The Visual Dynamics of Upper Palaeolithic Cave Art

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Franco-Cantabrian cave art continues to be the focus of much speculation but despite the many theories put forward there has been little progress in explaining the range of perplexing features of this 'art'. Only by regarding such wide-ranging and anomalous characteristics as central to this debate might some progress as to derivation be possible. The account presented in this article will demonstrate how the many 'contradictions' prevailing might provide an important indication as to provenance that can be explained through an understanding of the shifting nature of visual imagery in the context of the everyday lives of Upper Palaeolithic communities. This will be based on the notion that the visual world as perceived can be disrupted by certain types of psychological effects that can be subsequently triggered by particular kinds of stimulus cues and evocative situations.

Explanations as to why Upper Palaeolithic communities came to create cave art have been many and varied with the latest version emphasizing the priority of shamanism in relation to altered states of consciousness (Lewis-Williams & Dowson 1988; Clottes & Lewis Williams 1996). The latter has, however, been criticized by some authorities as being either misconceived or unable to account for the many diverse features involved (Hodgson 2006; Helvenston & Bahn 2003; Solomon 1999; Layton 2007). Although Lewis-Williams's approach is based on a universal neurophysiology, it will be demonstrated in this article that an alternative and more plausible theory can be constructed that is able to account for the many diverse features typical of this 'art'. In this respect, I will endeavour to demonstrate how a mental phenomenon referred to here as 'hyperimagery', which is loosely related but essentially separate from classic hallucinations, can account for the many peculiarities of Palaeoart. The crucial dynamic is held to be not what the observer perceives as existing beyond or within the cave wall, as Lewis-Williams suggests, but the interaction obtaining between the perceiver and wall surface itself. In this respect, I present a theory that radically changes the polemic as to the derivation of cave art. The aim of this approach is to show how these depictions can be parsimoniously explained by recourse to the everyday experiences of hunter-gatherer groups in relation to the environment of the late Pleistocene. In this analysis I will present recent research from neuroscience and related disciplines that will show how these depictions can be understood from the perspective of how the world is perceived by observers in relation to a range of psychological states. Part 1 will define hyperimages in the context of neuropsychology whereas Part 2 will show how such images have important implications for understanding Palaeoart.

Part 1: Visual memory, perception and psychological states

The normal visual system, visual memory and imagination

In order to understand how mental images can be relevant to understanding Franco-Cantabrian cave art, it is first necessary to examine how the visual system processes visual information. In this respect, it has been established that there is a common neurophysiological mechanism underlying visual representation, whether this involves perception, imagining, thinking, dreaming or memory (Shepard 1984; Kosslyn 1994; Farah 2000). Crucially, Kirby & Kosslyn (1992, 72) propose that visual memory, as such, evolved out of the perceptual/recognition system. What differentiates the various levels of the system depends on whether it is being stimulated by incoming visual data from the real world, whereupon the accent will be on the early to middle stages, or is being directed from the need to

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reflect on events whereby the later stages will come to the fore. This is consistent with the experienced visual world being a product of interactions between abstract top-down visual memory templates and bottom-up sensory ones, with the former generally more influential in subjective perception. Subjective perception can therefore be the consequence of dynamic reciprocal interactions among external sensory input, internal object and scene representations and goal directed attention. This is promoted by top-down biasing of information as a consequence of familiarity with objects, individual goals and expectancy that will influence the speed and accuracy of object awareness (Collerton *et al.* 2005).

PET-scanning studies have demonstrated that some of the same regions of the occipital lobes are indeed involved in both visual imagery and perception (Kosslyn & Thompson 2003). Another way of saying this is that imagined events are produced by some of the same neural architecture dedicated to the perception of actual events. Visual memory therefore appears to be underwritten by a system that is shared but asymmetrically biased according to priorities, and one of its properties is to suggest alternatives when confronted with ambiguity, as when one attempts to disambiguate a camouflaged or indistinct form (Mast 2005). Such an ability would have been crucial to early humans as an automatic system able to quickly furnish a host of different 'suggestions' to the identity of any ambiguous form that would have led to greater survival rates for those so disposed. The propensity of the higher end of the visual hierarchy to automatically 'suggest' alternatives is a mechanism useful when danger threatens as well as a device for preparing for actual situations. In this respect, Kosslyn & Shin (1994) emphasize that imagery selectively facilitates perception, so that if subjects imagine a form they will be more likely to detect a degraded version of a shape when presented with alternatives. Visual imagination seems to be an aspect of the visual system closely related to visual memory and one that is most 'detachable' from everyday reality in that it allows possible scenarios to be played out completely disengaged from the real situation. The obvious benefit of this capacity resides in the opportunity to rehearse situations so that in real circumstances one is more able to deal with the unexpected. A further useful effect of this would have been the ability to project content and meaning onto objects that may or may not have any resemblance to things in the real world — an ability with which humans are particularly well equipped, even at a young age (Cox 2005). Interestingly, Heider & Simmel (1944) found that adults, when viewing animated cartoons of a large and small triangle along with a disc portrayed as moving in and out of a large square, tended to see them as having human characteristics and intentions.

