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## SHAMANISM AND BRAIN ILLNESS IN ROCK ART PRODUCTION

Robert G. Bednarik

**Abstract.** Among the many generic explanations offered over the past two centuries for rock art production, those involving several brain illnesses and shamanism are selected for detailed analysis. These proposals are reviewed in light of the aetiologies of the psychiatric conditions linked to rock art. Some are related to the assumption that palaeoart was introduced through shamanism. Although no simplistic link between shamanism and brain disorders has been demonstrated, relevant susceptibility alleles might be involved in some shamanic experiences. No connection between rock art and shamanism has been credibly demonstrated to date. Moreover, the assumption that neuropathologies and shamanism preceded the advent of palaeoart also appears to be mistaken. It derives from the belief that palaeoart was introduced by ‘anatomically modern humans’ and on the discredited replacement hypothesis. These interlinked issues are discussed.

### Introduction

In this journal, the connection between rock art production and brain illness was first broached by Bullen (2011) and the ensuing discussion (Helvenston 2012a; Bullen (2012) concerning purported links between bipolar disorder and rock art. Bullen initially responded to the key propositions by Whitley (2009): that (a) shamans introduced palaeoart, (b) shamanism derives from bipolar disorder, (c) this disorder confers enhanced creativity on the patient, and (d) this illness explains the origins of artistic production. She refuted these, as did Helvenston’s commentary. Whitley had proposed that rock art was created by ‘unusual people’ with specific kinds of mental disorders that drove them mad but also promoted their genius (2009: 243). These mood disorders were the defining characteristics of shamanism, he had argued, and he defined bipolar disorder as the ‘shaman’s disease’ (Whitley 2009: 220). Helvenston (2012a; cf. Helvenston and Bednarik 2011) characterises his hypothesis as pseudoscience, and it is this example of pseudoscience applied to rock art that we will examine here. Substandard science is quite pervasive in commentary about rock art, occurring in many forms and nuances.

We first became involved in the shamanism debate when invited to comment on the seminal paper tying rock art to shamanism (Bednarik 1988). Not satisfied with Lewis-Williams and Dowson’s response, we clarified our objections further, noting that the trance dances of the San were not shamanic but communal events, and we suggested the need to

consider authentic shamanism, such as that of South America (Bednarik 1990; cf. Lewis-Williams 1990). More generally, we rejected their linking of phosphene motifs to shamanism, explaining that such motifs are indeed ‘the signs of all times’ (ironically, the title of Lewis-Williams and Dowson’s paper) rather than the signs of shamanism.

However, on reflection, we find that our attempts to clarify these matters need to be better explained and supplemented. What should be emphasised in such debates is that no generic explanations of rock art have ever been universally applicable. There is no Rosetta Stone of rock art, no simple formula to explain or interpret all of it. Such efforts are usually manifested in faddish, short-lived, but vigorously defended models involving slanted views of archaeology. Before these fads can be addressed meaningfully, the archaeological myths they derive from need to be considered.

Most contemporary Pleistocene archaeologists perceive a strong correlation between the advent of the exograms defined as palaeoart, the appearance of human modernity (Bednarik 2011a) and the origins of ‘modern human behaviour’ (Bednarik 2013a). Typically, they associate these with the ‘spread of anatomically modern humans’ (e.g. Stringer 2002; Mellars 2006). However, there is no consensus on what this term means (or that it serves any useful purpose; Latour 1993; Tobias 1995). Not only has their favoured model (replacement of all humans by a new species unable to breed with Robusts) been refuted (Bednarik 2008a, 2011a, 2020; Green et al. 2010; Reich et al. 2010;

Sankararaman et al. 2012; Prüfer et al. 2014; Sankararaman et al. 2014; Viegas 2015; Kuhlwilm et al. 2016; Vernot et al. 2016) and was attributable to a hoax initiated by the now discredited Professor Reiner Protsch, it is also plagued by numerous self-contradictions and inconsistencies which its advocates consistently ignored. Suffice it to note that robust and gracile subspecies of *Homo sapiens* are of the same species; they could interbreed.

The notion of archaeologically detecting evidence of past behaviour is fraught with difficulties, even if impeccable knowledge of the available empirical evidence is available. The following categories of 'evidence' for 'modern behaviour' are usually listed in the extensive literature on this topic. Among technological indicators (Mithen 1996; Bar-Yosef 2002; Mellars 2005, 2006) are the introduction of blades in the range of stone tools, the use of bone and antler, the introduction of hafted and composite tools, and that of geometrics or microliths. Nevertheless, these and other similarly cited technological indicators are mistaken or significantly over-emphasised. Blades, bone, antler and ivory have been in use since the Lower Palaeolithic, and although their use seems to increase with time, taphonomy selecting against non-lithic materials accounts at least partially for this apparent trend. Contrary to popular archaeological belief, hafted and composite tools occur in the Middle Palaeolithic or Middle Stone Age (e.g. the seven bone harpoons from Katanda, Zaire; Brooks et al. 1995), as do microliths (e.g. in Germany and southern Africa), and in some cases even in the Lower Palaeolithic (e.g. the two notched tool handles from Schöningen, Germany, Thieme 1995; the winged bone point from Salzgitter-Lebenstedt, also Germany, Tode 1953; or the bone harpoon from the Ngandong deposit on the Solo River in Java, Narr 1966: 123; cf. d'Errico 2003). Hence, the perceived technological plateau cannot be sustained.

The same applies to the purported sudden introduction of new social structures and communication mechanisms (Gamble 1999; McBrearty and Brooks 2000; Bar-Yosef 2002; Henshilwood et al. 2002; Conard and Bolus 2003; Henshilwood and Marean 2003). The notion of a 'creative explosion' (Pfeiffer 1983) or 'big bang of consciousness' (Klein and Edgar 2002) dominating the orthodox model is also without basis. This explosion is variously thought to have occurred with the end of the Mousterian in Europe, with the disappearance of *H. sapiens neanderthalensis*, with the beginning of a perceived technological phase called the Aurignacian, or with the appearance of people defined as anatomically modern — all of which are thought to have occurred at different times and which are irrelevant markers in most parts of the world. For instance, personal ornamentation and apparently non-utilitarian markings, as well as the use of symbolic systems, all occur hundreds of millennia before the supposed 'explosion', wherever it is placed (Bed-

narik 1992, 1995, 2003a, 2011b). Language, a symbol system, was not introduced with humans regarded as anatomically modern, as claimed by at least some replacement advocates (e.g. Davidson and Noble 1989, 1990). The unproductive and even irrelevant language origin debates, focused on such insipid evidence as the hyoid 'Neanderthal' bone from Kebara Cave (Arensburg et al. 1989; Marshall 1989; Lieberman 2007), show poignantly how the historical sequence and occurrence of finds determine the profound transience of our interpretations of the past. The Dikika australopithecine infant's hyoid bone (Alemseged et al. 2006) and the detection of the FOXP2 'language gene' on chromosome 7 from 'Neanderthal' remains (cf. Enard et al. 2002a; Zhang et al. 2002; Sanjuan et al. 2006; Krause et al. 2007) render these discussions superfluous. The major syntheses of recent decades about language origins tend to return to linguistic gradualist perspectives (Bickerton 1990, 1993, 1996, 2010; Dunbar 1996; Aitchison 1996; Falk 2009), and their authors arrive at the same basic finding: human language is such a complex phenomenon that its evolution, in every sense, demands a very lengthy process, dating back millions of years. Similarly, the contentions of replacement advocates, that interment practices began with the big bang of consciousness towards the end of the Pleistocene (Gargett 1989, 1999), ignore the common occurrence of intentionally buried 'Neanderthals' and contrast starkly with the 400-ka-old Acheulian cemetery of 120 graves excavated at Budrinna, Libya (Ziegert 2007).

