Is Palaeolithic cave art consistent with costly signalling theory? Lascaux as a test case.

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Abstract

Several proponents of Costly Signalling Theory have noted its potential for understanding Prehistoric art. We use the Late Upper Palaeolithic art of Lascaux Cave (Dordogne, France) as a test case as to whether we may be able to identify an assertive, individual style in Palaeolithic art. The cave's abundant images represent one of the most stunning examples of European Upper Palaeolithic cave art, and in terms of the material provisioning of the cave, demonstrable artistic skill, and difficulties accessing decorated areas, it represented a huge cost to its hunter-gatherer creators. But does it represent group cost, or can any CST element be identified? We approach this question using several characteristics we regard to be central to costly signalling, and explore the various ways by which this occurred within the cave. We conclude that it is best viewed as a group signal, and that no CST component can be identified.

Keywords

Cave art. Palaeolithic. Solutrean. Magdalenian. Costly signalling.

Introduction

Nearly eighty years since its discovery the Upper Palaeolithic art of Lascaux cave (Montignac, Dordogne, France) remains the most abundant and technically impressive example of an art form that spanned at least 30,000 years. Long characterised by many as the 'Sistine Chapel of prehistory', this relatively small cave contains over 500 painted and 1500 engraved images and signs, details of which continue to emerge (Aujoulat 2005). The scant chronological information that exists suggests that its art was created in at least two phases, between ~17,000-21,000 cal BP and 21,500 – 22,500 cal BP, relating culturally to the Solutrean and Early Magdalenian respectively, consistent with thematic and stylistic parallels at other caves dated to these periods[i], although the accumulative nature of depictions and superimpositions suggests that distinct bursts of activity occurred within these broad periods.

We explore here exactly how Lascaux's abundant cave art can be understood in terms of its signalling. We have chosen Lascaux due to its abundant and striking art; the effort expended in its creation, and the fact that among 'decorated caves' it is relatively well studied, well published, and its overwhelming importance is acknowledged widely. Only an unnecessarily harsh art critic could fail to appreciate its importance; Gombrich, for example, thought that its 'masterpieces…look far too controlled and deliberate to be the result of accident…thousands of years of image-making must have preceded them' (1960, 91). Given its importance in the canon of parietal art and its context as representing one of many activities at or near a presumed seasonal aggregation site (*sensu* Conkey 1980) we thought it a sensible test case for investigating whether costly signalling can be said to have been an organisational aspect of Late Upper Palaeolithic life. By so-doing we do not seek to 'explain' Lascaux's art as a consciously costly act and nothing else, nor do we mean to imply that any perceived 'function/s' its art was thought to have to its Palaeolithic creators/viewers should necessarily be inconsistent with a costly behavioural component. We do not seek to extend our conclusions to other decorated caves – particularly those of different Palaeolithic periods - although we suspect that investigations in other caves will repay effort, and suggest that ascertaining exactly what costly components of Palaeolithic art were should be a viable and valuable research goal. We are not trying to infer any 'meaning' behind the art – that has probably been done to any sensible interpretative limit by Aujoulat (2005) and his predecessors (see below) unless anyone decodes its non-figurative signs – its art belongs to a remote time and sociocultural context, and we cannot infer anything but vague aspects of its meaning as we cannot capture its context in any specific way (Leppert 1996, 10).

We believe, however, that Lascaux's art can be interrogated in terms of the predicted characteristics that arise from the process of signalling. Some of these should seem rather obvious - the time and effort spent creating the art, often in difficult positions, the danger of exploring the cave &c – but others need to be teased out of its material provision, creation, structure and form of communication. Thus while in the absence of informers we will never be able to ascertain with absolute confidence that a costly perspective is inherent in the art, we are confident that there are enough predictions in several areas to allow us a degree of confidence that its art signalled, and that its signalling can in a number of ways be seen as costly. The question is, however, whether its costs pertain more to group signalling or to the use of costly signals by individuals.

The potential relevance of costly signalling

Intra-group cooperation in hunting, gathering, food sharing and defence almost certainly has a long evolutionary history among hunter-gatherers (e.g. Gamble and Gaudzinski 2005), and to facilitate this,

social conformism is particularly important within small-scale groups inhabiting unpredictable environments (Henrich and Boyd 1998). It is therefore essential to ensure that individuals genuinely cooperate within these social units, rather than act as 'free riders', simply giving the appearance of cooperation. Kinship and direct reciprocity play roles to an extent, but the costly signalling by individuals of their cooperative intent has been invoked to explain behaviours that cannot be accounted for by these alone (Henrich 2012). Costly signalling is a quality dependant behaviour that is hard to fake, lacks immediately tangible benefits, and demonstrates both an individual's fitness and their commitment to their social group (Zahavi and Zahavi 1997). For a signal to be costly it must incur some form of personal risk or disadvantage, or carry no immediate or obvious individual benefit. In the modern world, tattooing and body piercing are painful and costly, yet have demonstrable effects on prosociality (Xygalatas et al. 2013); more specifically, gang tattoos demonstrate a commitment to a specific gang, and by so-doing place the tattooed individual in danger of violence from rival gangs (Gambetta 2008). Tattoos signal individual identity, life history and social commitment, adhering to strict rules manifesting in style and positioning on the body (Shoham 2010). While their costs are inevitably high, the benefits of group involvement and status they facilitate can be beneficial in a number of ways.

Costly signally theory (henceforth CST) has been invoked to explain various forms of non-optimised, unnecessary or 'wasteful' behaviours, including particularly high-risk and/or low-gain hunting observed among modern hunter-gatherers (e.g. Jones et al. 2013. Bliege Bird and Power 2015), footbinding, monumental architecture, and expensive public rituals such as funerary feasts among various small-scale societies (Smith and Bliege Bird 2000)[ii]. Aside from the modern world, it is of particular importance among groups that are widely scattered and/or interact infrequently (Murray and Moore 2009), which is certainly a characteristic of Palaeolithic hunter-gatherers. Among ethnographically documented groups adapted to harsh environments, where the benefits of intragroup sociality are high, the costs individuals must signal to prove their commitment must be equally high despite the time and/or energy this 'wastes' (Bliegebird and Smith 2005). The payoff is evident in several studies which demonstrate that the more costs placed on individuals within a specific group, the greater the longevity of that community (Sosis and Bressler 2003). Expressed in terms of game-theory, cooperative signals will indicate the quality of the signaller/s, eliciting responses from observers that should result in mutually beneficial outcomes (Gintis et al. 2001).

Ritual expression of 'religious' belief is commonly understood to be a purposefully evolved costly signal to encourage intragroup cooperation (e.g. Irons 2001. Sosis and Alcorta 2003. Rozen 2004. Alcorta and Sosis 2005. Murray and Moore 2009. Peoples and Marlowe 2012. Fischer et al. 2013). As it is usually impossible to rationalise religious beliefs logically, cooperating individuals tend to rationalise them emotionally[iii], through participation in rituals defined by a strong somatic experience that enhance long-term group cooperation in stronger ways than secular behavioural rituals (see discussion in Sosis and Alcorta 2003,

268). Hence 'religious' experiences are often perceived by participants as more real than reality itself; they can change how they perceive reality and consequently live their lives (d'Aquili and Newberg 1999). The link to fitness has been demonstrated in a number of cases; among 19th century American communes those of a religious nature were 2-4 times more likely to survive annually than their secular counterparts (Sosis 2000). Consequently, we follow the recommendation of Bulbulia (2014) that CST should form part of interdisciplinary research into the origins of art, ritual and religion.