Visual imagery, visual 'reality' and trigger cues

Neisser (1967) proposed that only selected parts of incoming data are represented in memory that provide a starting point for the reconstruction of a past event. Encoding and remembering are therefore closely related but this can lead to ambiguities in that present knowledge and needs exert a powerful influence on what is retained (Schacter 1996). These processes are thought to be part of how the brain attempts to impose order on the environment so that memory does not just depend on the strengths of associations but also on the cues that trigger the initial memory trace. Furthermore, when a retrieval cue elicits a memory, this is more likely to occur when the circumstances, especially those concerning emotional arousal, are similar. Interestingly, the trigger cue combines with the original memory trace to produce a memory experience that is different from that of the original event (Schacter 1996).

The normally functioning visual/memory system may therefore be subject to considerable error depending on circumstances as is further evidenced by what is termed 'The Perky Effect' (Perky 1910). This shows how the division between imagination and visual reality can be quite fluid. Perky placed observers in a dimly lit room and asked them to stare at a blank screen some distance away. The observers were then asked to summon up an image of an object and while preoccupied with this (and still staring at the screen), Perky surreptitiously projected a barely visible image of an object onto the back of the screen. To simulate the effect of a mental image, the projected object was agitated slightly to create a shimmering effect. Nearly all the observers remained oblivious to the attenuated screen projection and thought that what they were seeing was their own internally derived mental image. Participants not only reported the imagined image being in the same orientation as the projected image but also unwittingly combined what they saw with what they had imagined, e.g. one subject saw a leaf (the projected image) covered in veins (the mental image) and another a lemon (the projected image) lying on a table (the mental image). Even after the participants had been informed that what they had witnessed was a real projection, most observers insisted that they had imagined what was there. This effect has been confirmed by other investigators (Segal & Fusella 1970; Reeves 1982). These experiments add weight to

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the notion that our hold on 'visual reality' is tenuous and we are liable to be misled or make errors in certain situations. In other words, imagery can intrude on reality and reality on imagery. Other studies on the nature of visual imagery have found that there is a loss of high spatial frequencies, thereby reducing the amount of detail thus causing a certain blurring of the remaining outline contours (Harvey 1986; Sekuler & Blake 1994 — see esp. figs. 13.18, 485).

The 'normal' visual brain and hyperimagery

Pseudohallucinations are defined as visual images that are not usually mistaken for perception (Davis 1987). The term 'pseudohallucination' has, however, been criticized as defining too diverse a range of phenomena. I therefore propose to use the term 'hyperimagery' that better expresses the different causative factors concerned. Importantly, full blown hallucinations appear to exist in objective space whereas hyperimages seem to reside in subjective space (Whitlock 1987). Following Sims (2003), Jaspers (1963) and Aggernaes (1972) the main differences between hallucinations and hyperimagery can be summarized in Table 1.

It is obvious from Table 1 that there are important distinctions dividing hallucinations from hyperimagery. However, there may be a gradation linking the two. In this sense, Kraüpl Taylor (1979) refers to hyperimagery as a special type of hallucination. Moreover, hyperimagery may occupy a position along a continuum located between actual hallucinations, visual imagery and the everyday perception of the real world (Jaspers 1963). It is important to emphasize, however, that even though hyperimages are not perceived as real they can still have an emotionally charged dimension (Horowitz 1975). And, as we shall see, although one of the differences between hallucinations and hyperimagery resides in the fact that, in the latter case, the individual has insight into the fact that the image is not real, in some circumstances this boundary may be crossed in that there may be a situation where an individual is uncertain as to whether what is being seen is actually in the mind's eye or to do with the object being observed. In such cases, the image seems to reside in the space between the actual perceived world and the subjectively induced image. Moreover, as arousal states change this image may also appear to fluctuate between the two extremes, i.e. either appear to be emanating from the real object or surface observed, or remain within the limits of the individual's subjective experience.

Interactions between these various influences are outlined by Horowitz (1975) in stating that internal representations come to the fore due to several reasons:

1. relative reduction of external input with no concomitant lowering of activity in the representational system;
2. increase in activity of the representational system without increase in availability of external signals;
3. augmentation of internal input due to arousal of ideas or feelings secondary to drive states;
4. reduction of usual levels of inhibition over internal inputs;
5. alteration of the dynamic between different contingencies permitting internal inputs to gain more representation over direct perception.

Jaspers (1963) is also careful to make the point that these categories can combine in various ways according to the mental state of the individual. The relationships between these various categories are summarized in Table 2.