Other purported indicators of human modernity are specialised hunting of large and dangerous animals, again a view based on inadequate knowledge of the existing record. Many societies possessing Mode 2 and Mode 3 technologies focused on large game, including forest elephants, mammoths, rhinos and cave bears (e.g. Howell 1966; Villa 1990; Mania 1991; Thieme 1995). Indices such as seasonality in the exploitation of resources have also been cited as if only a few other species were mastering that ability without advanced cognition. Even the introduction of marine-based economies has been attributed to modern behaviour (Marean et al. 2007), which illustrates this mode of reasoning. First, we cannot know anything about the coastal people of the entire Pleistocene because the oscillations of the sea level have destroyed all archaeological evidence of them (except where recent tectonic uplifts occurred, e.g. in parts of Indonesia). Therefore, societies of marine economies only become archaeologically visible in any meaningful way in the early Holocene (Bednarik 2003b). Second, numerous other animal species have no difficulty adapting to a coastal environment (e.g. Ottoni and Izar 2008), so this notion that hominins had to learn this ability is absurd. Third, pelagic expeditions and colonisations began at least a million years ago (Bednarik 1997a, 1997b, 1999a, 1999b, 2001, 2014; Morwood et al. 1998; Brumm et al. 2010), and

we can safely assume that this capability developed from coastal economies. Finally, marine resources have been in use throughout the Pleistocene (Stewart 1994; Bednarik 1999a, 2014; Bednarik and Kuckenburg 1999: Fig. 28; Choi and Driwantoro 2007), and despite the severe taphonomic barrier imposed by the sea-level changes, there is ample evidence of this from the Mousterian.

Finally, even demographic changes have been proposed as indications of modern behaviour, yet the population dynamics of the Pleistocene are entirely unknown. All pronouncements of population densities are unfounded, and no significant geographical regions can be shown to have been first occupied by humans at the time the 'anatomically modern' people appeared, except perhaps the hypoxic Tibetan Plateau (Zhang J.-F. and Dennell 2018; Zhang X. L. et al. 2018). On the contrary, highly marginal regions, such as the Arctic, were inhabited by Robusts by the advent of the Late Pleistocene (Schulz 2002; Schulz et al. 2002). Therefore, only the most inhospitable regions of Afro-Eurasia should be assumed not to have been occupied by that time. In short, none of the illusory indices of cultural modernity coincide with the change from predominantly robust humans to gracile forms, which in Europe occurred *gradually* between 40 ka and 25 ka ago.

### Shamanism and rock art

Therefore, the extent of the inadequacies of mainstream Pleistocene archaeology needs to be appreciated before the issue of palaeoart origins can be adequately considered (Bednarik 2013b). They range from the inability to create emic knowledge or testable propositions to a litany of epistemological, taxonomic and ethical problems that have led to a historical trajectory of the discipline beginning with the rejection of Boucher de Perthes in the mid-19th century and leading to the recent 'African Eve' hoax and the 'Hobbit' debacle, comprising an endless list of mistakes and blunders. When the notion of Pleistocene rock art was first proposed, Pleistocene archaeologists rejected it for decades. They drove its proponent, Marcelino Santiago Tomás Sanz de Sautuola, into a premature death. Over a century later, they took to declaring any rock art images of bulls and horses found in south-western Europe to be of the period they call the Palaeolithic, even if the images are less than 200 years old (Bednarik 2009a, 2009b, 2015). The 'cult of Palaeolithic art' completely ignored inconvenient details such as the far greater body of Pleistocene rock art elsewhere (e.g. in Australia; Bednarik 2010: 113–115) than that of Europe or that most of the world's surviving Pleistocene rock art was made by people of Mode 3 rather than Mode 4 technological traditions. It also ignored that we have no evidence that the early part of this Franco-Cantabrian corpus must be the work of 'anatomically modern' humans, but that there is good evidence that it was made by robust *H. sapiens* (Bednarik 2007). Instead of

noticing that *all* forensic aspects of this 'art' that permit the estimation of the ages of artists suggest that these were juveniles or teenagers and that the great majority of imprints of human body parts in the caves featuring cave art are of children (Bednarik 2008b), a vast mythology of the profoundly religious, ideological and ceremonial meanings of the images was invented by archaeologists. Indeed, the much-debated notion of shamanism Bullen and Helvenston discuss derives from such misguided searches for meaning. However, even the more sober essay by Bullen (2011) suggests that scaffolding was an essential prerequisite for much of the cave art, for which no sound empirical evidence can be cited. Many of the sites where rock art is now beyond human reach provide clear indications that previous floor levels were higher (or lower) than at present, in the form of flowstone deposits (e.g. in Baume Latrone; Bednarik 1986) and sediment remnants (e.g. in Rouffignac; Bednarik 2006). The same, conversely, pertains to many cave art sites in Australia and to thousands of open-air rock art sites around the world (e.g. Malotki and Wallace 2011; Bednarik 2010): site topography can be highly variable through time, particularly in enclosed spaces.

The consensus model presently professed by mainstream archaeology concerning the origins of palaeoart and human modernity is so severely flawed that it deserves to be wholly ignored. The exograms (Gregory 1970: 148; Goody 1977; Carruthers 1990, 1998; Bednarik 1987, 2011b: 154–157; Donald 1991: 124–161) of palaeoart have been in use for hundreds of millennia, long before *H. sapiens sapiens* can be detected. Every central claim about the advent of palaeoart appears to be a falsity: most of it is not in Europe; most of its Pleistocene component predates the Mode 4 technologies ('Upper Palaeolithic'). Any notions concerning the introduction of palaeoart are likely to be false if they are based on the dominant paradigm; they often refer to an invalid timeframe, to invented and thus irrelevant technological traditions, and to an inconsequential understanding of the role or nature of the earliest palaeoart.

It also remains to be discovered at what point in human history the practices we define as shamanism were introduced, despite isolated claims for Holocene evidence (e.g. Porr and Alt 2006). However, there are alternative, logical methods of investigating the role of shamanism in rock art. In the entire ethnographic world literature, there is not a single report of a shaman having produced rock art. There are, however, numerous cases of rock art production having been observed and recorded or where the authors of the 'art' may be known to us (e.g. Haskovec and Sullivan 1986; Bednarik 1998: 26; Novellino 1999; Bradley et al. 2021; Goldhahn et al. 2021; May et al. 2021; Goldhahn et al. 2022). In all such recorded cases, no shamans were involved, and the utilitarian or ceremonial purpose of the rock art, where it is known, lacks any connection with shamanism. Indeed, one

of the most obvious prerequisites for considering what the characteristics of shamanic art might be is a definition of its ethnographically demonstrated idiosyncrasies. Without such an explicit index, we lack any definitive way of identifying authentic shamanic art traditions; we do not know the properties of shamanic art.

Moreover, most of the world's rock art occurs in regions where no shamanic practices are known ethnographically (e.g. India, the Middle East, northern Africa, Europe, Australia). Although none of this demonstrates that shamans never produced any rock art, the proposition that significant quantities of rock art are the work of shamans (Lewis Williams and Dowson 1988) is unwarranted by the empirical data. It is, of course, untestable. Thus, the null hypothesis, that most rock art is not shamanic, has empirical support; the favoured shamanic hypothesis has none.