Viewed from these perspectives it begins to make some kind of sense why small-scale Palaeolithic groups living in low population densities as hunter-gatherers scattered across wild and unpredictable Pleistocene environments expended, on occasion at least, much effort into 'decorating' deep caves as a form of signal. Kuhn (2014) suggested that the cost of hominin signalling has risen over evolutionary time, and associated art production with a marked rise in cost with the Early Upper Palaeolithic, although his discussion is largely focussed on portable examples (beads). While one might expect increased evidence of symbolic signalling with the social changes that seem to have accompanied the early dispersals of *Homo sapiens* in Europe (Sterelny 2014), the question remains as to the extent and nature of its cost. Artistic expression (as we would call it) can be viewed as a costly if it requires skill, time, patience, focus, planning, and occasionally (in the case of caves) an element of danger; it is no surprise, therefore, that participation in the creation of cave art could be used to demonstrate a commitment to society that is hard to fake (Bliegebird and Smith 2005). From any other perspective, creating art in the milieu of deep caves can be regarded as 'wasteful' and hence, costly (*sensu* Bliege Bird and Smith 2005), and surely any attempt to understand it as a purely aesthetic act (e.g. Halverson 1987; cf. Dutton 1987) simply projects anachronistic western concepts. There is no quotidian need to be in the potentially dangerous dark zones of caves (drink the water and you will inevitably suffer); yet the effort expended in creating art within them justifies, we suggest, the assumption that its production was costly, whatever its creators believed its meaning was. But was this cost borne by the group, or can it be regarded as evidence of individual competition *sensu* CST?

There have, to date, been few explorations of the potential of CST to prehistoric art, although given that its capital is information one might expect art to have provided strong potential for costly signalling if social circumstances allowed. Its potential was realised by McGuire and Hildebrandt (2005, 706-8) although in the context of a rise in production of symbolic media such as rock art depictions of bighorn sheep accompanying rises in high cost/low gain hunting activity, rather than in any nuanced analysis of symbolic culture. While stylistic variation may be used to highlight individual variations in skill and hence serve in social selection (Bliege Bird and Smith 2005, 230-1: 'technical flourishes' in the words of McGuire and Hildebrandt 2005, 708) even in such circumstances, decorative styles may still converge on common standards, which will therefore mask any nuanced signalling from the archaeological observer. Furthermore, while stylistic differences in pottery decoration may be used to signal political identity in

otherwise domestic contexts – as Bowser (2000) found in the Ecuadorian Amazon – there is no reason to assume that this was relatively costly to the individual potter. In order to function as signal, art needs 1) an audience, 2) images that are symbolically representative of the signalling individual, and 3) an associated cost (Flaherty 2012, 6). In the absence of unequivocal data we must assume that some kind of audience viewed the art – even if it were only the artists at the time of its production; we can assume some kind of associated cost, but whether this was high relative to other activities requires another assumption; and we need to identify individual signalling above and beyond communal characteristics such as theme, organisation and style. We will try to address the latter below.

Experimental replication of Coso rock art by Flaherty (2012) demonstrated that in terms of energy expenditure, the physical production of the art was less demanding than other quotidian activities such as gardening and outdoor walking, and hence in these terms it cannot be regarded as metabolically costly. But this is to ignore material provisioning, cave exploration and physical difficulties that are encountered in environments different to laboratories which all contribute to the creation of art. The major obstacle –as with any application of CST to archaeology – is the ambiguity of cost and return, the unquantifiable, intangible contributions to the product. How can one assign 'cost' to the accumulation of individual artistic expertise, or to whatever unknown social rules were guiding cave exploration or art production? The current inability to quantify all aspects of cost and gain is a serious limitation for CST applications dependent upon energy expenditure alone.

Palaeolithic cave art; group signal, individual signal

Art is one of a number of behaviours which demonstrably promote prosocial behaviour, including group singing, dancing and drumming for example (Kirschner and Tomasello 2009, 2010) and its relative floruit during periods of climate stress in the Upper Pleistocene is well known (Gamble 1982, 1991). We may suspect – indeed most archaeologists assume – that cave art formed part of wider activities within caves that stemmed from some kind of supernatural or religious context, and a number of its characteristics may even suggest this, but we cannot demonstrate it[iii]. Rossano (2015) included art as one example of costly activity in caves ('there is little question that Paleolithic spelunking was often a costly endeavour'; *ibid*., 89), although his argument was restricted to those few caves where access was of itself costly (difficult), rather than to the provisioning and production of the art itself. We will limit our argument to the creation and nature of cave art itself, merely noting that the success of ritual behaviour in promoting social solidarity often involves instilling them with an element of sanctity; why invest considerable costs underground for simple secular rituals which could be performed elsewhere? In any case, even if we could demonstrate how cave art functioned as part of wider ritual behaviour in the depths of caves, we would still never understand it clearly, given that rituals tend to be causally opaque, that is, lacking an explanation

of their causes (Legare and Souza 2012). In terms of signalling, specific beliefs are not important; 'what matters here is what people demonstrate to others' (Boyer and Bergstrom 2008. 116). But we can try to ascertain what kind of ritual element cave art possessed; how variable this was in space, context and time, and hence whether cave art can be said to have in some way at least 'functioned' similarly to distinct cultural groups, and whether it can be seen as evolutionarily advantageous (e.g. Dutton 2010).

We assume that signalling could occur between individuals within the same social group, and between such groups. Hence one might expect both emblemic signalling (to the group, about the group) and assertive signalling (to the group, about the individual) *sensu* Wiessner 1983)[iv]. Examples of the former may include shared totemic or animistic symbols (assuming they existed) or artistic style; the latter including individual variation in skill, style, theme or otherwise. In terms of CST it is assertive signalling that is key; although as individual signallers must strike a meaningful balance between conforming to social norms and displaying personal flair and skill (Bowser 2000) identifying it amidst a strong background of emblemic style will be difficult. Signalling between individuals within the same group could take a variety of forms and be embedded in quotidian activities and hence difficult to identify archaeologically; more overt signals may have been more important for indicating co-commitments to individuals from different groups who were encountered infrequently. Given the need for signal clarity in such circumstances we may, therefore, expect inter-group signalling to have been relatively more costly than intra-group signalling. Inter-group signalling may go some way to explaining the relatively long distances over which thematic and stylistic similarities can be observed; for Lascaux, for example, thematic and stylistic parallels can be found as far as south eastern France (Grotte Cosquer) which we assume is too distant to explain in terms of the mobility of the art's creators.

Identifying specific signalling behaviour from archaeological remains is difficult (e.g. Codding and Jones 2007 cf. McGuire et al. 2007) and we recognise that it would be easy simply to equate elements of almost all aspects of prehistoric art other than the simplest of doodles in domestic contexts with the predictions of CST. Furthermore, simply selecting examples of labour-intensive and skilled representations would not demonstrate that costly signalling played any role other than incidental to art. There are, however, several characteristics found to be common to signalling behaviour which, taken together, may bring us towards a more reliable evaluation of art in this sense. These are *synchrony, repetition* and *order*, in addition to which one might expect elements of minimally counter-intuitive content if there is a 'religious' element at work. Our reading of these, however, reveals the difficulty identifying with confidence specific assertive styles which could be said to correspond to the predictions of CST.

Behavioural s*ynchrony* – often expressed in terms of group singing, dancing and music but for which we suggest one include the creation of art – promotes positive emotions and prosociality and has played a considerable role in social evolution (Hagen and Bryant 2003. Wiltermuth and Heath 2009. Herrmann et al.

2013). Individuals who synchronise their behaviours - secular or sacred - with each other express relatively high levels of solidarity and cooperation (Bulbulia and Sosis 2011), and rituals involving a high degree of synchronous body movements (as the collective act of creating art might entail) and sacred attribution (which its themes might suggest) are the most likely to enhance prosocial attitudes (Fischer et al. 2013). In caves, even assuming an absence of a religious context, a combination of causal opacity (*this is important to us, but why exactly do we do it?*), emotional arousal and synchronised focus – particularly in a dangerous or unsettling context – would specifically promote group identity and fusion (Whitehouse and Lanman 2014). Synchronising individual behaviours requires an attention to social cues, and artistic elements such as theme, design, placing and style of images must, assuming the participation of more than one 'artist' manifest such social attention.

