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SEEING BEYOND PAREIDOLIA: IMPLICATIONS FOR PALAEOART

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Abstract. Pareidolia (seeing meaningful things in patterns) is regarded as a concept that can help identify and interpret rock art. However, its usefulness is deceptive and, consequently, can give rise to significant problems with interpretation because it is such a fundamental attribute of the human visual system. In this paper, I show that the heuristics that underpin pareidolia can mislead researchers into accepting natural rock marks as examples of rock art. Nevertheless, the concept can, to some extent, be leveraged to provide a useful means to identify and interpret rock art by considering the tendency in the context of other types of imagery. By utilising the concept of 'hyperdolia', where the human visual system is primed by a range of evolutionary, psychological and socio-cultural factors, I demonstrate how that concept can provide a more reliable means than pareidolia that rock art researchers can exploit when assessing, for example, Upper Palaeolithic depictions of animals. By drawing attention to the similarities and differences between pareidolia and hyperdolia within the broader context of projective mental imagery, this paper shows how the differences can be valuable in furnishing a more nuanced understanding of the subtle characteristics that underpin the experience of imagery in different circumstances and psychological states that can be useful to rock art researchers.

Introduction

In order to explore how projective mental imagery plays a role in understanding palaeoart, we need first to define what is meant by pareidolia. Pareidolia occurs 'when external stimuli trigger perceptions of non-existent entities, reflecting erroneous matches between internal representations and the sensory inputs' (Liu et al. 2014: 60) (see Fig 1 for examples). More generally:

> When looking at backgrounds, textures (e.g., clouds, rocks, and walls), or simply at elements or objects in a particular spatial arrangement, we often perceive seemingly real patterns resembling, for example, faces, animals, body shapes, and so forth. This common phenomenon is called pareidolia (Diana et al. 2020: 20).

The phenomenon is a regular experience of most individuals despite cultural background, whereby random subjective images are imposed on various external configurations. Simply put, it can be regarded as a form of perceptual curiosity (Lee 2016), which is an automatic process underwritten by certain evolutionary contingencies. Unfortunately, the concept has been employed to cover a broad set of criteria, from randomly seeing something not there to a more primed disposition where a range of experiences can incite the phenomenon. In essence, many kinds of things can be seen during a pareidolic experience, including faces, animals or everyday objects. From an archaeological perspective, this can cause problems in identifying and interpreting rock art. In order to counter such problems, I previously proposed the concept of 'hyperimages' (Hodgson 2008), which has some similarities with what might be termed 'primed pareidolia'. However, hyperimages also have correspondences with pseudo-hallucinations, which are non-psychotic intrusive images that arise from activities such as prolonged focussed attention, increased arousal, perceived threat, emotional factors, expectations and tiredness. (Pseudohallucinations were originally shown to be relevant to understanding palaeoart by Hodgson [2006a] in the context of 'normal' perceptual engagement with the world). Hyperimages, therefore, seem to occupy a space between pareidolia and pseudo-hallucinations but, nevertheless, share a greater number of traits with the latter than the former (see Table 1). In effect, the three concepts can be regarded as merging along a continuum (see Fig 2). Note that categorising psychological phenomena gives the false impression of precise distinctions when, in reality, those distinctions are blurred. To clarify what is meant by hyperimages, I introduce here the term 'hyperdolia', which refers to the subjective experience

Figure 1. Examples of pareidolia. Top, left to right: horse, bird. Bottom, left to right: human figure, human face (https://www.monolitonimbus.com.br/pareidolia/ Creative Commons Attribution-ShareAlike 4.0 International).

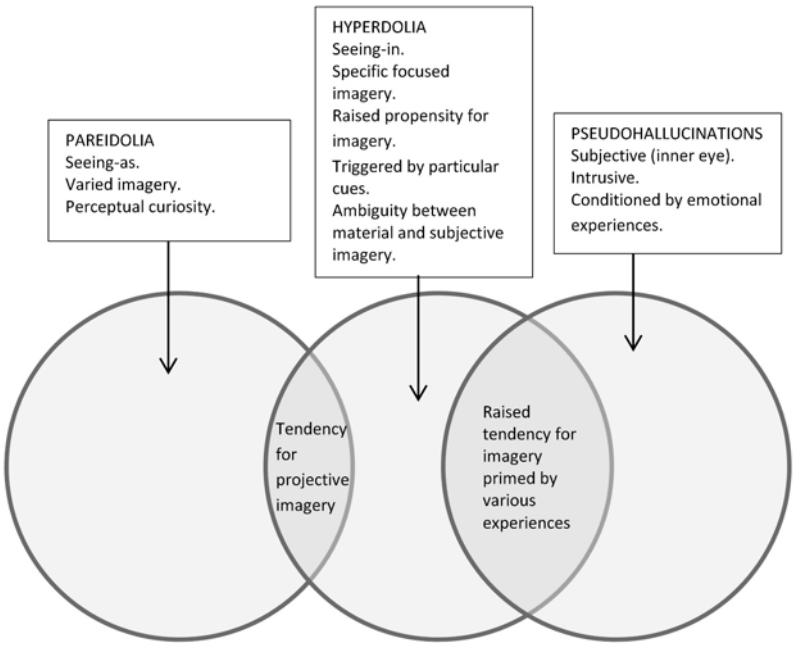

Figure 2. The relationship between pareidolia, hyperdolia and pseudo-hallucinations illustrating the basic principles of the phenomena in terms of commonalities and differences (see Table 1 for a detailed overview).

of imagery, whereas 'hyperimagery' refers to the material realisation of the subjective perceptual experience. I would maintain that many archaeologists continue to refer indiscriminately to pareidolia in relation to rock art (see Bednarik 2016 for a description of a prominent example; also Needham et al. 2022; Lahelma 2008; Bustamante et al. 2010), whereas what they actually refer to are hyperimages for reasons that will become clear below (note, pareidolia by definition refers to the subjective experience of imagery).

Pareidolia, it should be noted, is part of a wider spectrum of projective experiences known as apophenia, which Varella (2018) refers to as 'patternicity', defined as 'finding meaningful patterns in meaningless noise' that also encompasses anthropomorphism, zoomorphism and phyto/mycomorphism. Though a variety of senses experience pareidolia, we are, however, concerned in this paper only with the visual manifestations of the phenomenon, as the visual sense is particularly relevant to the study of rock art. By leveraging hyperdolia/hyperimages, it is hoped that the heuristics will provide a useful theoretical tool archaeologists can exploit to identify and interpret rock art. Psychologists, however, might object to referring to hyperdolia/hyperimages, as the term does not exist in the psychology lexicon (note, the two concepts are neologisms conceived by the author). I would, however, argue that archaeologists and anthropologists need to draw on finer distinctions in the context of understanding the role of materiality vis-a-vis the relationship existing between the prevailing environment and how individuals perceived it in the past. In order to demonstrate the efficacy of such an approach, I apply such finer distinctions to analysing the Upper Palaeolithic depictions of animals.

Problems with identification and interpretation

Bednarik (2016) provides cogent examples of how archaeologists can be misled by pareidolia by demonstrating how the phenomenon can lead to accepting purported rock art as real when, in fact, the phenomenon has led to a misconstrual of the evidence. In other words, because of pareidolia, natural rock markings are liable to be misconstrued as anthropogenic. Even some modern-day art historians have been misled by pareidolia, where objects are seen in 19th and 20th-century paintings that are not actually there (Wilner 2021). Bednarik's analysis is not the first time pareidolia has been shown to play a role in palaeoart, as Hodgson and Helvenston (2010) previously referred to the concept. On a practical level, archaeologists such as Lahelma (2008) and Montañés (2021), have turned to pareidolia as a way of understanding the motivation behind the Saami rock outcrops of Finland (known as 'Sieidi') and Pa-

	Hallucinations	**Pseudohallucinations** (or non-psychotic hallucinations)	**Hyperdolia/hyperimages**	**Pareidolia**	**Realistic perception**
Phenomenology	Image completely subjective. Experienced as totally real. Seen as part of actual world. Disconnection with real world Involuntary.	Image seems real, but subject knows it is an artefact. Often controllable but can be intrusive. Tends to be subjectively driven. Seen by 'inner eye'.	Image is influenced by subjective emotional factors and is triggered by cues in real object. Imagery initially appears real caused by confusion between real and projected image, then immediately realised to be a projected image. Equivalent to 'seeing-in' (e.g. x is an animal). Hold on reality endures. Material undergoes transformation based on imagery. Can intrude on perceptual awareness in certain situations. Ambiguity between real object and subjective experience. Sense of re-experiencing.	Random patterns of light and shadow interpreted as objects. Subject remains aware of the misperception. Equivalent to 'seeing-as' (e.g. x looks like an animal). Note misperception may be deemed real due to cultural dictate.	Near objective perception of things in the world.
Underlying cause	Characterised by mental illness such as schizophrenia or bipolar illness. Can be induced by hallucinogenic drugs or by electrical, chemical or magnetic stimulation of cortex. Unpredictable and uncontrollable.	Experienced in *some* drug-induced states. Can be induced by emotional trauma and stress related experiences.	Person under the influence of high emotion due to myth, ritual, ceremony or particular lifeway. Often elicited by intense focused concentration, expectations and emotional longing. Visual system primed to see specific objects through, e.g. hunger, fatigue, fear, stress. Specific objects perceived.	Normal perceptual response to random patterns or things that suggest non-existent objects. Driven by natural perceptual curiosity. Many kinds of objects perceived.	Normal human perception of real object. Complete voluntary attentional control.

Involuntary (not controllable).
Increasing dissociation from real world and more extreme experiences.
Increasingly subjective.

Voluntary (under attentional control).
Increasing association with the real perceptual world.
Less subjectively based.

Table 1. *Different criteria that characterise the way visual imagery is experienced as a result of various kinds of perceptual and cognitive states (note these categories are not mutually exclusive as there is a modicum of overlap between each group).*

laeolithic art, respectively. As will become clear below, such research actually refers to hyperdolia rather than pareidolia.

Although pareidolia can be informative as to how the human visual system functions, due to its pervasiveness and randomness, it can lead to considerable problems when applied to understanding palaeoart. In order to overcome those limitations, Hodgson (Hodgson 2008; Helvenston and Hodgson 2010) drew on some of the heuristics of pareidolia in relation to anthropomorphism, which leads to an interpretation of the world based on animism as per Guthrie (1993, 2002; see Varella 2018 for a review), by introducing the more finely-grained concept of hyperimages (note 'animism' here refers to 'new animism' [see Bird-David 1999; Helvenston and Hodgson 2010] that regards any group, whether ancient or modern, as susceptible to the phenomenon). That concept has proved more relevant to rock art analysis than pareidolia on a number of counts (Hodgson and Pettitt 2018; Hodgson 2019a; Sakamoto 2019; Pettitt et al. 2020; Wisher 2019, 2022), not least because it takes into account criteria that underpin pseudo-hallucinations. In fact, hyperimages/hyperdolia (as defined in Table 1 and Fig. 2) can assist in verifying genuine cases of rock art, as well as help in filtering out false positives, because the socio-cultural concerns specifically relating to the underlying perceptual priorities of hunter-gatherer communities are considered (this is not to say that rock art researchers do not consider socio-cultural factors, only that, with reference to visual imagery, this is not the main focus of concern). For example, in the case of Upper Palaeolithic cave art, Hodgson (2008) demonstrated that derivation can be more reliably inferred

Figure 3. *Typical example of a hyperimage fromTito Bustillo Cave, Spain showing the clever way the natural contours were exploited to depict the powerful form of a bison. This depiction is located in the cave's deepest, most ancient area. Note how the large upper dot on the head (to the left of the image) is utilised to create the eye of the bison that assists in triggering the rest of the anatomical features implicit in the natural rock typography. The other dots and marks may be related to ritual. (Thanks to Rodrigo de Balbín-Behrmann for permission to reproduce this figure: from Fig. 12B, de Balbín-Behrmann et al. 2017).*