Of particular concern are the endemic modes of polemic presented by the shamanists. Rather than citing ethnographic information, they reinterpret the original texts creatively (Hromnik 1991; Solomon 1999, 2000; Le Quellec 2006; Helvenston 2012b) and replace key terminology with their own preferred words. For instance, Lewis-Williams replaces the terms 'sorcerer', 'witchdoctor', 'medicine man' or 'healer' (and even 'teacher') with his preferred word 'shaman', even though there are very significant differences between these concepts. However, he believes that is what the ethnographers (e.g. Bleek 1933, 1935, 1936; How 1962; Katz 1976, 1982; Katz and Biesele 1986; Lee 1967; Marshall 1969; Orpen 1874; Prins 1990) meant when they wrote of sorcerers and medicine men, and that they were too ignorant to understand metaphors. He also mistranslates the word 'medicine man' used by an old Xhosa or Mpondomise woman in relation to the rock art painters (Lewis-Williams 1986; cf. Jolly 1986). When she reported that medicine men went into a river to catch a snake whose fat they ate and rubbed on their bodies, Lewis-Williams interpreted it as a metaphor for entering a trance (the 'manipulated evidence' Hromnik 1991 refers to). He also conflates a hallucinogen-induced trance with a trance involving no drugs, confusing analogical effects with identical causes (Lewis-Williams 2002). Similarly, he projects the ethnography of the Kalahari San, who produced no rock art, onto the extinct /Xam of the Northern Cape, who practised very little rock painting and applies his contrived interpretations to rock paintings elsewhere. Hromnik demonstrates that much of the rock art Lewis-Williams attributes to the San is more likely the work of Hottentots or Khoisan. Just as Lewis-Williams 'reinterpreted creatively' the early ethnographers of the /Xam, he

ignored the more recent studies of the Ju/'hoansi by Katz (1982) and Katz and Biesele (1986), who found no justification for the use of the words shaman and trance.

Similarly, he disregarded the advice of those engaged in the study of authentic shamanism (Eliade 1964; De Heusch 1965; Rouget 1980; Hamayon 1982, 1990; Hultkrantz 1993; Francfort et al. 2001), although he lacks first-hand knowledge of shamanism. Shamans are specialists, outsiders of society, who have undergone considerable training to attain their powers, often exercised in seclusion. The dances among the San Bushmen are communal affairs, with as many as half the people present participating. There are very few parallels between, on the one hand, genuine shamanism in Asia or the Americas and the southern African practices Lewis-Williams and his many followers (including Whitley) consistently misinterpret. Most of these 'shamanists' seem not to have ever met a shaman or made any attempt to review the living profession, even though thousands of shamans exist today. The present author has worked with and studied shamans, not one of whom had ever produced rock art or even seen any (Fig. 1). He has not observed nosebleeds, and most shamans do not 'dance', although they might move in ways one might so interpret. However, the strange body movements of shamans are not a form of 'possession', as in trance, they are part of their performance. Trance is not necessarily a part of their technique, and the most powerful among them (as best reflected in the degree of respect they command in their community) neither dance nor trance (Hamayon 1995: 420) or conduct themselves in any ecstatic way resembling the reductionist view of shamanism Lewis-Williams



**Figure 1.** The author (with back to camera) participates in an elaborate ceremony conducted by a female shaman, in which she implores the spirits to protect a crew of twelve on an impending dangerous mission. All other men are devout Moslems, but for this purpose, the power of a shaman is decisively preferred.

and his followers subscribe to. We observed that their power and social influence could be so potent that they eclipse very strongly ingrained religious practice. Helvenston (2012b) most pertinently observes that ‘when faced with uncertainty and the unknown the San resort to supernatural powers, when faced with familiar tasks like gathering food, or building huts, their approach is scientific’. In a very similar way, we have experienced that when the members of a strictly Islamic society are faced with a life-threatening risk, they turn to the local shaman for protection. The mere continuation of shamanism in such religiously rigid societies speaks for itself and illustrates the continuing innate power of shamanism. The communal dancing of the San Bushmen and even their healing trance is entirely different from the phenomenon of authentic shamanism, which is something Lewis-Williams has only read about in books and reinterpreted. As Consens (1988) observed in his comment on the seminal paper proclaiming Lewis-Williams’ shamanist explanation of rock art, ‘[t]his kind of paper clarifies the limits beyond which we fall into science fiction’.

Only when the shamanists in rock art research present a credible account of what true shamanic art looks like, and especially what shamanic rock art looks like, have they presented a scientific case.

#### A scientific solution to the shamanic rock art issue

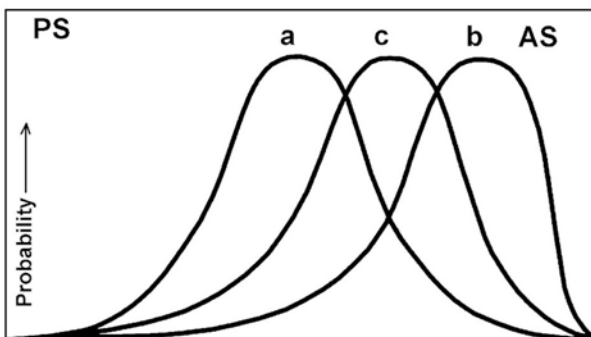
Although there are numerous nuances represented in the plethora of formally expressed opinions about shamanic contribution to rock art, ranging from the intensively documented to the entirely speculative, it is fair to say that the great majority of these contributions (ours included) have adopted either a pro-shamanist or a distinctly opposing view. This polarisation has not been conducive to constructive debate. A scientific rather than polemical approach might be preferable. It is all too easy to reject the pro-shamanism (henceforth PS) view by pointing out that it is unscientific because it offers no opportunity for falsification. Anti-shaman-

ist (henceforth AS) protagonists (this author included) have used this argument. However, the obvious corollary that the PS position is not scientific is no proof that it is necessarily or inherently false. These are separate issues, and if we were to exclude from consideration all untestable propositions, we would have to relegate many forms or archaeological interpretations to the realm of mythology. Such a position may be the epistemologically most rigorous to take, but it will not satisfy our natural curiosity. Instead, we propose to examine the underlying regime of probabilities.

To our knowledge, none of the protagonists take either of the two most extreme views: that categorically, all rock art was executed by shamans or that none was. Either of these two positions would be untenable. In the first instance, we do have extensive evidence that some rock art cannot have been made by shamans. Its actual authors may be known to us, or the rock art may occur in regions from which no shamanic practices are known ethnographically. In the second instance, it would be unreasonable to argue that shamans, where they existed, categorically abstained from producing any rock art, and no evidence has been offered for such cultural exclusion. Thus, both extreme views can safely be excluded a priori. This principle can be translated into formulations of probability: the probability that shamans made all rock art is zero, and the probability that shamans did not make any rock art is similarly zero. If we depict this principle as a graph, the expected probability rating will form two parabolas connected by a saddle marking the highest probability (Fig. 2, curve *a*). This might represent a ‘reasonable’ approximation of the PS position: that a substantial part of world rock art is the work of shamans.

However, it may not be a realistic scenario because, in reality, we have not a single rock art motif that can be demonstrated to have been made by a shaman. On the other hand, we have ample evidence for rock art created by non-shamans — in various parts of the world. In a purely quantitative sense, it is even more important to recall that most corpora of rock art occur in regions devoid of indications that shamanism was ever practised there. An example is Australia, accounting for around 15–20% of world rock art. Adding to this any other rock art corpora in areas apparently lacking historical shamanism shows that the left part of our probability curve needs to be flattened significantly, forcing the probability peak to the right (Fig. 2, curve *b*). This represents a realistic approximation of the AS position that a substantial part of world rock art is not the work of shamans.

