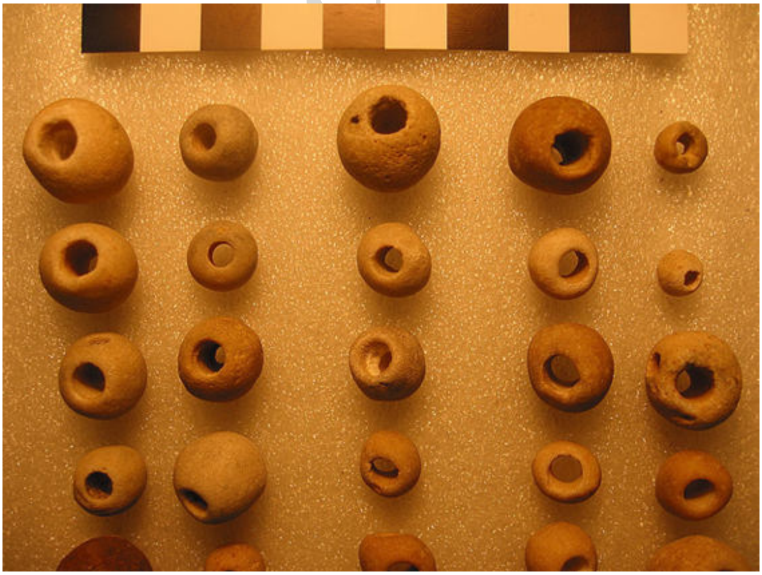

Fig. 1 Perforated sponge fossils from the Acheulian of Bedford, England

on investigating their context closely, we are no longer convinced their claimed antiquity is certain.

Petroglyphs (forms of rock art made by a reductive process) predating the Upper Palaeolithic or Mode 4 traditions are not only well represented, but they are also indeed far more numerous than those attributed to Mode 4 industries. All rock art of the Pleistocene and early Holocene of Australia is of Mode 3 traditions, and its petroglyphs vastly outnumber those known of the entire world's Mode 4 cultures (Bednarik 1995), estimated to number only about 3000. Petroglyphs attributed to the Lower Palaeolithic are presently limited to very few sites, two in India and a few in southern Africa. The first rock art of Acheulian or earlier age was reported from Auditorium Cave in Madhya Pradesh (Bednarik 1993), followed by another central Indian quartzite cave, Daraki-Chattan (Kumar 1996). In both cases, some of the cupules were excavated below Lower Palaeolithic occupation strata. Some were found in situ, and others had exfoliated after they were created on the walls.

These two sites feature the earliest currently known rock art, but there are reports of very early petroglyphs also from Africa. A grindstone of the Fauresmith tradition, which is final Mode 2 (late Lower Palaeolithic or Early Stone Age), featured a grid pattern and was found at Blind River Mouth at East London, South Africa (Laidler 1933). A sandstone slab excavated from the Lower Sangoan of Sai Island, Sudan, bears a series of cupules and is about 200 ka old (Van Peer et al. 2003). A series of open quartzite sites in the southern Kalahari features rich cupule sites attributed to the Middle Stone Age, but an earlier phase of cupule production also occurs at two of them, Nchwaneng and Potholes Hoek. It has been attributed to the Fauresmith and suggested to be about 410 ka old (Beaumont and Bednarik 2015) (Fig. 2).

The class of *pictograms* (rock art forms produced by an additive process) is not relevant here because no such material has been credibly demonstrated to be over 40 ka old.