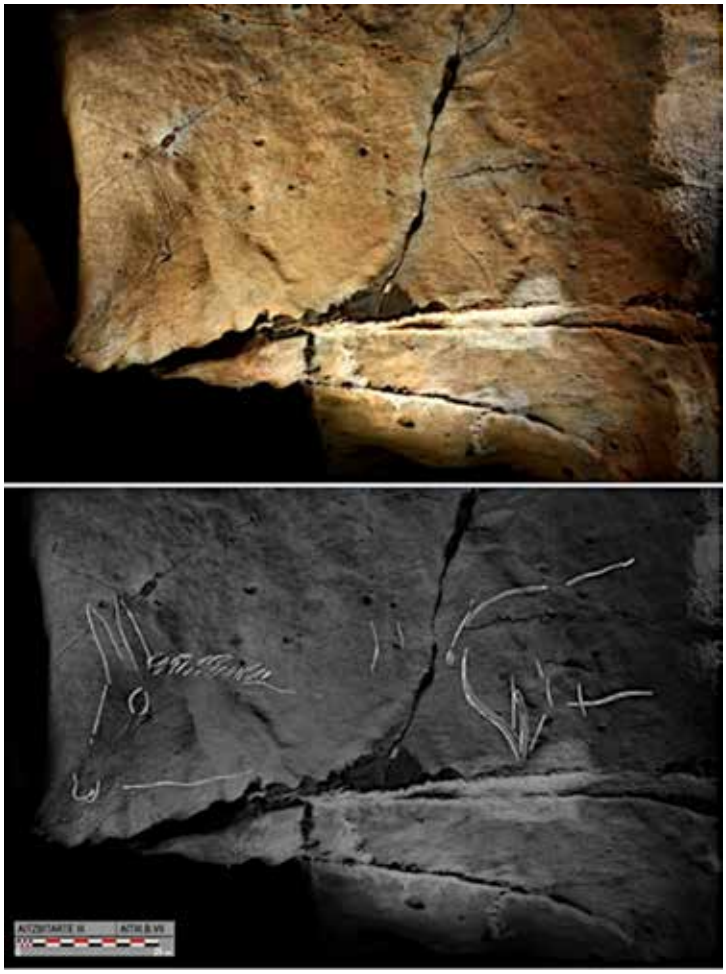

Figure 4. *Example of suggestive rock formation from Aitzbitarte Cave III, Spain overlain with a hyperimage (perphaps of a deer or horse's head). The figure to the right represents the rear quarters of an animal. From Fig. 4, Garate et al. (2020), Redefining shared symbolic networks during the Gravettian in Western PLoSONE 15(10): e0240481. https://doi.org/10.1371/journal.pone.0240481 Copyright: © 2020 Garate et al. Creative Commons Attribution License. Europe: New data from the rock art findings in Aitzbitarte caves (northern Spain).*

based upon the dynamic interaction between the need for an acute perceptual sensitivity to certain animals outlines on hunting forays (involving considerable emotional investment), the resulting hyper-sensitised visual system, and the suggestive outline of animals in cave rock formations. The heuristics of hyperimages/hyperdolia have, therefore, provided fertile ground for assessing palaeoart (Hodgson and Helvenston 2010; Hodgson 2019a; Hodgson and Pettitt 2018; Wisher 2022). Typical examples of hyperimagery/hyperdolia can be seen in Figures 3 and 4. The concept has also recently been applied to the discovery and interpretation of ancient rock art in Amazonia (Valle et al. 2018) and Mesoamerica (Wright-Carr 2018). Thus, as pareidolia leads to serious problems and ambiguities in establishing what constitutes rock art iconicity and is too generalised a concept to be beneficial in archaeology, hyperdolia provides a more secure basis for determining authenticity and assessing interpretation. In what follows, the justification of applying the tenets of hyperdolia to understanding palaeoart will be set out in a way that avoids the errors that can arise from the biases and misreadings that characterise pareidolia. In short, when considering palaeoart, hyperdolia needs to be given greater consideration and factored in alongside pareidolia, as the former is built on finer distinctions.

The main argument of this paper can be summarised as follows:

(1) Rock art researchers have previously employed the concept of pareidolia to identify and interpret palaeoart when they actually refer to hyperdolia/hyperimages.
(2) As a result, there have been cases in which images were misidentified and misinterpreted.
(3) Such failures could be avoided if the concept of hyperdolia/hyperimages were employed instead.
(4) Archaeologists would be better advised to refer to hyperdolia/hyperimages, which provides a more useful investigative tool for understanding rock art.

Seeing through pareidolia

In order to appreciate how pareidolia differs from hyperdolia, we need to consider where they coincide and diverge. The main difference between the two phenomena is that the imagery of pareidolia derives from mere perceptual

curiosity. It is more indiscriminate than hyperdolia because certain stress factors and socio-emotional criteria drive the latter, e.g. prolonged focused attention, fatigue, hunger, elevated emotional arousal and perceptual set. That is to say, in a way to be outlined below, although there are certain elements appertaining to pareidolia that overlap with hyperdolia, there are a number of important criteria that are not shared by the two concepts (see Table 1 and Fig. 2). The role of pareidolia in human cognition is undeniable, but in order to understand how it is linked to hyperdolia we need to explore why it is so pervasive in human visual perception. This may be related to what is referred to as the 'global precedence effect', that is, the tendency to see the overall gestalt by overriding the details. In order to appreciate the similarities and difference between the two concepts, the aetiology of pareidolia needs to be explored in greater depth with regard to a number of predisposing evolutionary factors.

The question arises as to why pareidolia is so pervasive in humans. The answer appears to reside in the fact that, seeing something that is not there rather than the opposite, provides a relatively dependable safeguard against threat. That is, it is a safer bet to regard something being there when it is not; a strategy which is referred to as 'adaptive conservatism' (Cantor 2005). Thus, pareidolia serves as a perceptual trigger that is easily activated to the extent we tend to see non-existent things even in everyday non-threatening situations. This finding helps to explain why pareidolia continues to be a common experience in modern humans and can mislead rock art researchers. The tendency may even have led to anthropomorphism and animistic beliefs, as Guthrie (1993) proposed, in that the propensity is deemed to derive from a pre-conscious perceptual strategy to rapidly detect things in the world. Despite the fact this can lead to many false positives, it nevertheless increases the likelihood of survival in that there are many more advantages in 'jumping to conclusions' when presented with minimum cues rather than requiring detailed information (Hodgson and Helvenston 2010). Thus, the raised tendency to perceive non-existent objects constitutes a beneficial survival tactic. The pervasiveness of pareidolia in humans is further underlined by the Rorschach test, where various, usually animate, objects are easily summoned up in the 'mind's eye' in response to amorphous but suggestive inkblots (Searls 2017).

The tendency for pareidolia begins as early as ten to twelve months in infants (Kato and Mugitani 2015; Kobayashi et al. 2012), and even rhesus monkeys are susceptible to the phenomenon (Taubert et al. 2017). However, in both cases, this has only been tested using images of human and simian faces, respectively. Despite monkeys being so disposed, humans seem much more susceptible, especially as simians are unable to complete illusory lines — as in the Kanizsa triangle — to the same extent as humans (Vyshedskiy 2014). Interestingly, chimpanzees, our closest living primate relative, are less susceptible to global gestalt integration than humans but are more liable than monkeys (Fagot and Tomonaga 1999, 2001). This suggests a phylogenetic trend in the ability to group local elements into global shapes. Furthermore, research indicates that in humans, global structural features tend to 'pop out' in a way that does not transpire in non-human primates (Fagot et al. 2008). That effect seems to be an important component underpinning pareidolia. In fact, it may be the human susceptibility to pareidolia — when enhanced by the heuristics of hyperdolia (visual system primed to 'see' certain objects through, for example, perceptual set as stipulated in Table 1) — which gave rise to the first figurative depictions (Hodgson 2019a; Hodgson and Pettitt 2018). 'Perceptual set', it should be added, refers to the proclivity to perceive things in a certain way due to expectations and preconceptions. That is, in particular situations, individuals tend to give primacy to features of an object while at the same time ignoring other aspects (Nevid 2022).

Given the proclivity to see faces in objects, it is therefore not surprising that pareidolia was probably the psychological mechanism that gave rise to the Makapansgat cobble (Hodgson 2000); a found object resembling a face collected by an australopithecine around three million years ago. Such findings are consistent with the idea that, 'hominins were selected on the savanna for their ability to better integrate multiple local features (predator body parts exposed in the swaying savanna grass) into coherent percepts (detection and recognition of a particular predator)' (Vyshedskiy 2014: 207). Significantly, the phenomenon can go into overdrive leading to hyperdolia and the related phenomenon of pseudo-hallucinations (referred to as 'non-psychotic hallucinations' by van der Zwaard and Polak 2001) or even full-blown hallucinations, each having its own aetiology (see Table 1). The propensity to 'see things not there' that typifies pareidolia appears to have been appropriated to realise the more focused visual experience that characterises hyperdolia as a result of perceptual priming (priming is discussed in detail below). Thus we can say that pareidolia is equivalent to 'seeing-as', which is an automatic, erroneous and involuntary perceptual interpretation involving mere curiosity with regard to a visual array (Davis 1987), whereas 'seeing-in' is the 'cultivation of a special kind of visual experience, which fastens on certain objects in the environment for its furtherance' (Wollheim 1980: 223) and is closely aligned with projective hyperimages. In essence, though certain elements of pareidolia overlap with hyperdolia, because hyperimages are not random and are based on particular psychological states and socio-cultural factors, and also have more components in common with pseudo-hallucinations, they can be leveraged as a way to understand how palaeoart first arose and in finding and interpreting rock art. In what follows, the similarities and, more importantly, the

differences will be emphasised to demonstrate the advantages of hyperdolia regarding understanding palaeoart. Table 1 provides an overview of the different criteria that characterise those concepts and related syndromes that arise from how the visual system functions in relation to different psychological states. To reiterate, Figure 2 provides a general overview of the relationship between pareidolia, hyperdolia and pseudo-hallucinations by showing that, although they all share a tendency for imagery, there are important differences that distinguish hyperdolia, not least because hyperdolia overlaps with traits associated with pseudo-hallucinations more than with pareidolia.

The ubiquity of pareidolia is supported by neuroimaging, which established that rapid activation of a detection system based upon coarse features is processed early in the visual stream by way of the amygdala/pulvinar system and is driven by an implicit emotional response, which is subsequently confirmed and fleshed-out in detail by the higher visual cortex as a fully-conscious output (Wardle et al. 2020; Liu et al. 2014). From the perspective of hyperdolia, the early visual system seems to hone in on salient, suggestive, animate features (such as faces and animals). They are implicitly and effortlessly evoked by neutral objects because sensitivity to such features is useful in promoting survival (see Hodgson 2019a and Hodgson and Pettitt 2018 for a detailed description of the neuroscience of pareidolia and hyperdolia apropos rock art). Again, I emphasise the way pareidolia functions because the same heuristics are exploited, built upon, and extended in hyperdolia. Crucially, in the case of hyperdolia, the heuristics are channelled in a way that leads to a preference for certain kinds of images as a function of intense concentration, expectations, emotional stress factors, and repetitive socio-cultural activities typified by ritual. However, although in pareidolia the projected image is invariably recognised as such, in certain circumstances — usually as a result of religious bias — the phenomenon may be regarded as real, usually as a sign or apparition, yet the predisposing object or pattern continues to be acknowledged (see below for more on this).

Interestingly, pareidolia (and which also applies to hyperdolia) is associated with creativity, which is experienced with greater flexibility and fluency in those with an artistic background (Diana et al. 2020). This suggests that the more one engages in making depictions, the more one is likely to see and exploit visual imagery and, therefore, engage in creative activity. Pertinently, Diana et al. found that the majority of pareidolic drawings made in response to observing everyday stimuli, which evoked visual imagery, were composed of 36.1 per cent animals and only 15.4 per cent humans/faces; a finding that, to a certain extent, parallels the predominance of animals in palaeoart. Having said that, humans and faces are extremely rare to non-existent in palaeoart, which suggests palaeoart derives mainly from hyperdolia rather than pareidolia. In short, it seems that many Upper Palaeolithic representations may derive from hyperdolia due to the fact that the depictions almost universally consist of particular kinds of large dangerous animals portrayed over a period of 25 000 years. If this was simply a result of pareidolia, we would see many more human faces depicted over that period in line with the way the human face is prevalent in contemporary humans experiencing pareidolia. In addition, we would also expect to see more variation in the types of animals and objects depicted over such an extended period.