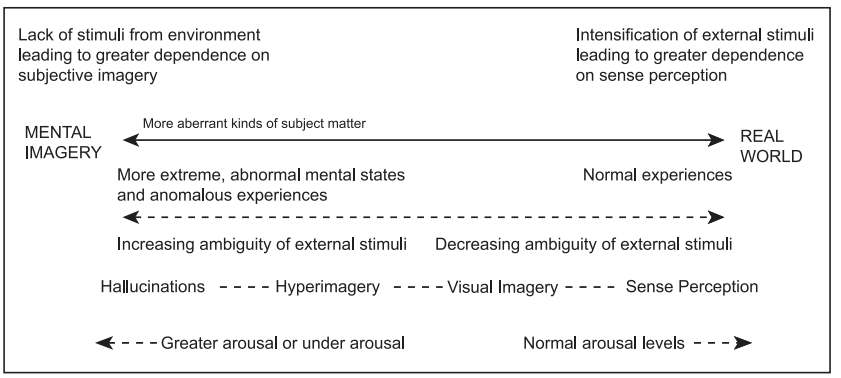
The effects of the realignment of these various factors can be seen in distinct psychological states, examples of which will now be described. As already indicated, what is remembered from an emotional experience may be influenced by arousal levels that serve to focus attention on specific aspects of an episode. In such cases, research has found that people exposed to dangerous events tend to focus on the central themes rather than peripheral details. This is commonly known as weapon focusing. For example, witnesses to a crime retain accurate memories of the particular implement or weapon used. They, nevertheless, have poor memories of the event itself, including the face of the person holding the weapon that is associated with a narrowing of attention (Schacter 1996). Interestingly, Eagleman and colleagues (2005) have found that in dangerous situations events appear

Table 1. *The different kinds of experiences associated with hallucinations and hyperimagery.*

Hallucinations	Hyperimagery
Experience is concrete, tangible, objective and real	Inner eye-pictorial, subjective
Location in outer objective space	Location in subjective inner space
Good definition	Indefinite, incomplete
Sensory wealth	Neutral or dim elements
Constant	Tendency to fade
Independent from volition (experience of passivity)	Sometimes experienced as voluntary
Perceptual flavour	Ideational flavour
Object exists independent of observer	Depends on observer for existence
Experienced in another sensory modality	Not experienced in another sensory modality

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Table 2. *The various dynamic relationships along a continuum linking sense perception, visual imagery, hyperimagery and hallucinations with regard to external stimuli and subjective experience. Greater arousal levels or a more disturbed psychological state would tend to move this continuum further to the left, i.e. in everyday viewing situations an over-aroused person will be more likely to misconstrue a real object for a subjective image than would a normally functioning individual.*



as if in slow motion which may explain why particular items are easily transposed to memory.

Focusing-in on an object can similarly lead to hyperimages — especially where the perceptual system has been subject to increased demands such as where prolonged concentration on particular objects is required when individuals often report intrusive mental images of the items subsequently appearing. For example, medical students and laboratory technicians, on learning to count blood cells for long hours through a microscope, later report seeing intrusive images of cells (Horowitz 1975). Motorists also report the occurrence of visual images of headlights after long bouts of night-time driving and archaeologists describe recurring images of searched-for objects or items that have been the focus of intense scrutiny. These experiences, it seems, can be quite startling because they enter awareness involuntarily and cannot easily be erased. It is as if the image of the object involved has become so imprinted in neural circuits that it can come to mind in the absence of the real stimulus. This effect may also be reinforced by the fact that when engrossed in intensely focused activities attention is distracted from other concerns. Correspondingly, when an individual endures hunger or thirst, the mental image of the item in question becomes increasingly intrusive until the need is placated (Gross 1992; Sandford 1936).

Hyperimages can also occur during episodes of fatigue — the opposite of arousal but still a disturbed conscious state. Those so affected often report seeing objects of various descriptions, invariably animals. For example, drivers who endure long and monotonous journeys on motorways through fog, snow-storms or at night often report seeing non-existent animals which they swerve to avoid before the mistake is realized (McFarland & Moore 1957; Whitlock 1987). In these cases, the attention to external stimuli is attenuated allowing visual imagery to come to the fore. Lack of sleep, especially over extended periods, can also encourage confusion so that one object can sometimes be mistaken for another. In extreme cases of sleeplessness, hyperimages can emerge in response to hints contained in the prevailing stimulus, e.g. spots on a table might be misperceived as insects or a street sign may be mistaken for a person (Coren 1998).

Although in normal circumstances a memory image fades quickly, images associated with conspicuous events tend to be retained longer (Vernon 1971), e.g. with the death of a close kin, a complete stranger is often mistaken for the deceased person (Grimby 1998; Lange *et al.* 1996; Kraüpl Taylor 1979). As well as in response to unexpected events, Horowitz (1975) also found intrusive and stimulus repetitive images experienced in over 50 per cent of cases where individuals had suffered mild to moderate levels of emotional shock, thereby emphasizing the widespread nature of the phenomenon. The attention of such individuals may be easily captured by particular key stimuli that remind them of a past event in that they tend to be chronically vigilant to the extent that harmless environmental signals are regarded as a threat.

The factor driving these quasi-hallucinatory episodes is not a psychoactive agent or damage to the brain but rather the hyper-aroused (or under-aroused) limbic regions that provoke the necessary imagery in higher visual centres (Joseph 1990). In such cases, the imagery may also be manifest in dreams or nightmares. Anything that induces over (or under) arousal in these systems may therefore elicit a hyperimage (Manford & Anderman 1998). The likelihood of a Perky-like effect occurring (mistaking an internally generated image for one based on external reality) is therefore greatly increased in such cases of distorted arousal.

All of the above examples illustrate how hyperimagery is likely to be experienced by the ordinary population as part of 'normal' experience and need not be confined to exceptional or abnormal groups. Furthermore the division between what is real and what constitutes a mental image can fluctuate according to the potency of environmental conditions and the intensity of predisposing psychological factors.