We thus have a model that lends itself to scientific discourse, contrasting sharply with most of the qualitative debates so far witnessed on this subject. Moreover, this model also shows that the seemingly unbridgeable gap between two antithetical positions is merely an artefact — the result of over-enthusiasm and fervency on the part of protagonists defending



**Figure 2.** Schematic depiction of the probability that the pro-shamanism (PS) model (*a*) or the anti-shamanism (AS) model (*b*) is valid or that some intermediate model (*c*) is. This is only a depiction of logical principles; it is not intended to be ‘to scale’ in any way.

or attacking one or the other position. The respective positions of the PS and AS lobbies are not separated, as it would have appeared, by an unbridgeable chasm, but merely by a division of where in our graph the probability curve's peak ought to be (Fig. 2). On this basis we have a means of replacing polemic with realistically framed discussion, effectively isolating those protagonists who have intractable agendas and are unlikely to yield to reason from those willing to reconsider their stance.

The remaining issue is which of the two versions, *a* and *b*, depicted in Figure 2, would most likely approximate reality. The difference is partly attributable to epistemological disparities and partly to firmly held personal convictions and commitments. The PS model suffers from a profound dearth of hard evidence, and the position of the PS advocates is weakened by the sometimes-excessive fervour and use of ad hominin argument to intimidate academic opponents. That position would benefit from deference to a more moderate version, as illustrated by the intermediate curve *c* in Figure 2. This is intended to depict the theoretical position of a PS scholar willing to acknowledge the need for some accommodation due to the limitations of ethnographic support.

It follows that, at least for most scholars concerned with these issues, the 'truth' would have to lie somewhere between my curves *b* and *c*. This model would reflect an adjusted version of the PS advocates who do have the luxury of having room to renegotiate their position, which their opponents lack. Whereas the PS lobby could preserve its proposition that a significant part of the world's rock art is the work of shamans, the scientists could not abandon their rigour without having to leave the realm of scientific method altogether. Their position can be expressed in the following terms: there is no good reason that shamans, where they existed and where their communities practised rock art, would have abstained from producing rock art. Therefore, one would have to expect that a proportion of this production, somehow corresponding to their number, is indeed the work of shamans. The incidence of shamanic rock art is a function primarily of three variables: the historical frequency of societies featuring shamanic systems, the number of shamans among those groups that do have them, and the frequency of shamanic rock art production relative to other rock art production in the cultures concerned. For instance, if half of all human populations possessed shamanic practices, if 1% of the respective populations concerned were shamans, and if shamans, on average, produced twice as much rock art than other members of their communities, then 1% of the world's rock art would be of shamans, all other things being equal.

In reality, the issue is more complex than that. For instance, if there were cultural reasons prompting shamans to favour taphonomic conditions facilitating significantly better survival prospects in the

creation of their art (e.g. through location, relative preservation conditions or petrography), then the proportion of surviving shamanic rock art would have to be assumed to be correspondingly greater. This might appear to boost the case of the PS lobby. However, the opposite is true: such factors would only express an over-representation of shamanic art in the surviving record. For instance, if it were the case that the rock art of all shamans of a Pleistocene tradition was made in deep limestone caves, then this corpus may even be the only one surviving from the society in question. It does not imply that all of these people's rock art was shamanic, but it indicates that only the diminutive shamanic component survived in the long term. *Surviving* rock art does not equate to *produced* rock art, and its taphonomy determines all quantitative variables of extant rock art corpora.

To modify the regime of highest probabilities science endeavours to satisfy, we would need one of the following: evidence of a higher frequency of shamanic societies in the past than one might predict from ethnography, significantly higher numbers of shamans in such cultures than one would be inclined to expect, or evidence that the proportion of shamanic art in past groups was much higher than expected from ethnographic indicators.

We can define the disagreement between the PS and AS supporters also in different terms. The latter's contribution to the debate seems limited to pointing out epistemic or empirical weaknesses or prescribing logical procedures for possible solutions. On the other side, the PS camp has yet to attempt a sustained critique of the scientific model as it relates to their notions. It appears to be only pleading to be allowed to conduct its speculative work outside of science — which, for various reasons, is a perfectly legitimate demand. The use of non-scientific hypothesis building is a standard procedure in archaeology, and veracity is a property that exists outside of falsifiability (i.e. non-scientific propositions may be valid, while many scientific propositions are not). For instance, we have hypotheses that pyramids on this planet were constructed by interstellar aliens, which science ignores not because they are false but because they are not falsifiable. From the scientific perspective, the possibility that such aliens did visit Earth does exist, just as it is possible that shamans made most rock art. This is not the issue here; the issue is that such hypotheses, whilst perhaps valid, are of no scientific consequence because they are not falsifiable. Conversely, the proposition that aliens did *not* build pyramids, that the Solutreans did *not* cross the Atlantic, or that shamans did not make most rock art are all refutable. Hence, they are scientific. Nothing we can conceivably expect to find will conclusively disprove the idea that aliens visited Earth. However, the proposition that they did not can easily be falsified, even by a single valid find. This is not some pedantic point of semantics; it refers to fundamental issues of



epistemology and knowledge acquisition methods.

### Autism and rock art

Another perspective of the hypothesis that shamans produced rock art is to consider the closely related proposition that it is the work of individuals suffering from brain illnesses. The two ideas are intertwined by authors who perceive them as complementary and mutually confirming. The trinity of mental illness, shamanism and rock art is engaged by many writers trying to establish the origins of rock art, sometimes adding a fourth ingredient, the replacement hypothesis of recent hominin evolution. Therefore, it is pertinent to examine the credibility of the notion that mentally ill individuals produced rock art.

Margaret Bullen (2005) once pointed out that there are features of deep trance that mimic autism, quoting Bogdashina (2003) to the effect that deprivation of sensory stimulation can lead to autistic-like behaviours. The human brain disease autism (autism spectrum disorder; Hermelin and O'Connor 1970; Frith 1989; Hughes et al. 1997; Baron-Cohen 2002, 2006; Allman et al. 2005; Grinker 2007; Brasic 2009a, 2009b, 2010; Balter 2007; Burack et al. 2009; Bednarik and Helvenston 2011; Helvenston and Bednarik 2011; Schaafsma and Pfaff 2014; Mozes 2018; Sarovic 2021) has been proposed to have been instrumental in introducing Pleistocene palaeoart (Kellman 1998, 1999; Humphrey 1998; Haworth 2006; Spikins 2009; Bogdashina 2010: 159–160; cf. Marr 1982; Treffert 2010).

Although Humphrey's 1998 paper presents no credible case for a nexus between Pleistocene cave art and autism, he raises some pertinent and interesting points. One concerns the ingrained belief that the Upper Palaeolithic artists shared our modern 'mind'. Pleistocene archaeologists often use such terms as 'modern behaviour' or 'modern mind', but it has become apparent that there is no agreement as to what they mean. Some authors refer to human modernity as a set of abilities one can reasonably expect to find a million years ago, even earlier (Bednarik 2011a, 2011b, 2013a). Others favour a much more narrow definition, attributing a 'pre-modern mind' even to the cave artists of the early Upper Palaeolithic (see Humphries 1998 and debate therein) and suggesting the 'modern mind' to postdate 20 ka BP. Bearing in mind (pun intended) that it is not clear what the mind is (what is its appearance, weight or composition?) and that this is probably intended as a shorthand generic term for mental processes occurring in the human brain, the concept of 'modernity of mind' is fraught with various difficulties. It is, therefore, doubtful that a scientific (testable) case can be made for a connection between the exceptional skills sometimes (but very rarely) found in autistics (Waterhouse 1988; Mottron and Belleville 1993, 1995; Mottron et al. 1999; Happé and Vital 2009) and the abilities of the graffitiists of the Franco-Cantabrian caves. Perhaps a better case could be presented by engaging the find-

ing that there is minimal evidence that the latter corpus involved adults (Bednarik 2008b), but that has not been attempted.