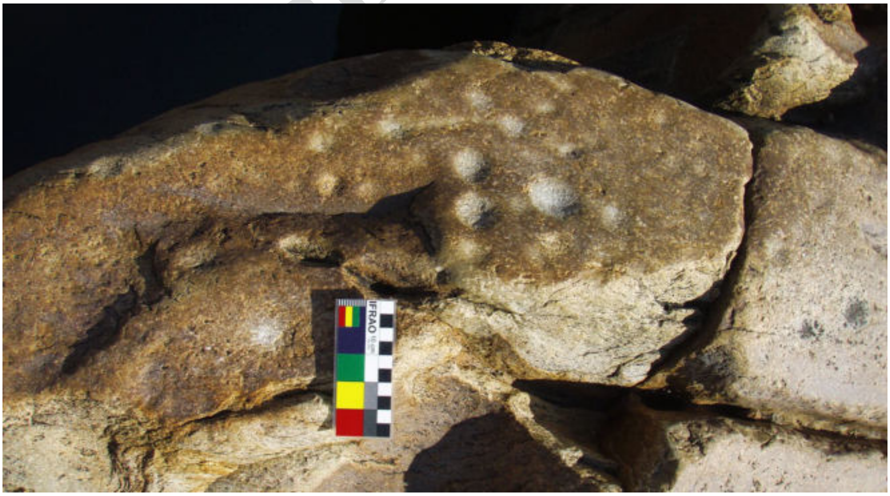

Fig. 2 Cupules of the Middle Fauresmith at Nchwaneng, Kalahari Desert

The largest site assemblage of *engraved portable objects* from the Lower Palaeolithic is that of Bilzingsleben in Germany (Mania and Mania 1988). Perhaps in the order of 400 ka old, it now includes six engraved bone fragments, most of the forest elephant, as well as one postulated engraving each on a large ivory point and a quartzite block (Bednarik 1995). The intentionality of the engravings has been demonstrated by microscopic laser analysis (Steguweit 1999). The markings' arrangement on one of the bones resembles that found on a much more recent find from a gravel pit at Oldisleben in the same region, occurring with two other engraved bones and Micoquian lithics (Günther 1994; Bednarik 2006). Another elephant bone of a Lower Palaeolithic assemblage bearing deliberately arranged lines has been reported from Stránská skála, Czech Republic (Valoch 1987). Then there is the bone fragment from the Acheulian of Sainte Anne I in France, bearing ten deliberately made cuts along an edge (Raynal and Séguy 1986). Similarly, the markings on a mammoth ivory fragment of the Rissian glacial from Whylen, southern Germany, seems to be notational (Moog 1939), but the specimen has been lost at the end of the Second World War. Wonderwerk Cave in South Africa has yielded a carefully and deliberately engraved microcrystalline ironstone plaque that is >276 ka old (Bednarik and Beaumont 2012).

The oldest postulated portable engraving came from the classical Trinil site in Java and was excavated in the early 1890s by Dubois (1894) but was detected only more than a century later (Joordens et al. 2014). It consists of a zigzag pattern on the outside of a freshwater mussel shell thought to be in the order of 500 ka old. During the Middle Palaeolithic/Middle Stone Age or Mode 3 traditions, portable engravings become quite numerous across Eurasia (Bednarik 2017). Of particular interest in detecting early exograms is the assemblage from Denisova Cave in southern Siberia. The putative Denisovans, robust hominins roughly coinciding with the Neanderthals, created a rich assemblage of them around 50 ka ago. It includes not only beads, pendants, circlets and other presumed 'ornaments' of various types (Fig. 3), but also a green chlorite bracelet fragment of extraordinary technological sophistication. It could have only been created with a method not re-discovered until Neolithic times (Semenov 1964, p. 74–83).

Figurines become very common in Mode 4 traditions of Eurasia, from France to Siberia, in the last 40 ka. They depict human females or a variety of animals such as water birds, mammoths and horses. However, there are also two instances of much earlier *proto-figurines*, naturally shaped stone objects that have been modified artificially to emphasise their iconographic properties. Both date from the principal tool tradition of the Lower Palaeolithic, the Acheulian. The first reported is a basaltic tuff pebble containing scoria clasts and was excavated from a Late Acheulian occupation deposit at Berekhat Ram, Israel (Goren-Inbar 1986). It is somewhat older than 230 ka, and its natural form is suggestive of the head, torso and arms of a female human, emphasised by grooves and other modifications (Marshack 1996). The Tan-Tan proto-figurine from Morocco is a natural anthropomorphous sandstone object found with numerous Middle Acheulian lithics suggesting an age of about 400 ka (Bednarik 2003). Eight symmetrically arranged grooves emphasise its human form, five of which have been modified by human hand and traces of red pigment suggest that it was once coated by red paint (Fig. 4).

Fig. 3 Presumed decorative objects from Denisova Cave, Siberia, made by Denisovans around 50 ka ago

Fig. 4 The Tan-Tan quartzite object from the Middle Acheulian of Morocco, the oldest known proto-figurine

So far we have not encountered any exogrammic phenomena older than half a million years. *Manuports*, however, have been reported that are of clearly greater ages. By far the earliest known is the Makapansgat jasperite/jaspilite cobble excavated in 1925 from the australopithecine-bearing level 3 pink stony bone breccia in the Limeworks cave of South Africa (Eitzman 1958). It was carried into the dolomite cave approximately 3 Ma (million years) ago. Its forensic history has been reconstructed by microscopic analysis of its surface markings and accretions (Bednarik 1998). The transport of the heavily worn, red cobble into the cave has been attributed to *Australopithecus africanus*, but since the discovery of *Kenyanthropus platyops* (3.5 Ma) it has become possible to consider that a hominin was involved. The specimen remains very isolated chronologically, but as it could not have been transported into the cave by a natural process, it needs to be appreciated that its outstanding iconographic characteristics probably prompted its curation. Notably, the specimen implies apperceptive capability. It became an exogram by virtue of its shape, markings and red colour (Fig. 5).