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The image can thereby appear to float anywhere in the space between the subjective experience of the observer and the actual world itself. This would, to some extent, depend on the arousal level of the individual as it is commonly accepted that, when a person is highly aroused, the perceptual system automatically suggests alternatives. For example, in the case of an alarming event, the individual will tend to interpret more readily any subsequent stimuli with the slightest resemblance to the originating cause, i.e. detection thresholds will be considerably lowered. In this respect, LeDoux (1994) found that the subcortical thalamus to amygdala pathway responds rapidly and pre-consciously to potentially threatening stimuli, especially those involving danger. There are, therefore, two neural pathways for reacting to a dangerous event, one subcortical (to do with implicit processes) and the other cortical (to do with explicit awareness). The subcortical route seems to provide only a crude perceptual image of the external world whereas the cortical pathway embellishes this in the form of a more detailed enhanced representation (Alorda *et al.* 2007). 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 — this is because not responding to a stimulus involves more costs than actually responding. The visual system may therefore simply store primitive cues of basic information that can be verified by a delayed functioning higher recognition system. Thus, the two systems operate in unison to provide a seamless conscious experience. Interestingly, LeDoux found that these kinds of emotionally driven memories are difficult, if not impossible, to erase. A consequence of this is that the alerting system produces a generalized attentional bias to focus on threatening stimuli that tend to persist when activated, as dangers do not strike in isolation then disappear, but rather tend to linger (Öhman & Soares 1998). This often leads to a further entrenchment of arousal levels and an associated increased motivation to seek further threats of the same order — a mechanism known as adaptive conservatism.

The neuropsychological factors outlined will have been further underwritten by the fact that animals, which are particularly relevant in the present context, were integral to the evolution of the human brain to the extent that the encoding of animal forms seems to have become a dedicated domain of the visual cortex (Caramazza & Mahon 2006; Farah & Rabinowitz 2003; Capitani *et al.* 2003; Hodgson 2003b; 2006) — specifically in the lateral fusiform gyrus (Caramazza & Mahon 2003; Martin & Chao 2001). A large number of investigations have confirmed the existence of semantic categories for major items such as animals for the purpose of both recognition and naming that has become one of the main lines of evidence for constraining conceptual organization in the human brain (Caramazza & Mahon 2003). Interestingly, the archaeological record (especially the preoccupation with animals in rock art) seems to confirm what cognitive neuroscience has established. Moreover, the stimulus properties arising from such a domain will have constituted the basis for more sophisticated representational abilities (Hodgson & Helvenston 2006). Implicit perceptual processes are also relevant in this regard, as it has been established that recent and repeated visual exposure to the same object has a tacit (subconscious) influence on visual memory recall (Hodgson 2003a). This is supported by the fact that studies of eye movements when viewing complex scenes have found that attention gravitates more to people and animals than inanimate objects (Yarbus 1967). Such observations are consistent with Gibson's (1979) direct theory of perception wherein what is perceived is embodied in that the processes of seeing are contingent. In other words, the categories for the recognition of animals in the cortex are a function of evolutionary imperatives that have an automatic dimension.

Part 2: Cave art and hyperimagery

Hyperimagery and Franco-Cantabrian cave art

How might the present analysis be relevant to understanding the depictions of animals in Franco-Cantabrian caves? The diverse ways by which hyperimages are induced can be informative as to why there are so many depictions of animals in this 'art' and the reasons for their representation. Most of the psychological processes and conditions cited above come together in the caves visited by Upper Palaeolithic people. It has been shown how hyperimagery of this type can be induced by certain types of experience relating to 'normal' interaction with the world. It is by examining Upper Palaeolithic communities in these terms that we might be in a better position to assess how hyperimages can be relevant in this context. Fatigue, sleep deprivation, over-concentration on particular items, anticipation, hunger and stress-related events have been identified as prime causes that can evoke hyperimagery. Moreover, individuals often find hyperimages so compelling they are occasionally regarded as real (Sims 2003), which provides an important pointer as to what might have motivated Franco-Cantabrians to treat these images as special.

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It is uncontroversial that such experiences would have been a regular occurrence in the daily lives of Cro-Magnons. On hunting forays, focused concentration would have been necessary for sustained periods in order to acquire the essential protein-rich meat and fat products as well as to maintain vigilance in case of marauding predators (this, however, does not presuppose the much criticized idea of 'man the hunter' but merely that all members of the community would have been involved in hunting activities and a concern for animals to a greater or lesser extent). As noted, one of the effects of raised and prolonged concentration levels is that the sought-after items come to be imprinted in neural circuits as a result of increased noradrenergic activation (McGaugh 2006). Mental fatigue is a hallmark of this level of focused attention that would have been exacerbated by the extreme physical exertion involved in tracking game. Hunger, if not starvation (malnutrition was common during the Upper Palaeolithic: Burenhult 2003), will have been another important factor (Hodgson 2006) for, as emphasized, lack of sustenance leads to an image of the food in question spontaneously coming to mind. Furthermore, mental states play a vital role in how perceptual information is processed to the extent that the hopes, fears and expectations affect what is perceived (Dror 2005). On entering a cave for whatever reason, the dim conditions meant that the constraining effect of external stimuli would have been reduced whilst, thanks to recent experiences to do with the interaction with animals, visual imagery would have come to the fore (bright light improves perception of external objects and, in this sense, discourages hyperimagery: Collerton *et al.* 2005).