The role of visual imagery

As pareidolia and hyperdolia constitute different manifestations of visual imagery, we need to explore how such imagery is experienced within the normal population. In that regard, recent research bears out the importance of visual imagery in human cognition, as some individuals experience what is referred to as 'hyperphantasia' or extreme image vividness (Milton et al. 2021). This is opposite to 'aphantasia', where a minority of individuals have difficulties summoning up images. The two conditions, however, represent endpoints of a continuum, with most individuals coming somewhere between the extremes. Of particular interest in the present context is that those with moderately enhanced vividness on perceptual tasks, who are more able to identify objects in degraded figures, tend to be artistically and creatively inclined. Enhanced vividness is associated with increased activity in the higher-order visual areas, as well as the limbic system and default mode network (Fulford et al. 2018). However, those falling within the range of the autistic/Asperger's spectrum, tend to exhibit reduced visual imagery (Milton et al. 2021; Dance et al. 2021) which, from the perspective of the approach defended here regarding the Upper Palaeolithic depictions of animals, poses problems for the role of Asperger's syndrome in explaining early cave art (e.g. Spikins et al. 2018). Moreover, those with enhanced visual imagery appear to be more susceptible to pareidolia, especially when presented with perceptual uncertainty and ambiguity (Salge et al. 2020). As Riekki et al. (2006) point out, such individuals are particularly susceptible to 'illusory imagery' (top-down imagery in visual memory) in a group setting, especially where ritual and socio-emotional factors predominate and where focused concentration on particular objects is a regular part of personal lifeways. Interestingly, Riekki et al., in referring to 'illusory imagery', fail to mention pareidolia in their analysis. As is obvious in the forgoing and to avoid confusion, I would submit that 'illusory imagery' — in the sense employed by Riekki et al. — should be referred to as hyperdolia. From the perspective of the Upper Palaeolithic depictions of animals, it may have been certain individuals with a proclivity for raised imagery that were predisposed to, not just see animals in ambiguous rock surfaces, but also highlight the perceived image by drawing the

main outline features.

Appositely, when observers are presented with an anomalous flickering display, referred to as a *Ganzflicker* (a uniform rhythmic flicker presentation), they tend to see pseudo-hallucinations in the array (Königsmark et al. 2021). Evidence suggests that this propensity may derive from the fact that the flicker mimics the alpha oscillatory frequency of the brain, which is associated with the onset of visual imagery. That finding has implications for understanding cave art as the flickering flames from torches and lamps in the ambient darkness of caves may have automatically triggered the cortical system that mediates visual imagery (the effect of flickering illumination on the perceptual system in caves can be empirically tested, which, as far as I am aware, has yet to be carried out). Similarly, weighting of priors in higher visual cortex leads to the likelihood of projective visual imagery intruding (Corlett et al. 2019). 'Priors' refer to a predictive bias based on previously acquired knowledge of the world (top-down) and the way it is matched with incoming sensory information from the environment (Königsmark et al. 2021; Van de Cruys and Wagemans 2011). Translated into understanding palaeoart, priors are set by the hunter-gatherer's higher to intermediate visual cortex being finely tuned to detect animal forms for the purpose of survival. Similarly, artificial neural networks trained with animals' images tend to over 'see' the trained features in presented scenes (Bracci et al. 2019).

In situations of relative darkness, visual imagery tends to dominate perception to the extent that a 'Perky effect' is likely to arise (Perky 1910), where imagery and perception of the world mutually interact. In other words, sensory input or perceptions are liable to be mistaken for a mental image to the extent that perceptual processes and mental imagery can interfere with each other. The effect seems to depend on whether the incoming perceptual information is congruent with information already existing in short and long-term visual memory. If so, facilitation occurs because there is more likelihood of a fusion between the various attributes (Ishai and Sagi 1997). In caves and other dimly lit environments, expectations facilitate visual imagery by providing hypotheses as to what exists in the half-light. To a certain degree, this simulates the fact that hunter-gatherers had to remain keenly attentive to the presence of animals even in night-time conditions beyond and around the campfire. For hunter-gatherers, such expectations were dominated by large animals, especially as the caves were often places where dangerous animals lurked. As a result, visual imagery became highly charged and was easily triggered by the slightest cue from any evocative rock surface suggestive of an animal contour, thereby evoking a hyperimage. It must be borne in mind that large herbivores can be as dangerous as predators, as even modern-day humans are sometimes killed through trampling or being gored. Accordingly, hyperdolia would have been regularly experienced by ancient intruders in the dark and liminal caverns. The relevance of expectations is underlined by the finding from perceptual psychology that, when observers anticipate that an object is present in an ambiguous array, they are more likely to perceive it sooner than when unanticipated (Pinto et al. 2015). Moreover, the prevailing object can either emerge as a whole or parts appear sequentially depending on how many cues are available at any one time, which reflects how the visual system engages in hypotheses testing by 'completing' the missing features.

Visual palaeopsychology

The relevance of perceptual psychology to understanding the Upper Palaeolithic cave depictions of animals is reinforced by recent empirical research based on the new sub-discipline of 'visual palaeopsychology' (Pettitt et al. 2020). Much of the research on which 'visual palaeopsychology' is based arose out of much earlier studies that demonstrated how perceptual psychology could be applied to understanding palaeoart (e.g. Hodgson 2003a, 2003b; 2006a; 2008; 2013). For example, Meyering et al. (2021) found that particular diagnostic outline features of animals were commonly employed in Upper Palaeolithic depictions that expedited the rapid identification of animals. Sakamoto (2019) came up with similar findings regarding the integration of the topography of cave walls concerning which contours are prioritised. By employing virtual reality technology — where a subject could wander around a simulated cave environment containing animal depictions and freely respond to the evocative natural features — Wisher (2022) found that hyperimages could account for many of the depictions. That finding complements empirical studies in which similar outline features were preferred concerning the order of drawing employed to depict animals (Fritz 1999; Fritz and Tosello 2000; Tosello and Fritz 2004). The cervico-dorsal line and head contours are invariably depicted first and are usually the only features depicted. Those studies are further complemented by the fact that the same features are selected to portray the sideways view of animals, which derive from certain perceptual fundamentals concerning how animals are detected and recognised by the visual system (Hodgson 2003a, 2003b, 2006a, 2013; Dobrez and Dobrez 2013). If cave art arose out of pareidolia, we would expect to find a wider range of objects to be depicted, which is not the case. Furthermore, as already noted, even faces, a common experience of pareidolia, are rare to non-existent in palaeoart. The fact that particular animals constitute the basic subject matter of Upper Palaeolithic cave art points to the crucial role of hyperdolia in fashioning animal depictions.

The analysis of the previous sections has drawn attention to the importance of emotional intensity — concerning arousal caused by an event — which can directly affect how the visual system processes an

image. That is, depending on the emotional profile of an event, an individual can either be biased towards a subjective internal stimulus that evokes an apparent objective image (i.e. hyperimage), or disposed more towards an externally derived 'image' originating directly from a real-world stimulus (Hodgson 2008). When associated with the ecological conditions that characterise hunter-gatherer lifeways, we see how a potent scenario led to the experience of hyperdolia (the relevance of implicit emotional criteria will be further addressed in the next section). In dimly-lit situations, a dynamic interaction will initially occur between the subjective visual imagery engaged in hypotheses-testing and the prevailing perceptual reality (Hodgson 2008, 2021). This is a situation where mesopic 'twilight' vision begins to take over from photopic day vision as a function of the overlapping residual cone system (day vision) with the coming online of night-time scotopic rod vision. When mesopic vision predominates, most accidents occur due to the conflicting information issued from the rod and cone systems. In caves, shelters and other situations already referred to, hunter-gatherers would have relied on mesopic vision to navigate the environment leading to the aforementioned perceptual effects and the sense of danger and uncertainty that comes with such vision. In that regard, some researchers discuss in detail the effects of various lighting systems (i.e. lamp burners, torches, natural light etc.) on the visual system in caves (see Hodgson 2008; Pettitt 2016; Medina-Alcaide et al. 2021; Pettitt et al. 2022). It should be added that many of the insights from those studies are just as applicable to other regions of the world where rock art exists in rock shelters and caves, such as Sulawesi in Indonesia (Aubert et al. 2014). Outdoor sites are relevant here, as rock surfaces can be potentially viewed both in twilight and shaded areas, as well as when weather conditions give rise to compromised lighting (Froese and Gallaga 2020).

Priming especially comes into play in darkened environments and where light is at a premium. Priming refers to the underlying biases of the visual system, which are instantiated by long-standing evolutionary precursors or through repeated ongoing experience with an event. The significance of priming with regard to palaeoart has been investigated in depth where, in certain perceptual situations — especially in ambiguous environmental conditions — this can lead to self-priming (Hodgson 2003a,b; 2008). As a result, the underlying evolutionary instantiated domains, e.g., for detecting animals and humans, are automatically activated (adaptive conservatism), leading to the apparent 'resolution' of the ambiguity perceived in a particular rock surface. So, although the human brain is subject to neural reformatting as a result of plasticity, there are certain domains linked to our evolutionary heritage that continue to bias behavioural outcomes, as Dehaene (2009) and Mitchell (2018) point out. Two such domains include those for identifying animals and humans, which have dedicated neural regions even in modern brains (Mahon and Caramazza 2009).

Emotional concerns and the implicit

The role of the visual brain in relation to hyperdolia is underlined by the fact that, not only does the higher visual cortex benefit from a dedicated region for perceiving animals (Mahon and Caramazza 2009), but also the right amygdala is dedicated to the implicit emotional, perceptual criteria employed to detect animals (Mormann et al. 2011). As Mormann et al. (2011: 1248) state: 'A plausible evolutionary explanation is that the phylogenetic importance of animals, which could represent either predators or prey, has resulted in neural adaptations for the dedicated processing of these biologically salient stimuli'.

Such an early fast subliminal pathway for the detection of animals subsequently interfaces with conscious recognition (LeDoux 1994, 1998), where considered appraisal takes place. That progression is underscored by the fact that attention is automatically drawn to animate, as opposed to inanimate objects in various scenes, even in modern humans, which reflects ancestral priorities (New et al. 2007). The importance of those contingencies concerning hyperdolia and seeing-in, which are linked to arousal and emotional engagement, is that they become subject to cultural modulation. Hodgson (Hodgson 2008; Helvenston and Hodgson 2010) set out the factors that drive hyperdolia as follows:

1. The subcortical thalamus to amygdala pathway that responds rapidly and pre-consciously to potentially threatening stimuli, especially those involving danger (see LeDoux 1994).
2. The subcortical route provides only primitive perceptual cues of the external world, whereas the cortical pathway embellishes this in the form of a more detailed enhanced representation (Alorda et al. 2007).
3. The subcortical system may trigger an emotional response to a stimulus before conscious recognition ensues, hence allowing fight or flight mechanisms to be readily tuned.
4. When this occurs, and especially during heightened emotional stimulation, internal subjective images can be misconstrued as reality.
5. Such emotionally driven memories are difficult, if not impossible, to erase.
6. The alerting system produces a generalised attentional bias to focus on threatening stimuli that tend to persist when activated, as dangers do not strike in isolation and then disappear but rather tend to linger (Öhman and Soares 1998).
7. This often leads to a further entrenchment of arousal levels and an associated increased motivation to seek further threats of the same order.

Thus, mental imagery may play a decisive role in threat perception (Imbriano et al. 2020) mainly because

imagery of threatening stimuli is more vivid (Bywaters et al. 2004) and gives rise to enhanced emotional arousal compared to neutral imagery (Lang 1979).

One point that needs to be emphasised, however, is the importance of neural feedback that projects from the higher areas of the visual cortex (the inferotemporal area where visual memory/imagery occurs) to the early visual cortex (V4, V2 and V1) (Biederman and Vessel, 2006; Chen et al. 2014), which is useful when enhanced scrutiny of an object is required and ambiguity is present. For example, in reduced lighting conditions, feedback serves to reinforce the compelling nature of any visual construal (Hodgson and Helvenston 2010), thereby making a perceived hyperimage more salient.

The relevance of implicit emotional factors to present concerns can be found in the fact that when objects, such as animals, have a high emotive saliency — as was the case for Upper Palaeolithic hunters — hyperdolia would have constituted the overriding influence on behaviour. This is because large dangerous animals — both predator and prey — were intimately and regularly associated with approach/avoidance to the extent that their perception became emotionally ingrained.