Humphrey's challenge of archaeologists' 'received view' (Dennett 1998) — to show why they assume that Upper Palaeolithic palaeoartists must have shared present-day perception and reality — is particularly interesting. So is Dennett's observation that '[i]t will be interesting to see if the defenders of the received view have such facts in reserve to salvage their case, or whether they will have to fall back on simply citing various eminent opinions in favour of the received view'. Indeed, the responses of archaeologists following the presentation of Humphrey's hypothesis have failed to offer such 'facts'. One of the most pervasive aspects of this particular corpus of palaeoart is the autosuggestive delusion that it 'speaks to us' (Mithen 1998: 181) more directly than other rock art traditions, and this has not been adequately analysed. There are hundreds, if not thousands, of rock art traditions worldwide, and only a few resonate well with the Western perception of reality. One might say that it is the degree of 'naturalism' that determines this, but there are no absolute criteria for what is naturalistic in graphic (two-dimensional) production.

Moreover, most Upper Palaeolithic motifs are certainly not 'naturalistic'. They consist primarily of semantic units ('signs') that are anything but intelligible to extant humans and of *abstractions* of biomorphs, or they are simple lines that are, perhaps correctly, read as the contours of, for instance, body parts of animals (e.g. lines resembling the upper body contour of a mammoth or cave lion). Such features may well depict what people read into them, but without knowing that, they are not naturalistic. It would be more appropriate to ask why people are so confident in interpreting a simple line this way. Is it not more likely that their perception always operates by scanning patterns in the search for recognisable contours, and when they find them in a human marking, they instinctively feel that they connect with the maker's intent? They are then merely recasting essential features in a way that resonates with their own neural systems (Hodgson 2012), and no 'communication with the artist' takes place. They are communicating with themselves. That the motif resonates with their perception is simply due to the operation of the human visual system, which presumably has been the same for long periods and has nothing to do with the cognitive state of its maker. One of the most endearing aspects of rock art is that the beholder finds it hard to resist the temptation to sense that it somehow communicates something; it *invites* interpretation.

Another fascinating aspect of Humphrey's contentions arises when he quotes Mithen as stating 'that modern humans ... were capable of the type of symbolic thought and sophisticated visual representation that was beyond Neanderthals'. Two issues

arise from this statement. First, the art of the 'Aurignacians' provides no proof whatsoever of symbolic thought, which seems to be believed by nearly all Pleistocene archaeologists. It only provides evidence of depiction, no more. That is not to say that the 'Aurignacians' were not capable of creating symbols, but the proof for that is to be (and can be) found elsewhere. Second, we have no evidence of any kind that 'Aurignacian' palaeoart was produced by 'anatomically modern humans' because all Final Pleistocene human remains of Europe predating, say, 26 ka are either of Robusts (usually called Neanderthals there) or of intermediate forms (Bednarik 1995, 2007, 2008a, 2011a, 2011b). Therefore, Mithen's claim is probably wrong on both counts and merely expresses the inherent defects of the replacement hypothesis.

Humphrey presents only a single example of an autistic child with advanced artistic abilities (Selfe 1977), although others have been reported (e.g. Pring and Hermelin 1993; Kellman 1998, 1999; Happé and Frith 2010), and he seems unaware of other authors pursuing the same issue (Waterhouse 1988; Mottron and Belleville 1993, 1995; Mottron et al. 1999; Happé and Vital 2009). Moreover, his hypothesis suffers from his lack of awareness that such abilities in children are certainly not limited to autistic savants but are also well known as 'precocious realism' in the art of non-autistic children (Selfe 1983; Drake and Winner 2009; O'Connor and Hermelin 1987, 1990; contra Snyder and Thomas 1997). In that context, Humphrey's hypothesis loses its appeal. If his suggestion that the palaeoart of the early Upper Palaeolithic implies an absence of language use because of their naturalism were applied to, say, the realistic rock art attributed to the San Bushmen, its absurdity would become apparent. Similarly, he seems to be unaware that throughout the world, the images we tend to regard as naturalistic are preceded by traditions that lack iconographic elements. Finally, the extremely rare occurrence of autistics of exceptional depictive abilities does not explain why 99.99% of autistic spectrum disorder (ASD) patients lack them. After all, ASD has recently become a widespread illness, affecting one in 110 children (Weintraub 2011; locally even as high as one in 38; cf. Mozes 2018). The epidemic increase in this diagnosis, from one in 5000 in 1975, cannot be entirely attributed to changing diagnostic criteria (cf. Buchen 2011). The explanation offered in Bednarik (2011b, 2020) is perhaps the most eligible.

#### Asperger's syndrome and rock art

Similarly, Spikins' (2009) 'different minds theory' suffers from an inadequate consideration of the relevant empirical evidence a more careful review of palaeoart would reveal. Spikins explains 'modern behaviour' as the rise in cognitive variation within populations through social mechanisms for integrating 'different minds'. She focuses particularly on

one form of autism, Asperger's syndrome, because it does not inhibit the effective use of language or cognitive development, and the associated attention to detail enables patients to compensate for the deficit of empathy. Subjects with autistic conditions (as well as in schizophrenia; Brüne 2006) have cognitively based deficiencies in the 'theory of mind' (ToM), which defines the ability to attribute mental states — beliefs, intents, desires, pretending, knowledge — to oneself and others and to understand that others have beliefs, desires and intentions that are different from one's own (Baron-Cohen 1991; Frith and Happé 1994; Ozonoff and Miller 1995; Happé et al. 1996; Happé 1997; Baron-Cohen et al. 1997; Jarrold et al. 2000; Jacques and Zelazo 2005; Bednarik 2011a).

Spikins' hypothesis is applied to the bland construct of the origins of modern human behaviour cited above, based as it is on the improbable and unsupported replacement hypothesis (Bednarik 2008a). Contradicting the scientific evidence, this hypothesis misuses the term 'species' by maintaining that *Homo sapiens neanderthalensis* is a separate species when in fact, it is a subspecies (different species cannot produce fertile offspring with each other). Spikins believes that the earliest evidence of symbolic communication appears in South Africa 165 ka ago. Leaving aside the small issue that symbolic communication, like behaviour or intention, cannot be demonstrated by archaeology, only conjectured, she ignores both the inferred use of symbolic communication by Lower Palaeolithic hominins (suggested by seafaring, use of beads, palaeoart of various types; Bednarik 2014) and the experimentally demonstrated symbolic communication ability of extant animals other than humans. This sapiens-centric viewpoint, which is so prevalent in Pleistocene archaeology, is expressed in her phrase 'modern human success', which characterises a neo-Darwinian discipline obsessed with exalting the magnificence of a devolving species (devolution is not an evolutionary success; Bednarik 2011b).