Given the daily round of Upper Palaeolithic life, it would have been more than likely that hunter-gatherer groups did experience such mental aberrations. This would have been reinforced, and has obvious parallels with the Perky Effect, in that many of the contours of the dimly-lit cave walls simulate animal outlines. That is, there would have been an ambiguity between the subjectively induced image and the suggestive, undulating contours of the walls — an ambiguity reinforced by the fluctuating light, and shadows cast, of lamp burners and fires (such light actually seems to make the walls move thus reinforcing cues for the eliciting of animal forms). This ambiguity will have been an important motivational factor inducing the visitors to render the mental image permanent.

Horowitz (1975), in relation to hyperimagery, points out that an ambiguous shape (such as a crack or undulating surface of a cave) can be 'illusioned' into either an item of food, if the subject is hungry, or sexual anatomy if in a state of heightened sexual arousal (which has implications for the vulva iconography in cave art), and so on. It has been estimated that at least 10–15 per cent of cave art involves the incorporation of natural features that are suggestive of an animal's anatomy (White 2003). This is probably an underestimation as many of the original rock features on which the animals were based will have disappeared, e.g. natural stains, blotches, protrusions, surface cracks, undulations, as well as shadows projected on to walls by intervening surfaces, concretions and rock formations. In fact, Clottes (2007) has recently proposed that the significance of natural features for understanding cave art has largely been overlooked.



Figure 1. *Three painted bison showing how the natural cracks and fissures of the cave are reflected in the contours of the animals that may have served as trigger cues that originally inspired the depictions by way of hyperimagery. Le Portel (France). © Jean Vertut*

Suggestive features of this order can be regarded as highly potent trigger cues (which parallel and act as a surrogate and stimulus for similar cues in visual memory) that will have helped encourage and reinforce a visual system already hyper-sensitized to the detection of animals. The exploitation of natural features that simulate animals provides a vital clue as to the relevance of hyperimagery and visual memory in cave art. This is reflected in the fact that on hunting expeditions raised arousal levels served to keep the individual in an alert state so that the slightest cue suggestive of an animal would have elicited an image of the same or similar. Yet any surface of the cave, whether flat or undulating, would have provided a suitable 'canvas' on which hyperimages may potentially have been projected so that depictions need not be exclusive to areas where natural features

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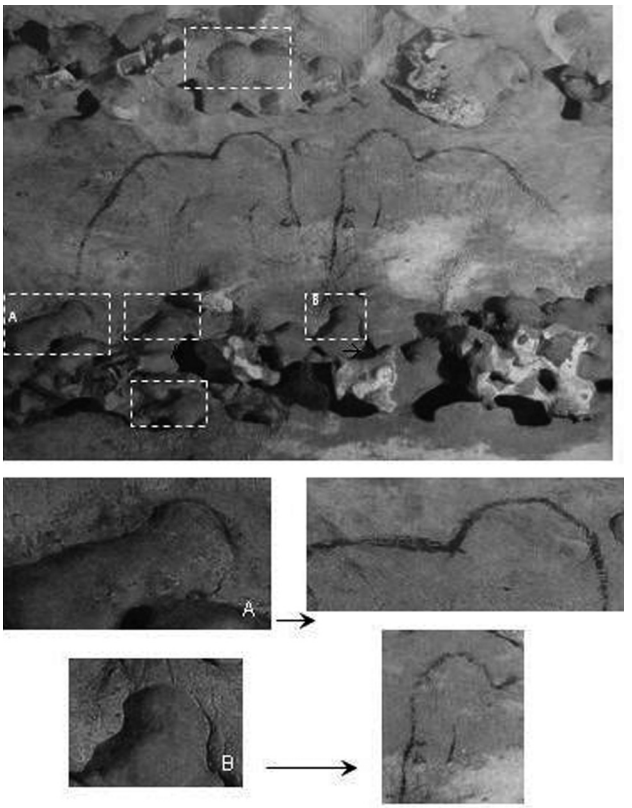


Figure 2. *Natural features of a cave (highlighted) that may have served as trigger cues that stimulated hyperimagery leading to the portrayal of the right and left facing mammoths. Other trigger cues may have consisted of shadows, protrusions, encrustations, blemishes and stains, etc. 'A' and 'B' have been extracted to show how closely they resemble the drawn outlines. © Jean Vertut*

of the cave resembled animals. In addition, many depictions, although not including suggestive natural features within the actual contours, are nevertheless often placed in proximity to rock surfaces and features that suggest animal outlines (see for example Figs. 1 & 2).