Prismatic crystals, particularly rock crystal, is another natural form that apparently became manuports very early. For instance, they occur in all Acheulian strata of Wonderwerk Cave, the lowest of the Early Pleistocene (>1 Ma). The six complete

Fig. 5 The Makapansgat jaspilite cobble from South Africa, the oldest known manuport and exogram

quartz prisms excavated at the Early Acheulian site Singi Talav in India range from only 7–25 mm in size, originate from different geodes and are too small to create implements from (d'Errico et al. 1989). Even smaller are the quartz crystals from the Acheulian of Gesher Benot Ya'aqov in Israel (Goren-Inbar et al. 1991). The twenty quartz crystals from Zhoujoudian, China, were collected by *Homo erectus* (Pei 1931). Clear quartz crystal lithics were also excavated in the Late Acheulian layer of Gudenus Cave in Austria (Bednarik 1992).

Other exogrammic manuports include the silicified cuttlefish fossil cast (*Orthoceras* sp.) from an Acheulian dwelling or windbreak at Erfoud Site A-84-2 in eastern Morocco. Such fossils do not occur naturally in that region, and it appears the specimen has been carried for a considerable distance before it was deposited at the occupation site (Fig. 6). It no doubt became a manuport because it resembles a human penis very closely (Bednarik 2002). It is also possible that the anthropomorphous dolomite fragment from Mumbwa Caves in Zambia was a manuport (Barham 2002). Numerous Acheulian handaxes may well have served as exograms. Some bear prominent fossil casts (such as specimens from West Tofts and Swanscombe, England), others were fashioned with holes through them (Berlant and Wynn 2018, Figs 38–41), and many were made to such high levels of craftsmanship that it seems they carried the message of perfection which is evident in other Acheulian artefacts as well, such as ostrich eggshell beads. Thus exogrammic manuports are known from roughly up to a million years ago, with one example three times as old.

Similarly, the use of colouring matter can be traced back over a million years. Half a dozen haematite manuports were excavated at Kathu Pan 1 from a rich Acheulian occupation level between 0.8 and 1.3 Ma old (Beaumont 1990a, 2004). Of similar age might be a haematite fragment and a red-stained spheroid from Kabwe, Zambia (McBrearty and Brooks 2000), although Clark et al. (1947) suggest a lower age. At Mashwening in central South Africa, specularite pieces are thought

Fig. 6 Fossil cast from Erfoud in eastern Morocco, a Late Acheulian manuport

to be in the order of 0.8 Ma old (Beaumont 1990a). Wonderwerk Cave has provided ochre or haematite from various layers, including the lowest from the Major Units 6 and 7 in Excavation 1, dated to ~1.1 Ma (Beaumont 1990b, 1999). Therefore, pigment was in use during the Early Pleistocene of Africa, and in all probability in the roles of exograms. With the Middle Pleistocene (780 ka to 126 ka), pigment use evidence becomes more common in the Old World. It has been reported from many Acheulian sites, including Pniel 6, Noitgedacht 2, Biesiesput 1, Canteen Koppie, Bushman Rock Shelter, Kapthurin Formation Site GnJh-15, Twin Rivers Kopje, Zombepata Cave, Bambata, Pomongwe, Kalambo Falls, Sai Island, Terra Amata, Achenheim, Ambrona, Beçov, Maastricht-Belvédère and Hunsgi (Bednarik 2017).

Despite yielding tens of thousands of stone implements, the major Early and Middle Acheulian site Canteen Koppie in central South Africa has not provided any pigment finds from the period between 1.9 and 1.25 Ma (Helgren 1978; Gibbon et al. 2009; Beaumont 2011). This has been interpreted as suggesting that pigments may not have been used during this earliest period of the Acheulian. Although it is risky to rely on the absence of evidence, in the context of other sites in the region and the wealth of artefacts at this particular site we may need to consider that pigment use did not extend beyond 1.3 Ma, when it may have commenced at Kathu Pan 1.

