Rimtautas Dapschauskas, and Andrew W. Kandel

Derivatives of Ritual

Investigating the Origins of Palaeolithic Art from the Perspective of an Evolutionary-Psychological Archaeology

Abstract The history of research into the origin and meaning of Palaeolithic art is long and complex. Most investigators either try to decipher the symbolic meaning of the depicted motifs or concentrate on questions about chronology, style and technique. Yet this leaves a large explanatory gap: the underlying human psychology and its evolutionary depth. At this level of analysis, art seems to be a conglomerate of psychological buildings blocks originating from ritual behavior coupled with our evolved aesthetic sense and the psychology of prestige. Especially the relationship among art and ritual seems highly relevant for understanding the origins of Palaeolithic art because this relationship manifests itself not only psychologically but also archaeologically. Here we discuss the deep evolutionary relationship among these peculiar phenomena of human behavior and relate it to the archaeological record. In doing so, we offer possible directions for a fruitful interdisciplinary cooperation between Palaeolithic Archaeology and Evolutionary Psychology – a relationship that is still surprisingly underdeveloped.

Keywords cluster concept of art, psychology of ritual, evolutionary aesthetics, psychology of prestige

Contact

Rimtautas Dapschauskas
rimtautas.dapschauskas@zaw.uni-heidelberg.de
https://orcid.org/0000-0001-6838-3923

Andrew W. Kandel
a.kandel@uni-tuebingen.de
https://orcid.org/0000-0002-9889-9418

Introduction

Looking at the more than one hundred years of research history attempting to interpret Palaeolithic art and shine light on its origins, one gets the impression that the field is trapped between two extremes. On the one hand,

Rimtautas Dapschauskas, and Andrew W. Kandel. 2025. "Derivatives of Ritual: Investigating the Origins of Palaeolithic Art from the Perspective of an Evolutionary-Psychological Archaeology." In *Images, Gestures, Voices, Lives. What Can We Learn from Palaeolithic Art?*, edited by Miriam Noël Haidle, Martin Porr, Sibylle Wolf, and Nicholas J. Conard, 147–180. ROCEEH Communications 2. Heidelberg: Heidelberg University Publishing. https://doi.org/10.17885/heiup.1453.c21860

there have been numerous efforts to develop all-encompassing theories about its function: art for art's sake, totemism, sympathetic hunting magic, fertility and sex, sanctuaries structured after an ideal blueprint, shamanism and trance, information storage for teaching and storytelling, and many others. Although there may be grains of truth in each of these approaches, they received thorough criticism no later than the next generation of researchers. All of these theories have been accused of being highly speculative, ultimately unverifiable, bending the archaeological evidence or selectively choosing ethnographic comparisons just to make them fit the respective theory (Conkey 2018; Solomon 2018; Bahn 2016, 275–336; 2010; Cruz Berrocal 2011; Francfort et al. 2001; Halverson 1987). On the other hand, not least because of this long history of controversy, there are many researchers today who try to avoid large-scale interpretative schemas altogether, as they are considered unproductive for scientific progress. These scholars prioritize chronological and technological aspects, the surrounding archaeological context, and comprehensive digital documentation. (e.g., Brady et al. 2018; Pastoors and Weniger 2011; Lorblanchet 2010; Pettitt and Pike 2007; Chalmin et al. 2003).

This situation is unfortunate for the progress of knowledge with respect to the question posed by the organizers of the 2018 International Senckenberg Conference: *What can we learn from Palaeolithic art?* We suggest that there might be a third way to approach the two intermingled problems of interpreting archaeological remains *and* investigating the evolutionary origins of art in general by adopting an evolutionary-psychological approach. This requires:

1. A shift in the level of analysis from the possible content and symbolic meaning of Palaeolithic art to the underlying psychological mechanisms;
2. An abandonment of overly relativist and constructivist positions about art in general;
3. A proper anchoring in evolutionary theory.

Furthermore, a truly interdisciplinary evolutionary-psychological archaeology of the 21st century should also integrate findings from neuroscientific research on the human brain with respect to the visual, auditory, reward, mirror neuron, and memory systems (Janik and Kaner 2018; Smedt and Cruz 2010; Watson 2009). After all, the field of *Neuroaesthetics* has developed rapidly in recent years (Demarin et al. 2016; Kapoula and Vernet 2016; Pearce et al. 2016; Huston et al. 2015; Lauring 2014; Chatterjee and Vartanian 2014; Zeki 1999). Neuroscientist Anjan Chatterjee (2014, xi–xii) put it nicely when he said that Neuroscience tells us the "how" of aesthetics, and Evolutionary Psychology the "why". We would like to add that Archaeology tells us the "where" and "when" – and even sheds light on important evolutionary precursors. While we agree that neuroscientific findings need to be incorporated into a comprehensive understanding of the evolution of art, we would like to defer this level of description due to the enormous complexity of such an enterprise. Likewise, we cannot offer a full-fledged model about the origins of art on a higher level of abstraction. Rather, the goal of this contribution is to sketch out theoretical starting points and potential directions for interdisciplinary cooperation between Archaeology and Evolutionary Psychology while focusing on the relationship between art and ritual.

Defining Art

Starting Problems

To investigate a phenomenon from an evolutionary perspective, it must first be defined and distinguished from other phenomena. Establishing a comprehensive and universally valid definition of art is a notoriously difficult undertaking and loaded with a long and complex history of thought (Adajian 2018; Davies 2013; Chatterjee 2014; Carroll 2000). Influenced by Wittgenstein's (1953) philosophy and the cultural relativism particularly prevalent in US-American Cultural Anthropology (e.g. Boas 1927; Mead 1928; Benedict 1934) and accompanied by the erroneous psychological theory of the human mind as a blank slate (Pinker 2002), many scholars in the second half of the 20th century have declared every attempt for a universal definition of art to be unproductive, if not outright impossible (e.g. Weitz 1956; Geertz 1976; Novitz 1998; Weiner 1998). The concept of art is seen essentially as a construct of Western civilization because, it is argued, other languages and cultures do not have an equivalent term or the same abstract conceptualization. But as Morales (2005) and Dutton (2000) have pointed out, a lack of a special word for art in a certain language or a lack of an abstract concept of art in a particular culture does not equate with a lack of art as a distinct behavioral pattern (and its material results). The boundaries of a particular dictionary are not identical to the boundaries of cognition, emotion and behavior of the respective speaker (Pinker 2007).

Some archaeologists raised and trained in the second half of the 20th century were heavily influenced by these intellectual currents. This led them to the position that it is better to avoid the term 'art' for prehistory altogether (Conkey 2009, 182; Gendron 2007, 262; Lewis-Williams 2005, 386; White 1992, 539; Davidson and Noble 1989, 128: fn. 2). Instead, they used substitute terms such as "image making", "graphic behavior", "rock marking", "material/visual representation", "decoration", "figurative depiction", among others. However, it is questionable whether these terms serve archaeological investigations about this peculiar human behavior and the pursuit of knowledge about its evolutionary origins better than the term 'art'. This tactic rather shifts the problem of defining terms to other words. Perhaps a better strategy could be to use the word 'art' as a catch-all term for the decoration and aesthetic manipulation of different materials whatever its motivation or function (Bahn 2016, vii; Whitley 2011, 23–24). This may indeed be more practical for the everyday work of archaeologists as they catalog artifacts and features. Yet such a strategy is not helpful for understanding the evolutionary origins of this phenomenon. Without a conceptual definition (even if only preliminary), we cannot know what kinds of behavior (and underlying mental mechanisms) require an evolutionary explanation.

How do we get to a useful working definition for pursuing scientific research? First, to establish a definition for art, it is important to distinguish between the constantly shifting meaning of the word 'art' in the English language (or *Kunst* in German) and universal behavioral phenomena (Moravcsik 1991). The former is a subject for linguists and philosophers of language, while the latter is observable in most societies and social strata and can be studied empirically.

Second, evolutionary explanations should not use European fine arts, modern art or contemporary postmodern art as starting points. These are historically conditioned categories used by a fairly circumscribed social elite in specific socio-cultural contexts.

Such categories can hardly be transferred to other times and cultures (Junker 2013, 14–15). Relativist and constructivist views consider either everything as art, as long as it is seen as such by any person or group. Or, conversely, nothing can be called art if it is deemed 'non-Western'. In contrast, the naturalistic-evolutionary view assumes that art, like language or tool use, is a universal and delimitable pattern of behavior grounded in our evolved psychology (Dissanayake 2013; Dutton 2013). An evolutionary explanation must therefore take a bottom-up approach that can be applied across cultures (and subcultures), to most contemporary, historical and prehistoric manifestations including the ornamentation and ritualization of other species. From this perspective, the fine, modern, and postmodern arts represent very recent and locally confined instantiations of a much broader phenomenon (Miller 2000, 265–267; Dutton 2009, 4).

Third, such a bottom-up approach does not allow for sharp boundaries between art and other aesthetic activities such as the embellishment of human bodies, clothing and tools. Evolution occurs through gradual transitions and not miraculous leaps, although some transitions were faster and more consequential than others (Dennett 2017). Thus, transitional phenomena that are difficult to categorize should be expected. For example, because the transition from design to art is gradual, it is difficult to define a specific point when this happens, as is the case with the development of symmetrical and colorful handaxes. In general, it can be said that in design the functionality of an artifact predominates, whereas in art the free play with shapes and materials is paramount (Schmidt-Salomon 2014, 193).

Fourth, a useful working definition should not be based on rare outliers. The philosopher Denis Dutton (2009, 47–51) criticized that contemporary art theory has maneuvered itself into a dead end, not only in focusing on modern and postmodern art, but on its extreme fringes (e.g., Ready-mades, Dada). Theory building was therefore not properly oriented towards the central characteristics of a worldwide phenomenon. A naturalistic-evolutionary approach should consider art as a field of activities (including the associated experiences and material objects) which occur *commonly* in human life across cultures and times, without the explicit help of academically trained art theorists or art museums. The same strategy can be suggested for *defining* Palaeolithic art: controversial phenomena such as quasi-geometric engravings on ochre pieces, notched bones, pecked pebbles or isolated cupules on a rock should not be the starting point. Rather, the basis should be undisputed core phenomena such as the thousands of known figurative cave paintings and statuettes of the Upper Palaeolithic. From this solid ground, the less clear manifestations that necessarily appear within the soft transitions between categories can then be investigated.

Based on these conditions, a number of useful efforts have been made in recent years to define and understand art from an evolutionary perspective with somewhat different strategies. Although no real conceptual consensus exists yet, there seems to be a degree of overlap among them, because they operate under the broad umbrella of Darwin's theory of evolution by natural and sexual selection. The different hypotheses can be used as starting points for further theory building and empirical testing. Moreover, there are also different views on whether artistic creation is an adaptation directly shaped by natural (Dissanayake 1992) and/or sexual selection (Miller 2000), a by-product of other adaptations (Hodgson and Verpooten 2015; Pinker 2002), a meta-phenomenon of genetic and cultural drift (Chatterjee 2014), or a mixture of these views (Dutton 2009). Regardless

of what holds true, the evolutionary perspective indicates that art is a cross-cultural, universal behavioral phenomenon deeply rooted in our evolved psychology.

Cluster Criteria

To help us understand a complex phenomenon scientifically, we can use the strategy of disaggregating its elements into separate building blocks. With the ongoing progress of scientific research, we are then able to adjust the details and may discover important elements that are now invisible to us. But how do we break down such a complex and heterogeneous phenomenon like art with its soft boundaries into individual parts? Some philosophers suggest the use of cluster criteria where a conceptual category is not defined by a core essence but rather by a list of properties that are connected through a web of family resemblances (Longworth and Scarantino 2010; Dutton 2009; Gaut 2005; 2000). This means, for a phenomenon to belong to a conceptual category, all properties on the list do not have to apply simultaneously, nor does one of the properties represent a necessary condition. Some manifestations will meet all criteria; others only part of it. Some will share numerous properties with each other; others will overlap only slightly. If one creates such a list for the category of art, then it is not necessary for every work of art or artistic performance to satisfy *all* criteria – but only *some* of them. The rule of thumb is, the more criteria are met, the more a real-world phenomenon belongs to this conceptual category. This allows for a flexible terminological umbrella with soft transitions at the periphery. Conversely, individual criteria on the list do not belong exclusively to the defined conceptual category. They are typically situated on a continuum with non-artistic patterns of behavior. In this way, a useful guideline is created on the basis of which difficult marginal phenomena can be discussed on a case-by-case basis. The obvious disadvantage of this approach is that there will be many examples for which no final decision can be made as to whether they belong to the category or not.