Myth and ritual

Sauvet (2019, 2021) found that during the Upper Palaeolithic, large predators and prey tended to dominate the depictions in predictable ways throughout Europe, with horses (29.5%) and bison 23.3%) dominating, then deer/hind (11.1%), followed by Ibex (9.7%), mammoths (7.4%), aurochs (5.7%), reindeer (3.4%), lion (2.6%), rhino (1.6%), and bear (1.4%). Sauvet suggests that the horse's predominance derives from its mythological status associated with animism, which was reinforced and shared among diverse groups across the European continent. He regards the similarities and convergences in the preference for certain animals, as well as the way they are depicted, as stemming from widespread cultural interchange across hunter-gatherer groups over an extended period. However, I would add a third major contributory factor, namely the perceptual constraints already alluded to, arising from how the visual brain deals with animal forms for rapid detection. Although the primacy of horses Sauvet associates with mythology, from the perspective of perceptual psychology, this can be explained by favouring a particular hyperimage, which is reinforced thanks to increased focused attention on one species due to a culturally derived preoccupation through, for example, rituals, ceremonies, rites, customs etc. This is underscored by the finding that, as horses were one of the most prevalent and resilient species throughout the Upper Palaeolithic, they would have loomed large in the visual system of Cro-Magnons. Moreover, unlike many other species, horses were well suited to thrive, if not increase in herd numbers, during colder periods (Sandoval-Castellanos et al. 2017), and their profile would have stood out against the snow-white landscape. Given that ritual is believed to be a regular activity carried out in caves — even though its archaeological signature can be subtle (Arias 2009; Noiret 2017) — horses were, therefore, ideally suited to become a focus of concern. Recall that one of the defining features of hyperdolia is the over-concentration on a particular object during an extended period, particularly when agents participate in repetitive ritual activities. Similarly, research on modern humans found that, compared to sceptics, those of a religious inclination or those who believe in the paranormal tend to see faces in ambiguous, as well as completely random patterns, due to the fact they have been primed by their personal belief system (Riekki et al. 2013). In other words, hyperdolia is more likely to spring to mind in those of such a predisposition.

Discussion

Though pareidolia is often referred to by archaeologists when assessing palaeoart (for a recent example, see Needham et al. 2022), we have seen that they not only tend to overemphasise its role but also ignore other types of imagery, such as pseudo-hallucinations and, by implication, hyperimages. This does not mean that pareidolia is unimportant, only that equal, if not more, attention needs to be given to alternative forms of imagery. After all, in the dark liminal unstable light of caves, the visuoperceptual status of hunter-gatherers will have varied considerably such that the kinds of imagery experienced differed according to the changing circumstances (Hodgson 2021). The perceptual parameters necessary for successfully detecting animals in the wild for survival, and the way certain aspects of caves simulated that environment (Hodgson and Pettitt 2018), meant that the depiction of animal profiles gave hunter-gatherers a sense of control over the animals portrayed. This is reflected in the fact that hunters need to think like animals in order to successfully track prey and avoid predators (Hodgson 2017a). That control may have planted the seed in the minds of our forebears of the possibility that animals could be tamed (Hodgson 2021). In one way, the animals would seem to have emerged from the hands and fingers of palaeo-artists in that fauna appeared to flow onto the various suggestive rock surfaces miraculously. Perhaps it was the enchantment of that engagement, together with the animals seeming to magically emerge from the evocative rock surfaces through the aegis of hyperdolia, that gave the depictions a special status perhaps as magical images (Hodgson 2021). That search for 'magical images' was more than likely a communal enterprise with children and infants being involved, where even the more dangerous areas were visited by children in some caverns while, in others, only adults entered (Liliana and Cooney Williams 2018).

The exploitation of the different levels of the perceptual hierarchy for detecting and 'imagining' animals seems, in certain cases, to have mutated into

an aesthetic interest, as is obvious by the way some animals are portrayed in palaeoart. Indeed, Rádlová et al. (2018) established that there is a cross-cultural consensus as to which features are regarded as aesthetically positive when observers view various animals, namely, certain diagnostic outline saliencies. By taking those insights into account, we can understand why animals were 'good to think' (Lévi-Strauss 1962). Moreover, because Upper Palaeolithic individuals remained unaware as to the causes of hyperimagery, it is probable that such imagery was regarded as special. It is additionally possible that the dimly lit cave environment may have been associated with 'visions' of animals (Hodgson 2008). In that regard, the repetitive depiction of animal outlines — often of the same quadruped — provides further confirmation that caves were a location where ritualistic behaviour was enacted, as one of the major symptoms of such behaviour is the replaying of the comportment that gave rise to the material signature (Hodgson 2017b). Although that behaviour is probably related to an animistic belief system, what exactly gave rise to such beliefs continues to be hotly debated.

Interestingly, Whitehouse (2002) maintains that hunter-gatherers engage in infrequent emotive imagistic rituals that can take on various forms depending on context. Caves, where most palaeoart survives, provide an archetypical environment for such rituals, not least because dark, liminal places are where hyperimages were most likely to be experienced. In effect, caverns served as a location where 'magical' images could be perceived in that they seemed to emerge from both the rock surface and the ambient darkness. It is, therefore, probable that hunter-gatherers entered the caves in a quest, not only to experience the animals apparently emerging from the rock surfaces but also to re-find previously made depictions. That quest seems, however, not to have been the preserve of a privileged few but involved male and female adults as well as infants, children and adolescents (Nowell and Van Gelder 2020). Let me add here that no value judgement is intended in referring to the susceptibility of hunter-gatherers to animism, pareidolia, and hyperimages, as modern technologically savvy humans can, in equal measure, be just as prone to the same tendencies.

The theoretical position followed in the above analysis sees rock surfaces as potential affordances (an action possibility related to an implicit understanding of how to interact with an object) and embodied cognition whereby some were acted upon to realise depictions, perhaps performatively by way of entanglement and enactive engagement (Froese and Gallaga 2020). Therefore, it was not the depiction itself as a finished article that was important but the process of making, finding and re-experiencing images.

That entangled engagement and sense of enchantment were mediated by visual imagery/memory (encoded by neural networks as there are no 'pictures' in the brain), which is consistent with the role of hypothesis-testing in relation to forward prediction that seeks to minimise errors (Van de Cruys and Wagemans 2011; Friston et al 2012) in the sense that the world as perceived interacts with the way it is interpreted top-down, especially when incoming information is ambiguous. 'Forward prediction' refers to higher-order top-down assumptions that are established in the late to intermediate visual cortex through previous experience, whereas 'forward prediction errors' refer to ongoing bottom-up engagement with stimuli that may not, initially, conform to established assumptions and can, therefore, give rise to new learning. The way visual imagery transpires with regard to such perceptual inference is consistent with how pareidolia and hyperimagery unfold in that visual imagery/memory, as a top-down system, furnishes the best hypothesis as to the makeup of a perceived stimulus (see Seth et al. 2019 for how this can be applied to understanding visual art). Visual memory, however, will have interacted with the affordances deriving from a rock surface by inviting engagement with the evocative material saliency. Although the role of suggestive rock formations concerning the beginning of iconic depictions has been noted before, the present analysis adds weight to that notion by illustrating that projective imagery plays a more substantial role than previously surmised. That proposition is substantiated by the fact that empirical studies described above and discoveries of Upper Palaeolithic depictions have been based on the role of suggestive rock surfaces in triggering depictive episodes to the extent that the phenomenon's significance has been underestimated (Clottes 2007; Hodgson 2013). Moreover, the facilitative nature of projective imagery has been found to be significant to portable art (Sauvet 2009), including plaquettes (Needham et al. 2022), which points to the widespread nature of the phenomenon.

Based on the above insights, some authorities might assert that the claim is being made that the inception of iconic depictions derived from an error of perception (Dobrez 2007). However, this 'error' can be seen in a positive light because it was exploited for positive effect—in the sense that it allowed iconic depictions to be conceived and acted upon in such a way that social customs could be preserved and transmitted in a way that facilitated cumulative effects (Hodgson and Helvenston 2007). In fact, neuroscience confirms that our hold on visual reality is tenuous in that what is perceived is a form of controlled hallucination, i.e. the appropriation of error (Seth 2021). The 'mistake' is further confirmed by the fact that when, for example, a drawing of an animal is viewed, the same area of the cortex is activated as when a real animal is perceived (Walther et al. 2011). Remarkably, the same cortical area becomes even more active when viewing an impoverished outline drawing of an animal. Those observations provide confirmation of Bednarik's (2004: 36) proposal that the beginning of iconicity was a '…

"managed", intentional use of visual ambiguity'.

Finally, some researchers believe there is too great a focus on mimicry and how it was discovered or invented when other ways of expression are of equal, if not greater, importance; a sentiment I wholeheartedly support. Nevertheless, the fact that the first depictions of animals, whether in Europe or Indonesia, evince a distinct tendency for natural appearances is a phenomenon that needs to be explained, which, hopefully, the present analysis has addressed in some way. Having said that, the fact that the Makapansgat cobble, Berekhat Ram, and Tan Tan artefacts predate the animal depictions by a considerable margin, and were minimally transformed, suggests their significance was mainly based on pareidolia, whereas the Upper Palaeolithic depictions derived from hyperimages. That trajectory, however, does not mean hyperimages derive from a pathological state of mind, as the underlying cause of such imagery falls within the normal spectrum of behaviour, e.g. over-concentration on an item or an over-investment in a particular way of thinking relating to the world. The idea that one thing could stand for another, however, was probably not a standalone discovery but may well have been preceded and primed by the ability to make hand-marks, identify animal tracks and make animal disguises employed for hunting (Hodgson and Helvenston 2010; Hodgson and Pettitt 2018). In support of that scenario, hand-marks have been found to predate the animal representations of both Europe and Indonesia by a considerable period (Hoffman et al. 2018; Aubert et al. 2014).

Conclusion

The main message from the foregoing is that our hold on visual reality is conditioned by various emotional and perceptual states, which, in turn, depend on an interaction with the affordances existing in the world. The relevance of that insight with regard to rock art centres on the fact that, first, rock art investigators need to approach any potential rock art with great care as they can be deceived by their own perceptual system; second, appreciating that dynamic can assist in understanding the relationship of the original authors of rock art to the material world, which, in turn, can provide insights into cultural affinities. The concept of hyperdolia, as defined above, not only avoids such pitfalls but also establishes a firmer ground for assessing various types of palaeoart. By considering the insights that visual palaeopsychology can provide, the analyses of ancient rock art sites will be much better placed to determine the significance of specific images.

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COMMENTS

Pareidolia: a power that gives us the gift to see

By AHMED ACHRATI

Seeking 'a more nuanced understanding of the processes that underpin the experience of imagery, particularly as relates to rock art', Hodgson identifies pareidolia, a visual experience wherein subjective images are imposed on perceived external patterns, as the source of 'serious problems and ambiguities' relating to iconicity in rock art. To remedy this, he proposes hyperimage, a projective experience located between pareidolia and pseudo-hallucinations, as more helpful in understanding 'how palaeoart first arose and in finding and interpreting rock art'. To arrive at this conclusion, Hodgson examines the neurological mechanisms that underpin the processing of visual representations in pareidolia and hyperimages, stressing the role of knowledge, emotions, memories and expectations in shaping these visual experiences. In addition to this top-down analysis, he also underscores the influence of cultural factors on how humans deal with projective ambiguities.

Though the aim of this study is to understand 'psychological states that can be useful to rock art researchers', the focus is almost exclusively on 'the identification and interpretation' of rock art. Left out is the actual realisation of this art — which, in the end, is what counts most. Additionally, it is never made clear how substituting hyperdolia/hyperimage for pareidolia can improve our understanding of this creative activity. Regardless of either, the nature of Palaeolithic art is such that some of it is always difficult to identify and much more impossible to interpret.

Moreover, the rationale provided for the 'de-authorisation' of pareidolia is insufficient, given its widely acknowledged positive function within cognitive processes. As da Vinci (1950) said, pareidolia is of 'great utility in arousing the mind to various inventions'. Elaborating on the stimulating benefits of pareidolia, Da Vinci gives the example of how in wall stains one could see 'a resemblance to various different landscapes … combats and figures in quick movement, and strange expressions of faces, … and an infinite number of things which you can reduce into separate and well-conceived forms'. All this, he adds, 'comes about as it does with the sound of bells,

in whose clanging you may discover every name and word you can imagine'.