4 Creating Constructs of Reality

Thus, we have reviewed the available record of archaeological phenomena that suggest the hominin use of external memory traces to convey, manipulate, or store information bits. Keeping in mind the vital proviso that the effects of taphonomy severely truncate this record, this catalogue would suggest an initial timeframe of these developments. Its first importance is to appreciate that while exogram use can have begun earlier than indicated, it cannot be a more recent development; it is a *terminus ante quem* indicator. According to this record, some features have been recruited as exograms since roughly half-way between the split of the hominins from the apes and the present time. That split is thought to have occurred 6 or 7 million years ago. By at least 1 million years ago, the incidence of exogram use had become more common and archaeologically visible, and by a few hundred thousand years ago—but still well before the advent of what some define as 'anatomically modern humans'—these practices had become widespread. Eventually, competence in exogram use became established as a crucial natural selection factor for humans.

All animals possess certain forms of responses to conditions in the external world, but it appears that only the human animal can freely modulate such responses by mental or cognitive processes and reflect on these deliberate choices. It is probably that capability that accounts for the human species' cognitive and technological rise over the last several million years. However, the precise mechanism of this archaeologically evident rise is not established. To mention an apparent inconsistency in the standard explanations: it has long been claimed that the cultural and cognitive ascent of hominins has been underwritten by encephalisation, the relentless increase in brain volume. However, this is squarely contradicted by the atrophy in human brain volume over the past forty millennia (Bednarik 2014b). It occurred at a time when the cognitive demands made on that brain are thought to have increased if anything. This is one of many generalisations in the mainstream's explanation of human evolution that are not credible; we will encounter others below.

It is true that in the long term, the human cranial volume rose by an average of 7 ml per 10 ka (1000 years). However, around 40 to 50 ka ago, that trend 'suddenly' reversed, and it did so at a time we assume the demands made of the brain rose dramatically. Since Mesolithic times, that atrophy of the brain has amounted on average to 261 ml. That represents 37 times the rate of the long-term increase in brain size during the second half of the Pleistocene, and it follows brain atrophy since the Neanderthals, whose brains ranged in size up to 1900 ml. The brains of hominins ancestral to us, such as the Neanderthals, were on average around 13% larger than our own. This is not a new insight; it has been known for several decades (Beals et al. 1984), but as it clashed with the concept of our rise to the image of a deity, it was widely ignored (but see Henneberg 1988, 1990).

The plummeting size of the brain during the most recent evolution of hominins is important for two reasons. First, it illustrates the fashion-driven nature of the field addressing our evolution. Second, it is incompatible with the enormous evolutionary and other costs of encephalisation, such as prolonged infant dependency, reduced fertility and significant obstetric costs (Joffe 1997; O'Connell et al. 1999; Bednarik 2011). We only need to consider how brain size dictates infant dependency and mortality among nomadic tribes. If a smaller brain can be more effective, as the evidence seems to suggest, the traditional correlation between encephalisation and increasing cognitive, intellectual and memory resources is without rational basis. If brain size is irrelevant to the volume of mental sources, why would our evolution have imposed a larger brain's massive evolutionary costs? The demand for neural resources is thought to have increased significantly since the Neanderthals, yet this period has seen such a significant reduction in brain size.

Disregard for such factors mirrors other questionable trends, such as the humanistic imposition of teleological concepts on aspects of evolution, a process that is entirely dysteleological. Although the African Eve or replacement hypothesis (Bednarik 2013a) has effectively been refuted by the genetic evidence that all hominins of the Late Pleistocene were interfertile, its teleological message continues to be disseminated. However, the replacement hypothesis has never been credible (Maddison et al. 1991; Barinaga 1992; Hedges et al. 1992; Templeton 1992, 1993, 1996, 2002, 2005; Brookfield 1997; Klyosov and Rozhanskii 2012a b; Klyosov et al. 2012; Klyosov and Tomezzoli 2013). It is based on a claimed speciation event in sub-Saharan Africa, and genetic evidence (Krings et al. 1997; Gutierrez et al. 2002; Hardy et al. 2005; Garrigan et al. 2005; Green et al. 2006; 2010; Gibbons 2010) has refuted that claim, and thus the validity of the Eve notion. Comparisons between the DNA sequences of Denisovans, Neanderthals and present humans have shown that many variants are shared among them (Sankararaman et al. 2012; 2014; Prüfer et al. 2014; Vernot and Akey 2014; Viegas 2015; Kuhlwilm et al. 2016; Vernot et al. 2016). Not only are Denisovans and Neanderthals subspecies of *Homo sapiens*, but it has also long been suggested that *H. heidelbergensis* and possibly even *H. erectus* are so as well (e.g. by Milford Wolpoff). Eve's advocates have even adopted the practice of limiting the term ‘humans’ to what they define as anatomically modern populations (bearing in mind that ‘we have never been modern’; Latour 1993).