The suggestive natural cave features closely resemble abbreviated animal outlines and so replicate incomplete figures which thereby automatically facilitate and stimulate recognition and visual memory templates. This process will have been further promoted by an over-stimulated and activated visual system so that natural features that looked marginally similar to animals would have been enough to incite visual memory or provoke hyperimages. In other words, Upper Palaeolithic people would have tended to see more animal forms in the natural features of the cave than a modern individual because Cro-Magnons perceived animals in the evocative cave environment due to the lower recognition thresholds for triggering such items. Of course, repeated visits to caves over prolonged periods would have led to a reciprocal process where the original factors that had 'inspired' the depictions of animals were further compounded by the already existing productions of previous cave artists. In many instances, the most recent visitors would have remained unaware that the previous depictions had been done by earlier groups due to loss of contact over time thereby lending a further air of mystery to these sites. Previous depictions therefore became trigger features which in themselves led to the production of yet further animal outlines — a process that may account for the endurance of these kinds of depictions over such a long period.

It also needs to be remembered that various animals, such as bears, wolves and cave lions frequented the caves used by Cro-Magnons, so it would have been necessary to make certain these spaces were uninhabited by carefully examining the various chambers beforehand. In this case, the visual system would automatically have been suggesting possible alternatives in the ambiguous and unstable light where there were many false positives (the suggestive animal-like cave features). Accordingly, on visiting a rock shelter, vigilance levels would have remained high with the effect that any slight resemblance to an animal outline in the shifting light and shadows cast onto the undulating walls would have been enough to evoke an image of an animal. And once a hallucinatory-like image has been experienced in a particular setting it is inclined, in future, to come to mind more easily in that venue through association (Collerton *et al.* 2005) which further explains why caves became a favoured location for the making of Palaeoart. The fact that graphic images are found in the deep, more inaccessible parts of caves is explained by the fact that hyperimagery would have been even more likely to occur in these areas than in the more accessible chambers. In fact, the strangeness and increased danger associated with these remoter areas would have further increased arousal and vigilance levels, making the appearance of hyperimages more likely.

One of the characteristics of hyperimages (and visual imagery) is that they tend to be in the form of a single representative example of a class or category (Collerton *et al.* 2005; Vernon 1971). For animals, this is the typical viewing profile (see Hodgson 2003b for a discussion), a common trait in Upper Palaeolithic depictions as Halverson (1991) has demonstrated wherein the contour outline defines the class (see Fig. 3). Another characteristic of hyperimagery is the fact that only the main defining aspects (diagnostic features) of the object

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Figure 3. *Horses from Ekain cave (Guipúzcoa) showing repeated drawing of typical sideways view, some blurring, basic level template, differences in scale, abbreviated contours and faded quality which are all features of hyperimagery. This example also illustrates how abbreviated contours served as supplementary trigger cues leading to a feedback mechanism that triggered repeated depictions of the same or similar. © Jean Vertut*

are included in the subjective image: the features more attended to during interaction with an object tend also to be those liable to accentuation (Henderson *et al.* 2001), which, again, matches exactly the characteristics of Franco-Cantabrian art. For example, the lower extremities of an animal's legs are regularly omitted whereas the upper diagnostic features are invariably included and drawn in order of priority (Fritz 1999; Hodgson 2003b). Twisted perspective, where horns, hooves, antlers or tusks might be turned towards the viewer whereas the rest of the animal remains in profile, is a common aspect of cave art and can be similarly explained by the focusing-in effect, as in the weapon example mentioned above. The author of the depiction is thereby attending to different aspects of an animal's anatomy and in so doing triggers the typical view for particular anatomical features — antlers, horns and suchlike can potentially cause injury or death (and the hunter could potentially be trampled on by hooves). This is especially obvious in the twisted horns of the bison in the 'fallen man' scene at Lascaux.

The outline contour of hyperimages has been shown to be incomplete or liable to various levels of fading or accentuation according to the psychological state and level of awareness of the individual. One of the predominant aspects of parietal art is not just the concern for the contour but also the abbreviation of this outline in various ways (the more complete figures at Lascaux are an exception). In fact, the indistinct outline seems to be one of the commonest traits of parietal art that was intended and not a product of natural deterioration (Ucko & Rosenfeld 1967). Upper Palaeolithic Cave art abounds in such outlines (Ucko & Rosenfeld 1967, 58), the representations of Chauvet being prime examples with many at Lascaux displaying similar traits as well as the horse panel at Ekain (Guipúzcoa) (Fig. 3.) Having said this, there are many depictions that show a concern for the more detailed aspects of an animal's anatomy and a more defined outline. The more precise outlines can also be explained by hyperimages in that the latter can often display more definite edges (Jaspers 1963), depending on the intensity of the experience which is consistent with the view that subjective images can seem quite real if the level of emotional arousal happens to be high. Otherwise, such portrayals may simply represent those depictions that were chosen from a previous corpus of outlines for further embellishment for any number of possible reasons (see below).

Another curious aspect of this art is the disregard for the scale of animals portrayed in the same 'scene', (as Fig. 3 illustrates) which parallels the fact that subjective visual images are subject to size distortions to the extent that an image can range in size from the small to relatively large (Jaspers 1963). A further unusual characteristic is the juxtaposition of animals not normally seen together, which is all the more surprising given that some authorities claim that the hunters responsible for cave art were astutely aware of the behaviour of the various fauna (Clottes 2003). Because hyperimages are unpredictable, intrusive and tend to linger, a species of animal is likely to have been seen against any number of previously executed portrayals thereby leading to the incongruous assortment of species.