The *repetition* of oral traditions, secular and ritual acts and artistic themes and styles is fundamental to the maintenance of group social norms, even to the point that if an untruth is repeated enough individuals will come to believe it (Zaragoza and Mitchell 1996). Within the process of repetition the act of imitation is an important instrument of conformity (Henrich and Boyd 1998) and presumably interdigitates with synchrony. In rituals, repeated actions are often reiterated to the point of internal redundancy, i.e. to a prescribed number beyond that needed simply to 'get the point across' (Boyer and Bergstrom 2008, 120-1). The repetition of group talismans and totems may catalyse emotionally anchored social solidarity (Sosis and Alcorta 2003), and we will examine Lascaux's artistic repetition in this light.

Order emerges from the combination of synchrony, repetition, symmetry and imitation. Religious rituals typically cue in to participants' preoccupations with environmental order – the reassurance of the right things in their right places (McCauley 2014). Many examples of social ritualised behaviour focus on the use of specially prescribed colours, numbers, delineation of particular spaces, and an emphasis on order and symmetry, features that can also be observed in obsessive compulsive disorders (Dulaney and Fiske 1994). No wonder why Freud (1906) saw such 'neuroses' as personal rituals, and religious rituals as collective neuroses. We will examine these aspects of order in Lascaux's compositional structure.

The art of Lascaux has been referred to as a work of memory (Geneste et al. 2004). Although we do not know how many individuals participated in its creation or 'life', the reworking and superimposition of images and chronology insofar as it exists suggests that its importance was 'memorised' and repeated at least several times, in at least two periods separated by a millennium or so. Laming-Emperaire (1959) claimed that the stylistic contrasts between its images suggest that the art was created over a long period, and this can further be taken to indicate that multiple artists had been at work in the cave. The harmony observable in several of its painted and engraved panels suggests that images that had been superimposed upon others were not intended to deface or hide previous images but to further build upon existing work (du Brul 1968). Furthermore, Bahn (1994) suggested on stylistic grounds that the art at Lascaux does not

represent a single homogenous moment, but was created over multiple periods, which is certainly borne out by the existing chronological information discussed above and by the distinct mineral characterisation and preparation methods of the pigments used to depict a bison and a rhinoceros in the cave's Shaft of the Dead Man (Chalmin et al. 2004). Furthermore, there are a number of indications that its painted art was meant to be viewed, and not necessarily from the viewpoint of the artist – as we discuss below – so we may justifiably assume that Lascaux's art signalled to numerous people, over repeated visits.

If memory were truly important to its function, its images should be under selection for their clarity, as signals with a highly visual nature are recalled easier than those with lower (Slone et al. 2007). A 'minimally counter-intuitive' (MCI) content – subjects that are not entirely prosaic but neither ludicrously illogical – would further improve the memorisation of its signal (Gonce et al. 2006. Willard et al. 2016) as MCI content does for religious belief (Atran and Norenzayan 2004). We can explore Lascaux's art for any plausible MCI content, whether or not this is pertinent to CST.

Lascaux

Lascaux's ~200m is divided into seven galleries, five of which contain the bi- and tri-chrome paintings the cave is justifiably famous for (Hall of the Bulls, Axial Gallery, Passage, Nave and Shaft of the Dead Man) and three the cave's abundance of engravings (the Apse, Chamber of the Felines, and also in the Nave). Some 70% of the 915 animals depicted on its walls have been identified to taxon. Horse overwhelmingly dominates (at least 364 examples) and is evenly depicted through the system, followed by red deer (90), aurochs (36), ibex (35), bison (29), lion (7) and singular examples of a bear, bird and rhino, all of which have more specific distributions (Aujoulat 2005). Various non-figurative 'signs' such as its famous divided rectangles ('blazons'), 'hooked javelins', paired lines, 'asteriforms' and stacked double convergent lines, depicted either alone or in association with its figurative art, account for some 23% of the cave's art, some of which are also repeated on a lamp and two *sagaies* recovered from the cave's Palaeolithic archaeology (Allain 1979)[v]. The art originally visible on its walls was more abundant: the passage of humans and animals has worn away images in the narrower passages, and super-impositioning has covered others, and it is for these reasons that other animal depictions cannot be identified to taxon. Authorities agree that in terms of theme, style and available chronology the art was produced during the late Solutrean and Early Magdalenian. The homogeneity of most of the cave's images suggest one main period of activity (e.g. Delluc and Delluc 1984), although as Bahn (1994) has noted, some images in the Shaft of the Dead Man at least are dissimilar in style and technique and suggestive of a separate period, and one cannot rule out a later (e.g. Middle or Late Magdalenian) input (see also Pigeaud 2004) and one cannot rule out a minor Holocene contribution[vi]. Considerable planning and structure are evident in the cave's most striking

galleries, where vivid scenes of rutting behaviours swirl above the viewers' heads. The rutting coats worn by horse and aurochs, and developed antlers on stags reveal that the major painted panels present a calendar of creation; horse rut in late winter/early spring, aurochs in summer, and deer in autumn (Aujoulat 2005, 262-3)[vii]. We will describe more characteristics of the cave's art as we consider specific examples of costly signalling below. Specific information is presented in Table 1.

The cave; access, exploration, activity and effort

Lascaux may be relatively small and its art within 250m of its existing entrance, but exploring and 'decorating' it was not always easy. It can be dichotomised (Figure 1) into the two outermost galleries – the Hall of the Bulls and its continuation, the Axial Gallery, that were relatively easy to access and relatively capacious; and its innermost galleries, where light is absent and physical movement is more constricted (Delluc and Delluc 1979b). The narrow Lateral Passage is the first zone that requires stooping and crawling, a demand repeated in the Chamber of the Felines. Despite this, the entire extent of the cave was clearly explored and decorated to the point where access is no longer possible (Geneste et al. 2004, 56. Aujoulat 2005). Despite the low ceilings and difficult access in places, no attempt was made to lower the floor or make access easier. The whole exploration of the cave seems to have been meaningful: artistic form and technique followed the irregularities and surfaces of the cave walls, enhancing suggestive shapes as if the cave itself were determining what would be placed where. The intense levels of superimposed engravings of the Apse suggest that this gallery was regularly visited and used (Aujoulat 2005, 144. Nechvatal 2005), and The Chamber of Felines, despite the difficulty accessing and working in this zone (Aujoulat 2005, 40 describes it as 'barely passable'), contains ten percent of Lascaux's art. We note also that two zones in the cave, the Chamber of the Felines and the Shaft have dangerously high carbon dioxide concentrations in the lowest extremities of the cave [viii] (Denis et al. 2005). Leaving aside the issue of whether or not the Shaft was, at the time of the creation of its art accessible only through the whole system (i.e. forming a rear most part) or through a subsequently blocked entrance (and hence perhaps in a daylight zone)[ix], the Chamber of the Felines demonstrates difficulty and danger were no obstacle to activity.

Originally, Lascaux possessed one (probably two) relatively large entrances. Given its proximity to one of these, it has been suggested that Hall of the Bulls was a daylight zone, the orientation of Lascaux's entrance (facing northwest) providing a crepuscular red light at sunlight and sunset (Geneste et al. 2004, 49). Beyond this zone artificial light was necessary. Approximately 130 stone lamps have been found in Lascaux (Delluc and Delluc 1979a. Pastoors and Weniger 2011), numerous examples of which cluster in the

same area, e.g. in the Shaft of the Dead Man (at least twenty-one unmodified or rudimentary forms) and along the wall of the Nave, where surely they must have illuminated entire panels. The former includes the example carved from red sandstone derived from the Charente (Glory 1961), where fragmentary remains of others suggest that the region served as a regional production centre (Delluc and Delluc 1979a, 137). That this example is engraved with the stacked double divergent sign also visible on the cave's walls and on a *sagaie* found in the Shaft is a fascinating example of a specific signal depicted on various media.