This is why pareidolia was exploited by modern artists, who integrated it into their creations using techniques such as, for example, the inkblots or rubbing (frottage) developed by Max Ernst. Pareidolia-induced illusion is also deployed in many artistic works (e.g. André Masson, Salvador Dali) (see also Pepin et al. 2022, who show a higher incidence of pareidolia in creative individuals).

Hodgson uses a heuristic strategy to displace pareidolia, but heuristics affords many possibilities of analysis, including the use of backward reasoning and simplification. Looking at pareidolia from this side of heuristics reveals just how cognitively significant this perceptual phenomenon is. An apt illustration of this is found in the way writing — another graphic activity — was developed. Whereas in pareidolia, subjective images are imposed on perceived external patterns, the rise of writing, especially logographic scripts, reverses this process by stripping a figurative image down to a few suggestive traces. A testimony to the cross-cultural salience of pareidolia as a cognitive framework, this reductive process, or 'pareidolisation', is, for example, seen in the design of the symbols of fish, bird, axe, arrow and vase in three writing systems: cuneiform, hieroglyphic and archaic Chinese (Maspero 1980: 243, Fig. 38) (Fig. 1). Pareidolic influence crops up even in phonetic writing, where, despite the extreme abstraction which they underwent in becoming phonemes, some letters still retained hints of the constitutive features of the figures from which they were derived. A good example is the development of the letter 'k'. The shape of this letter traces its ancestry to the Proto-Sinaitic and Phoenician scripts, where 'k' was represented by a bird print, sometimes attached to a line to form a stylised brush or broom. With time, the stick aligned itself with one of the fingers, and 'k' took its form as known in Aramaic, Greek, Etruscan and Nabatean, first as a backward, upside-down 'k' (Achrati 2003: 27).

Interestingly, in crossing paths, both pareidolia and writing have shown a distinct susceptibility to religious and mystical interpretation. Early writing was usually a priestly function. The birth of Chinese scripts is closely associated with divinatory practices wherein a question was inscribed on a bone, which was then heated to reveal cracks supposed to hold the answer.

Even when scientists deploy today's technological advances to study the creative and artistic functions of the brain, the neural system remains a mystery. Alzheimer's, for example, is a disease that deeply affects memory, abstract thinking and executive functions. Artists afflicted with this neurological disorder gradually lose their creative ability. As their condition progresses, they start producing images of mostly pareidolic nature. This was seen, for instance, in the case of William Utermohlen (1933–2007). Pertinently, his last portrait, *Head 1* (2000), is eerily similar to the Makapansgat face.

Moving up from pareidolia to hallucination, hyperphantasia and phantasia may yield some insight into human cognitive processes, but the results have proved to be of little help to the goal of this study: the origin, identification and interpretation of rock art. To compensate for this explanatory limitation, Hodgson tries to appeal to mythical and socio-cultural factors: 'In one way', Hodgson says, 'the animals would seem to have emerged from the hands and fingers of palaeo-artists in that fauna appeared to flow onto the

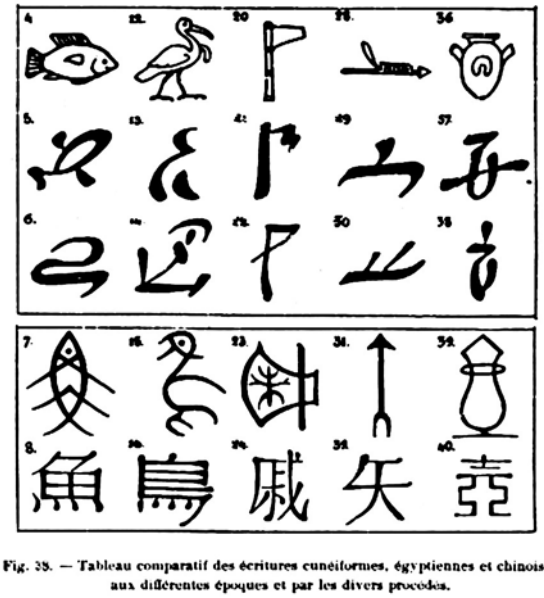

Fig. 38. — Tableau comparatif des écritures cunéiformes, égyptiennes et chinoises aux différentes époques et par les divers procédés.

Figure 1. *Symbols of fish, bird, axe, arrow and vase in three writing systems: cuneiform, hieroglyphic and archaic Chinese (Maspero 1980).*

Figure 2. Head I, *by William Utermohlen (2000), https://en.wikipedia.org/wiki/William_Utermohlen.*

various suggestive rock surfaces miraculously. Perhaps it was the enchantment of that engagement, together with the animals seeming to magically emerge from the evocative rock surfaces through the aegis of hyperdolia, that gave the depictions a special status perhaps as magical images.' This is a hermeneutic move that risks returning to entoptic and shamanistic theories of rock art.

To the extent that it is an issue of concern in Palaeolithic art, pareidolia, like the rest of rock art, is, perhaps, best understood when approached from a synesthetic perspective, which would then account for the kinesthetic, tactile haptic, and auditory functions that undergird the perception and projection of images. The predominance of horses in cave art, for example, which Hodgson cites, is most of all an instance of the ideals that seem to have moved the Palaeolithic artists: a realisation of form and texture in motion.

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On pictures as perceptual stimuli — a marginal note

By JAN B. DERĘGOWSKI

Empirical evidence shows that the human visual system does not always operate with great certainty and aplomb. The unfortunate misshapen creature, rabbit/duck, has been making its hopping/waddling way through the introductory text on perception since the 19th century and has been assisted in its efforts by the drawings of the Necker cube and three-pronged trident and, in three dimensions, by perceptual inversions of a cone, all of which show that unchanging stimuli can evoke blatantly contradictory percepts.

This inherent vagueness of the system makes it difficult to divide the spectrum of percepts convincingly, a fact that Hodgson acknowledges. This obliges him to introduce the notion of hyperdolia to account for the influence of 'subjective emotional factors'. All the vectors driving such influence listed in Table 1 would, in texts on perception, be comfortably ensconced under *attention.* Attention to particular perceptual cues is at the core of training microscopists as well as hunters. Its role in cultural settings was exposed by Mrs Muldrow (Deręgowski et al. 1972), who observed that the Meen (Mekan) men, unfamiliar both with paper and pictures, were shown pictures printed on paper. They ignored the depictions entirely and attended solely to the new to them substance. However, when the pictures were printed on very coarse cloth (a material familiar to them), they attended to the depictions. Their behaviours in the two circumstances were probably similar to those one would expect from a geologist and a rock art student placed side by side, facing a wall of a cave.

The main concern of this impressive essay is the notion of *pareidolia*, the tendency of the perceptual system to recognise in depictions 'things' whilst remaining aware that these 'things' are not there. The author postulates that these 'things' are objects. If by objects he means physical objects familiar to the viewer, then it is an unfortunate *lapsus calami*, as the gestalt crowd gleefully demonstrated by postulating the law of good continuation with its immediate applicability to lines rather than objects (Hamlyn 1995).

Pictures are thought of, by human beings, as special. Especially so by those involved in making pictures. The human perceptual system does not recognise such elevation; it merely endeavours to make sense of perceptual cues it receives. It treats cues coming from pictures as it treats cues from other sources 'out there'. Gestalt psychologists thought that visual percepts have their alter egos in the neural system — there seems to be no convincing empirical evidence supporting this view; however, their *law of enclosedness* comes to the fore (von Fiendt and Moustgaard 1977; Hochberg 1987; Johnson and Proctor 2004). A closed outline of a bison establishes a bison, but not every possible outline yields an effective depiction of the beast. A circle is a perfectly legitimate outline of an egg, but it is not its favoured depiction. An element of lived experience creeps in and, with it, the classical psychological notion that we perceive whatever more probably would produce the stimulation we receive. When the stimulation would probably derive from two distinct and incompatible sources, such as birds' wings and a horse's body, we accept with puzzlement, but no confusion, a Pegasus, but when the elements of a configuration are such that perception of one nullifies perception of the other, as for example when viewing a two-pronged trident, we are greatly bemused. This bemusement abides after the figure is removed from sight, so the observer finds it very difficult to draw what he has seen.

Such figures, therefore, are puzzling to the protagonists of the traditional theories of perception and also question how the notion of pareidolia could be applied to them. Is there a realm of visual perception in which pareidolia is barred? (This touches upon the enduring truism that any general theory of visual perception of pictures must apply to all pictures.)

If not, this is unexpected because pareidolia occurs naturally when viewing. An animal, say, appears more or less distinctly on a background. The artist can manipulate this distinction and attains full strength when the picture is judged to be *trompe l'oeil*. The author does not address this issue, which is at the root of camouflage, a device frequently encountered as when one tries to find a matching nut for a screw in a box of loose nuts.

It is a pity that in so broad an essay impressively founded on a large number of references, no room was found for this psychological query.

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Jumping the gun

By LIVIO and PATRICIA DOBREZ

Hodgson's article seeks to add nuance to the concept of pareidolia as used in psychology and as applied to rock art studies. The term pareidolia has been used in connection with rock art, notably by Bednarik (Bednarik 2016). *Rock Art Research* has featured critiques of megafauna attributions to rock images in Australia (Bednarik 2013a; Lewis 2017), and of motif identification in the U.S.A. (Bednarik 2015), some of which may be the result of pareidolia, understood as seeing something which is probably not there. Pareidolia thus amounts to a hermeneutic 'jumping the gun'. Caution is frequently good advice to rock art scholars who may well be in need of public funding for their next field trip and accordingly overly inclined to interpret their finds as headline-making. Bednarik's claim that dubious attributions lead to dubious, possibly false, rock art chronologies is one that has to be taken seriously. There are very diverse cases of false or unlikely readings. In the case of Mountford's Panaramitee 'crocodile', or of '*genyornis*' in Australia, and, in America, the Sand Island 'mammoths', there is external evidence encouraging scepticism — one or more of the following: absence of relevant fossils, or too great a time gap between the recorded presence of the actual animal and the likely date of the rock art, or no likelihood of the rock support being of the right antiquity. Thus, seeing something not actually there would be a reasonable explanation for the attribution, and the appeal to pareidolia a timely warning to researchers. The case of the 'dragon' in the vicinity of Green River, Utah, is most obviously a straight case of joining unlikely dots. Without any prior knowledge of its polemical context, the present authors found the supposed dragon in 2010, and drew it in their notebook as several disparate images. Later they saw that this corresponded with Bednarik's (2015) illustration taken from Senter's analysis.

In the present discussion it may be as well to add the point, of which Hodgson is aware, that the pareidolia effect is not restricted to perceptual errors, since that glosses over the positive evolutionary value of seeing patterns, whether they be there or not. If you see a shape in the grass as a possible lion, you do well to get up the nearest tree, and if it turns out to be an antelope, no harm has been done.

All in all, then, we accept the relevance of that cautionary reference to seeing one pattern too many, not least in rock art imagery. Pareidolia is a real category in the phenomenology of seeing. Can the same be said of Hodgson's hyperdolia?

Turning to hyperdolia as adding greater subtlety to the idea of pareidolia, we are unconvinced. The term is, as Hodgson admits, not in the psychology vocabulary. It is put forward as an additional category in a spectrum that goes from psychotic hallucination, to pseudo-hallucination (as with some drug experiences), to 'hyperdolia', to pareidolia, to 'normal' visual perception. But is there a significant difference between pareidolia and the proposed hyperdolia? Hodgson proposes his neologism as potentially helpful in eliminating perceptual false positives. We do not readily see how it would do so in a way different from the pareidolia thesis. The main example given is the established and, as far as it goes, uncontroversial idea of the makers of the art seeing images in rock art surfaces. This brings us to the one aspect of hyperdolia as here defined which we can see as specific to it, and as distinguishing it from the pareidolia thesis: its focus on a form of primitivism.