Bednarik (2008a, 2011, 2020) counters the replacement hypothesis with the more plausible domestication theory, which explains practically every characteristic distinguishing present humans from their predecessors and is supported by the available genetic data. For instance, it explicates the reduction in cranial volume and explains thousands of genetic disorder alleles’ preservation. It provides a rationalisation for the appearance of neurogenerative diseases of which other animals are free, explains why brain illnesses involve mostly those areas of the brain that are the phylogenetically most recent, and clarifies the significant and accelerating reduction in human dentition size (Brace et al. 1987). The domestication theory elucidates the human menopause and abolition of oestrus, explains the dramatic neotenisation of humans in the last few tens of millennia, as well as the loss of bone robusticity, muscle bulk and physical strength. It explicates the preservation of exclusive homosexuality and Mendelian disorders, the pronounced male preference of neotenous females, and even why the extant human is the only animal whose males select females based on cultural variables. The replacement model explained virtually nothing by comparison, besides lacking archaeological, palaeoanthropological or genetics support. Recent genetic data concerning the effects of the domestication syndrome suggest that humans have indeed undergone self-domestication (Castellano et al. 2014; Prüfer et al. 2014; Benítez-Burraco et al. 2016; Racimo 2016; Peyrégne et al. 2017; Theofanopoulou et al. 2017; Makino et al. 2018).

Since there is consensus that at the time this rapid reduction in cranial volume occurred, the demands made on the human brain were increasing exponentially, our brain atrophy beggars an explanation. Moreover, if a much smaller brain could provide better processing power, we face the conundrum of explaining why evolution has consistently selected for encephalisation for millions of years. This glaring incommensurability can easily be resolved by considering the rough metaphor of the computer. Its functionality can be significantly enhanced by storing much of its memory in external drives and reserving the computer’s resources for more immediate issues and managing external devices. Thus, as the brain shrank, individuals best at delegating memory to external traces (exograms) had a significant advantage and would have outcompeted those that failed in this. This explanation lacks direct evidence, but until an alternative can be found that accommodates the empirical evidence at our disposal, it is available for refutation. It does explain how hominins managed to thrive culturally, technologically and cognitively when their neural resources were reduced by genetic developments directly related to their auto-domestication.

However, it does tell us a great deal more, which happens to be more profound than explaining the emergence of human modernity (Bednarik 2012a). This becomes immediately apparent when we consider another role of exograms. We are accustomed to assuming that our brain creates its perceptions of reality from our sensory organs’ messages and, to a minor extent, from our proprioceptors. This is no doubt true, but there is another factor that needs to be considered. By being external entities linked to our memory, exograms connect the brain with real links to the world external to our bodies, in much the same way our sensory equipment reacts to specific properties of the world, but at a different cognitive level. Exograms must be seen as part of what connects us to the base reality assumed to exist out there.

This insight provides a fresh glimpse into the unknown processes that translate base reality into an internalised world model that can be manipulated as only humans can. It needs to be considered in the light of the—somewhat limited—indications we have about the advents of Theory of Mind, self-consciousness and, especially, awareness in the evolution of hominins (Bednarik 2012a, 2012b, 2015). The theory of autopoiesis implies that when we refer to our interactions with a concrete autopoietic system, we project this system on the space of our manipulations and make a description of this projection (Maturana and Varela 1980, p. 89). An autopoietic system is one that possesses sufficient processes within it to maintain the whole. Human cognition yields precisely what Plotkin (2002) describes as an 'imagined world made real'. Autopoietic mechanisms operating as self-generating feedback systems cannot be separated from those who manipulate and use them (McGann 1991, p. 15).

Provided that the internally consistent logical framework is not challenged by it, there is no reason to assume that an entirely false, cultural cosmology or epistemological model could not be formed and maintained indefinitely by an intelligent species (Bednarik 1990). Most importantly, the evolution of human sensory facilities and intellect can be assumed to have equipped us with only adequate faculties to make them useful; there is no evolutionary benefit in defining the reality of the cosmos correctly (Bednarik 1984). Consciousness is self-referential awareness, the self's sense of its existence, and this is why its aetiology remains unsolved. The reality it creates is as hard to define as finding a self-consistent set of axioms for deducing all of mathematics, another self-referential system (Hofstadter 2007).