The exploration of and artistic activity within Lascaux, cannot have been a random matter; the provisioning of several materials was necessary for this difficult, time-consuming and at times dangerous activity. The repetition of visits into the cave as suggested by the phasing of the art show that such difficulties were a regular event. Some provisioning is attested archaeologically, notably the clusters of lamps, pigment 'blocks/crayons', stone 'palettes' stained with pigment and conceivably a fragment of plaited rope for climbing down into the Shaft (Delluc and Delluc 1979b, 183). The use of distinct mineral pigments suggests not only diverse sources but also differences in the production of these 'paints' (Chalmin et al. 2004a, b, 2007. Vignaud et al. 2006. Chadefaud et al. 2008), and one can only speculate what this implies for the sharing and use of such resources. Two distinct manganese sources and production techniques were used in the depiction of the Great Bull, for example, the rare form of one of which (Hausmannite) suggests a source in the Pyrenees some 250km distant (Chalmin et al. 2007). The amount of lithics in the depths of decorated caves is never vast, but given the abundance of engravings in Lascaux the number of burins and blades recovered from the cave (Allain 1979) is remarkably low, even in the Apse, Passage and Nave where engraving is most common. Perhaps some were deliberately removed from the cave after use? Based on experimental replication of engravings with flint burins (PP pers. obs.) the turnover of engraving tools must have been huge. It is difficult to see this degree of material provisioning as anything other than a product of the group.

Many of Lascaux's paintings and engravings were created at the artist's head height, or at least at arm's length. In places, however, constrained space would require she/he to work uncomfortably close to the wall or ceiling, and at others some assistance to gain height would have been necessary (Table 1). The impressive height of images in the Hall of the Bulls, Apse and Axial Gallery has led to observations that some assistance from wooden logs would have been necessary (Aujoulat 2005, 149). The Nave's 'Great Black Cow' has been described as the 'riskiest' piece of art to produce, for example (Geneste et al. 2004, 71). Clearly, even if suggestions of 'scaffolding' may be exaggerated, it was some effort for artist's to maintain themselves at the height of the images and bring materials to hand, which we may reasonably interpret as evidence of collaborative effort. It goes without saying that the organisation of the cave's friezes and clusters of animals; the abundance of images painted, drawn and engraved onto all accessible and suitable walls; the variety of methods of depiction and demonstrations of artistic skill; the stratigraphic

overwriting or 'stacking' of images; and the remarkable abundance of images engraved onto its hard limestone represents hundreds of hours of repeated effort, in uncomfortable positions, in the dark. In terms of effort, therefore, we might view Lascaux's art as a form of communal *primitive valuable* (*sensu* Dalton 1971); after all, *participation* in production can be exchanged as much as physical objects. Thus, one must regard Lascaux's art as a costly venture, but in terms of its creation there are no unambiguous indications of specifically assertive signals.

Artistic fitness

Within the primitive valuable of Lascaux, knowledge, memory, artistic skill and production materials, effort and danger were being shared, i.e. exchanged. From an artistic point of view, Lascaux's art - whether its 'masterpieces' in the Hall of the Bulls and Axial Gallery or its hidden engravings - demonstrates what can still be said to be the zenith of Palaeolithic artistic skills. Produced in short, intensive bursts by talented artists (Bahn 1998, 124), it is an obvious demonstration of artistic fitness. We must remember that artists were recalling what they knew and committing it to stone, yet most images display a remarkable degree of detail about the anatomical features and likenesses, behaviours and observations of animals in their prime (Aujoulat 2005), often displaying tricks to accentuate perspective, exaggeration of specific features to improve likenesses (Sieveking 1979, 118-9), and both twisted and true perspective with great skill (Aujoulat 2005). The artists who worked in the Hall of the Bulls and Axial Gallery worked to a highly planned organisational scheme, conceiving of friezes as collective wholes rather than individual animals. That these seem to have been accumulated in repeated phases (horse first, followed by aurochsen, then stags: see Table 1) reflecting a chronology of rutting suggests that this planning was extended over time, rather than simply as a visual scheme. Organisational schemes abound throughout the cave, notably processions of animals, paired ('confronting') animals and heads, a deliberate asymmetry of images to either side of decorated galleries, and conventions of depiction and placing of signs that must derive from a socially meaningful repertoire (Table 1).

In terms of the provisioning, planning, difficulty and skilled execution of Lascaux's art it is difficult to see how participation in its creation would be possible for the 'free riders' that costly signalling successfully selects against (Murray and Moore 2009). All of this must be *impossible* to fake; the very act of participation is costly and communal, and artistic skill cannot be faked. A way of seeing is evident too; the twisted perspective common to many of Lascaux's images show that the artists were depicting *what they knew*, rather than simply what they saw. They followed a knowledgeable interaction with the cave's walls, allowing the topography to dictate artistic theme and method; as a result, animals float in space, decontextualised from their landscapes[x]; they fall from cracks, swirl above the viewers heads, and emerge

from and fade into the darkness as light sources move. There is, however, variation in the artistic quality of images, at least in terms of the engravings. The lions of the Chamber of Felines, for example, are relatively simplistic. This may reflect 'works of a developing artistic hand' (Guthrie 2005, 7) although it is more likely that this reflects the difficulty of working in the constrained space and on the irregular wall in this gallery (Aujoulat 2005).

In terms of artistic fitness we may identify aspects of individual signalling that correspond to CST, although given the communal nature of Lascaux's art it is difficult to see how individuals could display competing signals to each other within the cave. Parsimoniously, its art should be seen as the product of a communal enterprise.

Theme, style, convention and social commitment

As with all cave art Lascaux displays a limited theme, although it does so spectacularly. It is, in the main, an art of large, noisy prey animals (horse, aurochsen, deer) in the cave's main chambers where human viewers could participate in the scenes, and more solitary subjects and viewers stalking quietly in the more hidden depths of the cave (lion). Herbivorous prey are depicted in gregarious herds, wearing their rutting coats and interacting aggressively, a mediation between dictated convention and active dialogue with the cave's walls, and a repetitive, seasonal celebration of creation. The 'scenes' depicted are social in nature (Guthrie 2005, 61). This much is clear, as is the evidence of individual creativity usually celebrated by Palaeolithic archaeologists, but it is rarely said of Lascaux that its art is the creation of corporate acts; everyone was 'on message' and there is no evidence of individual experiment in terms of themes, techniques and styles which deviate much from the norm. Artistic conventions including multiple (repetitive) lines of animals, opposed animals, asymmetrical organisation of friezes and a host of stylistic conventions (Table 1) were followed closely and are repeated throughout the system in pigment and with the engraved line. Superimposed upon this, the individual galleries display their own dominant (never exclusive) theme and style (Du Brul 1968. Aurochs dominate only in the outer zones; lion in the depths, horse overall and especially in the intensively decorated centre).

One is therefore presented with an overall homogeneity, superimposed upon which is variation in degree of themes, styles and interaction with the walls; as a whole it is overwhelmingly emblemic in its signalling. But can one identify any assertive signalling within these? The art is could have signalled at several levels; initial and superficial engagement with its galleries will provide a strikingly communal message, whereas close reading of the images in any gallery may provide a far more nuanced story. The faunal assemblage from Lascaux is dominated by reindeer, despite the lack of depictions of this animal in the cave's parietal art (Bouchud 1979). Over several phases, the artists therefore 'stuck to the script' of a seasonal schedule of

horse, aurochs and red deer, irrespective of what they were eating seasonally in the cave's environs (Geneste et al. 2004, 51). Accumulations of images – often part or occasionally entirely superimposed over previous images - suggests that images continued to be active symbols after they were depicted, the whole accumulation taking on complex meaning. The persistence of such rule-bound behaviour over several phases the two main clusters of which were perhaps separated by a millennium or more, suggests that strong, shared conceptual framework dictated the art (Clottes 2008). There seems little evidence of individual experimentation.