This does not necessarily render her hypothesis false because it could still be validly applied to a better-informed model of hominin evolution, one based on empirical data rather than archaeological myths (Bednarik 2011a). Spikins' primary contention is that autism is a spectrum of differences displayed across the modern population, and that modern behaviour arose when autistic modes of thinking were integrated into the practices of human societies. Focusing on Asperger's, a form of 'mild autism' (Bednarik and Helvenston 2011), she emphasises the analytical and mathematical thinking it involves and attributes to it the changes she detects in technology: 'Rigid analytical thinking (both by autistic individuals and through their influence) might improve technology and foraging efficiency'. She cites projectile weapons, bladelets, bone artefacts, hafting, 'elaborate fire use', exploitation of marine resources and large game, apparently un-



aware that all of these have been demonstrated from the Lower Palaeolithic, together with palaeoart and 'personal ornamentation'. Nevertheless, she feels that these are all attributable to the 'attention to detail, exceptional memory, a thirst for knowledge and narrow, obsessive focus' of autistics, particularly when coupled with their desire for social isolation.

However, these proficiencies are not limited to people with ASD. This condition also includes diagnostic characteristics such as inflexibility in thinking, difficulty with planning and organisation, and rigorous adherence to routine (Pickard et al. 2011), which impede originality and innovative thought. The creativity Spikins invokes is impoverished in ASD patients (Frith 1972; Craig and Baron-Cohen 1999; Turner 1999) unless fostered, and the savant skills ascribed to them occasionally need to be nurtured and are specific to the ordered cultural context of modern life (Baron-Cohen 2000; Folstein and Rosen-Sheidley 2001; Thioux et al. 2006). Moreover, the neuropsychiatric disorders of humans absent in other extant primates (Rubinsztein et al. 1994; Walker and Cork 1999; Olson and Varki 2003; Marvanová et al. 2003; Bednarik and Helvenston 2011; Sherwood et al. 2011; Enard et al. 2011), are a deleterious by-product of recent evolution (Bednarik 2011a, 2011b, 2013b; Bednarik and Helvenston 2011; Helvenston and Bednarik 2011; Pickard et al. 2011). Finally, the phylogenetic timing of the introduction of ASD is the crucial issue here: to influence society, the illness had to exist, but for this, society and selective processes had to tolerate it first. The lack of social skills typical of ASD in societies heavily reliant upon social dynamics would tend to select against it, socially as well as genetically. Thus, Spikins' hypothesis runs up against the classical Keller and Miller paradox, the resolution to which will be considered below because it applies to all neuropathologies. Spikins fails to consider the complexities of their genetic bases and how or why they arose in the first place. Until 2008, no solution had been provided for this, which renders her notion without a reference frame and scientific justification.

### Schizophrenia and rock art

Another stab in the dark, Whitley's (2009) attribution of shamanism to bipolar disorder, was preceded by implicating the similarly severe neuropsychiatric condition schizophrenia (e.g. Kroeber 1940; Demerath 1942; Kirchner 1952; Devereux 1956; Silverman 1967; Scheff 1970; La Barre 1970, 1972). The altered states in (North American) shamanism were perhaps first recognised by Oesterreich (1935: 295). Peters and Price-Williams (1980: 397) examined them across 42 cultures. Loeb (1924), Radin (1937) and Devereux (1961) defined shamans variously as epileptic, hysteric or neurotic, whereas Silverman (1967) introduced the notion that shamanism is an acute form of schizophrenia. His hypothesis attracted criticism immediately (Handelman 1968; Weakland 1968; Boy-

er 1969) and was followed by later work rejecting it. Lex (1984) suggested that the popularity of the notion that schizophrenia explains shamanic experiences and behaviour appears to emanate from distorted and romantic interpretations of the significance of hallucinatory symptoms. Noll (1983), in examining altered states of consciousness, demonstrated that the anthropological 'schizophrenia metaphor' of shamanism and its altered states is untenable. Significant phenomenological differences exist between the shamanic and schizophrenic states of consciousness. Despite these authoritative rebuttals, the notion that there is a connection between shamanism and schizophrenia continued to be pursued in more recent years (e.g. Polimeni and Reiss 2002; El-Mallakh 2006).

Twin and adoption studies have conclusively shown that schizophrenia (Os and Kapur 2009) is a genetic disorder (Cardno and Gottesman 2000; Kennedy et al. 2003; Riley and Kendler 2006). However, because its underlying physiological abnormalities remain inadequately understood, an adequately integrated aetiologic and pathophysiological model does not yet exist. Although numerous schizophrenia susceptibility genes have been identified (Yoshikawa et al. 2001; Spinks et al. 2004; Cho et al. 2005; Li et al. 2006; Xu et al. 2006; Hosak 2013; Henriksen et al. 2017; Trifu et al. 2020), they are of small or non-detrimental individual effect; the illness is polygenic. These genes may affect changes in attention, memory, language or other cognitive functions through minor effects on neurotransmitter function, cerebral structural organisation, brain metabolism or connectivity as they interact with nongenetic factors. Susceptibility alleles only constitute an increasing risk for schizophrenia through aggregating, be it by chance, assortative mating, or other mechanisms (Cannon 2005). They may be individually associated with normal or increased fertility or be operating under positive selection, unlike full-fledged schizophrenia. Carriers of small numbers of schizophrenia susceptibility genes are far more numerous (about 15% of any population) than cases of the actual disorder (0.3–1%), and the advantages selected for in first-degree relatives of schizophrenia patients have been suggested to include creativity (Horrobin 2001). Thus, schizophrenia, 'the very embodiment of maladaptive traits' (Keller and Miller 2006), is most likely the result of complex polygenic inheritance and environmental susceptibility factors.

Crow (1997) perceives a connection between schizophrenia and language and that the speciation event defining modern humans also introduced language. According to his hypothesis, schizophrenia and language are linked to cerebral asymmetry, and the hemispherical dominance for language led to collateral hemispheric lateralisation and psychosis (Crow 1995a 1995b). However, this notion, theorising that genetic drift can occur more frequently on the

Y chromosome, is countered by several indices, not only the error of linking language origins with the falsity of speciation of Graciles (see above, and Falk 2009; Bickerton 2010). For instance, the *planum temporale*, presenting a left-right asymmetry favouring the left (Geschwind and Levitsky 1968), which has been related to language reception, is also present in apes (Gannon et al. 1998, 2001). Moreover, the detection of the FOXP2 gene on chromosome 7 of Robusts (Krause et al. 2007; cf. Enard et al. 2002a; Zhang et al. 2002; Sanjuan et al. 2006) but the absence of such schizophrenia susceptibility alleles as NRG3 in them refutes the idea (in fact schizophrenia may have appeared much later than Graciles; Bednarik and Helvenston 2011).

The records of the UK National Childhood Development Study (Karlsson 1984; Crow et al. 1995) suggest that children later diagnosed with schizophrenia had persistent reading impairment and low IQ scores. Schizophrenia occurs in all cultures, and all perceive it as a severe maladaptive dysfunction (Pearlson and Folley 2008). Introverted anhedonia, a typical symptom of schizophrenia (Schuldberg 2000), decreases creative activity significantly, thus providing a clear separation between creative and clinical cohorts. Therefore, the notion that schizophrenia fosters creativity or artistic production has little or no credibility, and if shamanism is derived from that illness, the explanation of rock art as the work of shamans loses further support.