We propose that around 50 ka ago, competence in employing and gradually exploiting exograms began replacing traditional, 'natural' selection and became the primary selecting factor in hominins' cognitive fitness. By its very nature, this process was autocatalytic, and its effects can be observed throughout all present-day societies. The sustained use of any reference system changes the brain's structure, chemistry and operation by neuroplasticity. No such system could be assumed to be as effective and all-pervasive in effecting such changes as the continuous use of externalised memory traces. Without it, the human brain as it exists today would be rather like an unconnected computer terminal, rendering the individual's ability to relate to what is experienced as reality severely impaired. Numerous neuropathological conditions illustrate such a state.

The mechanism of establishing perceptions of reality remains unknown, but it may well resemble the better-understood system of body awareness or how the individual judges a conspecific's body movements (Bednarik 2012a). Body awareness/ownership is established in the right hemisphere's superior parietal lobule (Bednarik 2013b, p. 27). A conspecific's body movements are thought to be read by running a virtual reality simulation of the corresponding movements in one's own brain (Ramachandran 2009). Mirror neurons (Stern 1985; Di Pellegrino et al. 1992; Rizzolatti et al. 1996; Bråten 2004, 2007; Ramachandran 2009) are presumably involved in this process, as deduced from specific neuropathologies (Bednarik 2011). Therefore, the most likely explanation of how human constructs of reality are established is that the brain creates a virtual-reality-like model of the external world (perhaps in the parietal lobe?) in much the same way as the mental image of the body is shaped (Bednarik 2012b). The exograms are indispensable in this, forming a reliable link between brain activity and the external world. This could be the mechanism by which humans experience 'reality' 'consciously'.

5 Summary

The most significant quandary of science is that it remains unable to explain how the brain, specifically the human brain, processes the sensory data it receives to create conscious realities. Since there are practically as many individual perceptions of reality as there are people, it stands to reason that they cannot represent a base reality or a comprehensive model of what is really out there. This renders it very difficult to assess these constructs or even communicate about them effectively; they are self-referential, autopoietic creations. This problem places a considerable burden on science, in that it invites interrogation of all propositions in science. To secure a better understanding of the conception of human perceptions of reality, this paper endeavours to fathom the origins of the human ability to form such models. It is proposed that memory traces external to the human brain played a significant role in that respect. They provide a more tangible link between the brain and the external world than randomly selected sensory information that had to be translated into a neural format and, somehow, decoded within the brain. These exograms are expressed in myriad features, some of which can be identified archaeologically. These are defined as palaeoart, art-like phenomena known from the archaeological record.

The earliest instances known of such phenomena have been presented here. They provide some level of indication of how the human ability to create the ideational world in which the ancestors saw themselves existing was developed. By anchoring meaning to external features, these became reference points for communication that could be shared. Thus, as one individual collected and retained an exotic find (e.g. a crystal or fossil cast), another could detect the same properties in it, sparking volitional communication. Both individuals understood that what was a stone also seemed to be a penis (as in the case of the Erfoud manuport from Morocco). Similarly, an oral sound could have a specific meaning, as could any other exogram. Not only could it hold meaning, but that meaning could also be transferred to a conspecific.

The ability to create and use such exograms was strongly selected by evolution, most notably when it became available to compensate for the relatively rapid brain atrophy, one of the many effects of auto-domestication (Bednarik 2020). Irrespective of which factor prompted the other, the effect was that exogrammic competence was established as an autocatalytic or self-replicating process leading to our state of being entirely dependent upon exograms. *The creation of reality constructs is a by-product of that process.*

Alternative explanations of humanly perceived reality lack in clarity or causal elucidation. An example is Bostrom's (2003) proposal that reality is a simulacrum, a computer simulation by a posthuman civilisation. It resembles Descartes' dream hypothesis or evil demon argument, which Russell (1912) responded to by defining the former as a less simple hypothesis than "the common-sense hypothesis that there really are objects independent of us, whose action on us causes our sensations". The simulacrum proposal still assumes the existence of a base reality but shielded from us by the simulation, so instead of trying to solve the issue, it merely defers it. Moreover, it omits to tell us how every trace of the posthumans pulling our strings has been erased in our simulation. Here we have suggested that a more productive way than philosophical speculations to approach the issue is by asking: how did human constructions of reality arise in the first place, in our early history, given that other animals seem to lack them? We have presented our answer here and invite its falsification.

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