The (supposed) primitive may be regarded positively (see Seneca on Roman decadence vis à vis the barbarians, Tacitus on the Germans, and the more recent *bon sauvage*), or negatively, as debased — in the relevant literature usually represented by Fuegians and indigenous Australians (see Dampier and the Dutch as against Joseph Banks' Rousseau-inspired Noble Savage). In the twenty-first century and leaving aside notions of savage nobility as historically dated, it would of course make no sense for Hodgson to be in the negative camp. Nonetheless his categorial spectrum unwittingly calls up the ghost of a simplistic post-Enlightenment dismissal of the supposed primitive and the concomitant idea of animistic or mythic thinking. The one significant difference between hyperdolia and pareidolia has to do with inbuilt assumptions about the primitive which are objectionable, as regards Hodgson unwittingly so. Hyperdolia emerges as an animist confusion of real and imagined, pareidolia as a small mistake that any modern might make. Add to this Hodgson's reiteration of the old and possibly true idea that cave art was enhanced by torchlight — an idea unfortunately also evocative of savages capering ritually while subject to exotic emotions. Hodgson does not intend this, stressing that his 'animism' is of a new variety, and that we contemporaries are equally liable to feel the emotive effects of ritual. We agree, but feel the whole notion of animism, however renovated, evokes imagery of this sort. For a more informed approach, one might go to the anthropological essays of Stanner in Australia, or Lévi-Strauss' idea of hunter-gatherer thought as perfectly rational but taken up with non-modern problems and therefore coming up with quite different solutions. In this connection we also note that Hodgson's spectrum places the primitive, represented by

hyperdolia, next to the pathological, with pareidolia comfortably on the side of contemporary normality. Hodgson will no doubt say that he is far from implying that the spectrum implies a shift from hunter-gatherer pathology to modern normality. But this suggestion is unhappily built into the spectrum itself. We think the spectrum needs radical rethinking. We may admit limited connection between the psychotic (1) and pseudo-hallucination (2). However, in that case not only do hyperdolia (3) and pareidolia (4) seem much of a muchness, but both are totally of a piece with 'normal' perception (5). This leaves only two categories, the more or less abnormal (1–2), and the normal (3–5). It is true that Hodgson insists on overlap between his categories. Does this proviso suffice?

Hodgson also raises the fraught question of possible origins for figurative art. His focus is firmly Eurocentric in that he limits his discussion to Europe (with a nod in the direction of Sulawesi); to palaeoart understood as European cave art; and to mimetic art, the notion of mimesis being a key element of European approaches to art since the time of Aristotle's *Poetics*. Our view is that, while pareidolia, taken simply as mistaken identification, should not be made the basis for a theory of iconic representation, an evolution-driven definition of it could provide a general starting point by pursuing the idea of the brain as evolved to see pattern. The difficulty remains that of bridging the gap between an automatic response (the lion which turns out to be an antelope), to the intentional making of an image. The natural resemblance of a rock to an animal figure may be supposed to have been grasped in pre-Historic antiquity, just as today astronomers view a distant formation and refer to it as the Horse's Head Nebula, or just as Hamlet, teasing the foolish Polonius in Act 3, Scene 2, has him successively admit a camel, a weasel and a whale in a cloud. But the leap from natural iconicity to symbolic substitution remains. In this connection one of the present authors has proposed the inherent iconicity of originally non-intentional marks such as handprints and tracks (P. Dobrez 2013, 2022 and 2023; P. Dobrez and L. Dobrez 2023), marks which are natural but not in the same sense as a rock formation or a cloud or a nebula — since they are marks we ourselves make. Perhaps the idea of metaphor has some relevance here: we might, without the mediation of thought, i.e. automatically, respond to a sunny morning as a stand-in for, or image of, a feeling of pleasure. If there is anything in the idea, it might suggest that metaphoric sensibility would go hand in hand with seeing-likeness and be a prerequisite for intentional symbolic substitution. A further point: by itself the pareidolia thesis implies a solitary mental act, leaving us with an inexplicable origin for the object as art. Though biology encourages form recognition, the transition to art may have more to do with social factors, such as the wish to communicate. Perhaps this is what Hodgson wants to suggest with his otherwise concerning references to ritual. At the same time his locating the genesis of figurative art in the experience of hyperdolia is problematical, and for varied reasons, perhaps not the least of these being the implication that figuratives are so easily separated from non-figurative art.

A final comment, this time on Hodgson's distinction between seeing-as and seeing-in. The difficulty here is that it can mean different things in different contexts. In an article on 'canonical form' (L. Dobrez and P. Dobrez 2013) we used the expression seeing-as, citing Wittgenstein, since he famously used it in his *Philosophical investigations*, though by no means following his argument to its language-games conclusions. We wanted to stress that when you hear a sound in the street, you do not first hear noise understood as raw data, subsequently interpreting it as a car. Rather, you hear a car. This is in line with phenomenological emphasis on the notion of an 'intentional object'. It is only partially in line with Wittgenstein and Wollheim (cited by Hodgson), both of whom are talking in yet further different contexts. In his essay 'Seeing-as, seeing-in, and pictorial representation' (Wollheim 1980), Wollheim wants to debate Gombrich on the issue of the perception of a representation. Gombrich thought you could not see medium (e.g. paint on canvas) and content (e.g. a dog) without an attentional switch. We agree with this, though we share Wollheim's scepticism about Gombrich's notion of pictorial representation as illusion-based. Wollheim also wants, as he sees it, to put Wittgenstein right, though in this respect he hardly goes far enough into the latter's argument. In the end, what Wollheim wants to say is that we see both representational medium and content in the one perceptual act. This is surely correct, though it does not follow that we cannot make Gombrich's attentional switch, nor that seeing-in is the best way of expressing the phenomenon. Frankly we feel that seeing-as does the job equally well. The point is that Wollheim insists on seeing-in as peculiar to the perception of the pictured dog as distinct from that of the real dog. There is certainly a distinction, since light from the picture contains less visual information to the eye than light from the real dog. But it is equally important to stress the continuity (supported by neurophysiology) of perception of real and depicted forms (L. Dobrez 2013). None of the complex scenario we briefly sketch here is included in Hodgson's appeal to the Wollheim distinction, which is applied to that of pareidolia (characterised as seeing-as) and hyperdolia (characterised as seeing-in). This goes to Hodgson's distinction of the way we contemporaries see things as against the way humans in the remote past saw them under the influence of myth and ritual. All of this is so far from Wollheim's essay that it would have been better not to refer to it. Naturally we recall Hodgson's insistence that we moderns too are subject to lively emotions in unusual lighting, as perhaps obtains at a rock concert. Still, it has little to do with the perception of pictures in the context presumed by Wollheim.

In conclusion, we feel that Hodgson's article, while raising a stimulatingly wide range of important issues, is too prone to cutting Gordian knots; in other words, is itself hermeneutically liable to jump the gun.

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Protologisms and palaeoart

By BEN WATSON

Despite its very different meaning in visual aesthetics and art history (Thurlemann 2019), the term 'hyperimage' was introduced by Hodgson (2008) to deal with problems associated with 'pseudohallucination', defining too broad a range of phenomena. In the present paper, 'hyperdolia' is argued to have comparable advantages over pareidolia, allowing for a more precise definition of subjective apophenic imagery experienced under certain circumstances and, thus, a more reliable means of assessing palaeoart. As Hodgson points out, hyperimage has been adopted by others (e.g. Valle et al. 2018; Wright-Carr 2018), which suggests it has been a useful theoretical tool for palaeoart interpretation. Its definition appears to have changed somewhat since its introduction, however, being first referred to as a form of visual imagery that occurs in subjective space (Hodgson 2008), and here described as 'the material realisation of the subjective perceptual experience', with the 'subjective experience of imagery' now attributed to hyperdolia. The attempt to clarify what is meant by hyperimage by the introduction of hyperdolia is welcomed, though it does not alleviate all confusion. There is an apparent difference between the two concepts, but the words are also used interchangeably, suggesting the intention is that hyperdolia replace hyperimage. The definitions and distinction between them remain unclear, so there is a danger that the concepts will be misunderstood and misused.

In contrast to hyperimage, hyperdolia is not strictly a neologism, as Hodgson notes, but rather a *protologism*. It is a very new term that has not yet been published independently of the author (at least to my knowledge) nor established outside the participants of this *RAR* debate. It might in fact be more accurately referred to as a *prelogism*, being in a developmental stage between a protologism and a neologism; whether the term becomes accepted and used more widely remains to be seen. It may only ever be used within the subdiscipline of visual palaeopsychology and therefore remain a protologism. The invention of new words and changes to standard terms is not always successful. For example, in the rock art vocabulary, existing terms are preferred to maintain consistency and established tradition of use (Chippindale 2001; Chippindale and Taçon 2006). The use of consistent terminology helps establish a common framework for discussing complex concepts, which is particularly important in specialist fields such as visual psychology to reduce the risk of confusion and misinterpretation. This might be a contributing factor to the use of pareidolia by rock art researchers, even though they might be referring to something slightly different.

Importantly, there appear to be existing terms already used for the types of subjective experience attributed to hyperimagery/hyperdolia. 'Illusory perception' is employed by psychologists in studies relating to pareidolia, such as the one by Riekki et al. (2013), which Hodgson cites. It should be clarified that Riekki et al. do not explicitly employ the term 'illusory imagery' as intimated by Hodgson, but rather illusory perception. Illusory perception in this context refers to the perception of objects in 'artefact pictures' (pictures in which face-like features may be perceived even though they do not contain actual faces), which is influenced by top-down processes or expectations and previous experiences. It is this concept that is comparable in definition to hyperdolia. Illusory imagery refers more closely to the artefact pictures or illusory stimuli used in Riekki et al.'s experiments – the equivalent of the suggestive outlines of animals on rock surfaces enhanced by Upper Palaeolithic artists. Like pareidolia and pseudohallucination, illusory perception has a broader definition, which may be why Hodgson avoids it. For example, it can relate to the perceptual tendency to complete patterns by automatically visualising what is not present, something previously considered in relation to 'incomplete figures' in Upper Palaeolithic art (Watson 2019a). However, its use in the way defined by Riekki et al. and others (e.g. Caruana and Seymour 2022) shows that it is an established term in visual psychology and has essentially the same meaning as hyperimagery/hyperdolia, or can at least be adapted for use when referring to the types of subjective visual phenomena these words aim to define. I do not think enough justification has been provided as to why illusory perception should be referred to as hyperdolia and not the other way around and why it is not already an effective tool for understanding the problems in rock art identification and interpretation Hodgson raises.

I do not want to detract from the point of Hodgson's paper and its importance in furthering our understanding of the notion that natural features of rock walls are suggestive of the types of imageries experienced subjectively and that these served as a motivational influence for palaeoart. Pareidolia and illusory imagery may well have been more influential than previously realised. The fact that there is a close relationship between pareidolia and artistic creativity

lends further support to the argument and is something I think warrants further investigation. And I agree the criteria pareidolia covers are too broad, making it difficult to develop a nuanced understanding of the different cognitive processes involved, which can lead to problems regarding identification and interpretation. However, if there are existing and established concepts that can be adapted to accurately describe related visual apophenic phenomena, is another protologism necessary? To my mind, it is essential that consistent and clearly defined constructs are used to reduce ambiguity, facilitate cross-disciplinary conversation, and develop clear and valid understandings.

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Beyond the visual brain

By GEORGE F. STEINER

This article provides a critical re-evaluation of the role of pareidolia in rock art research, highlighting its limitations and proposing a more specific and reliable approach. While previous publications and presentations by Hodgson have also addressed the phenomenon, this paper stands out for its convincing arguments and clarifications. The concept of hyperdolia discussed in the text is a valuable contribution to the field, and by locating it at the interface between pareidolia and pseudo-hallucinations, the paper also dispels the oversimplified nexus between rock art and altered states of consciousness (e.g. Lewis-Williams and Dowson 1988), which would place its origin towards the hallucinatory end of the continuum illustrated in Table 1.

Above all, Dr Hodgson provides a credible answer to the question of how our perception of reality is conditioned by emotional and perceptual states, which are in turn influenced by the affordances of the world around us and offers a promising approach that has the potential to enhance the accuracy and reliability of identifying palaeoart.