However, the relationship between these three factors is much more complex, which may explain the competing models. As in autism, there is a spectrum within which schizophrenia is merely the extreme form. For instance, first-degree relatives of psychotic patients have been consistently shown to be notably creative (Heston 1966; Karlsson 1970). Elevated levels of some schizotypal traits are commonly observed in individuals active in the creative arts (Schuldberg 1988, 2000; Brod 1997; Nettle 2001; Nettle and Clegg 2006). Schizotypal diathesis, which may lead to actual illness under specific environmental factors (Tsuang et al. 2001) but in most cases does not, is therefore more convincingly implicated in creativity, much in the same way as mild forms of autism can yield high-performing individuals. It is through polygenic mutation-selection balance that mental disorders reflect the inevitable mutational load on the thousands of genes underlying human behaviour. The data on the factors of increased risks of mental disorders with brain trauma, inbreeding and paternal age on mental disorder prevalence rates, the fitness costs of the illness and the rarity of susceptibility alleles all indicate this.

Of significance — although of no direct bearing on the issue of the involvement of shamans — is that schizophrenia is associated with a ‘drastically reduced probability of reproduction’ (Bassett et al. 1996; Avila et al. 2001), through significantly dimin-

ished fertility, mediated by reduced survival and social competence (Brüne 2006), reduced attractiveness for mating and lower marriage rates, as well as possibly via reduced fertility once married. The notion that artistic production has its origins in ‘costly displays’ (Miller 2000, 2001; Varella et al. 2011) would, therefore, seem to exclude the involvement of schizophrenic artists.

However, the involvement of schizophrenia or schizotypy in shamanism deserves further examination. The discovery of the rubber hand illusion (RHI) in schizophrenic patients (Peled et al. 2003) has considerable implications for the notion of out-of-body experiences (Thakkar et al. 2011). It has been suggested that a weakened sense of the self may contribute to psychotic experiences. The RHI illustrates proprioceptive drift, which is observed to be significantly greater in schizophrenia patients than in a control sample and can even lead to an out-of-body experience, linking ‘body disownership’ and psychotic experiences.

In summary, there is no credible empirical evidence linking schizophrenia with palaeoart production, just as there is none linking shamanism with it or with schizophrenia. However, susceptibility to proprioceptive drift can be shown to be linked to schizotypy and may well account for specific experiences of shamans.

### Bipolar disorder and rock art

Whitley (2009) has proposed this connection, apparently with much less justification than the above proposals. His confused collation of ‘mad geniuses’, ‘first religion’, shamanism and mood disorders may well derive from his long-standing dedication to proving the shamanistic origins of rock art. Bipolar disorder has been much less prevalent as an explanation of shamanism because its aetiology renders it less likely. It also differs from schizophrenia in several crucial ways. Although chronic, it is not neurodegenerative with advanced age, in contrast to schizophrenia. In schizophrenia, there is increased neuronal density in the prefrontal cortex, whereas in bipolar disorder, there is decreased neuronal and glial density associated with glial hypertrophy (Rajkowska 2009). Both illnesses are highly heritable (Edvardsen et al. 2008), as shown by monozygotic twin studies (Kieseppä et al. 2004), and they are polygenic, as indicated by the broad spectrum of their manifestations. Also, there is an overlap of susceptibility between bipolar disorder and schizophrenia for several individual risk alleles and the polygenic risk (Craddock and Sklar 2013). The bipolar range stretches from bipolar I through bipolar II and to mild forms of cyclothymia. It is reflected in the lack of resolution in decisively determining the genetic basis, although regions of interest identified in linkage studies include chromosome 18, 4p16, 12q23-q24, 16p13, 21q22 and Xq24-q26 (Craddock and Jones 1999; Craddock

et al. 2005; Saito et al. 2001), and genes *DRD4*, *SYNJ1*, *MAOA CACNA1C*, *ODZ4* and *NCAN* are among those implicated (Muglia et al. 2002; Stopkova et al. 2004; Andres et al. 2004; Cho et al. 2005; Preisig et al. 2005; Jansson et al. 2005; Craddock and Sklar 2013). Just as autism and schizophrenia comprise spectra rather than discrete illnesses, much the same applies to bipolar disorders, and probably for the same reasons: numerous genetic predispositions (Schulze 2010) and a range of environmental factors determine any patient's specific condition.

Bullen (2011, 2012) and Helvenston (2012a) have already responded most adequately to Whitley's proposition and negated both his notions: that shamans have bipolar disorder and that the Pleistocene cave art of France and Spain is the work of such bipolar shamans. Helvenston has rightly emphasised that bipolar illness is a very serious disorder and even today it is not well controlled in a large group of people suffering from it. During the manic or depressive phases, the individual is almost completely disabled, and unlikely to be creating anything, let alone distinguished art. Sufferers are frequently unable to care for themselves during these phases and would only be productive during remission. During remission they often have to cope with the consequences of what they have done during the manic or depressive phases (Helvenston 2012a: 109).

She also insists that 'no ape has ever shown any illness even remotely resembling bipolar illness', citing Mason and Rushen (2006). Following Bullen's presentation of her paper at the Broken Hill AURA Inter-Congress Symposium of 2009, which prompted her 2011 article, Bednarik challenged Bullen's proposition that apes experience brain illnesses similar to humans. She maintains that we

cannot ask a baboon if it has low self-esteem or if it feels hopeless but it can portray those perceptions in its observed helplessness. Genetic studies in primates may help to elucidate which genetic variants associated with affective disorders could have been present in the early hominid genome (Bullen 2012: 111).

More important than the confirmation bias ethology invites (of seeing what we want to see; Marsh and Hanlon 2007) is that the presence of genes thought to be involved in human neuropathologies is irrelevant to detecting such illness. The mere presence of individual genes does not result in major brain illnesses. A paper sometimes cited as presenting evidence of neuropathology in non-human primates (Marvanová et al. 2003), in fact, merely reports the incidence of similar genes in the brains of *healthy* humans, apes and monkeys. For instance, some of the genes thought to be involved in Alzheimer's are concordant in humans and other primates, while others are not. Moreover, most of the data used in this report derives from another study (Enard et al. 2002b) that was entirely of specimens that were all free of mental disorders and brain abnormalities detectable by autopsy. While epilepsy and stroke do occur in non-human primates, other brain illnesses have not

been reported from natural settings or free-roaming populations (Rubinsztein et al. 1994; Walker and Cork 1999; Olson and Varki 2003; Bednarik and Helvenston 2011; Helvenston and Bednarik 2011). It is true that when captive apes and monkeys are deprived of environmental stimulation and the company of conspecifics, they often present symptoms resembling obsessive-compulsive behaviour. However, such behaviour is not attributable to inherent defects of the brain but to protracted enforced conditions, i.e. it is of a somewhat different aetiology. Moreover, variations of such aberrant behaviour are also evident in numerous captive non-primate species. Chimpanzees do not experience significant atrophy in the brain size and other internal structures that inevitably accompany aging in humans (Sherwood et al. 2011). Consequently, the human susceptibility to neuropathologies such as Alzheimer's disease is unique in the animal world. It is attributable to the wear and tear of the excessively large brain, most of whose neurons cannot be renewed. Indeed, the cognitive ability of humans may have prompted the reduced apoptosis (the process of 'programmed' cell death) of neurons relative to chimpanzees. This has been proposed to cause a higher risk in humans of cancer and other diseases associated with reduced apoptotic function (Arora et al. 2009).