A frequently cited and well thought through proposal for a cluster concept of art comes from Denis Dutton (2009, 52–59). He assembled the following 12 criteria:

1. Direct pleasure: Art is enjoyed for its own sake, not for practical purposes.
2. Skill and virtuosity: Art requires and showcases special talents and abilities.
3. Style: Art follows rules of form and composition, allowing for both recognition and innovation.
4. Novelty and creativity: Art is valued for its originality and ability to surprise.
5. Criticism: Art is evaluated by audiences through a range of critical judgments.
6. Representation: Art symbolically represents human experiences and emotions.
7. Special focus: Art creates an intense focus of experience which is often separated in time and/or space from mundane activities of everyday life.
8. Expressive individuality: Art allows for individual expression and recognition of outstanding artists.
9. Emotional saturation: Art elicits emotions through content and form.
10. Intellectual challenge: Art engages multiple intellectual capacities.
11. Art traditions and institutions: Art is embedded in historical and cultural contexts.
12. Imaginative experience: Art creates and explores imaginative worlds and ideas.

Finding the Core

Other evolutionary attempts to tackle the conceptualization problem follow a different path. They try to uncover a specific behavioral core grounded in the deeper universals of mental structure which underlies artistic creation across cultures. This entails searching for the essence of art which the cluster concept tried to avoid. The core is seen either as an adaptation shaped by natural and sexual selection or as a side effect thereof. Such approaches conceptualize art primarily on the basis of action and perception, not so much in terms of its material outcome. The identification of such a behavioral core is not intended to explain all aspects of artistic creation and the vast variety of cultural expressions. The goal is to narrow down those aspects which might have a biological origin. The disadvantage here is that *definitions* of art slip into evolutionary *explanations* for art. This is conceptually imprecise, but difficult to avoid when searching for an evolutionary core (Chatterjee 2014, 171).

Ellen Dissanayake can be considered a true pioneer in this particular field of enquiry (Dissanayake 2018; 1992; cf. Chatterjee 2014, 166; Miller 2000, 259). In her extensive work she developed the concept of "making special" as *the core element* of art, which she believes has originated from ritualized behavior during human evolution. In her account, people of all cultures sometimes turn everyday things (e.g., objects, materials, movements, words, sounds and ideas) into something special. Every artform, regardless of its genre or its cultural or historical context, always surpasses what is common and mundane. This "making special" is achieved by changing color, shape or sound, by repetition, exaggeration, patterning, formalization, dynamic variation or surprise. These techniques are designed to be highly attention-grabbing for human perception. The artist elevates the mundane to express emotions, feelings and thoughts that are difficult to articulate abstractly in normal language. Dissanayake argues that simple preforms of this "making special" are already recognizable in early mother-infant interactions as well as in the ritualized behavior of many other species, thus pointing to a biological origin. In her account, art is adaptive because it fundamentally serves as a social glue holding cultural groups together – just like collective rituals do from which art originated. In fact, Dissanayake's distinction between art and ritual blurs because she sees "making special" as the behavioral core of both.

Recently Henrik Høgh-Olesen (2019) proposed that the core of art is a universal *aesthetic impulse*, which is based on the *Optimal Stimulation Level Theory* of cognitive motivation. According to this theory, humans and animals seek a species-specific ideal balance between change and stability, novelty and familiarity. Humans have a significantly higher optimal stimulation level than other species, which could explain our perpetual engagement in aesthetic activities. However, aesthetic actions are not solely a response to restlessness and boredom but are also associated with beauty, pleasure, and surprise. Thus, the *aesthetic impulse* is accompanied by a corresponding *aesthetic sense* – the ability to appreciate and enjoy works created by the aesthetic impulse. How and why the aesthetic sense evolved is a subject for evolutionary aesthetics.

Evolutionary Aesthetics

Evolutionary aesthetics conceptualizes the aesthetic sense as a bundle of universal preferences for particular properties of natural environments, bodies, faces, sounds, vocalizations, colors, materials, artifacts and social relationships (Voland and Grammer 2003). Their cross-cultural universality points to a shared evolutionary origin which is empirically investigated through a plethora of controlled experiments and survey measures. This type of empirical data represents an important line of evidence which challenges the long-held view that our aesthetic preferences only reflect arbitrary standards of beauty set by socialization (e.g., Mehr et al. 2019; Falk and Balling 2010; Little et al. 2007). A second line of evidence pointing in the same direction comes from experiments with newborn infants, toddlers and pre-school children to determine universal innate predispositions which are subsequently molded by developmental factors (e.g., Thompson and Goldstein 2019; Franklin et al. 2008; Schellenberg and Trehub 1996). A third important empirical basis for the evolutionary perspective is cross-species comparison, especially with regards to other primates (Saito et al. 2014; Snowdon and Teie 2010; Westergaard and Suomi 1997).

Although summarized under one terminological umbrella as *the* aesthetic sense, many of the aesthetic preferences will have their own evolutionary history, shaped by processes of natural and sexual selection as well as culture-gene-coevolution during different periods in the Pliocene and Pleistocene. Overall, these preferences, it is argued, helped our hominin ancestors determine which things in their environment had properties to potentially enhance fitness. The aesthetic sense not only includes the perception of such properties connected to corresponding positive emotions, but also their active advertisement to potential cooperation and, especially, mating partners. Undoubtedly, Darwin's second great discovery, sexual selection, will have played a prominent role in the evolutionary origins of art. Sexual selection may be the evolutionary root of those elements of art which are lavish, flamboyant, costly and attention-grabbing (Dutton 2009, 151–157; 2000, 258–291).

Pinker (2002, 405; 1997, 524–545) argued that some aspects of art developed through cultural evolution into pure pleasure technologies – completely decoupled from their original evolutionary benefit. Sound, image, olfactory and tactile patterns are used to artificially trigger our inner reward systems which originally evolved in response to problems unrelated to art. From this perspective, art functions like drugs, erotica or fine cuisine, as a method of concentrating and intensifying pleasurable stimuli in a highly dosed form just for pleasure's sake. A number of authors additionally pointed out that in the context of cultural evolution forms of art can emerge which not only have no direct evolutionary advantage for the biological organism but can even be maladaptive to some degree – until they are countered by the much slower operating mechanism of natural selection (Hodgson and Verpooten 2015; Chatterjee 2014).

Evolutionary Aesthetics is now an established branch of Evolutionary Psychology, but collaboration with Palaeolithic Archaeology remains underdeveloped. However, if we want to ground our understanding of the evolution of art on as broad an empirical database as possible, we cannot rely solely on experiments and survey measures with contemporary humans or primatological comparisons. The oldest material remains should also be integrated into our considerations, because they represent the only

tangible evidence of how, when and where this evolution *actually* took place. The first promising attempts at integrating archaeology into this field of enquiry include the emergence and development of aesthetics in early tool technology (Hodgson 2019; Wynn and Berlant 2019; Mithen 2003), the underlying color psychology in early pigment use (Dapschauskas et al. 2022), the possible impact of sexual selection on rock art aesthetics (Varella et al. 2011) and the evolution of decoration with respect to saliency, memorability, reproducibility and expressiveness in style (Tylén et al. 2020).

Art as a Special Mode of Communication

Evolutionary Aesthetics is mainly concerned with the deeper, pre-symbolic, culturally invariant, phenomenal core properties of art. But on top of the sensory level there almost always exists an additional symbolic or meta-cognitive layer in which the actual meaning is embedded. A number of scholars proposed converging hypotheses about the possible evolutionary function of this meta-level: communicating content and meaning that is difficult to express in words. We are an ultra-social species with a highly developed *theory of mind* that is deeply interested in the inner life of others (Wellman 2014; Keysers 2011; Hrdy 2009). Because art opens a window into another mind and its thoughts, emotions and personality, it can generate intense interest, enjoyment, entertainment and excitement, and thus generate strong emotional reactions (Dutton 2009, 235). Chatterjee (2014, 182) hypothesized that one of the reasons why art is able to express emotional content that is hard to convey in words is that it often weaves several different emotions simultaneously into nuanced and complex compositions. Junker (2013) sees art even as a special kind of language with which a person is able to communicate emotional and motivational content not only difficult but also dangerous to express verbally and directly, such as secret wishes, desires and fears. Thus, he argues, art made it possible to practice dealing with social conflicts in a playful way without immediately endangering the social fabric, as well as to store and pass on this important information to others in the group. Aesthetic forms (rhythm, rhyme, symmetry, colors, etc.) support the transmission and memorization of this kind of unarticulated knowledge. This take on art is closely related to the psychoanalytic perspective of Peterson (2017). He sees art as the mediator between the known and the unknown – a psychological technique of exploration of potentially dangerous but also rewarding things in the natural and social world we do not (yet) understand in a fully articulated manner. This includes how people act – and more importantly – how they should and shouldn't act. Art emerged in the form of images, rituals, mythological stories and music because for the longest time during our evolution we were not able to describe such knowledge abstractly – and even today are only partially able to do so. What draws us to works of art are not just sensory experiences but their deep emotional and symbolic content. German philosopher Michael Schmidt-Salomon (2006, 44) summarized this point in a nutshell: art makes the meaning of life sensuously tangible. For Schmidt-Salomon art is not only a powerful instrument of social communication but also of social change. Through the use of deeply anchored emotions, the conveyed messages are loaded with an additional powerful force for changing the inner states of others (Schmidt-Salomon 2014, 194–195). This is the reason, he argues, why art is not only concerned with the beautiful, pleasurable and appealing,

but also the ugly, unpleasant, dangerous, painful and terrifying. With art, people are able to communicate the full range of their desires, experiences, norms, conflicts and worldviews with sweeping emotional power. Because of this emotional power, many societies use art for ideological purposes and often restrict it by censorship. Conversely, works of art are capable of challenging existing norms and perceptions of the world, pointing out contradictions, confronting the existing circumstances with alternative solutions, anticipating the not-yet-possible, thus becoming a major engine of cultural evolution.

Prestige

This digression has already made it clear that art is not a one-dimensional phenomenon. It concerns sensory perception, emotion, cognition, action and symbolism simultaneously. But there is more. Pinker (2002, 400–420; 1997, 521–524) pointed out that one of the reasons why art is so difficult to define may be that it is not only related to aesthetics and emotional communication but also to the *psychology of prestige*. This brings with it an additional dynamic of a constant urge for distinction and the desire to redefine conceptual boundaries.

Sociologists like Thorstein Veblen (1899) and Pierre Bourdieu (1996) have elaborated on the expensive uselessness of art, which makes it best suited to emphasize the merits and high social status of the artist or the owner of the artwork. Art is used for conspicuous consumption, conspicuous leisure, conspicuous waste (Dutton 2009, 154–163). Status symbols are usually made of rare and expensive materials with high craftsmanship or they are displayed in wasteful contexts. We should expect that in prehistoric hunter gatherer societies expensiveness was not measured in terms of monetary value, but with rarity, high procurement and production efforts, personal skill, virtuosity, special/secret ritual knowledge, and so on.

The psychology of prestige emerged in our lineage as consequence of cumulative cultural evolution (Henrich 2016, 117–139) and is tightly intertwined with costly signaling – a central building block of ritual and art (see below). However, it may be possible to trace the emergence of the psychology of prestige independently from Palaeolithic art in the archeological record, albeit only indirectly. Henrich (2016, 288) argues, that with the occurrence of particularly rich Acheulian sites such as Gesher Benot Ya'aqov (Israel), material culture became so complex and demanding, that it cannot be explained without cumulative cultural evolution that was already based partially on prestige-biased imitation (see also Paige and Perreault 2024). Hence one could argue that a distinct psychology of prestige already emerged in archaic hominins of the Acheulian long before the emergence of Upper Palaeolithic art.

The Relationship between Art and Ritual

The central focus of our paper is the close relationship between the evolution of both art and ritual. We would argue that this is deducible not only from a historical and psychological but also from an archaeological perspective. However, we are not the first to point out a deep evolutionary connection between these two phenomena (Brown and Dissanayake 2018; Dissanayake 2018; 2013; 1992, 43–52; Hodgson and

Verpooten 2015; Rappaport 1999, 384–385; McConachie 2011). What we add to these excellent studies is an archaeological perspective, while proposing possibilities about how material remains of the Palaeolithic might be integrated into a broader evolutionary-psychological framework.

There is no agreement between scholars on whether the arts evolved as a by-product of ritualized behavior, or whether art and ritual can be traced to a common origin – the aforementioned behavioral core (e.g., "making special", the "aesthetic impulse"). The latter possibility would make a conceptual distinction between art and ritual very difficult for the Palaeolithic. In some ways, we think that both positions are correct. On the one hand, art and ritual share several psychological building blocks which might represent aspects of their common evolutionary origin. On the other hand, if we adopt a cluster concept of art, we see that the archaeological and primatological evidence show that ritualized behavior is significantly older than the parietal and portable art of the Upper Palaeolithic.