However, the paper's self-imposed focus on Upper Palaeolithic iconic depictions inevitably limits its exploration of the origin of other types of rock art. To his credit, in a 2019 article, Hodgson (2019b) addressed the aetiology of the earliest geometric patterns in the archaeological record and suggested that the first non-utilitarian marks were not necessarily representational or symbolic in nature but rather closely tied to the way the early visual cortex processed information. His arguments are presented convincingly, and placing them within the framework of his neurovisual resonance theory (2006b), they offer a credible — although not exhaustive — explanation for the aetiology of abstract and iconic rock art. The author's in-depth knowledge and understanding of the neurological underpinnings of human-specific mark-making leave little place for argumentation, which makes commenting on the paper at hand a challenge.

Although Hodgson covers the problem of the aetiology of rock art, he does not address its interpretation. Also, he advises researchers to approach the topic with great care, given the potential for their own perceptual biases and cultural conditioning to deceive them. Having in mind Bednarik's (2016: 167) observation that 'unless ethnographic information about the meaning of rock art is accessible, markings created by humans whose mental and cognitive world is entirely unknown cannot be interpreted with scientific credibility', I can only commend Hodgson's hesitation in entering such a controversial and speculative territory.

The concept of hyperimagery, which Hodgson presented at the 11th International Conference on Neuroaesthetics (2014), is further explored in this paper which, together with a precise definition of what he means by hyperdolia — and what differentiates it from common pareidolia — is, in my opinion, one of the most thought-provoking parts of the article. Thus, hyperdolia is construed as a subjective experience of imagery, whilst hyperimages refer to the material realisation of such a subjective visual experience.

In a slide of the abovementioned presentation, the author compares the photograph of a lion stalking its prey in high grass with the representation of the animal in Chauvet Cave. In both instances, the lower part of the body is ambiguous, and it is up to the observer to fill in the missing visual information. Hodgson shows that the same technique applies to depicting many other animals painted on the cave walls. Although he explains the origin of such depictions as a primed reaction — in this case, the high level of alertness for dangerous animals lurking in the dark recesses of a cave — the presence of aurochs, horses and rhinos does not fit this approach. The depiction of animals other than bears and lions remains thus unexplained as long as we do not infer a long tradition based on such priming, but which is already divorced from its initial neurological underpinnings and is more of a cultural inheritance.

The reason for the material realisation of a subjective visual experience that can be attributed to hyperdolia begs for a more detailed explanation than that offered in the text. Why does it become necessary to outline or complete a suggestive shape? In my opinion and given the depiction of animals that are not expected to pose a threat in a cave, the only possible explanation is that hyperimages convey certain meanings or, as Hodgson also proposes, they were drawn under the influence of high emotion due to certain beliefs, ceremonies or ritual. Thus, from subjective pseudo-hallucinations that others cannot experience, visual clues become elevated to a collective level by

pointing out the outlines of a hyperimage to an audience. In other words, a phenomenal/individual visual experience becomes accessible and communal. Going a step further, I would suggest that communication, other than visual, must have also been present during the creation and appreciation of such representations. I would thus connect pareidolia to what is known as *individual*/phenomenal biological memory and hyperdolia with *collective*/accessible cultural memory. My stress on the concept of *memory* will be explained in the paragraphs below.

Although our visual perception curtails the cognitive assessment of palaeoart, its function and meaning are complex issues and, in my opinion, beyond the mere visual processing of information. They rather reflect what is perceived as meaningful and important in a specific cultural context. Contrary to the prevalent understanding, I do not consider the transition from abstract to representational as a cognitive leap but as a preferred technique applying already well-developed iconic understanding meant to answer novel cultural demands during the Upper Palaeolithic (Steiner 2020).

Rock art is a mere illustration and support of concepts expressed in stories, dance and music, which, I suggest, are integral parts of the missing ethnographic information mentioned by Bednarik. Thus, a contextual explanation that considers all our senses seems more plausible than a strictly visual one. Visual priming may explain the biological ability for both mark and image making, but it still does not clarify the cultural incentives calling for their material realisation.

Considering the ambiguity of visual information and that pareidolia refers to the tendency to see meaningful patterns in random stimuli, it would be interesting to explore how the larger concept of apophenia ('patternicity', of which pareidolia is only the visual and auditory aspect), applies to other periods and styles of palaeoart, and whether it can provide similar insights into the aetiology of the non-visual behaviours that rock art only accompanies and illustrates.

Following Bednarik's understanding of palaeoart as *memory traces* stored outside the brain (Bednarik 2014a), I would start such an enquiry by taking a closer look at autobiographical and collective 'memory', as already suggested above. Especially so because of the ongoing hominin encephalisation during the Middle Pleistocene, which seems to have supported a synchronous application of *mnemonic techniques*, such as controlled and contextual vocalisations (Bickerton 2000), meaningful mimetic and acoustic progressions (Donald 1991; Morley 2003), and abstract markings on rocks and bones (Bednarik 2013b, 2014b).

Phenomenal memory traces could thus be stored outside the brain and accessed collectively as causally-sequenced 'information packages' meant to stabilise either adaptively advantageous or strictly cultural perceptions/constructs of reality. The cognitive ability for external memory storage seems to have initiated a ritually orchestrated mnemonic convergence (Coman et al. 2016). In turn, it became conducive to the emergence and 'evolution' of human-specific culture.

Memory is of fundamental importance in what makes us human and how we experience the world in a conscious format. Memory is not necessarily something of the past. Mental time travel (Suddendorf and Corballis 1997), for example, is the capacity to conceptually reconstruct events from the past as well as to hypothesise possible scenarios for the present and future. An indispensable feature of episodic memory is our ability to temporally piece together different elements of an experience into a coherent narrative (Reddy et al. 2021). At a more complex scale, inductive reasoning recalls the memory of specific observations and detects patterns and regularities upon which causally consistent hypotheses can be elaborated. Such mental constructs are heavily influenced by 'the predictable-world bias', which revolves around the inclination to perceive order where it has not been proved to exist, either at all or at a particular level of abstraction (Holland et al. 1989). Needless to say, apophenia plays a vital role in memory recall.

The consensus view in neuroscience (see Schacter 2002) is that the sorts of memory involved in complex tasks are likely to be distributed among various neural systems. Yet, certain types of knowledge may be processed and contained in specific brain regions. Such brain parts as the cerebellum, striatum, cerebral cortex, hippocampus and amygdala are thought to play an important role in memory. For example, the hippocampus is believed to be involved in spatial, temporal and declarative learning and consolidates short-term into long-term memory. Leila Reddy and colleagues (2021) suggest that human hippocampal neurons could play an essential role in temporally organising distinct moments of an experience in episodic memory. As Cohn-Sheehy and his research team (2021) put it, the human hippocampus supports the ability to construct causally consistent narratives that bind together distant events in memory. The hippocampus, which stores memory fragments of past events, can support the integration of overlapping associations or separate events in memory. Thus, a key function of the hippocampus is integrating events into a narrative structure.

The question is whether internally stored memory traces — let us call them, for convenience's sake and following Semon (1921), 'engrams'– become re-consolidated each time when specific external stimuli recur or whether they exist as permanently consolidated 'information packages' that can be retrieved in an unaltered form — voluntarily, or in response to such stimuli? I would suggest (concurring with Thum et al. 2007; De Jaeger et al. 2014) that they are perpetually re-constructed, with slight variations between successive consolidations. In this case, memory is unreliable, it plays tricks on us, and the narratives are dependent on emotional states present at the time of reconstruction or shifts in subjective values

and attitudes that have developed during the time elapsed between the experience and its reconstruction. A long-term consolidation of an engram cannot occur as long as memory traces are in such a state of superposition (see Cohn-Sheehy 2021, above) and as long as each retrieval results in slightly different and, thus, unreliable configurations (Schacter 2002). The only way to add durability and stability to specific configurations is by embedding them according to an objective causality that serves as a conceptual point of reference for the narrative.

Engrams belong to what is known as subjective, i.e., autobiographical memory. As seen, they are ephemeral, and their texture may vary from one reconsolidation to the next. Given the almost unlimited probabilities in re-sequencing memory traces stored in various parts of a large and complex brain, the only solution to add detectable durability to specific configurations that memory traces can assume is, as said above, to adjust them to an objective causality. Objectivity implies an *external* and *agreed-upon rule of sequencing*, which would also render them *accessible* to other brains (*sensu* Block 1995). Such a 'rule' must be accessible itself — learned through copying or by resorting to social learning and other cultural techniques. It also necessitates well-developed conceptual sequencing and communication abilities (Docherty et al. 2000).

On the same note, and as Planton et al. (2021) hypothesise, conceptual sequence coding relies on an internal compression algorithm using language-like nested structures. In other words, consciously constructed information packages that follow a communally agreed-upon objective causality can be fixed and passed on from one individual to the other and from one generation to the next. This is precisely the commonly accepted definition of *collective memory*, which is already a cultural category. Therefore, unlike engrams, culturally constructed, stabilised and transmitted information packages are stored externally and devised to last. Whilst subjective (individual) memory relies on short-lived engrams, objective (collective) memory can be passed on from one generation to the next with the help of exograms.

However, exogrammatic representation is not restricted to graphic illustrations. Memory traces are not strictly visual, but, like those used to consolidate engrams, they are provided by *all the senses*. Graphically-externalised memory traces serve only as indexical references to those who are in possession of exogrammatic skills and are thus able to re-iterate and express a causal sequence meant to explain the essence of a specific natural — or other — phenomenon. The re-iteration, that is, the conscious causal sequencing of memory traces, relies just as much on vocalisations and mimetics (Bickerton 2000; Donald 1991) with rhythmic and melodic support (Morley 2003). Moreover, exogrammatic skills must also be learned — although the ability for the external storage of information is a biological development, the transmission of exogrammatic meaning becomes culturally conditioned. Cultural manifestations in which the abovementioned graphic, lexical, rhythmic/musical abilities are applied simultaneously as means of transmission are known in anthropology and ethnography as 'ritual'.

Ritual may be construed as a *conscious sequence execution strategy* using symbolic representations and relying on the cognitive and neural underpinnings of what Verwey et al. (2015) call 'serial movement behaviour'. Ritual is also characterised by its rigid and conservative nature, which is vital for a high-fidelity transmission of knowledge and, implicitly, for reducing the risk of loss, which is inevitable when transmission relies on mere copying or in small demographic settings (Shennan 2001). By the same token, *repetitiveness* is instrumental in embedding the specific causal order (protocol) upon which ritual is constructed. Therefore, the first instances of investing in 'fixing' such causality in stone, bone or wood — instead of simply 'illustrating' it in sand (Helm et al. 2020, 2021) — should coincide with the emergence of hominin ritual behaviour. The systematic use — which is not necessarily the origin but the result of a 'cognitive coupling' (Kolodny and Edelman 2018) of the abilities that are the prerequisites of ritual behaviour — of external storage of information, proto-language, mimetic skills, rhythmic and proto-musical abilities can be confidently traced back to archaic hominins, hundreds of thousands of years ago.

The benefits of external memory storage lie in the ability to overcome the risk of a potential downfall of information processing, which would be the inevitable outcome of trying to compute the ever-increasing amount of memory traces that could be stored in the neural recesses of our big-brained ancestors and could have easily resulted in a combinatorial explosion of possibilities (Gabora 2003). Symbolic thinking led to a fundamentally different way of computing data, which extracts only the essence required for abstract representation instead of computing the entire set of internal and/or incoming raw information (Miyagawa et al. 2018). This is achieved with the help of ritual behaviour, which lends to a causal calibration of reality the durability necessary for its perception, representation, transmission and, last but not least, *adoption*. Again, I would suggest that apophenia could have been pivotal in such a culturally orchestrated mnemonic convergence.

In the comments above, I have tried to enlarge the approach adopted in the text by citing hypotheses that — although only tangentially related to rock art research or the topic of the article at hand — could lead to a better assessment of the role played by the non-visual components of apophenia in our understanding of additional behaviours which may complement a strictly visual explanation and place exograms in a more accommodating contextual frame. Far from being a

critique, my comments only illustrate the thought-provoking character of this outstanding paper.