We will never know how many participants celebrated the art in Lascaux – i.e. quantify its audience - but there are indications that the painted art in the larger chambers was meant to be seen, and not just by its creators. The 'swirling' effect of the frieze of the Hall of the Bulls, the asymmetrical organisation here and elsewhere in the cave suggest so, as does especially the case of anamorphosis in the Axial Gallery, where the elevated 'red cow' would appear distorted in the artist's view (i.e. alongside it), whereas from the viewer's perspective lower down it appears natural (Aujoulat 1985; cf. Surre 1992. Aujoulat 1992). These areas suggest 'a community of gazes' (Geneste et al. 2004, 74) – a sharing of signal from artist to other/s – whereas, by contrast, the engravings in the cave's central and rear areas appear far more 'private'. There were, therefore, 'public' and 'private' ways of engaging with the cave, which is perhaps not surprising; as Sosis (2003) noted, in addition to communal activities, religious groups usually require individuals to perform private, unobserved rituals. These cannot be faked, although by their very nature are inconsistent with the predictions of CST.

The cave's non-figurative signs, usually associated with animal depictions, form part of an Early Magdalenian system represented at other sites to the south and north (Leroi-Gourhan 1958). As noted by Leroi-Gourhan (1979a) Lascaux's signs were based on an accumulation of linear marks which can be linked into an increasingly elaborate series from the simple (e.g. paired lines, 'hooked' lines) to complex (stacked double divergent lines and asteriforms). Note the two examples of the latter on Figure 3 (numbers 7 & 8); one is 'complete' (with six lines) the other missing one line. This is essentially a system of fragmentation and accumulation, whereby individual elements of the signs are added and subtracted to form the signs themselves. It is tempting to link this to the fission-fusion of the hunter-gatherer groups who created the art, although this of course remains speculative, although it is justifiable to view these as communal signals.

Petrognani and Sauvet (2012) undertook a statistical analysis of the horse depictions in Lascaux and Gabillou caves, showing that each cave possessed its own, unique way of depicting heads, legs and hoofs. 'Lascaux style' horses portray fetlocks in profile but rounded hoofs viewed from the bottom, i.e. like a hoof print. 'Gabillou style' horses, by contrast lack hooves, their legs terminating in a point. In each cave, however, small numbers of examples exist of the other, in addition to the two caves other thematic and

stylistic similarities, which they interpret as evidence that artists working in each of the caves shared a degree of information, and that these functioned as symbols for distinct individuals or social groups. If this was the case, it reveals that the accumulation of these panels was a joint undertaking either between several individuals, one 'school' of which was dominant in each cave, or between two or more social groups. Either way, it could represent a degree of assertive style embedded in an otherwise emblemic act.

Viewing the nature of the figurative palimpsests and non-figurative signs together, the art takes on an episodic, rule bound, accumulative and perhaps agglutinative nature, through which assertive signals could be embedded in the emblemic whole. Principles of fission-fusion and the annual calendar of rutting may have given this meaning. Despite this, the overwhelming picture is once again communal.

Order, repetition, redundancy and stacking.

The importance of the expression of natural order in rituals has been discussed above, and provides considerable rationale for group signals. Order is observable at several levels in Lascaux's art. It governs the composition of friezes and their (a)symmetry to either side of the viewer; what animals are dominant where, how they interact or are spatially associated, in what style or state of completeness they are depicted, and whether they 'follow' or 'confront' other individuals. One assumes that such an order dictated the creation and positioning of the non-figurative signs, even if that is lost to us. The repetition of these themes in other caves indicates that this order was widespread in the Magdalenian landscape.

Repetition was a major way of expressing order in Palaeolithic art. In Lascaux, where images are superimposed, it is clear that horse were depicted first, followed by aurochs, then deer (e.g. in the Hall of the Bulls; thus the sequence of depiction follows the annual sequence of rutting in all sectors of the cave (Aujoulat 2005, 262). The galleries seem to have been decorated cumulatively, the order in which this was done mirroring the advent of rutting in the landscape from season to season. Thus by adding rutting species in their respective rutting coats, the images accumulate as an agglutinative whole. In terms of overall message Lascaux's art can even be said to be *wilfully* repetitive in two ways; by the replication of individual animals (typically 3-15 horses in each 'herd' for example), and in its accumulative celebration of the seasonal rut, an annual cycle of creation. The additive process whereby repetition was practised could involve partial or complete superimposition, remarking of an existing figure, or modification of an existing figure to form part of or contribute to another.

Repeated figures that remain spatially distinct from existing ones were presented either in line (procession) where they can be said to be following others; and in opposition (a symmetrical mirror image), i.e. in confrontation, where in places, non-figurative signs separate the two antagonists.

Superimposition of images is particularly noticeable among the cave's engravings, particularly in the Apse, where in places they form a tangled mass of complete and incomplete images (Vialou 1979). While superimposition of images is found on Mid and Late Upper Palaeolithic portable art (particularly on Magdalenian engraved stone plaquettes) the fact that it was repeated so commonly in the depths of caves such as Lascaux and many others, at least in the Middle and Late Magdalenian, may prove important if we are to understand the functional differences between parietal and portable signalling. Examples of horses superimposed in procession and in opposition are shown in Figure 2. A general symmetry is maintained within this group, with six individuals facing each direction, as some horses are indicated by isolated dorsal lines, heads or forequarters, and a leg and ventral line. A 'stacking' of several complete and incomplete horses is noticeable to the right of the panel, where a smaller horse (numbered 12) presumably reflects perspective.

A more complicated form of repetition is noticeable in Figure 3. Here, horses are vertically stacked and opposed, but the vertically stacked horses (numbered 3, 4 and 12) are incomplete, whereas the human eye fills in the missing ventral and dorsal lines using these lines from other horses. Thus the belly of horse 3 becomes the dorsal line of horse 4, and the belly of horse 4 becomes the dorsal line of horse 12. The horses are therefore joined in this subtle way.

A further aspect is noticeable in Figures 2 and 3 (and found more widely in Lascaux's engravings). The engraved lines, normally confident and naturalistic, are broken, for example on Figure 2 the bellies of several horses (especially numbers 5, 10 and 12) and on Figure 3 the belly and rear leg of horse 2; the belly of horse 3/dorsal line of horse 4; the belly of horse 4/dorsal line of horse 12. Why is breaking only present on the bellies/backs, exactly the features shared by the 'stacked' horses? It also appears on the legs/hoofs of Figure 2 horse 5 and 3 horse 4. Why do the asteriform signs (Figure 3 numbers 7 and 8) appear to fill the gap between the belly of horse 4 and back of horse 12? To an extent this is reminiscent of other 'attenuations' in Lascaux's art, such as the tendency to add perspective by representing the rear legs of animals distinct from the line of their body, and the attenuated depiction of hoofs/fetlocks. Given these similarities with its stylistic traits and the effort expended in the engraving of images in Lascaux this must surely be intentional. Even if these breaks represent 'boundaries' between the contributions of individual engravers it is hard to view this as anything but communal. It may be an agglutinative signalling system, but it is difficult to see how this might function in terms of CST.

Minimally counter-intuitive content?