Historical Observations

First, it should be pointed out that from a historical standpoint an explicit behavioral separation between art and ritual is a relatively recent development. One of the founders of the *Performance Studies*, Richard Schechner (1974), speculated about the origins of modern theater from collective ritual on the basis of his observations in the highlands of New Guinea. He argued, that during the Renaissance, a transition from ritual-centered to entertainment-centered cultural practices began, giving birth to modern theater. In general, the Renaissance was a critical precondition for the emergence of modernity, in which the power of religion and the priesthood began to shrink in Europe (Roeck 2017, 23). But as its name suggests, the first flowering of naturalism can be found in ancient Greek civilization, without which the Renaissance would be unthinkable. For this reason, the beginning of the philosophical and social process through which art emerged as a separate category independent from the sphere of ritual and religious mythology must be sought in the historical context of ancient Greece (Dutton 2009, 31–36, 66; Tanner 2006; Tatarkiewicz 1979). Some parallel processes may be observed in high cultures of Asia, such as the development of the largely secular theater forms *Nō*, *Kyōgen* and *Kabuki* in medieval Japan, whose roots also lie in more ancient rituals (Pinnington 2019; Salz 2016). Whether ancient Greece, Renaissance Europe or medieval Japan, these historical developments are extremely recent phenomena compared to the evolutionary periods of interest here – not to mention movements like *l'art pour l'art* in 19th century France. A similar historical analysis could be made for music and dance (Brown and Dissanayake 2018; Kowalzig 2007) or competitive sports (Decker 2012). From a historical viewpoint, they are all derivatives of ritual.

Anthropological Observations

Since the mid-20th century, the cultural anthropology of art repeatedly emphasized that the sharp distinctions between the 'sacred' and the 'profane' or the 'natural'and the 'supernatural' make little sense when investigating non-European art, since many

traditional societies do not consider such conceptual distinctions (Otten 1971). On the other hand, anthropologists have also criticized that individual art objects from traditional societies exhibited in Western museums would in themselves make little sense to a local viewer because they are torn from their context – one that is almost always ritualistic in nature (Förster 2006, 229–230). As Dissanayake (1992, 48) notes, ritual and art share many similarities and are virtually always linked together in practice. Understanding ritual is critical to understanding art.

Brown and Dissanayake (2018) later pointed out the striking similarity in scale and scope between the complex conglomerates of arts employed during ceremonial rituals in indigenous cultures and what modern aesthetic philosophers later would call "total works of art" or *Gesamtkunstwerk*, a performance spectacle that synthesizes multiple artforms into a unified work (Smith 2007). The authors propose a thought experiment. If all the arts used in traditional ceremonial rituals, such as music, dance, visual ornamentation, chemical arts, special language, role-playing, etc., were removed piece by piece, there would soon be nothing left. Moreover, ritual makers and participants exploit the same aesthetic preferences and (dis)inclinations of our evolved psychology to attract attention and evoke certain emotions as artists do (Dissanayake 2018). In view of these similarities, Brown and Dissanayake argue for a co-evolution of ritual and the arts, whereby ritual is regarded as the older phenomenon.

Taking the historical and the ethnographic perspective together, we see that a full separation of individual artforms from an original ritual context seems to be a relatively rare and late phenomenon which first occurred in some complex and structured sedentary societies with a highly organized division of labor and where naturalistic intellectual currents could develop (e.g., ancient Greece, medieval Japan). Even in today's Western societies some artforms like rock concerts, raves, pilgrimages to famous exhibitions and cultural sites, or attending a theater performance are still almost indistinguishable from collective rituals. For these historical and anthropological reasons, it seems plausible to assume that a significant part of the material remains that we address as Palaeolithic art were, too, deeply embedded in ritual in one way or another, and on a meta-level probably also in the symbolic-mythological context that was associated with the ritual action. In the absence of written sources, however, the concrete symbolic messages on the meta-level remain largely unknown to us. Nevertheless, the recognition of a coherent notation system (Dutkiewicz et al. 2018; Petzinger 2016) or a careful deduction of the "symbolic ecology" derived from anthropological, psychological and zoobiological comparative data is not impossible (cf. Hussain and Floss 2015).

Shared Psychological Building Blocks

Over the last 25 years, the rapidly growing field of *Cognitive Science of Religion* – an amalgamation of anthropology, evolutionary biology and psychology committed to a naturalistic study of religion and ritual (Slone and McCorkle 2019; Martin and Wiebe 2017) – has managed to successfully break down the phenomenon of ritual into its individual psychologically active components. Researchers investigate these parts intensively using quantitative methods in the laboratory and the field (Hobson et al. 2018; Legare and Watson-Jones 2016; Whitehouse and Lanman 2014; Whitehouse

2013). Ritual is seen as a "psychologically prepared and culturally inherited behavioural hallmark of our species" (Legare and Nielsen 2020, 1) which exploits various aspects of our evolved psychology. Accompanied with insights from primatology and the archaeological record of the African Middle Stone Age (MSA), especially with respect to early pigment use, we are now able to paint a coarse picture of early ritual evolution (Dapschauskas et al. 2022).

If we compare the different psychological building blocks of ritual with Dutton's cluster criteria for art, we are able to recognize a significant number of derived elements (Tab. 1).

Tab. 1 | Shared elements of ritual and art (number of Dutton's properties in parentheses)

properties of ritual (after Dapschauskas 2023)	derived properties of art (after Dutton 2009)
goal demotion, causal opaqueness	direct pleasure (1)
costly signaling	skill and virtuosity (2), novelty and creativity (4), expressive individuality (8)
framing	special focus (7)
sensory pageantry	emotional saturation (9)
symbolism	representation (6), intellectual challenge (10), imaginative experience (12)
repetition, formality, rule-boundedness	style and art traditions (3, 11)
performance	criticism (5)

Goal demotion, causal opaqueness

A central component of art stressed by many scholars is its fundamental non-utilitarian nature (Dutton's criterion (1) "direct pleasure"). Interestingly enough, even if art theories in the Humanities and Evolutionary Psychology can hardly be reconciled in terms of the definition of their object of investigation, most disputants seem to agree that a central characteristic of art lies in its independence from immediate basic needs and pragmatic considerations (Junker 2013, 45–47; Dutton 2009, 52; Pinker 1997, 521; Bourdieu 1996, 285; Adorno 1970, 27–28). This building block of art is closely related to central properties of ritual action, namely 'goal demotion' and 'causal opaqueness' – technical terms used in Cognitive Science of Religion to describe that "rituals either lack overt instrumental purpose, or their constitutive actions themselves are not immediately causally linked to the stated goal of ritual." (Hobson et al. 2018, 261). The correct execution of the action sequence is prioritized over the achievement of a physical outcome (Nielsen et al. 2018, 343). Thus, an external observer "cannot link what the actor does with what his or her intentions might be. Instead of being guided and structured by the intentions of actors, ritualized action is constituted and structured by prescription, not just in the sense that people follow rules, but in the much deeper sense that a reclassification takes place so that only following the rules counts as action." (Humphrey and Laidlaw 1994, 106). Despite this lack of instrumental purpose, ritualized actions are almost always imitated exactly by other group members. They exploit our evolved proclivity for overimitation – that is, copying causally irrelevant

actions from others despite the presence of clear causal information and implicit interpretation of such actions as highly normative since early childhood (Nielsen et al. 2018; Keupp et al. 2013; Nielsen and Tomaselli 2010). This central property of ritual fosters the transmission of cultural norms, symbols and shared fictions (Schjoedt et al. 2013; Rossano 2012).

Costly signaling

Dutton's criteria (2) "skill and virtuosity", (4) "novelty and creativity" and (8) "expressive individuality" represent costly signaling in various forms: large amounts of resources, time, effort and talent are invested into a non-utilitarian activity. The lavishness not only elevates artistic expressions above everyday life (Dissanayake's "making special"), but also demonstrates the availability of surplus resources for those who can spend their time creating, collecting and enjoying art. The artist or the collector demonstrates effectively that they obviously do not need those resources, energy or time for survival concerns. This is tightly linked to our evolved psychology of prestige.

Furthermore, skill, virtuosity, creativity, intellectual capacity and expressive individuality are difficult to fake with a cheap trick. Thus, they become honest signals of the true genetic and social quality of the signalers as well as their commitment to the task (Miller 2000, 296–299). As many researchers have noted and further investigated quantitatively, most rituals are also very costly for the participants in one way or another, because they may involve a great quantity of material resources, time, repetition, physical and intellectual effort, risk taking, physical suffering and other personal sacrifices. Although the nature and severity of ritual costliness varies highly among different ritual types and societies (Kapitány et al. 2020; Atkinson and Whitehouse 2011; Sosis et al. 2007), a consensus is emerging. The mechanism of costly signaling represents an effective psychological technique to test and signal true social, emotional and moralistic commitment to the group. This deters free-riders, fosters group cohesion and promotes prosocial behavior towards group members (Sosis 2019; Rossano 2015; Whitehouse and Lanman 2014). The difference between costly signaling in ritual and art might be the degree of individuality. While rituals usually follow more or less strict rules, more individuality might be expressed in art.

Costly signaling and goal demotion manifest themselves in the archaeological record in many ways: in the form of procuring special materials from distant sources (Watts et al. 2016; Coulson et al. 2011); the use of otherwise valuable nutritional resources for non-utilitarian means (Villa et al. 2015; Henshilwood et al. 2011); the equipment and the great effort needed to produce works of art (Rossano 2015); the repeated production and intentional destruction or discarding of artifacts without using them as tools (Coulson et al. 2011); the intentional removal of difficult to produce art objects from the human sphere through hiding or burying (Wolf 2019) and the risks and physical efforts involved when procuring raw materials (Murphy et al. 2010) or visiting difficult to reach places in deep and dark cave systems equipped only with lamps or torches where artistic and ritual activities were performed (Bahn 2016, 316–333; Pfeiffer 1982). All of these activities were performed for non-subsistence, non-practical purposes, and simultaneously served to grab the attention of human perception (cf. Rossano 2015; Watts 2009). This combination of behavioral properties is central to both ritual and art.

Framing

Another common feature between art and ritual that immediately catches the eye is the spatial, material and temporal separation from everyday life – what Dutton calls "special focus" (criterion 7) and what ritual theorists call "framing". Junker (2013, 73–74) points out that even today, art is usually presented to the public in special "cult buildings" like museums, galleries, theaters, stages, cinemas, and churches. Spatial and temporal framing has not yet received the same attention in the Cognitive Science of Religion as other ritual components. What can be said is that being together in a special place (often decorated with symbols of group identity) and mentally focusing on the same thing helps to synchronize the emotional states of the participants: we are here together, we see the same, we think the same, we feel the same, we are one. Through a shared special focus and emotional synchronization, the distinction between the group and the self is attenuated and thus the feeling of oneness, group affiliation and social bonding enhanced (Jackson et al. 2018; Mogan et al. 2017; Launay et al. 2016). From an evolutionary perspective, a precondition for the ability to share a special focus with others, supported by spatial and temporal framing, could be the capacity of shared intentionality in the human lineage (Tomasello et al. 2012).

The aspect of spatial framing is especially interesting for archaeology because it can manifest itself in the archaeological record. Examples include art found in special cave areas or on hidden surfaces (Wolf 2019; Bahn 2016, 312–320; Pastoors and Weniger 2011; Bégouën et al. 2009; Lorblanchet 2010; 2009; Arias 2009), the building of special structures (Clottes 2018; Jaubert et al. 2016; Delannoy et al. 2012; Arias 2009; Arias et al. 2003) or the separation between living spaces and art/ritual spaces (Bahn 2016, 63; Floss 2015, 125; Ontañón 2003; Bégouën and Clottes 1991).

Within the large cave systems of the Franco-Cantabrian region, various forms of spatial framing can be found. Most striking is the contrast between visible/public and hidden/secret (Bahn 2010, 152–156). Several pictures have been placed in easily accessible positions and are visible from some distance (Fig. 1: Isturitz). In some cases, dripstones and concretions even seem to have been intentionally broken to make certain pictures more visible, such as in Cougnac and Candamo (Bahn 2016, 314–317). In contrast to that, other motifs were deliberately placed in hidden and/or difficult to access places (Fig. 1: Aitzbitarte; Garate et al. 2020; 2001, 63–64).