One of Bullen's (2011) chapters is titled 'Are we any nearer to knowing how it all started?' – referring to the origins of palaeoart. Rather than helping in this quest, propositions such as that of Whitley only succeed in clouding the issue by appealing to the readers' inclination to prefer the alluring narratives of the storyteller to the tedious interpretations of science. As Bullen notes, Whitley contends that both shamanism and bipolar disorder tend to run in the family, i.e. if two discrete characteristics are heritable, they must be connected. On this reasoning, any heritable characteristic could be related to bipolar conditions. Indeed, carefully analysing this pattern would be precious in learning to understand modern reactions to rock art: why are its interpretations as the work of extraterrestrials or shamans so popular? Why are modern people so strongly inclined to interpret rock art? As mentioned above, modern beholders of some forms of ancient palaeoart delude themselves into believing that it communicates with them through a form of autosuggestion, and this process deserves careful analysis. The shamanic hypotheses play on this susceptibility and on the perception that such master keys to rock art interpretation (Le Quellec 2006) provide codes of meaning.

## Discussion

The perhaps most fundamental problem with the shamanic, bipolar, schizophrenic, Asperger's and autistic 'explanations' of rock art is that their advocates do not attempt to determine whether these conditions actually applied in the Pleistocene. As Helvenston

notes in her authoritative commentary:

If there had been manic-depressives during the Palaeolithic, they would have been completely disabled prior to modern medication, so it is highly unlikely that they produced any great art and there is no more reason to suppose that a manic-depressive created the Palaeolithic cave paintings than that a normal person did — in fact there is less reason (Helvenston 2012a: 109).

This is not just a question of clarifying when neuropathologies began to have a significant impact on the human genome, but more importantly, why they were not selected against at some point in our evolution. The mental and cognitive developments in the human brain rendered humans vulnerable to neurodegenerative diseases as well as frontal lobe connectivity problems, demyelination or dysmyelination, and Mendelian disorders — in fact, to thousands of syndromes and disorders endemic to humans. Why their rise was not vigorously selected against by natural evolution is the *Keller and Miller* (2006) *paradox*, which was resolved the year after it was posed (Bednarik 2007, 2008b, 2008c). In a species fully subject to the canons of natural selection, such numerous disadvantageous mutations would indeed tend to be suppressed vigorously. They include many thousands of Mendelian (single gene) disorders but also countless somatic changes, such as cleidocranial dysplasia or delayed closure of cranial sutures, malformed clavicles and dental abnormalities (genes *RUNX2* and *CBRA1* refer), type 2 diabetes (*THADA*); the microcephalin D allele, introduced in the Final Pleistocene through a single progenitor copy (Evans et al. 2005); or the *ASPM* allele, another contributor to microcephaly, appearing around 5800 years ago (Mekel-Bobrov et al. 2005). Indeed, most changes from Robusts (such as *H. sapiens neanderthalensis* or *H. sapiens denisova*) to Graciles (*H. sapiens sapiens*) have been maladaptive: significantly reduced brain volume (by ~13%) and cranial as well as other skeletal robusticity, and significantly reduced physical strength. Why did natural selection fail to cull the alleles underlying hominin neotenisation and neuropathologies? Why did it allow the ‘devolution’ that marks the last forty or so millennia of human ‘evolution’? In reality, evolution is dysteleological. Therefore, biological devolution is impossible, whereas cultural devolution certainly can occur.

The suspension of human evolution determined by natural selection has remained completely unrecognised until recently because Pleistocene archaeology and palaeoanthropology have pursued the replacement hypothesis with such enthusiasm when it has no genetic, skeletal or cultural justification (Bednarik 2008b) and is attributable to a hoax. That hypothesis demands that natural selection and genetic drift (Bednarik 2011c) governed recent evolution and speciation when, in fact, the emergence of the Graciles involved no speciation. They derive from Robusts via intermediate forms (as implied by genetic

findings since 2010, gracilisation/neotenisation being a gradual process commencing in Europe between 40 and 35 ka ago. The distinctive changes during the final third of the Late Pleistocene are almost entirely the result of self-domestication caused by the determination of breeding patterns by rising cultural imperatives that have been defined (Bednarik 2008c). Domestication promotes unfavourable alleles in all species so affected (e.g. Horrobin 1998, 2001; Andolfatto 2001; Lu et al. 2006), and it can even account for other unexplained features, such as the abolition of oestrus in females. Assuming that it was under the auspices of this process that predispositions for brain illnesses were protected from natural selection, which is the rational explanation, such pathologies must postdate these developments. It would then be expected that most appeared significantly less than 40 ka ago and are endemic to *H. sapiens sapiens* (Bednarik 2008c, 2011b, 2020; Helvenston and Bednarik 2011). Where relevant genetic indications are already available, they confirm this prediction. For instance, the genes *CADPS2* and *AUTS2*, involved in autism, appear with Graciles, and *NRG1* and *NRG3* (schizophrenia) are also absent in ‘Neanderthals’ (Voigt et al. 2006). Using the human haplotype map to test for selective sweeps in regions associated in genome scans with psychosis, such as 1q21, is promising (op. cit.). Such selective sweeps yield relatively recent aetiologies of less than 20 ka. Some conditions, such as schizophrenia, have been suggested to be much more recent (Bednarik and Helvenston 2012). So far, no known susceptibility alleles of it have been reported from Neanderthaloid remains.

Another way to test the domestication hypothesis is to conduct selective sweeps in the genomes of present humans and domesticated mammalian species to detect overlapping genes (Prüfer et al. 2014; Racimo 2016; Peyrégne et al. 2017). For instance, the domesticated horse shares seven genes with extant humans, cattle and humans share nine genes, and the cat and the dog each share fifteen genes with us. The forty-one genes associated with loci under positive selection, both in extant humans and in one or more of the four domesticates considered, do not necessarily prove that domestication proceeded analogously in the five species. The circumstances of domestication can be assumed to have differed in each species affected by it. Nevertheless, the genes established to be shared by domesticated animals and *H. sapiens sapiens* suggest that the latter was subjected to changes resembling those of domestication in other mammalian domesticates. Furthermore, none of the 17 367 protein-coding genes found in the remains of two Neanderthals (Castellano et al. 2014) is listed among the fifteen genes known to overlap between at least two domesticated species (*ADAMTS13*, *ATXN7L1*, *BRAF*, *CLEC5A*, *DCC*, *FAM172A*, *GRIK3*, *NRG2*, *PLA-C8L1*, *RNPC3*, *SEC24A*, *SMG6*, *STK10*, *TMEM132D* and *VEZT*). The pre-domestication status of *H. sapi-*

*ens neanderthalensis* appears to be confirmed by this finding.

Therefore, at this stage, none of the more severe brain illnesses should be expected to be found in hominin populations prior to the partial suspension of natural selection. On present indications, that may have begun between 40 ka and 35 ka ago, initially on a small scale. It is, therefore, unlikely that by the time the Chauvet or l'Aldène rock art was created (Bednarik 2007; Sadier et al. 2012), any of the brain diseases to which it has been attributed could have even taken root. The shamanism that is claimed to have given rise to it must have been established much later if it derived from neuropathologies, and its occurrence in any Pleistocene society has not been demonstrated or even proposed except via circular reasoning. As noted, all types of the European Pleistocene palaeoart that are capable of providing empirical evidence about the age of the artists were demonstrated to have been produced by children or teenagers, which renders it likely that the same applies to a significant part of the rest of this palaeoart. This hypothesis offers testability, whereas the hypotheses involving brain illnesses lack falsifiability or sound epistemology. Whether it is Asperger's syndrome, bipolar syndrome, autism or schizophrenia, neurosis, hysteria or epilepsy, none of them seems to account for either palaeoart or shamanism, nor have shamans produced much palaeoart.

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Prof. Robert G. Bednarik  
P.O. Box 216  
Caulfield South, VIC 3162  
Australia  
robertbednarik@hotmail.com

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