Other than the creation and context of the art itself there are sadly no clear indications of any 'ritual' activity in Lascaux. We will never know if the early excavations removed such traces from the cave's floor,

although as small stone circles and other features that were created to enclose 'ritual' space seem to belong a little later in the Magdalenian (Arias 2009) it is possibly anachronistic to expect these for Lascaux. It could well be that the very use of caves favoured the counter-intuitive – permeable walls linking them to other worlds, animals that fall through cracks and drip off ceilings, rituals involving cause-and-effect magic, pools of water that reflect and distort reality - all may involve a degree of minimally counter-intuitive belief. More specifically, if the 'unicorn' is truly an imaginary animal (rather than, we suggest, a poorly drawn piebald horse to which the 'horns' were added later); if the 'hooked javelins' and 'arrows' drawn within the bodies of animals truly represent 'hunting magic', or if the interaction of image and wall represents a 'veil' through which these animals are 'born' then we have clear evidence of MCIs, but none of these can be demonstrated unambiguously. One might argue that 'twisted perspective' itself represents an MCI 'variant' of an animal, but we wouldn't say that of cubist art, hence it is difficult to see this as an assertive signal. Perhaps the only possible indications of MCI content are the re-engraving and re-painting of animals so as to represent another species. We may suspect that the very act of creating some of these images – particularly those that one can only see with great difficulty – was more important than their visual effect. This might be taken for ritual too, particularly given the difficulty taken to engrave on hard stone. Some areas were repeatedly visited, even in the cave's depths, to the extent that the wall above the Shaft has taken on a polish (Geneste et al. 2004, 95). Perhaps the *sagaies* found in the Shaft were 'votive' offerings (Geneste et al., 67); but perhaps they were simply lost in the dark. Sadly, we cannot confidently use MCI as a factor in the signalling potential of Lascaux.

The art of Lascaux: group signalling or costly signalling?

Signalling is a hard-to-fake, quality-dependant behaviour that proves an individual's commitment to their society. It seems obvious that its creation is a form of sharing – an emblemic style – although our brief survey suggests that it is very difficult to isolate any specific aspects of assertive style that could be said to correspond to the predictions of CST. Either that or such aspects formed a minimal component of an overwhelmingly communal act. In terms of cost, the following aspects are pertinent.

- The material and physical provisioning necessary to explore the cave and create its art (including the provisioning of skill sets), and the effort expended doing so which at times brought some danger is best seen as a group cost.
- The deployment of multiple artistic (and technical) skill sets in the preparation of pigments (and one assumes perishable tools for the task), organisation, recall from memory and depiction of 'authentic' animals, perspective, movement and detail, all the while adhering to thematic and

stylistic conventions, may display individual fitness although above all this is best seen as a communal act.

- The long periods of time spent creating these communal panels, adhering to emblemic styles with (if anything) restricted use of assertive styles, according to strong rules about the calendar of rutting, and perhaps the contribution of specific individuals to 'units' of one image demonstrate a group commitment to the endeavour of 'decorating' Lascaux, as does the provisioning noted above and communal nature of work above head height.
- The repetitive nature of Lascaux's subject, common themes, styles and signs, suggest that its art was strongly restricted by established social norms and traditions, perhaps simplified to facilitate easy recognition and memory recall by disparate groups. It does not suggest a strong assertive component.

As with the ethnographic record - wherein examples of CST in hunting are very rare (Flaherty 2012, 23) - we have found it difficult to identify assertive signals corresponding to the predictions of CST in Lascaux's art. Such an endeavour may require a nuanced reading of the art beyond current analytical potential, but we suspect that if individual assertive signals were incorporated into its art they were swamped by an overwhelmingly communal signal.

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Captions.

Table 1. Signalling criteria and their application to cave art, with examples from Lascaux.

Signalling criterion	Relation to cave art	Examples	References
Incurs personal cost	Areas requiring artificial light show evidence of access and use.	All areas beyond the Hall of the Bulls.	Aujoulat 2005. Delluc and Delluc 1979a
	Depths of cave are penetrated	Images appear in all accessible parts of the cave, including its depths, i.e. Chamber of the Felines and the Shaft.	Aujoulat 2005, 182f.
	Areas or panels in which working is difficult show evidence of art	e.g. low height constraints of Lateral Passage. Height of images in Hall of the Bulls, Axial Gallery and Apse required assistance and/or standing on narrow ledges and *possibly* of wooden ladders', 'masts' or 'scaffolding', e.g. the dome of the Apse.	Aujoulat 2005, 138, 149, 234-41. Geneste et al. 2004, 60, 71.
		Artists would often have to work either at arm's length or about 30cm from the wall.	Geneste et al. 2004, 69.
	Unpleasant or potentially dangerous areas were decorated.	Dangerous levels of carbon dioxide in Chamber of the Felines and Shaft.	Denis et al. 2005.
	Galleries difficult to navigate or access	Lateral Passage requires stooping, in Chamber of the Felines passage is 'arduous'.	Aujoulat 2005, 37, 182. Geneste et al. 2004, 60. Delluc and Delluc 1979b.
		Chamber of the Felines is very constricted and 'barely passable'.	Aujoulat 2005, 40.
		Access to the Shaft, unless this was accessible by a second, subsequently blocked entrance; requires crawling and 5m drop.	Aujoulat 2005, 40.
	Cave needs to be provisioned with light (fuel, lamps), pigments, palettes and tools.	Multiple pigments in evidence, e.g. on the Great Bull; those used to depict the back-to-back bison were different to those used to depict the quadrangular 'blazons'.	Aujoulat 2005, 198-200. Chalmin et al. 2004a, b, 2007. Vignaud et al. 2006. Chadefaud et al. 2008.
		Source of white pigment (kaolin) >20km distant; source of one manganese pigment 250km to the south.	Couraud and Laming-Emperaire 1979. Chalmin et al. 2007.
		Carved red sandstone lamp deriving from Charente.	Delluc and Delluc 1979a.
	Depiction is labour intensive and/or difficult.	The dense engravings of the Apse required a total of hundreds of hours engraving hard stone.	Geneste et al. 2004, 93.
Demonstrates personal fitness or quality	Exploration of cave's depths.	All accessible areas of the cave were decorated irrespective of difficulty.	Aujoulat 2005.
	Demonstration of artistic skill	Various examples of naturalism, dynamism, perspective, movement (e.g. multiple heads drawn for horse in the Nave) & use of wall to accentuate animals' volume (e.g. red outline bison & red horse in the Axial Gallery; the 'Fallen stag' of the Apse); notably the 190 images in the Axial Gallery – 'an uninterrupted succession of major works of art'. Very rare example of engraved horse in frontal view in the Chamber of the Felines.	Aujoulat 2005, 90,168, 183-4.
		Use of colour to distinguish body parts, e.g. dichromatic painting (e.g. brown horses with black manes in the Hall of the Bulls; bovids red body, black anterior in the Axial Gallery);	Aujoulat 2005.