Overall, the images of the Upper Palaeolithic rock art themselves should only be understood as one part of the sensational experience leading to a special focus of the mind. Reaching the respective cave chambers in the dark zone, equipped only with small lamps or torches, the extraordinary sensory impressions (absolute darkness, silence, reverberation, change of temperature, sounds of dripping or flowing water) and the occasional dangers, such as large carnivores using the cave, difficult squeezing, crawling and climbing passages or the labyrinth-like structure of some cave systems causing possible loss of orientation and claustrophobia, must all be considered part of the experiential process (Bahn 2016, 331–332; Pfeiffer 1982).

A totally different form of special focus may be represented in inter-regional "aggregation sites" (Conkey 1980). They are evidenced in exceptionally large concentrations of tool production remains, other settlement waste and portable art objects in the direct vicinity of easily accessible rock art. The occurrence of portable and parietal

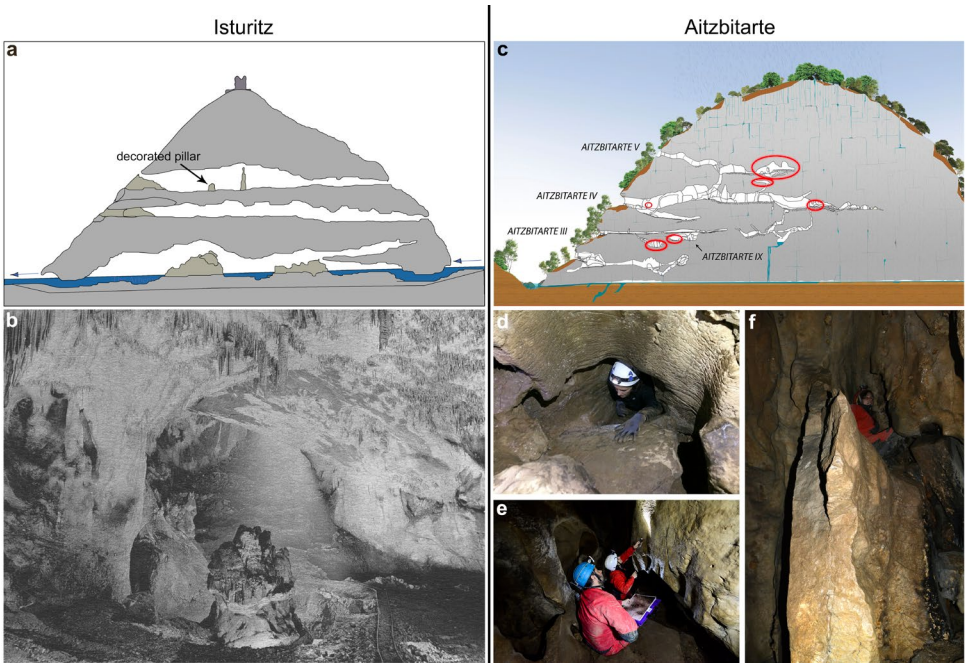

Fig. 1 | Two contrasting types of framing. The Grande Salle of Isturitz (Département Pyrénées-Atlantiques, France) with its iconic decorated central pillar was easily accessible from the broad original entrance, which was visible from afar. With an area of more than 1500 m² and ceiling heights as great as 15 m, the cave offered enough space for a larger group of people to assemble and was partially illuminated by daylight (a, b; modified after Garate et al. 2013, Fig. 3 & Garate et al. 2016, Fig. 6). In contrast, some of the newly discovered decorated panels of the Aitzbitarte caves (País Vasco, Spain) are very difficult to reach even with modern equipment and are located in the dark zone (c; the decorated sectors are indicated with a red circle). The photographs d, e and f show the very narrow maze of passages leading to eleven decorated panels of Aitzbitarte III. (Modified after Garate et al. 2020, Fig. 2 & 3).

art in the same locality is rare in the European Upper Palaeolithic and therefore speaks to the importance of these places. Supra-regional connections between different groups are indicated by artistic, lithic and faunal evidence (Bourdier 2013; Bahn 1982). It is conceivable that such socio-economic centers served as meeting places for seasonally recurring rituals, thus pointing indirectly to temporal framing (cf. Ross and Davidson 2006, 320–321). Among the best-known candidates are Isturitz (Fig. 1: Isturitz), Le Mas d'Azil, Enlène, Trois Frères including nearby Tuc d'Audoubert and, to a lesser extent, Altamira and Castillo (Bahn 2016, 63).

These very different forms of special focus or framing may point to different ritual types. For example, one can imagine communal rituals with larger groups of people at the localities with 'public' art displays and at aggregation sites – to strengthen social ties between different local groups and exchange goods and ideas. In the case of secret and difficult to reach locations, rites of passage for a small number of specially selected initiates seem more likely.

Sensory pageantry

To Dutton's criteria 9 and 10 (emotional saturation and intellectual challenge) a direct parallel can be drawn to the high sensory pageantry (sensual stimulation and emotional arousal) and the embedding in culture specific symbolism of high-arousal rituals. Cognitive Science of Religion quantitatively investigates memory formation and the generation of different types of bonding mechanisms in relationship to the intensity of the ritual pageantry (Whitehouse 2022; Kapitány et al. 2020; Xygalatas et al. 2013). On a neurophysiological level the multisensory stimulation, combined with behavioral synchronization and physical exhaustion, leads to the release of endogenous opioids and monoamine neurotransmitters which induce feelings of euphoria and a positive sense toward other group members (Tarr et al. 2015; Fischer et al. 2014). Archaeologically, the multisensory stimulation can be explored through the analysis of the often exceptional acoustic properties of decorated caves (Waller 2019; Fazenda et al. 2017; Till 2014; Reznikoff 2012; Reznikoff and Dauvois 1988) and other large halls which are directly associated with Palaeolithic music making such as Hohle Fels (Conard et al. 2009) or the experiential impact of flowing, standing or dripping water (Lorblanchet 2010, 140–146; Arias 2009, 268; Bahn 1978). Another aspect is the impact of darkness (Dowd and Hensey 2016; Moyes 2013) and the effect of flickering light from fire and Palaeolithic lamps on the perception of the images and engravings (Bahn 2016, 197–200; Coulson et al. 2011; Pastoors and Weniger 2011; de Beaune 2000; 1987). Furthermore, the deliberate use of three-dimensional surface-shapes, natural symmetries around entrances, cracks and fissures or the dramatic association of particular motives with "bouches d'ombre" to create impressions of "appearing" are effects that ancient masters cleverly exploited (Bahn 2016, 312–319; Clottes 2010; Lorblanchet 2001; García 1987). Insofar as the depicted motifs and signs represented specific symbolic systems of meaning and/or referred to mythological stories (see section style and tradition), they constituted not only sensory stimulation but also intellectual challenge (Dutton's criterion 10).

Repetition, formality, rule-boundedness

Dutton's criteria 3 and 11 (style, art traditions and institutions) are closely related to central properties of ritual action: the repetition of formal and rule-bounded, non-utilitarian and socially transmitted behavior (Hobson et al. 2018; Whitehouse 2013; Rappaport 1999). In ritual cultural norms, symbols and stories are shared, transmitted and internalized through the dramatization and continual repetition, rhythmicity, (over-)imitation, and synchronization on the basis of trust, feelings of oneness and a shared identity created through ritual action (Legare and Watson-Jones 2016, 835; Rossano 2012; Dennett 2006, 146–151). Repetition is an essential aspect of rituals. It reinforces formality and adherence to culturally-learned, invariant rules. These rules, in turn, give rise to long-lasting traditions that lend legitimacy to the rituals and demonstrate participants' submission to the social norms of their group (Rossano 2012; Rappaport 1999).

The repetition of rule-bounded, non-utilitarian and socially transmitted behavior is clearly recognizable in the Franco-Cantabrian rock art of the Upper Palaeolithic. First, there is a certain thematic unity throughout the entire period. Based on the analysis of thousands of motives from hundreds of sites the caves were decorated with a limited selection of animal species following certain hierarchical combination rules

(Sauvet 2019), which is – interestingly enough – often not reflected in the subsistence strategies of the hunter-gatherer groups responsible for the art (Bahn 2016, 284–286). Second, the animals are almost always shown in profile. This clearly reflects a culturally transmitted style. However, some have argued that the similarity between the 35,000 year old animal depiction form Maros (Sulawesi) with those from Franco-Cantabria may point to an underlying universal neurological constraint (Hodgson and Watson 2015). Third, the development of extensive databases has also shown that particular motifs are depicted over and over again, especially horses and bison. These animals are also often found in combination with each other (Sauvet 2019; Bicho et al. 2007; Sauvet and Wlodarczyk 2000–2001; 1992). On the other hand, certain combinations are rare or do not occur at all in the entire Franco-Cantabrian rock art of the Upper Palaeolithic: bison and aurochs, bison and stag (male deer), mammoth and hind (female deer), aurochs and reindeer (Bahn 2016, 309–310; Sauvet and Wlodarczyk 1992). Nor are human depictions arbitrary but seem to follow certain rules related to the incidence of light (Bahn 2016, 309; Pales and Saint Péreuse 1976, 153–155). Granted, these patterns are subject to regional and chronological variations, and there are often interesting exceptions. However, the basic selection of species seems to remain stable throughout the entire Upper Palaeolithic (Sauvet 2019). Fourth, sometimes a repetition on individual rock faces and stone slabs is clearly recognizable. The evidence, including reiterative finger markings, hand stencils, hand rubbings, striated areas, hammering impacts, reworkings and superimpositions of images and engravings, indicates that the repeated enacting of 'art making' was at least as important as viewing (Feruglio et al. 2019; Mélard and Airvaux 2017; Pettitt et al. 2014; Lorblanchet 2010, 282–305; Mélard 2008; Fritz and Tosello 2007). Repetition in connection with standardized selection of motifs and techniques is also clearly present in the production of the thousands of decorated plaquettes from several Upper Palaeolithic sites such as Parpalló (Roldán García et al. 2016; Villaverde Bonilla 1994), La Marche (Chisena and Delage 2018; Mélard 2008), Enlène (Bégouën and Clottes 2008; 1991; Bégouën et al. 1984; 1982; Bahn 1983), Foz do Medal (Figueiredo et al. 2014), Gönnersdorf (Bosinski and Fischer 1980; 1974) and others. Some of the plaquettes even seem to be intentionally broken or burnt (Bahn 2016, 133–134), thus additionally pointing to costly signaling (although other explanations are possible).

Overall, the decorated caves and the portable art of the Upper Palaeolithic in Western Europe do not represent an arbitrary conglomeration of motifs, styles, themes and techniques. Rather, they reflect culturally transmitted rules – with local variations on a superordinate meta-theme. Bahn summarizes: "In short, there seems to be a definite system or 'grammar' at work" (Bahn 2016, 310). This constant repetition of rule-bounded, non-utilitarian (= goal demoted) and socially transmitted behavior *in combination* with framing, costliness, sensory pageantry and symbolism shows the close phylogenetic relationship between ritual and art from an archaeological perspective.

Performance

Ritual often yields performative properties: it is presented to an audience which observes, evaluates and judges. Sometimes performers and spectators are the same people; other times, the latter is imagined to be a supernatural being. Regardless of the details, an essential quality of ritual is that the performance *must be presented to*

someone (Grimes 2006; Rappaport 1999, 37–46). This aspect of ritual is reflected in Dutton's art criterion 5: criticism. Brown and Dissanayake (2018, 1) point out that the audience of art often undertakes long journeys to admire certain concerts, theater performances, paintings, sculptures or architecture just like ritual participants do in pilgrimages. Whether an audience was present during the production of Upper Palaeolithic art and what role it played are very difficult questions to answer archaeologically. What can be said is that certain localities with rock art were better suited for the gathering of larger groups than others, such as the monumental panel halls at Chauvet and Lascaux (Aujoulat 2004; Chauvet et al. 1996) or the Salon Noir in Niaux (Clottes 2010). Moreover, the symbolic level of rock art refers not only to the meaning of the motifs, which is largely inaccessible to us today. As Ross and Davidson (2006, 319–320) emphasize, rock art created or used in the context of a ritual also leaves a lasting message to the community and/or supernatural agents that the ritual was *actually* performed.

Reaching a High Evidentiary Threshold

The fact that all these psychological properties are shared by art and ritual, and are recognizable to some degree in the archaeological record of many Upper Palaeolithic sites with parietal and portable art, speaks to the close evolutionary relationship between these two phenomena. But that doesn't mean that we can assume *a priori* that every single decorated slab or dot on a wall was created in a ritual context. Only if it is possible to show through a proper investigation of the entire archaeological context that multiple building blocks of ritual action are simultaneously present, can an interpretative connection between the art at the site and ritual behavior be warranted. The same rule of thumb applies here as for the cluster concept of art: the more properties detected, the more plausible the categorization. This strategy has the benefit that it does not require speculation about the symbolic meaning of the depicted motifs – although in rare cases a connection to ritual may be also apparent on this level of analysis, for example in the case of therianthrope figures with combined animal features and human attributes (Wolf 2019; Bahn 2016, 266–269; Tymula 1995).