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REPLY

More to pareidolia than meets the eye

By DEREK HODGSON

Let me first thank the reviewers for their considered commentaries which, all told, continue to be sceptical regarding the concept of hyperdolia. The main point I make in the paper is that one cannot simply lump such a complex human phenomenon as visual imagery under the rubric of pareidolia. In fact, pareidolia can be regarded as just one manifestation of the diversity that constitutes visual imagery. To give just one example of that diversity, consider benign hypnogogic imagery experienced in half-awake or drowsy states. In that state, one often becomes prone to what is described as the Tetris Effect, where visual imagery is manifest as a quasi-hallucination, which is usually brought about by engaging in repetitive activities beforehand (Stickgold et al. 2000). That diversity is further underlined by the fact that modern neuroscience has found that even the world, as perceived veridically, is a kind of visual image referred to as a controlled hallucination, as I mention in my paper.

Neuroscience has also found that the way we visually experience the world is contingent on an interplay between previously instantiated contingencies, which are integrated into neural networks as assumptions, with higher-order cognitive criteria that are continuously monitoring any discrepancies that may be useful in updating those assumptions, which is achieved through Bayesian probability statistics (Seth 2019). However, the balance between those two attributes can change according to circumstances, whether due to external environmental factors or in-brain criteria linked to emotion or arousal systems, including cultural affinities. Thus, rock art researchers can sometimes become seduced by their enthusiasm to see things that are not there. Correspondingly, rock art can result from the way those systems either interact or are driven by any one of the underlying determinants.

Achrati

To answer criticisms specifically, I begin with Achrati, who states that I do not demonstrate how the identified heuristics help understand the realisation of rock art. I beg to differ, as I explicitly showed in the paper, with relevant citations, how we can exploit the concept of hyperdolia to throw light on how rock art was created in certain circumstances by pointing out how some research teams have taken up the idea in a way that confirms its utility. I reproduce the relevant text here:

> For example, in the case of Upper Palaeolithic cave art, Hodgson (2008) demonstrated that derivation could be more reliably inferred based upon the dynamic interaction between the need for an acute perceptual sensitivity to certain animals outlines on hunting forays involving considerable emotional investment, the resulting hyper-sensitised visual system, and the suggestive outline of animals in cave rock formations. Therefore, the heuristics of hyperimages/hyperdolia have provided fertile ground for assessing palaeoart.

Sakamoto's (2019) empirical research, along with that of Wisher (2022) — both mentioned in the text — show how the principles of hyperimages/hyperdolia can be applied to Palaeolithic cave depictions to provide an understanding of the animal outlines on several levels. I also provide cogent examples as to how visual imagery, especially hyperimages, can furnish insights into what initially triggered and probably sustained the making of animal outlines over such an extended period.

Achrati suggests that I am attempting to 'displace' pareidolia as a paradigm when, in fact, I do just the opposite by showing that pareidolia is a real but subjective phenomenon that needs to be seen in the context of other kinds of visual imagery, such as hyperimages, which can be just as enthralling if not more so (see also the Tetris Effect mentioned above).

The 'backward reasoning' from the iconic to hieroglyphs to writing referred to can be regarded as a function of top-down cognitive criteria imposing constraints, mainly through attention, on early bottom-up perceptual systems in the visual cortex. I doubt this has much to do with pareidolia, however. Rather that process is achieved through an interactive engagement with how the visual cortex functions and the material being manipulated, which, through successive approximation, eventually led to the alphabet (see Hodgson 2023 for more on this).

Concerning the neural foundations of pareidolia remaining a mystery, I cited and direct readers to Hodgson and Pettitt's (2018) paper, where this is discussed at some length (see also Hodgson 2019).

I disagree that focusing on hyperdolia and associated visual imagery is tantamount to returning to shamanistic theories of rock art. In fact, just the opposite, as many of my previous papers on visual imagery have centred on providing a counter-framework to the shamanic model (e.g. Hodgson 2008).

Deręgowski

Concerning the comment on attention, this is highly relevant to understanding how various kinds of visual imagery function. For example, attention is invariably driven by emotional and arousal factors that bias the visual system, so it has a lower threshold for discerning potential objects. Depending on the level of arousal, the visual imagery experienced will be mild to intense; thus, we can go from pareidolia (a mild form of visual imagery) to hyperimages (a more intense experience).

When I allude to 'things' I mean the mistake of thinking that what may be initially perceived is regarded as real. These are 'things' which are seen in the brain.

The point about the perceptual system endeavouring to make sense of any perceptual cue experienced is well made. I cover that point where I mention that '… [when] a drawing of an animal is viewed, the same area of the cortex is activated as when a real animal is perceived (Walther et al. 2011). Remarkably, the same cortical area becomes even more active when viewing an impoverished outline drawing of an animal.' In that regard, the visual system is 'making sense' of the ambiguous cues coming from a surface whereby the invariances are taken to be an animal by the same area of the visual cortex that becomes active when viewing a real animal.

Regarding Gestalt perception, copious evidence has found that the way neural networks function, especially in the visual cortex, is scaffolded by Gestalt fundamentals (see, for example, Gilbert and Sigman 2007; Wagemans et al. 2012).

Concerning camouflage and pareidolia, I dealt with this issue in the cited paper by Hodgson and Pettitt (2018), which I also deal with at length in my book *The roots of visual depiction in art* (Hodgson 2019). Camouflage is related to pareidolia because, as mentioned, it's a better survival strategy to assume that something (e.g. predator or prey) is there when it is not than the opposite.

Livio and Patricia Dobrez

Dobrez and Dobrez doubt whether there is a real difference between pareidolia and hyperdolia. However, as I point out in the introduction to the present commentaries, pareidolia constitutes just one manifestation of visual imagery. Thus, it would be well not to regard all such manifestations as pareidolia, especially as rock art is mainly a visual phenomenon that relies on the different ways the visual system functions. Consequently, rock art researchers require a more nuanced understanding of how visual imagery proceeds, not least to avoid errors in attribution, as well as to illustrate how it can be applied to understanding and interpreting rock art. Thus, I assert that real differences need to be considered.

I vehemently reject the point regarding primitivism. As I state in the paper, animism and its relationship with visual imagery pertains to 'new animism', which is explored in detail in the Helvenston and Hodgson reference mentioned in the paper. Thus, rather than seeing one thinking mode as superior to another, new animism sees different ways of relating to the world on an equal footing. Moreover, I stress the point that so-called modern 'enlightened' techno-industrialised individuals are just as prone to pareidolia and hyperimages, which are invariably interpreted as magical and extolled as such.

I agree that hyperdolia and pareidolia reside within the more normal scale of perception. I have made this point in several previous papers (e.g. Hodgson 2008) in order to show how we can potentially explain certain aspects of the Upper Palaeolithic cave depictions of animals as a function of normal perception, as opposed to the consensus that predominated at the time that such depictions could be explained by abnormal perceptual states arising from shamanism.

Regarding the criticism that pareidolia should not be regarded as the basis for a theory of representation because the problem vis-à-vis the intentional making of images remains unanswered. This is precisely why I have introduced a more nuanced understanding of the different forms of visual imagery. In Hodgson and Pettitt (2018), we detail how visual imagery, including hyperimages, was transformed by a motor act to produce the first representational depictions. Moreover, in the same paper, we mention the role of animal tracks and hand marks (see also Hodgson 2013) in that such contingencies, to a certain extent, primed the visuomotor system, which eventually gave rise to the more sophisticated animal depictions.

The point regarding the importance of social factors and the transition to making depictions; this does not exclude the relevance of visual imagery or the role of pareidolia or hyperimages. It seems logical to suppose that, in the darkness of caves, perhaps an individual with a primed hunter's visual perception was more likely to see phantom animals in the suggestive cave walls and decided to point them out to others in the group. To accentuate this, she or he may have drawn or engraved a mark to indicate a prominent part of the animal perceived, thereby inducing others to see the same thing. Thus, it is more than likely that such depictions were regarded as special and sought after by others to the extent that they may have become a focus of ritual concerns. In short, one could surmise that an individual made the first animal depiction but then rapidly became a social phenomenon.

The point about Wollheim and Wittgenstein is intriguing as Dobrez and Dobrez contend that the relationship between hyperimages and seeing-as and seeing-in should be dropped. I am loathe to get into a discussion as to what Wittgenstein meant by seeing-as, due to the fact this has been the cause of endless debates with little consensus emerging on the matter (see, for example, the recent edited book devoted to the topic by Kemp and Mras 2016). Furthermore,

some assert that Wittgenstein's take on seeing-as has little to do with the process of seeing, as it was simply employed as a metaphor for understanding the conceptual and propositional attributes of meaning (Alloa 2021). As for Wollheim's seeing-in, I hold that it can be usefully integrated with hyperimages, especially by considering the idea of 'twofoldness' where one can, to some extent, remain aware of the support and 'raw' marks while, at the same time, being able to see the image of an object in that support. Thus, for example, when one eventually manages to detect the Dalmatian dog in the famous illusion of that name, the actual image of the dog takes precedence as this is what the visual system is most interested in, which may be a product of the 'global precedence effect'. Despite this, the visual system continues to be 'aware' of the raw supporting details through implicit perceptual contingencies that are overseen by the bottom-up preconscious correlates of the early visual system (Dehaene et al. 2006). However, the visual system can choose to bring the raw elements into focus at the expense of the larger Gestalt by changing the attentional focus. That scenario is supported by evidence from modern neuroscience, which has established that the early visual cortex can continue to moderate information subliminally and in parallel. At the same time, the higher-order top-down system operates more serially as a consciously determined experience (Dehaene and Changeux 2011). Neuroscientifically, this shows that Gombrich's projective imagery and Wollheim's seeing-in are both correct depending on how one chooses to approach the problem. Accordingly, I would say that hyperimages seem to have more in common with seeing-in than seeing-as.

Watson

Watson makes a number of interesting points regarding definitions and clarifications. He doubts that the terms hyperdolia and hyperimages are necessary due to the fact that the existing accepted concept of 'illusory images' seems to be adequate in accounting for the corresponding behavioural criteria. He also claims that the difference between hyperdolia and hyperimages is not clearly defined. One of the reasons for utilising these terms was to provide a more specific definition than 'illusory images' or 'illusory perception', the latter, which, although employed by psychologists, I maintain does not immediately indicate the suggested meaning. Thus, I employ the prefix 'hyper' to indicate that the visual system is compelled by various factors, such as overcharged emotions or over-concentration, whereby visual images are likely to be projected onto a perceived surface. Regarding the apparent confusion between hyperdolia and hyperimages, I defined this quite clearly as follows, 'I introduce here the term 'hyperdolia', which refers to the subjective experience of imagery, whereas 'hyperimagery' refers to the material realisation of the subjective perceptual experience.' Of course, the two terms are actively intertwined in the actualised experience. Thus, I continue to hold that the concepts of hyperimagery and hyperdolia are useful in the context of understanding palaeoart in that the terms provide a coherent framework to which rock art specialists can usefully refer in their research.

I thank Watson for pointing out an earlier adoption of the term 'hyperimages' as described by Thurlemann (2019). That usage, however, alludes to the curation and management of collected artworks as displayed in an exhibition, which is radically different to the way the term is referred to with regard to palaeoart.

Steiner

I thank Steiner for the positive response to my paper and pointing out the relevance of alternative forms of perception other than the visual that need to be taken into account when considering rock art. The reason I concentrate on the visual is that this faculty in humans is the most dominant, which would have been especially relevant in subdued lighting conditions, though the tactile sense would also have come into play in such conditions. The relevance of ritual is highlighted in the paper, the importance of which is reinforced by Steiner. The correlation of pareidolia with individual experience and hyperimages with collective social information is welcomed, which is a point I make both in the targeted paper and previously, especially in relation to ritual.

With regard to '… the presence of aurochs, horses and rhinos does not fit this approach. The depiction of animals other than bears and lions remains thus unexplained …', I covered this point in the paper by, for example, demonstrating that horses and other large quadrupeds, loomed large in the visual system of hunter-gatherers because, not only did they need to be searched for in challenging circumstances, but also can be dangerous animals when approached.

The referencing of the terms engrams and exograms is pertinent in that hyperdolia may relate to engrams as an individual experience that can become an exogram expressed as a hyperimage. As Steiner suggests, these contingencies need to be seen in the larger context of an early ability to consolidate and process information in ways that had not occurred before.

Finally, with regard to what inspired the need to transform hyperdolia into a materially-based hyperimage, I made the point that the ability to create outlines of animals on suggestive rock surfaces may well have been regarded as magical in the sense that the images projected onto the wall by the visual system were rendered permanent as a way of demonstrating to others in a group the reality of the phenomenon.

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