		trichromatic painting (e.g. horses in Axial Gallery). Use of natural cave wall to add detail, e.g. to surrounds of the eyes and nostrils.	
		Economical use of pigments, e.g. ochre is effective at covering surfaces, hence was used more sparingly than manganese.	Aujoulat 2005, 207.
		Observational recall/skill, e.g. the Axial Gallery's 'falling cow' (sliding on frozen surface), aggressive characteristics of the Lateral Passage's 'Bearded Horse' and Yellow Horse of the Apse. Smaller animals shown to background in scenes with perspective have less detail than those in foreground, e.g. horses below the 'Falling' Cow.	Aujoulat 2005, 114-20; 142-3, 148, 225-6.
		High skill evident in various techniques; brush painting, blowing from the mouth or through a tube in combination with 'stencils', use of pad, drawing and engraving. Preparatory drawings or engravings.	Aujoulat 2005.
		Conventions of depicting specific parts of animals is adapted to variations in the underlying support (wall), i.e. additive methods (painting, drawing) used on hard calcite surfaces, subtractive (engraving) on softer.	Aujoulat 2005, 207, 209.
		Clarity of modest sized blown horses on coarse stalactite wall in the Panel of the Falling Cow 'demanded a confident motion'.	Aujoulat 2005, 212-3.
Demonstrates commitment to social group	Dedication of time and energy	Density of engravings in the Apse & Lateral Passage which require effort to see.	Aujouat 2005, 144f, 169.
	Depiction of shared symbols.	Geometrical signs in the Axial Gallery, various signs in Apse, 'barbed signs' associated with horses in the Nave, quadrangular 'blazons' in the Apse and Nave.	
	Participation in group compositions. Repetition of images.	Evidence of individual artists at work in form of highly specific conventions, e.g. depiction of horse tails on Panel of the Falling Horse in Axial Gallery; distinction between clusters of horses on the same panel in the Nave.	Aujoulat 2005, 130, 174-5. Geneste et al. 2004, 57.
		Position of the artists – central to the figures and lacking in movement- similar for most images.	Aujoulat 2005, 207.
		Despite variation in methods of depiction all animals in single taxa groups face the same direction; in mixed taxa groups disconnected heads usually face the opposite to the complete images.	Aujoulat 2005, 242.
		Processions: horses, e.g. Hall of the Bulls (grouped by colour). Lines of antlered/horned animal heads, e.g. 'Swimming' stags of the Nave. Yellow aurochs with polls in Axial Gallery. Stags in Apse, ibex heads in Apse. Ibex in the Nave's Panel of the Seven Ibex, horses in the Nave's Panel of the Imprint and Panel of the Black Cow.	Vialou 1979, e.g. Figs. 193, 217, 218, Plate XIII. Leroi-Gourhan 1979b, e.g. Fig. 288, Plates XXIV, XXV.
		Pairs/oppositions: bulls, ibex, back-to-back bison. E.g. horses in Axial Gallery, stags in Apse. Yellow and red horse of the Apse. Lions in the Chamber of the Felines. Some oppositions involve almost perfect symmetry e.g. two confronted stags.	Aujoulat 2005, e.g. 150, 176-9. Geneste et al. 2004, 59. Vialou 1979, Fig. 229, Plate XVII. Lerio-Gourhan 1979b, Fig.

			316.
		'Signs' e.g. dots & linear forms in Hall of the Bulls; hooked 'javelins' and 'curly brackets' in Axial Gallery & elsewhere; engraved and painted quadrangular 'blazons' in Apse and Nave; 'feather like' 'barbed lines' e.g. in the Apse.	Aujoulat 2005, 99-100.
		Complete and incomplete horses follow the same conventions.	Aujoulat 2005, 211.
		Stratigraphic 'stacking' of images atop others: (e.g. several over the 'unicorn'; aurochs in Axial Gallery). Where this exists it repeats the order or horse (first), aurochs, stags. Numerous examples among the engravings of the Apse and Nave.	Aujoulat 2005, 80, 247. Vialou 1979, e.g. Plate VIII.
		Vertical stacking of images, whereby individual animals of the same or different taxa are depicted as a vertical stack, especially in the horse engravings of the Passage and Apse, and the engraved stags of the Apse's Panel of the Little Sorceror. Lions in the Chamber of the Felines.	Vialou 1979, e.g. Figs. 211, 214. Plates VI, IX, XIa, XII. Leroi-Gourhan 1979b, Figs. 316, 321.
	Repetition of techniques.	Three-stage depiction of horse heads. High levels of repetition of technique with horses of the Nave.	Aujoulat 2005, 212.
Constrained by social norms/expectations	Similarity of external topography of site to others.	Lascaux, Saint-Cirq, Bara-Bahau, Gabillou & Villars all on smoothly sloping hillsides, distinct from earlier or later sites.	Aujoulat 2005, 61.
	Thematic and/or stylistic similarities within the cave.	Thickset outline and underdeveloped limbs of horses. Rutting behaviour. Double dorsal line on horse & bovids. Bovid, horse and deer hoofs. Bovid horns in twisted perspective, & use of one simple curve and one s-curve to add perspective (Hall of the Bulls and Axial Gallery). Opposed animals/heads. Limbs to rear of viewer separate than main body of animal. Horses painted similarly (e.g. lack of eyes, M-shaped bellies, S-shaped dorsal line). Double curve of stags' lower tines. Depiction restricted to forequarters for smaller animals (e.g. horses in Axial Gallery). Incomplete shorthand depiction of ibexes both in paint and engraved. Use of parallel lines by lions' mouths in Chamber of the Felines.	Aujoulat 2005. Papers in Leroi-Gourhan and Allain (eds.) 1979.
	Thematic/stylistic/technical similarities with other caves and rockshelters.	Confronted ibex (Roc-de-Sers).	Aujoulat 2005, 59.
		'Scutiform', 'tectiform' and 'penniform' (branched line) signs in El Castillo, Chimeneas, Altamira, Las Monedas, Marsoulas, Cougnac. Geometrical signs of Placard or 'chimney' type (Le Placard, Cougnac, Pech-Merle).	Leroi-Gourhan 1958, 1979.
		Man confronting bovid (Roc-de-Sers and Villars).	Duhard and Tosello 1996. Glory and Pierret 1960.
		Ball shaped hooves[xi], separated hind legs to suggest perspective, relatively short limbs, 'flying gallop' positions and well-rounded stomachs on horses in the Sorceror's Cave at Saint-Cirq.	Pigeaud et al. 2012.
		Horses with disproportional abdomens, small heads relative to body, rounded, incompete hoofs similar to La Ségognole rockshelter (Seine-et-Marne).	Benard 2010.
		Similarities with Gabillou, in bison depictions (e.g. hooves, twisted perspective single curved horns).	Vialou 1979. Gaussen 1988. Martin 2016.

		Similar depictions in Rouffignac and Villars exclusively made with Perigord manganese.	Aujoulat 2005, 199.
	Formal organisation beyond what one might expect for depictions of 'natural' scenes.	Asymmetrical distribution of animals within the same galleries, e.g. bovines in Hall of the Bulls & Axial Gallery. Friezes of animals in Hall of the Bulls and Axial Passage: clusters in Lateral Passage and Apse. Friezes of one dominant animal opposed by single animal of different species in the Nave. Marking of the deepest chambers (Shaft and Chamber of the Felines) with three pairs of dots.	Aujoulat 2005, e.g. 162, 186.
		Oppositions: e.g. 'Confronted ibex' separated by quadrangular sign (Axial Gallery).	Aujoulat 2005.
Constituents include elements of the imaginary, supernatural or religious, i.e. Minimally Counter-Intuitive (MCI) content.	Aspects of the art shows imaginary nature.	Possibly the ambiguous 'unicorn'.	Aujoulat 2005.
		Positioning of 'Upside Down' horse appears to be used to suggest that it is falling out of a 'gaping chasm'.	Aujoulat 2005, 232.

Figure 1. Plan of Lascaux showing its main galleries. Zones shaded in light grey are easy to access; those in dark difficult. Redrawn (simplified) from Aujoulat 2005 Figure 16.