At some phases or in some places during the 30,000 years of the Upper Palaeolithic, with its pronounced climatic oscillations and substantial cultural changes, it be possible that certain artforms slowly began to separate themselves from their ritual ancestors. This might be reflected in cases where artistic expressions are found amidst residential areas (Arias et al. 2011; Ontañon 2003) or on elaborately decorated stone slabs whose working surfaces show signs of practical use (Mélard 2017, 367; Terberger 1997, 90; Bosinski and Fischer 1980). With some tools, the practical merges with the artistic, for example, the beautifully decorated Magdalenian spear throwers (Uthmeier 2017, 289; Bahn 2016, 10, 144–146; Stodiek 1993) – although it cannot be ruled out that these highly decorated weapons were connected to certain hunting rituals. Some authors justifiably warn against the inflationary use of the label 'ritual' as a vague blanket term for "strange" behavior which we just do not understand from today's perspective (Howey and O'Shea 2006, 261–262; Insoll 2004, 1–2). We agree with this concern. Thus, we must provide sufficient evidence for a ritual interpretation in every single case – ideally based on cluster concepts properly grounded in Evolutionary Psychology and Cognitive Science of Religion.

An Evolutionary Precursor: Ochre Use in the African Middle Stone Age

That the blossoming of Upper Palaeolithic art derived from ritual and resulted from a long evolutionary process seems plausible from a theoretical standpoint. Today this can also be recognized by looking at the archaeological record of the African Middle Stone Age. A plethora of new evidence concerning (quasi-) geometrical engravings (Henshilwood et al. 2014; 2009; Henshilwood and d'Errico 2011; Texier et al. 2010), personal ornaments (Bar-Yosef Mayer et al. 2020; Steele et al. 2019; d'Errico and Backwell 2016; Dapschauskas 2015; Vanhaeren et al. 2013) and ochre use (Dapschauskas et al. 2022) has accumulated over the last 25 years. Of these three categories, ochre is quantitatively by far the most abundant and can be interpreted as largely the material remain of ritual activity. In a recent collaborative research effort, we reviewed the African archaeological record for indications of when and where ocher use became a habitual part of the behavioral repertoire of early modern humans (Dapschauskas et al. 2022). Ochre use, which had been expanding since about 500,000 years ago, became a habitual and geographically widespread cultural practice around 160,000 years ago, which we view as a proxy for increasing ritual activity in expanding *Homo sapiens* populations (Fig. 2). On the basis of several lines of empirical evidence from archaeology, psychology and ethnography, we argued that large parts of the material were used in ritualized displays probably related to body decoration.

If our ritual interpretation of the majority of ochre use in the African Middle Stone Age is correct, then a deep evolutionary relationship between art and ritual is again archaeologically evident, with the record suggesting that ritual predates art — at least when viewed through a cluster concept. This is also indicated by primatological comparisons since elaborated ritualized displays are common in many primate species, and art is not (e.g., Dal Pesco and Fischer 2020; Perry and Smolla 2020; Tennie and van Schaik 2020; McGrew 2017; Kühl et al. 2016).

Furthermore, the archaeological record indicates that perceptional and psychological biases towards the color red played important roles in the evolution of collective ritual (Dapschauskas et al. 2022; Watts et al. 2016). Fittingly, cross-cultural experiments on contemporary human subjects (Wu et al. 2018; Elliot 2015; Elliot et al. 2013) as well as primatological studies indicate a deep evolutionary basis for at least some (pre-symbolic) emotional and motivational effects of red stimuli. In the realm of primate social and sexual signaling, researchers observed and experimentally tested the role of reddened skin (Gerald et al. 2007; Waitt et al. 2006; 2003; Bielert et al. 1989). Interestingly, where reddened skin plays a role, signaling often occurs in the form of ritualized displays (Petersdorf et al. 2017; Dixson 2012, 130–149; Higham et al. 2012; Setchell and Wickings 2005). Such deep-seated evolutionary reactions to the color red constitute a psychological starting point upon which colorful and attention-grabbing ritual performances with an additional symbolic meaning could later be built – with the help of material culture and through cultural evolution. Therefore, it is possible that red ochre applied to the body, face, hair or clothes initially played a role as an *artificial amplifier* of sexual signals in mating contexts, dominance in cases of competition, or warning in contexts of danger or death, thus exploiting ancestral cognitive biases in primates. It seems likely that with red ochre, these artificially amplified signals were used ever more strategically in ritualized displays as the "social brain" (cf. Gowlett et al. 2012) evolved during the Pleistocene.

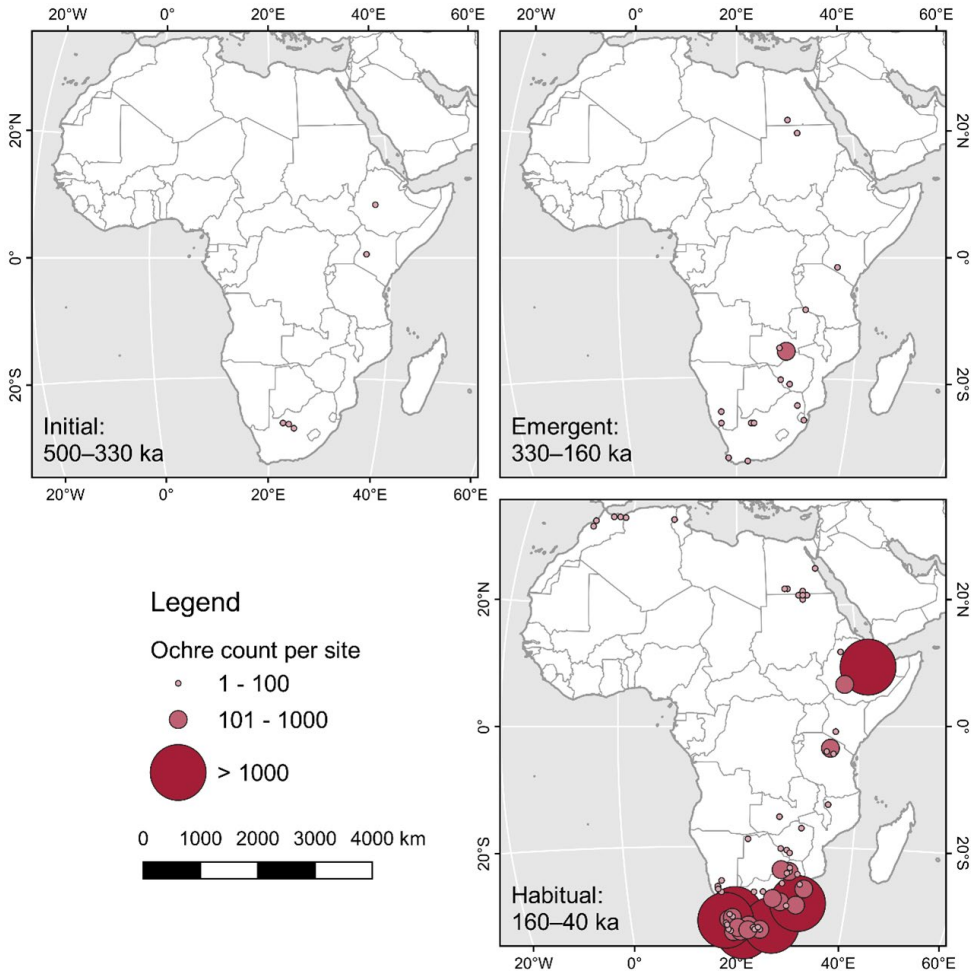

Fig. 2 | Maps of the three phases of ochre use in the African Middle Stone Age showing the geographical distribution of ochre sites and the number of ochre pieces per site for each phase (Dapschauskas et al. 2022).

Overall, the archaeological record of the African Middle Stone Age demonstrates that the application of artificial coloring agents by hominins had a long history before the emergence of Upper Palaeolithic art and was already deeply incorporated into the cultural repertoire of anatomically modern humans when they arrived in Australia 65,000 (Clarkson et al. 2017) and in Europe 42,000 years ago (Wolf et al. 2018). There is also robust evidence that some Neanderthal groups used red and black pigment to a noticeable degree (Hoffmann et al. 2018; Dayet et al. 2014; Bodu et al. 2014; Roebroeks et al. 2012; Zilhão et al. 2010; d'Errico 2008; Demars 1992). Strikingly, the color choice in Upper Palaeolithic parietal art is fairly restricted to red and black as well. The painted motives are mostly *either* red *or* black. Bi- or polychrome drawings are rare (Bahn 2016, 273–274; Geoffroy 1974; but see Petzinger and Nowell 2014). In the case of abstract signs, the color red usually dominates (Bahn 2016, 273; Petzinger 2016, 120; Geoffroy 1974, 47, 57; Clottes et al. 2005, 139). The flickering glow of fire

in dark caves would have also had an effect on color perception. Since red is better seen in the faint shimmer of Palaeolithic lamps and torches than black, one factor in color choice could have been this: certain signs and motifs should be deliberately emphasized over others (Bahn 2016, 200, 273).

Social Networks and Identity

The adaptive function of collective ritual for group cohesion, cooperation, prosociality and the transmission of cultural norms is now well established within an evolutionary framework (Whitehouse 2022; Legare and Nielsen 2020; Hobson et al. 2018; Legare and Watson-Jones 2016; Whitehouse and Lanman 2014). In our work we hypothesized that human collective ritual evolved by amalgamating the older building blocks of costly signaling and ritualization with several new psychological adaptations as a consequence of encephalization (Dapschauskas et al. 2022). The main benefit of collective ritual as a new social institution was its positive effect on binding larger cultural groups together beyond the older mechanisms of kinship, social grooming and reciprocity. Collective rituals enabled the expansion of social networks significantly and increased the number and reliability of internal connections in those networks. Thus, they may have played a crucial part in facilitating cumulative cultural evolution and the demographic expansion of *Homo sapiens* populations – signified in the quantitative and geographical expansion of ochre use during the Middle Stone Age. Here lies another deep connection between art and ritual. Many scholars stress the identity-establishing power of art in general (Høgh-Olesen 2019, 129; Junker 2013, 27, 138; Dilly 2008, 16; Dissanayake 1988, 62–64) and for the Upper Palaeolithic period in particular (Conard and Kind 2019, 166–167; Bourrillon and White 2015; Bourdier 2013; Floss 2009). Moreover, through its sheer longevity, which may outlast many human generations, rock art can contribute to the formation of tradition and become important for the construction of a local identity. Even if the original symbolic messages are no longer understood, the motifs can be reintegrated and reinterpreted in later symbolic systems (Ross and Davidson 2006, 326). Insofar that Palaeolithic art supported prosociality by creating broader cultural group identities, it again represents a direct psychological derivative of ritual.

Connecting the Dots

Now we can return to our original premise posed at the beginning of the paper and ask again: What is this phenomenon called 'art' from the perspective of an evolutionary-psychological archaeology? Clearly, we have learned that art is not just one thing. It consists of multiple psychological building blocks likely of different evolutionary age. The arts are essentially derivatives of ritual, intermingled with our evolved aesthetic sense, enriched by the psychology of prestige and accompanied by an additional communicative and symbolic meta-layer. However, only in their mature phase did the arts allow more leeway for individual creativity than their ritual predecessors and develop into an independent mode of expression and communication – a liberation process that took its first small steps during the Upper Palaeolithic, but which only reached full bloom much later in human history.

A Call to Interdisciplinarity

Due to substantial progress over the last 25 years in the fields of Evolutionary Aesthetics, Cognitive Science of Religion, and Palaeolithic Archaeology a synthetic partnership now seems more promising than ever. To tackle the evolutionary origins of particularly challenging phenomena of human behavior such as art, a broad interdisciplinary approach is indispensable. This requires not only the interweaving of empirical research and the forming of theory from these different disciplines – each with its own unique research history. It is also necessary to shift the focus from the weakest point of archaeological research – unverifiable speculations about the symbolic content of early art based on the "ethnographic snap" (Bahn 2016, 336) to something that can be grasped archaeologically – behavioral patterns. A close cooperation between Archaeology and Evolutionary Psychology substantially expands our understanding of material remains resulting from certain patterns of behavior with their underlying psychological mechanisms. Such expansion in interdisciplinary knowledge may also lead to new insights concerning the complex cognitive evolution of our lineage. Much progress has already been made by Cognitive Archaeology in this direction, especially with respect to tool use and subsistence behavior (Henley et al. 2019; Overmann and Coolidge 2019; Wynn and Coolidge 2017; Haidle et al. 2015; Lombard and Haidle 2012). In order to tackle fuzzier behavioral phenomena such as art, we emphasize that not only do we need cognitive modeling in archaeology; we also need more psychological embedding in terms of perception, emotion, motivation and social bonding. After all, humans are not only a *thinking* species. We are also a *feeling* species exhibiting behaviors unshackled from physical practicality and economic rationality.