The many dense superimpositions to be found on cave ceilings seem puzzling to the modern eye but for Palaeolithic people they were a kind of record of the persistent hyperimages seen against the backdrop of ceilings and previously painted surfaces (see Fig. 4). The haphazard orientation of these superimposed depictions is explained by the fact that, for any of the aforementioned reasons, hunters gazing upwards at this ceiling would have seen hyperimagery from a number of different positions. Another curious aspect of cave art is the rotation of figures on walls, such as the 'vertical rhinoceros' of Chauvet (Clottes 2003). Rotations of this kind are more frequent on ceilings for reasons already posited and less common on walls

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due to the fact that the observer's viewpoint is more likely to be dictated by a common standing posture and therefore a shared line of view.

In sum, the reduced light of the cave with its animal-like undulating contours and the highly charged visual system of the human visitors will have come together ensuring that hyperimagery of animals would have been experienced, thus motivating and directing how animals were depicted on cave walls and ceilings. The main similarities between hyperimagery and Franco-Cantabrian cave art can be summarized as follows:

- incompleteness;
- outline contour;
- faded quality;
- size disparities;
- exaggeration and concern for salient features;
- single units;
- basic category or class.

The range of specific psychological factors experienced in the dim and ambiguity-provoking illumination of caves, in order of precedence, that would have invoked hyperimagery of animals during the Upper Palaeolithic can be summarized as follows:

1. prolonged and focused concentration directed towards various animals;
2. anticipation and expectation;
3. fatigue;
4. sleep deprivation;
5. hunger;
6. fear;
7. stress factors.

Hyperimages allow many aspects of Upper Palaeolithic cave art that have previously resisted interpretation to be understood more clearly. For example, they explain why the depictions are so naturalistic at an early date in the sense that a hyperimage would have been immediately available for the purpose of portraying fauna and, when interacting with the suggestive features of the cave, provided an adequate template for producing a naturalistic depiction. The fact that these representations endured for 20,000 years in virtually the same format is further corroboration of this explanation in that the same visual image, i.e. the typical viewing profile, will have remained constant.

Socio-cultural factors and hyperimages

Upper Palaeolithic peoples must have had a range of experiences in relation to animals including, hunger, tiredness, focused attention, expectations as well as fear, any one of which would have been enough to elicit a hyperimage. Also, with fear comes respect, to the extent that carnivores can be regarded as 'positive'



Figure 4. *Superimposing of lines at Peche Merle (Lot) showing how one outline is transposed over another without any regard for previously drawn contours. This can be explained by the fact that hyperimages were being seen against the backdrop of existing outlines.*

which is perfectly consistent with hyperimages. It is precisely because Palaeolithic people would have been wary of and in competition with large animals that they would also have regarded them with admiration. The carnivores depicted at Chauvet are thought to portray such a sense of reverence (Robert-Lamblin 2003). To reinforce the point, threatening animals were only one factor leading to the experience of hyperimages; other factors concerned the conditions in which Upper Palaeolithic people lived as they interacted with animals on many different levels that were equally, if not more, important.

The criticism could be raised that humans are, for obvious reasons, more interested in the human figure/face than animals, yet the human form is rare and often poorly drawn in Franco-Cantabrian art. However, as the population density of humans living in Europe at the time would have been extremely sparse (10,000 to 40,000 by one estimate: Bocquet-Appel 2000) the likelihood of coming into contact with other groups of humans would have been extremely low. Secondly, the suggestive curvilinear contours of the caves are much more similar to animal outlines than the human figure and, thirdly, as already stated, there would probably have been regular daily contact with animals of different kinds on a number of levels compared to the more limited interaction with human groups. These points suggest hyperimages of animals would have been more common than those of humans.

It is highly likely that, because Cro-Magnons will have remained oblivious as to the causes of hyper-

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imagery, they came to be regarded as special, leading to their attempted preservation in a tangible form. Images of this kind are often referred to as 'visions' even in the present day (Reed 1972) and are sometimes associated with haunting (Lange *et al.* 1996) which has implications for how Palaeolithic communities might have labelled such manifestations. The possibility therefore arises that caves may have been concerned with a quest to visit locations where hyperimages were optimally experienced. And it may also be the case that hyperimages, as realized in graphic form, were only meant to be seen by certain members of the group because of the special status accorded to such 'apparitions'.

If hyperimages and their material embodiment did become the focus of socio-cultural factors, the question remains as to why there was not much more variation in style and content over such an extended period. One response would be to propose that because the various images existed both in the real world, as suggestive natural outlines and associated depictions as well as in the mind's eye, the interplay between the two may have had a constraining effect, especially if the images came to be thought of as akin to visions. A powerful feedback mechanism must have existed between the suggestive wall surfaces of the cave, the daily experiences with animals, and the visual brain. As visions, the images may also have become proscribed and, in this respect, integrated into a broader mythic narrative that remains archaeologically invisible. The fallen man scene from Lascaux, as one of the few examples of a pictorial narrative, tentatively suggests this to be the case. Theranthropes may similarly be cited as evidence of mythic or socio-cultural leanings. Modern hunter-gatherer groups have a complex relationship with animals that is usually associated with some all-embracing narrative whereby the boundaries between humans and animals are held to be fluid (Fausto 2007). The animals portrayed in Franco-Cantabrian cave art may, in a way that still remains obscure, be part of such a complex narrative unrelated to shamanism.