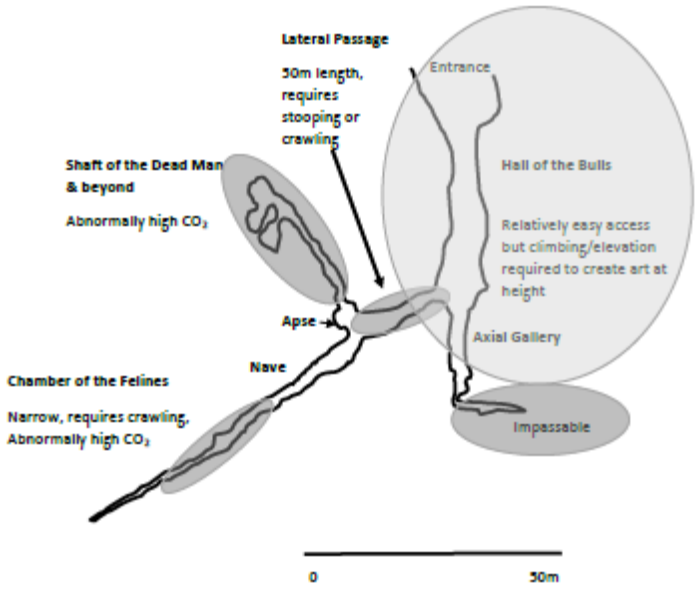
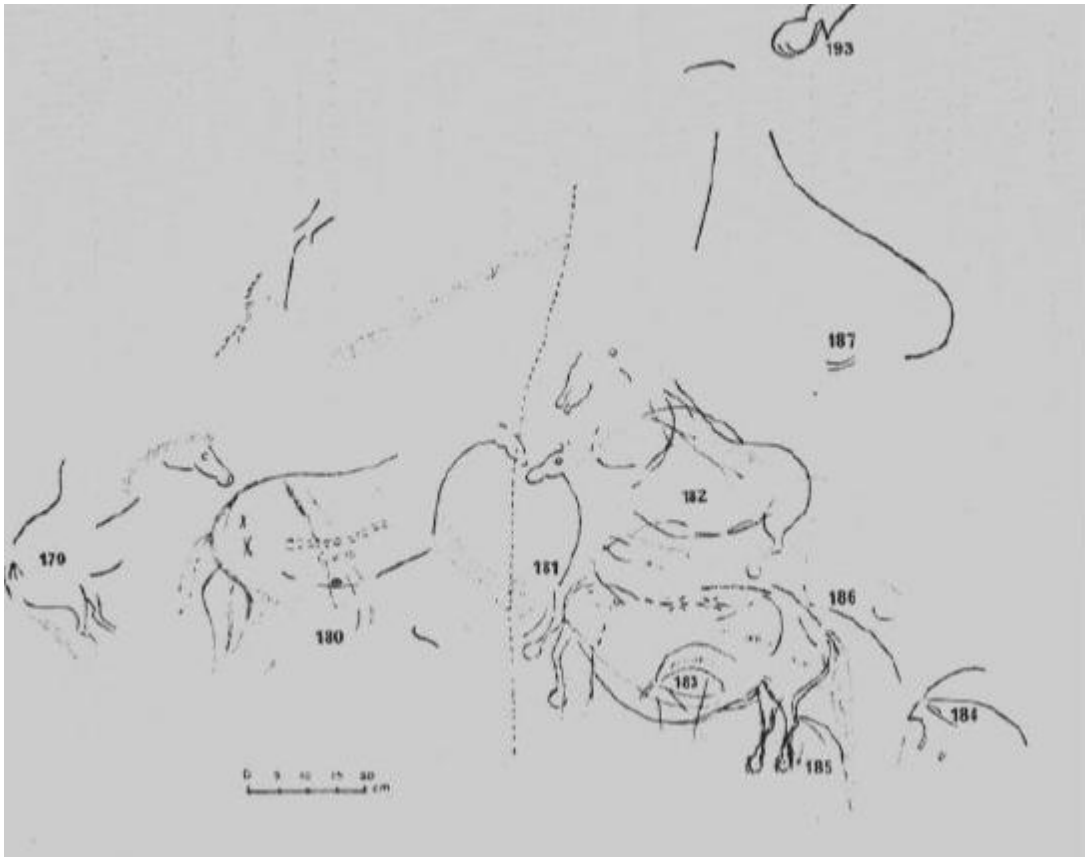


Figure 2. The Abbé Glory's drawing of the engravings of the left side of the Nave's Panel of the Black Cow, reproduced in Leroi-Gourhan 1979b Figure 299. No scale has been provided: the whole panel is over 7m in length; the section depicted around 3m. Six horses face right, seven face left; a slight asymmetry.

Figure 3. The Abbé Glory's drawing of the engraved horses and ibex of the east wall of the Axial Passage, reproduced in Vialou 1979, Figure 211. Note the X signs and paired lines on the flanks of Horse 180, and the asteriform signs on the ventral/dorsal line of Horse 181. Note also the ibex heads 183 and 184.



[i] Given the overwhelming importance of Lascaux's art it is surprising that since the advent of chronometric dating techniques half a century ago it remains to be dated at all well. As the paintings were created with mineral pigments lacking in carbon and as the cave is inaccessible due to ongoing issues of contamination and degradation of the art (e.g. Graff 2006), dating of the art itself is impossible, as is the use of U-Th dating of the numerous flowstones overlying the art, which would provide minimum ages. Numerous organic materials exist from excavations in the cave, deriving from Late Upper Palaeolithic levels that can be convincingly equated with the art. These are accessible in museum collections. Despite this, very few have been dated. Why not? We take our calibrated age ranges from the data presented by Valladas et al. (2013, Table 1), which amount to three

conventional ^{14}C measurements on charcoal and two AMS ^{14}C measurements on bone and antler samples. The former produced the younger age range. These samples comprised bulk samples measured during the infancy of the radiocarbon technique, e.g. a 'sachet des charbons' and a 'sélection de gros fragments de bois' (Glory 1964, CXV), using pretreatment methods far less successful than those of today, and one must surely view them as inaccurate. The association between the charcoal samples, stone lamps and a *sagaie* (see below) sufficed to allow Breuil (1954, 545) to assign them to the Solutrean/Early Magdalenian, but why they continue to be reported as indicative of the art's specific age is unclear (see, for example, Leroi-Gourhan and Evin 1979). Perhaps more accurate are the two accelerator measurements from which we derive our older age range, measured on a bone *sagaie* and a fragment of reindeer antler *baguette* reported by Aujoulat et al. (1998) who concluded that artistic activity in the cave spanned one or two millennia of the late Solutrean and early Magdalenian (ibid., 321). Plenty of datable flowstones have formed over the cave's art; sampling for U-Th would be minimally damaging to the stalactite itself (Hoffmann et al. 2016) and would not go near the art; it has already been used on calcite formations (gours) around water pools in the cave (Genty et al. 2011). Why not use it to improve this poor chronological picture of the art?

[ii] These studies have their critics, and it is of course dangerous to assume that all activities need reflect costly signalling to some degree (for a cautionary note see Codding and Jones 2007).

[iii] The irony has not escaped us that many archaeologists believe that there must have been a 'religious' component to Palaeolithic cave art, but as they cannot demonstrate this logically they tend to believe it emotionally.

[iv] Wiessner used these terms to distinguish between two types of *style*, in this case among Kalahari San projectile points. We have used her terms here to refer to *signal* types.

[v] It is often stressed that the fauna on Lascaux's walls is a temperate one (e.g. including aurochsen, red deer), while its faunal assemblage is dominated by reindeer (around 88%: Bouchud 1979). Traces of crushed reindeer antler have, however, been found in the pigments of several of its images (Chadefaux et al. 2008).

[vi] On the basis of the existing chronology it is possibly that the majority of images in the cave's main galleries – including the painted scenes – belong to a relatively tight period of time in the Early Magdalenian, whereas some of the images in the Shaft were created earlier, during the Solutrean, when this gallery was accessible from a second, closer entrance.

[vii] We suggest that the apparent lack of an identifiable winter among the scenes is solved by the 'back to back bison' painted close to the Black Cow in the cave's Nave, which are depicted in winter coats. Bison are otherwise rare in Lascaux.

[viii] The Shaft is often described as belonging to a lower system, but as Aujoulat has noted is not; its ceiling is the same as that of the Apse and it simply represents a continuation of the axis of that gallery, albeit with a 5m drop. Its name is unfortunately misleading.

[ix] We note, however, that like the Chamber of the Felines the Shaft possesses three pairs of dots, as if both were marking the two deepest ends of the cave (Aujoulat 2005, 186). This may support the notion that the Shaft *was* entered – with difficulty – last.

[x] This is usually the case for Palaeolithic parietal art, although a little exaggerated. In some of Lascaux's galleries, sedimentary levels on the cave walls have been used to indicate the position of a ground, and animals added accordingly. Where this 'natural ground' is lacking, in places simple lines seem to denote it.