References

Adajian, T. "The Definition of Art." In *The Stanford Encyclopedia of Philosophy*, edited by E. N. Zalta, (Fall 2018 Edition). https://plato.stanford.edu/archives/fall2018/entries/art-definition.

Adorno, T. W. 1970. *Ästhetische Theorie.* Gesammelte Schriften 7. Frankfurt am Main: Suhrkamp.

Arias, P. 2009. "Rites in the Dark? An Evaluation of the Current Evidence for Ritual Areas at Magdalenian Cave Sites." *World Archaeology* 41 (2): 262–94.

Arias, P., R. Ontañón, E. Á. Fernández, M. Cueto, M. Elorza, C. García-Moncó, A. Güth, M.-J. Iriarte-Chiapusso, L. C. Teira, and D. Zurro. 2011. "Magdalenian Floors in the Lower Gallery of La Garma: A Preliminary Report." In *Site-Internal Spatial Organization of Hunter-Gatherer Societies: Case Studies from the European Palaeolithic and Mesolithic*, edited by S. Gaudzinski-Windheuser, O. Jöris, M. Sensburg, and E. Turner, 31–51. Mainz: Verlag des Römisch-Germanischen Zentralmuseums.

Arias, P., C. González Sainz, A. Moure, and R. Ontañón. 2003. "Unterirdischer Raum, Wandkunst und Paläolithische Strukturen: Einige Beispiele der Höhle La Garma (Spanien)." In *Höhlenkunst und Raum: Archäologische und Architektonische Perspektiven*, edited by A. Pastoors and G.-C. Weniger, 29–46. Wissenschaftliche Schriften des Neanderthal Museums 3. Mettmann: Neanderthal Museum.

Atkinson, Q. D., and H. Whitehouse. 2011. "The Cultural Morphospace of Ritual Form." *Evolution and Human Behavior* 32 (1): 50–62.

Aujoulat, N. 2004. *Lascaux: Le geste, l'espace et le temps.* Paris: Seuil.

Bahn, P. G. 1978. "Water Mythology and the Distribution of Palaeolithic Parietal Art." *Proceedings of the Prehistoric Society* 44: 125–134.

Bahn, P. G. 1982. "Inter-Site and Inter-Regional Links During the Upper Palaeolithic: The Pyrenean Evidence." *The Oxford Journal of Archaeology* 1: 247–268.

Bahn, P. G. 1983. "A Palaeolithic Treasure House in the Pyrenees." *Nature* 302: 571–572.

Bahn, P. G. 2010. *Prehistoric Rock Art: Polemics and Progress.* The 2006 Rhind Lectures for the Society of Antiquaries of Scotland. Cambridge: Cambridge University Press.

Bahn, P. G. 2016. *Images of the Ice Age.* Oxford: Oxford University Press.

Bar-Yosef Mayer, D. E., I. Groman-Yaroslavski, O. Bar-Yosef, I. Hershkovitz, A. Kampen-Hasday, B. Vandermeersch, Y. Zaidner, and M. Weinstein-Evron. 2020. "On Holes and Strings: Earliest Displays of Human Adornment in the Middle Palaeolithic." *PLOS ONE* 15 (7): e0234924.

Beaune, S. A. de. 1987. "Palaeolithic Lamps and Their Specialization: A Hypothesis." *Current Anthropology* 28 (4): 569–577.

Beaune, S. A. de. 2000. "Les techniques d'éclairage paléolithiques: un bilan/ Paleolithic Lighting Technics: An Overview." *Paléo* 12 (1): 19–27.

Bégouën, R., and J. Clottes. 1991. "Portable and Wall Art in the Volp Caves, Montesquieu-Avantès (Ariège)." *Proceedings of the Prehistoric Society* 57 (01): 65–79.

Bégouën, R., and J. Clottes. 2008. "Douze nouvelles plaquettes gravées d'Enlène." *Espacio, Tiempo y Forma* Serie I, Nueva época (1): 77–92.

Bégouën, R., J. Clottes, J. P. Giraud, and F. Rouzaud. 1982. "Plaquette gravée d'Enlène, Montesquieu-Avantès (Ariège)." *Bulletin de la Société Préhistorique Française* 79 (4): 103–109.

Bégouën, R., J. Clottes, J. P. Giraud, and F. Rouzaud. 1984. "Compléments à la grande plaquette gravée d'Enlène." *Bulletin de la Société Préhistorique Française* 81 (5): 142–148.

Bégouën, R., C. Fritz, G. Tosello, and J. Clottes. 2009. *Le sanctuaire secret des bisons: Il y a 14 000 ans, dans la caverne du Tuc d'Audoubert.* Paris: Somogy.

Benedict, R. 1934. *Patterns of Culture.* Boston: Mifflin.

Bicho, N., A. F. Carvalho, C. González-Sainz, J. L. Sanchidrián, V. Villaverde, and L. G. Straus. 2007. "The Upper Paleolithic Rock Art of Iberia." *Journal of Archaeological Method and Theory* 14 (1): 81–151.

Bielert, C., L. Girolami, and S. Jowell. 1989. "An Experimental Examination of the Colour Component in Visually Mediated Sexual Arousal of the Male Chacma Baboon (Papio Ursinus)." *Journal of Zoology* 219 (4): 569–579.

Boas, F. 1927. *Primitive Art.* Oslo: Aschehoug.

Bodu, P., H. Salomon, M. Leroyer, H.-G. Naton, J. Lacarriere, and M. Dessoles. 2014. "An Open-Air Site from the Recent Middle Palaeolithic in the Paris Basin (France): Les Bossats at Ormesson (Seine-Et-Marne)." *Quaternary International* 331: 39–59.

Bosinski, G., and G. Fischer. 1974. *Die Menschendarstellungen von Gönnersdorf der Ausgrabung von 1968.* Der Magdalénien-Fundplatz Gönnersdorf 1. Stuttgart: Franz Steiner.

Bosinski, G., and G. Fischer. 1980. *Mammut- und Pferdedarstellungen von Gönnersdorf.* Der Magdalénien-Fundplatz Gönnersdorf 5. Stuttgart: Franz Steiner.

Bourdier, C. 2013. "Rock Art and Social Geography in the Upper Paleolithic. Contribution to the Socio-Cultural Function of the Roc-Aux-Sorciers Rock-Shelter (Angles-sur-l'Anglin, France) from the Viewpoint of Its Sculpted Frieze." *Journal of Anthropological Archaeology* 32 (4): 368–382.

Bourdieu, P. 1996. *The Rules of Art: Genesis and Structure of the Literary Field.* Stanford: Stanford University Press.

Bourrillon, R., and R. White. 2015. "Early Aurignacian Graphic Arts in the Vézère Valley: In Search of an Identity?" In *Aurignacian Genius: Art, Technology and Society of the First Modern Humans in Europe*, edited by R. White, R. Bourrillon, and F. Bon. Palethnology 7: 118–137.

Brady, L. M., J. Hampson, and I. Domingo Sanz. 2018. "Recording Rock Art: Strategies, Challenges, and Embracing the Digital Revolution." In *The Oxford Handbook of the Archaeology and Anthropology of Rock Art*, edited by B. David and I. J. McNiven, 763–86. New York: Oxford University Press.

Brown, S., and E. Dissanayake. 2018. "The Synthesis of the Arts: From Ceremonial Ritual to 'Total Work of Art'." *Frontiers in Sociology* 3: Article 9.

Carroll, N., ed. 2000. *Theories of Art Today.* Madison: University of Wisconsin Press.

Chalmin, E., M. Menu, and C. Vignaud. 2003. "Analysis of Rock Art Painting and Technology of Palaeolithic Painters." *Measurement Science and Technology* 14 (9): 1590–1597.

Chatterjee, A. 2014. *The Aesthetic Brain: How We Evolved to Desire Beauty and Enjoy Art.* Oxford, New York: Oxford University Press.

Chatterjee, A., and O. Vartanian. 2014. "Neuroaesthetics." *Trends in Cognitive Sciences* 18 (7): 370–375.

Chauvet, J.-M., E. Brunel Deschamps, and C. Hillaire. 1996. *Chauvet Cave: The Discovery of the World's Oldest Paintings.* London: Thames and Hudson.

Chisena, S., and C. Delage. 2018. "On the Attribution of Palaeolithic Artworks: The Case of La Marche (Lussac-Les-Châteaux, Vienne)." *Open Archaeology* 4 (1): 239–261.

Clarkson, C., Z. Jacobs, B. Marwick, R. Fullagar, L. Wallis, M. Smith, R. G. Roberts et al. 2017. "Human Occupation of Northern Australia by 65,000 Years Ago." *Nature* 547: 306–310.

Clottes, J. 2010. *Les cavernes de Niaux: art préhistorique en Ariège-Pyrénées.* 2nd ed. Paris: Errance.

Clottes, J. 2018. "European Palaeolithic Rock Art and Spatial Structures." In *The Oxford Handbook of the Archaeology and Anthropology of Rock Art*, edited by B. David and I. J. McNiven, 397–410. New York: Oxford University Press.

Clottes, J., J. Courtin, and L. Vanrell. 2005. *Cosquer redécouvert.* Paris: Le Seuil.

Conard, N. J., and C.-J. Kind. 2019. *Als der Mensch die Kunst erfand: Eiszeithöhlen der Schwäbischen Alb.* 2. ed. Darmstadt: WBG Theiss.

Conard, N. J., M. Malina, and S. C. Münzel. 2009. "New Flutes Document the Earliest Musical Tradition in Southwestern Germany." *Nature* 460: 737–740.

Conkey, M. W. 1980. "The Identification of Prehistoric Hunter-Gatherer Aggregation Sites: The Case of Altamira." *Current Anthropology* 21 (5): 609–630.

Conkey, M. W. 2009. "Materiality and Meaning-Making in the Understanding of the Palaeolithic 'Arts'." In *Becoming Human: Innovation in Prehistoric Material and Spiritual Culture*, edited by C. Renfrew and I. Morley, 179–194. Cambridge: Cambridge University Press.

Conkey, M. W. 2018. "Interpretative Frameworks and the Study of Rock Arts." In *The Oxford Handbook of the Archaeology and Anthropology of Rock Art*, edited by B. David and I. J. McNiven, 25–50. New York: Oxford University Press.

Coulson, S., S. Staurset, and N. Walker. 2011. "Ritualized Behavior in the Middle Stone Age: Evidence from Rhino Cave, Tsodilo Hills, Botswana." *PaleoAnthropology*, 18–61.

Cruz Berrocal, M. 2011. "Analogical Evidence and Shamanism in Archaeological Interpretation: South African and European Palaeolithic Rock Art." *Norwegian Archaeological Review* 44 (1): 1–20.

Dal Pesco, F., and J. Fischer. 2020. "On the Evolution of Baboon Greeting Rituals." *Philosophical Transactions of the Royal Society B* 375 (1805): 20190420.

Dapschauskas, R. 2015. "Der älteste Schmuck der Menschheit: Implikationen für die kognitive Evolution von *Homo*

sapiens." *Mitteilungen der Gesellschaft für Urgeschichte* 24: 13–80.

Dapschauskas, R., M. B. Göden, C. Sommer, and A. W. Kandel. 2022. "The Emergence of Habitual Ochre Use in Africa and Its Significance for the Development of Ritual Behavior During the Middle Stone Age." *Journal of World Prehistory* 35: 233–319.

Davies, S. 2013. "Definitions of Art." In *The Routledge Companion to Aesthetics*, edited by B. Gaut and D. Lopes. 3. rev. ed., 213–223. London: Routledge.

Dayet, L., F. d'Errico, and R. Garcia-Moreno. 2014. "Searching for Consistencies in Châtelperronian Pigment Use." *Journal of Archaeological Science* 44: 180–193.

Decker, W. 2012. *Sport in der griechischen Antike: Vom Minoischen Wettkampf bis zu den Olympischen Spielen.* 2. ed. Hildesheim: Arete.