The explanatory scope of hyperimages

Taken together with the fact that animals continued to be a crucial aspect of the everyday lives of Cro-Magnons, it is incontrovertible that the profiles of fauna often came to the mind's eye of such individuals — thus explaining why animals were so pervasive in this 'art'. To summarize, the range of cave art phenomena that can be explained by hyperimages is as follows:

- the preoccupation with animal outlines for 20,000 years;
- apparent naturalism at an early date;
- the inclusion of undulating wall surfaces and fissures and other features as part of animal form;
- superimpositions;
- haphazard placement of images;
- location of depictions on ceilings and in deep recesses;
- caves as favoured location;
- the universality of the typical viewing profile;
- size differentials of animals;
- various orientations of animals on walls and ceilings;
- indistinct, incomplete outlines;
- animals portrayed together that do not co-exist in reality;
- twisted perspective.

Conclusion

Franco-Cantabrian caves served as a particularly favourable location that promoted and encouraged the experience of hyperimagery with many natural features serving as trigger cues for visual memory. Upper Palaeolithic groups visiting these caves will have engaged in demanding situations on expeditions involving highly focused and prolonged concentration that led to an accentuation of visual imagery at the expense of externally perceived stimuli. This may have been further reinforced by hunger or experiences related to the practicalities of tracking game. The classic range of experiences that provoke hyperimagery appear to have been common to those inhabiting the Upper Palaeolithic refugium, namely prolonged focused attention, anticipation, starvation, fatigue, sleep deprivation as well as various kinds of psychological stress. Because Upper Palaeolithic people would have been unaware of the reasons for the existence of hyperimagery, it is probable that this imagery came to be regarded as special. Indeed, the dimly lit cave environment may have been particularly associated with 'visions' of animals. The fact that the depictions of fauna show many similarities with hyperimagery strongly suggests that this type of imagery is responsible for many aspects of Franco-Cantabrian cave art. Unlike many previous explanations, this account is firmly based on the regular activities of Upper Palaeolithic people as they attempted to survive during the fluctuating climate of the Ice Age — conditions that directly influenced their psychological state that determined how parietal art was produced.[1]

Note

1. One of the advantages of this theory is that it can be potentially corroborated by evidence from modern-

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day populations. For example, an experiment could be devised whereby subjects might be given an identification task involving prolonged concentration of animal pictures thereby simulating the perceptual activity with which Upper Palaeolithic hunters would have been concerned in locating and searching for animals. The targeted group could then be asked to enter a cave (with suggestive contours) and asked to record what they saw. A control group would simply follow their normal routine and their comments on what they witnessed in the cave also registered. The prediction is that the target group would tend to see more animal forms than the control group. This procedure could be made more authentic by giving the focal group adrenaline to induce arousal that would predict the seeing of an even greater number of animals as a consequence. Alternatively, the target group could be deprived of sleep and similarly admitted to a cave and their responses recorded which could then be compared to the reports of a normal-sleep control group. Although these experiments could not prove the authenticity of hyperimages as applied to Palaeoart, it would at least be informative.

Glossary

Amygdala
One of two small, almond-shaped areas of grey matter that are part of the limbic system located in the temporal lobes of the cerebral hemispheres concerned with the memory of emotional responses.

Arousal
Is a *physiological* and *psychological* raised state of wakefulness. It involves the activation of the *reticular activating system* in the *brain stem*, *autonomic nervous system* and *endocrine system*, leading to increased heart rate and blood pressure and a condition of sensory alertness, mobility and readiness to respond. Four major systems originating in the brainstem, with connections extending throughout the cortex, are based on the brain's neurotransmitters, *acetylcholine*, *norepinephrine*, *dopamine* and *serotonin*. When these systems are in action, the receiving neural areas become sensitive and responsive to incoming signals.

Emotion
A complex reaction concerning experiential, behavioural and physiological factors whereby an individual strives to deal with personally significant matters and events that arises without conscious effort and can be positive or negative depending on circumstances.

Fusiform gyrus
The fusiform gyrus is situated in the lower area of the temporal lobe (on each side of the inferior cerebral cortex) and also known as the occipitotemporal cortex and is implicated in visual memory.

Limbic
The limbic system is a part of the human brain concerned with emotion, motivation, and emotional memory. It influences the formation of memory by integrating emotional states with stored memories of physical sensations.

Noradrenergic
(noradrenaline — also known as norepinephrine)
A *stress hormone* that affects parts of the *human brain* where *attention* and responses to actions are controlled. Along with *epinephrine*, noadrenaline underlies the *fight-or-flight response*, directly increasing *heart rate*, triggering the release of *glucose* from energy stores, and increasing *skeletal muscle* readiness.

Subcortical
Beneath the cerebral cortex.

Thalamus
Relays sensory impulses to the cerebral cortex.

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