Delannoy, J.-J., J.-M. Geneste, S. Jaillet, É. Boche, and B. Sadier. 2012. "Les aménagements et structures anthropiques de la Grotte Chauvet-Pont d'Arc. Apport d'une approche intégrative géomorpho-archéologique." *Collection EDYTEM* 13 (1): 43–62.

Demarin, V., M. Roje Bedeković, M. Bosnar Puretić, and M. Bošnjak Pašić. 2016. "Arts, Brain and Cognition." *Psychiatria Danubina* 28 (4): 343–348.

Demars, P.-Y. 1992. "Les colorants dans le Moustérien du Périgord: L'apport des fouilles de F. Bordes." *Préhistoire Ariegeoise* 47: 185–194.

Dennett, D. C. 2006. *Breaking the Spell: Religion as a Natural Phenomenon.* New York: Viking.

Dennett, D. C. 2017. *From Bacteria to Bach and Back: The Evolution of Minds.* New York: W. W. Norton & Company.

d'Errico, F. 2008. "Le Rouge et le Noir: Implications of Early Pigment Use in Africa, the Near East and Europe for the Origin of Cultural Modernity." *South African Archaeological Society Goodwin Series* 10: 168–174.

d'Errico, F., and L. Backwell. 2016. "Earliest Evidence of Personal Ornaments Associated with Burial: The Conus Shells from Border Cave." *Journal of Human Evolution* 93: 91–108.

Dilly, H. 2008. "Einleitung." In *Kunstgeschichte: Eine Einführung*, edited by H. Belting. 7. ed., 9–18. Berlin: Reimer.

Dissanayake, E. 1988. *What Is Art for?* Washington: University of Washington Press.

Dissanayake, E. 1992. *Homo aestheticus: Where Art Comes from and Why.* New York: Free Press.

Dissanayake, E. 2013. "Art as a Human Universal: An Adaptationist View." In *Origins of Religion, Cognition and Culture*, edited by A. W. Geertz, 121–139. Durham: Acumen.

Dissanayake, E. 2018. "From Play and Ritualisation to Ritual and Its Arts: Sources of Upper Pleistocene Ritual Practices in Lower Middle Pleistocene Ritualised and Play Behaviours in Ancestral Hominins." In *Ritual, Play, and Belief in Evolution and Early Human Societies*, edited by C. Renfrew, I. Morley, and M. J. Boyd, 87–100. Cambridge: Cambridge University Press.

Dixson, A. F. 2012. *Primate Sexuality: Comparative Studies of the Prosimians, Monkeys, Apes, and Human Beings.* 2. ed. Oxford, New York: Oxford University Press.

Dowd, M., and R. Hensey, eds. 2016. *The Archaeology of Darkness.* Oxford and Philadelphia: Oxbow Books.

Dutkiewicz, E., S. Wolf, and N. J. Conard. 2018. "Early Symbolism in the Ach and the Lone Valleys of Southwestern Germany." *Quaternary International* 491: 30–45.

Dutton, D. 2000. "'But They Don't Have Our Concept of Art'" In *Theories of Art Today*, edited by N. Carroll, 217–240. Madison: University of Wisconsin Press.

Dutton, D. 2009. *The Art Instinct: Beauty, Pleasure, and Human Evolution.* New York: Bloomsbury Press.

Dutton, D. 2013. "Aesthetic Universals." In *The Routledge Companion to Aesthetics*, edited by B. Gaut and D. Lopes. 3. rev. ed., 267–277. London: Routledge.

Elliot, A. J. 2015. "Color and Psychological Functioning: A Review of Theoretical and Empirical Work." *Frontiers in Psychology* 6: 368.

Elliot, A. J., J. L. Tracy, A. D. Pazda, and A. T. Beall. 2013. "Red Enhances Women's Attractiveness to Men: First Evidence Suggesting Universality." *Journal of Experimental Social Psychology* 49 (1): 165–168.

Falk, J. H., and J. D. Balling. 2010. "Evolutionary Influence on Human Landscape Preference." *Environment and Behavior* 42 (4): 479–493.

Fazenda, B., C. Scarre, R. Till, R. Jiménez Pasalodos, M. Rojo Guerra, C. Tejedor, R. Ontañón Peredo et al. 2017. "Cave Acoustics in Prehistory: Exploring the Association of Palaeolithic Visual Motifs and Acoustic Response." *The Journal of the Acoustical Society of America* 142 (3): 1332.

Feruglio, V., C. Bourdier, M. Delluc, P. Mora, N. Aujoulat, and J. Jaubert. 2019. "Rock Art, Performance and Palaeolithic Cognitive Systems: The Example of the Grand Panel Palimpsest of Cussac Cave, Dordogne, France." *Journal of Anthropological Archaeology* 56: 101104.

Figueiredo, S. S., L. Nobre, R. Gaspar, J. Carrondo, A. Cristo Ropero, J. Ferreira, M. J. D. Silva, and F. J. Molina. 2014. "Foz Do Medal Terrace: An Open-Air Settlement with Paleolithic Portable Art." *INORA* 68: 12–20.

Fischer, R., D. Xygalatas, P. Mitkidis, P. Reddish, P. Tok, I. Konvalinka, and J. A. Bulbulia. 2014. "The Fire-Walker's High: Affect and Physiological Responses in an Extreme Collective Ritual." *PLOS ONE* 9 (2): e88355.

Floss, H. 2009. "Kunst schafft Identität: Das Aurignacien und die Zeit der ersten Kunst." In *Eiszeit. Kunst und Kultur: Begleitband zur Großen Landesausstellung Eiszeit – Kunst und Kultur im Kunstgebäude Stuttgart, 18. September 2009 bis 10. Januar 2010*, edited by Archäologisches Landesmuseum Baden-Württemberg and Abteilung Ältere Urgeschichte und Quartärökologie der Eberhard Karls Universität Tübingen, 248–257. Ostfildern: Thorbecke.

Floss, H. 2015. "The Start of Art." In *The Genesis of Creativity and the Origin of the Human Mind*, edited by B. Putova and V. Soukup, 123–129. Prag: Karolinum.

Förster, T. 2006. "Kunstethnologie." In *Ethnologie: Einführung und Überblick*, edited by B. Beer and H. Fischer. 6. ed., 221–237. Berlin: Reimer.

Francfort, H.-P., R. N. Hamayon, and P. G. Bahn, eds. 2001. *The Concept of Shamanism: Uses and Abuses.* Budapest: Akadémiai Kiadó.

Franklin, A., N. Pitchford, L. Hart, I. R. L. Davies, S. Clausse, and S. Jennings. 2008. "Salience of Primary and Secondary Colours in Infancy." *British Journal of Developmental Psychology* 26 (4): 471–483.

Fritz, C., and G. Tosello. 2007. "The Hidden Meaning of Forms: Methods of Recording Paleolithic Parietal Art." *Journal of Archaeological Method and Theory* 14 (1): 48–80.

Garate, D., A. Labarge, O. Rivero, C. Normand, and J. Darricau. 2013. "The Cave of Isturitz (West Pyrenees, France): One Century of Research in Paleolithic Parietal Art." *Arts* 2 (4): 253–272.

Garate, D., O. Rivero, A. Labarge, and C. Normand. 2016. "Le pilier gravé de la grotte d'Isturitz (Saint-Martin-D'Arberoue, Pyrénées-Atlantiques): Cent ans après sa découverte." *Bulletin de la Société Préhistorique Française* 113 (3): 501–522.

Garate, D., O. Rivero, J. Rios-Garaizar, M. Arriolabengoa, I. Intxaurbe, and S. Salazar. 2020. "Redefining Shared Symbolic Networks During the Gravettian in Western Europe: New Data from the Rock Art Findings in Aitzbitarte Caves (Northern Spain)." *PLOS ONE* 15 (10): e0240481.

García, R. G. 1987. "Organisation, Distribution and Typology of the Cave Art

of Monte Del Castillo, Spain." *Rock Art Research* 4 (2): 127–136.

Gaut, B. 2000. "'Art' as a Cluster Concept." In *Theories of Art Today*, edited by N. Carroll, 25–44. Madison: University of Wisconsin Press.

Gaut, B. 2005. "The Cluster Account of Art Defended." *The British Journal of Aesthetics* 45 (3): 273–288.

Geertz, C. 1976. "Art as a Cultural System." *MLN* 91 (6): 1473–1499.

Gendron, D. 2007. "Review of 'Introduction to Rock Art Research' by David S. Whitley." *Canadian Journal of Archaeology* 31 (2): 261–263.

Geoffroy, C. 1974. "La couleur dans l'art pariétal paléolithique." *Cahiers du Centre de Recherches Préhistoriques* 3: 45–64.

Gerald, M. S., C. Waitt, A. C. Little, and E. Kraiselburd. 2007. "Females Pay Attention to Female Secondary Sexual Color: An Experimental Study in *Macaca mulatta*." *International Journal of Primatology* 28 (1): 1–7.

Gowlett, J. A. J., C. Gamble, and R. I. McDonald Dunbar. 2012. "Human Evolution and the Archaeology of the Social Brain." *Current Anthropology* 53 (6): 693–722.

Grimes, R. L. 2006. "Performance." In *Theorizing Rituals: Issues, Topics, Approaches, Concepts*, edited by J. Kreinath, J. Snoek, and M. Stausberg, 379–394. Leiden: Brill.

Haidle, M. N., M. Bolus, M. Collard, N. J. Conard, D. Garofoli, M. Lombard, A. Nowell, C. Tennie, and A. Whiten. 2015. "The Nature of Culture: An Eight-Grade Model for the Evolution and Expansion of Cultural Capacities in Hominins and Other Animals." *Journal of Anthropological Sciences* 93: 43–70.

Halverson, J. 1987. "Art for Art's Sake in the Paleolithic." *Current Anthropology* 28 (1): 63–89.

Henley, T. B., M. J. Rossano, and E. P. Kardas, eds. 2019. *Handbook of Cognitive Archaeology: A Psychological Framework.* Milton: Routledge.

Henrich, J. 2016. *The Secret of Our Success: How Culture Is Driving Human Evolution, Domesticating Our Species, and Making Us Smarter.* Princeton: Princeton University Press.

Henshilwood, C. S., and F. d'Errico. 2011. "Middle Stone Age Engravings and Their Significance to the Debate on the Emergence of Symbolic Material Culture." In *Homo symbolicus: The Dawn of Language, Imagination and Spirituality*, edited by C. S. Henshilwood and F. d'Errico, 75–96. Amsterdam: John Benjamins Publ.

Henshilwood, C. S., F. d'Errico, and I. Watts. 2009. "Engraved Ochres from the Middle Stone Age Levels at Blombos Cave, South Africa." *Journal of Human Evolution* 57: 27–47.

Henshilwood, C. S., F. d'Errico, K. L. van Niekerk, Y. Coquinot, Z. Jacobs, S.-E. Lauritzen, M. Menu, and R. García Moreno. 2011. "A 100,000-Year-Old Ochre-Processing Workshop at Blombos Cave, South Africa." *Science* 334: 219–222.

Henshilwood, C. S., K. L. van Niekerk, S. Wurz, A. Delagnes, S. J. Armitage, R. Francois Rifkin, K. Douze et al. 2014. "Klipdrift Shelter, Southern Cape, South Africa: Preliminary Report on the Howiesons Poort Layers." *Journal of Archaeological Science* 45: 284–303.

Higham, J. P., M. Heistermann, C. Saggau, M. Agil, D. Perwitasari-Farajallah, and A. Engelhardt. 2012. "Sexual Signalling in Female Crested Macaques and the Evolution of Primate Fertility Signals." *BMC Evolutionary Biology* 12: 89. https://doi.org/10.1186/1471-2148-12-89.

Hobson, N. M., J. Schroeder, J. L. Risen, D. Xygalatas, and M. Inzlicht. 2018. "The Psychology of Rituals: An Integrative Review and Process-Based Framework." *Personality and Social Psychology Review* 22 (3): 260–284.

Hodgson, D. 2019. "The Cognitive Mechanisms Deriving from the Acheulean Handaxe That Gave Rise to Symmetry, Form, and Pattern Perception." In *Handbook of Cognitive Archaeology: A Psychological Framework*, edited by T. B. Henley, M. J. Rossano, and E. P. Kardas, 241–260. Milton: Routledge.

Hodgson, D., and J. Verpooten. 2015. "The Evolutionary Significance of the Arts: Exploring the By-Product Hypothesis in the Context of Ritual, Precursors, and Cultural Evolution." *Biological Theory* 10 (1): 73–85.

Hodgson, D., and B. Watson. 2015. "The Visual Brain and the Early Depiction of Animals in Europe and Southeast Asia." *World Archaeology* 47 (5): 776–791.

Hoffmann, D. L., D. E. Angelucci, V. Villaverde, J. Zapata, and J. Zilhão. 2018. "Symbolic Use of Marine Shells and Mineral Pigments by Iberian Neandertals 115,000 Years Ago." *Science Advances* 4 (2): eaar5255.

Høgh-Olesen, H. 2019. *The Aesthetic Animal.* Oxford: Oxford University Press.

Howey, M. C. L., and J. M. O'Shea. 2006. "Bear's Journey and the Study of Ritual in Archaeology." *American Antiquity* 71 (2): 261–282.

Hrdy, S. B. 2009. *Mothers and Others: The Evolutionary Origins of Mutual Understanding.* Cambridge, Mass: Belknap Press.

Humphrey, C., and J. Laidlaw. 1994. *The Archetypal Actions of Ritual: A Theory of Ritual Illustrated by the Jain Rite of Worship.* Oxford: Clarendon Press.

Hussain, S. T., and H. Floss. 2015. "Sharing the World with Mammoths, Cave Lions and Other Beings: Linking Animal-Human Interactions and the Aurignacian 'Belief World'." *Quartär* 62: 85–120.

Huston, J. P., M. Nadal, F. Mora, L. F. Agnati, and C. José Cela Conde, eds. 2015. *Art, Aesthetics, and the Brain.* Oxford: Oxford University Press.

Insoll, T. 2004. *Archaeology, Ritual, Religion.* New York: Routledge.

Jackson, J. C., J. Jong, D. Bilkey, H. Whitehouse, S. Zollmann, C. McNaughton, and J. Halberstadt. 2018. "Synchrony and Physiological Arousal Increase Cohesion and Cooperation in Large Naturalistic Groups." *Scientific Reports* 8 (1): 127.

Janik, L., and S. Kaner. 2018. "Art and the Brain: Archaeological Perspectives on Visual Communication." *Open Archaeology* 4 (1): 145–151.

Jaubert, J., S. Verheyden, D. Genty, M. Soulier, H. Cheng, D. Blamart, C. Burlet et al. 2016. "Early Neanderthal Constructions Deep in Bruniquel Cave in Southwestern France." *Nature* 534: 111–114.

Junker, T. 2013. *Die Evolution der Phantasie: Wie der Mensch zum Künstler wurde.* Stuttgart: Hirzel.

Kapitány, R., C. Kavanagh, and H. Whitehouse. 2020. "Ritual Morphospace Revisited: The Form, Function and Factor Structure of Ritual Practice." *Philosophical Transactions of the Royal Society B* 375: 20190436.

Kapoula, Z., and M. Vernet, eds. 2016. *Aesthetics and Neuroscience.* Cham: Springer.

Keupp, S., T. Behne, and H. Rakoczy. 2013. "Why Do Children Overimitate? Normativity Is Crucial." *Journal of Experimental Child Psychology* 116 (2): 392–406.

Keysers, C. 2011. *The Empathic Brain: How the Discovery of Mirror Neurons Changes Our Understanding of Human Nature.* Lexington: Social Brain Press.

Kowalzig, B. 2007. *Singing for the Gods: Performances of Myth and Ritual in Archaic and Classical Greece.* Oxford: Oxford University Press.

Kühl, H. S., A. K. Kalan, M. Arandjelovic, F. Aubert, L. D'Auvergne, A. Goedmakers, S. Jones et al. 2016. "Chimpanzee Accumulative Stone Throwing." *Scientific Reports* 6: 22219.

Launay, J., B. Tarr, R. I. McDonald Dunbar, and R. Bshary. 2016. "Synchrony as an Adaptive Mechanism for Large-Scale Human Social Bonding." *Ethology* 122 (10): 779–789.

Lauring, J. O., ed. 2014. *An Introduction to Neuroaesthetics: The Neuroscientific Approach to Aesthetic Experience, Artistic Creativity, and Arts Appreciation.* Copenhagen: Museum Tusculanum Press.

Legare, C. H., and M. Nielsen. 2020. "Ritual Explained: Interdisciplinary Answers to Tinbergen's Four Questions." *Philosophical Transactions of the Royal Society B* 375 (1805): 20190419.

Legare, C. H., and R. E. Watson-Jones. 2016. "The Evolution and Ontogeny of Ritual." In *The Handbook of Evolutionary Psychology: Volume 2: Integrations*, edited by D. M. Buss. 2. rev. ed., 829–47. Hoboken, New Jersey: John Wiley & Sons.

Lewis-Williams, J. D. 2005. "New Neighbours: Interaction and Imagemaking During the West European Middle to Upper Palaeolithic Transition." In *From Tools to Symbols: From Early Hominids to Modern Humans*, edited by F. d'Errico and L. Backwell, 372–388. Johannesburg: Wits University Press.

Little, A. C., C. L. Apicella, and F. W. Marlowe. 2007. "Preferences for Symmetry in Human Faces in Two Cultures: Data from the UK and the Hadza, an Isolated Group of Hunter-Gatherers." *Proceedings of the Royal Society B* 274 (1629): 3113–3117.

Lombard, M., and M. N. Haidle. 2012. "Thinking a Bow-and-Arrow Set: Cognitive Implications of Middle Stone Age Bow and Stone-Tipped Arrow Technology." *Cambridge Archaeological Journal* 22 (2): 237–264.

Longworth, F., and A. Scarantino. 2010. "The Disjunctive Theory of Art: The Cluster Account Reformulated." *The British Journal of Aesthetics* 50 (2): 151–167.

Lorblanchet, M. 2001. *La grotte de Pergouset (Saint-Géry, Lot): un sanctuaire secret paléolithique*. Documents d'Archéologie Française 85. Paris: Editions de la Maison des Sciences de l'Homme.

Lorblanchet, M. 2009. "Claw Marks and Ritual Traces in the Palaeolithic Sanctuaries of the Quercy." In *An Enquiring Mind: Studies in Honor of Alexander Marshack*, edited by P. G. Bahn, 165–170. Oxford: Oxbow Books.

Lorblanchet, M. 2010. *Art pariétal: grottes ornées du Quercy*. Rodez: Rouergue.

Martin, L. H., and D. Wiebe, eds. 2017. *Religion Explained? The Cognitive Science of Religion After Twenty-Five Years*. Scientific Studies of Religion: Inquiry and Explanation. London: Bloomsbury Academic.

McConachie, B. 2011. "An Evolutionary Perspective on Play, Performance, and Ritual." *TDR: The Drama Review* 55 (4): 33–50.

McGrew, W. C. 2017. "Grooming Hand Clasp." In *The International Encyclopedia of Primatology: Volume I: A–G*, edited by A. Fuentes, 486–488. Chichester, West Sussex: Wiley Blackwell.

Mead, M. 1928. *Coming of Age in Samoa: A Study of Sex in Primitive Societies*. New York: Morrow.

Mehr, S. A., M. Singh, D. Knox, D. M. Ketter, D. Pickens-Jones, S. Atwood, C. Lucas et al. 2019. "Universality and Diversity in Human Song." *Science* 366: eaax0868..

Mélard, N. 2008. "Pierres Gravées de La Marche à Lussac-Les-Châteaux (Vienne): Techniques, Technologie et Interprétations." *Gallia Préhistoire* 50 (1): 143–268.

Mélard, N. 2017. "Lebenskünstler der Eiszeit und Ihre Bilder: 30 000 Jahre Kunstgeschichte." In *Klimagewalten: Treibende Kraft der Evolution*, edited by H. Meller and T. Puttkammer, 360–371. Darmstadt: Theiss.

Mélard, N., and J. Airvaux. 2017. "Die Kunst des Mittleren Magdalénien von Lussac-Angles (Westfrankreich): Ein Beispiel der Entwicklung einer Regionalen Kultur vor 16 000 Jahren." In *Klimagewalten: Treibende Kraft der Evolution*, edited by H. Meller and T. Puttkammer, 372–390. Darmstadt: Theiss.

Miller, G. F. 2000. *The Mating Mind: How Sexual Choice Shaped the Evolution of Human Nature*. New York: Doubleday.

Mithen, S. J. 2003. "Handaxes: The First Aesthetic Artefacts." In *Evolutionary Aesthetics*, edited by E. Voland and K. Grammer, 261–275. Berlin, New York: Springer.

Mogan, R., R. Fischer, and J. A. Bulbulia. 2017. "To Be in Synchrony or Not? A Meta-Analysis of Synchrony's Effects on Behavior, Perception, Cognition and Affect." *Journal of Experimental Social Psychology* 72: 13–20.

Morales, R. Jr. 2005. "Considerations on the Art and Aesthetics of Rock Art." In

Aesthetics and Rock Art, edited by T. Heyd and J. Clegg, 61–74. Aldershot: Ashgate.

Moravcsik, J. M. 1991. "Art and 'Art'." *Midwest Studies in Philosophy* 16 (1): 302–313.

Moyes, H., ed. 2013. *Sacred Darkness: A Global Perspective on the Ritual Use of Caves*. Boulder: University Press of Colorado.

Murphy, M., L. Robbins, and A. C. Campbell. 2010. "The Prehistoric Mining of Specularite." In *Tsodilo Hills: Copper Bracelet of the Kalahari*, edited by A. C. Campbell, L. Robbins, and M. Taylor, 82–94. East Lansing: Michigan State University Press.

Nielsen, M., and K. Tomaselli. 2010. "Overimitation in Kalahari Bushman Children and the Origins of Human Cultural Cognition." *Psychological Science* 21 (5): 729–736.

Nielsen, M., K. Tomaselli, and R. Kapitány. 2018. "The Influence of Goal Demotion on Children's Reproduction of Ritual Behavior." *Evolution and Human Behavior* 39 (3): 343–348.

Novitz, D. 1998. "Art by Another Name." *The British Journal of Aesthetics* 38 (1): 19–32.

Ontañón, R. 2003. "Sols et structures d'habitat du Paléolithique supérieur, nouvelles données depuis les Cantabres: La Galerie Inférieure de La Garma (Cantabrie, Espagne)." *L'Anthropologie* 107 (3): 333–363.

Otten, C. M., ed. 1971. *Anthropology and Art: Readings in Cross-Cultured Aesthetics*. Austin: University of Texas Press.

Overmann, K. A., and F. L. Coolidge, eds. 2019. *Squeezing Minds from Stones: Cognitive Archaeology and the Evolution of the Human Mind*. New York: Oxford University Press.

Paige, J., and C. Perreault. 2024. "3.3 Million Years of Stone Tool Complexity Suggests that Cumulative Culture Began during the Middle Pleistocene." *Proceedings of the National Academy of Sciences of the United States of America* 121 (26): e2319175121.

Pales, L., and M. Tassin de Saint Péreuse. 1976. *Les gravures de La Marche 2: les humains*. Gap: Ophrys.

Pastoors, A., and G.-C. Weniger. 2011. "Cave Art in Context: Methods for the Analysis of the Spatial Organization of Cave Sites." *Journal of Archaeological Research* 19 (4): 377–400.

Pearce, M. T., D. W. Zaidel, O. Vartanian, M. Skov, H. Leder, A. Chatterjee, and M. Nadal. 2016. "Neuroaesthetics: The Cognitive Neuroscience of Aesthetic Experience." *Perspectives on Psychological Science* 11 (2): 265–279.

Perry, S., and M. Smolla. 2020. "Capuchin Monkey Rituals: An Interdisciplinary Study of Form and Function." *Philosophical Transactions of the Royal Society B* 375: 20190422.

Petersdorf, M., C. Dubuc, A. V. Georgiev, S. Winters, and J. P. Higham. 2017. "Is Male Rhesus Macaque Facial Coloration under Intrasexual Selection?" *Behavioral Ecology* 28 (6): 1472–1481.

Peterson, J. B. 2017. "Biblical Series I: Introduction to the Idea of God." Transcript. https://www.studocu.com/row/document/university-of-khartoum/organization-behavior/biblical-series-i-introduction-to-the-idea-of-god-transcript/47885410 [Accessed February 10, 2025]

Pettitt, P., and A. W. G. Pike. 2007. "Dating European Palaeolithic Cave Art: Progress, Prospects, Problems." *Journal of Archaeological Method and Theory* 14 (1): 27–47.

Pettitt, P., A. M. Castillejo, P. Arias, R. Ontañón Peredo, and R. Harrison. 2014. "New Views on Old Hands: The Context of Stencils in El Castillo and La Garma Caves (Cantabria, Spain)." *Antiquity* 88 (339): 47–63.

Petzinger, G. von. 2016. *The First Signs: Unlocking the Mysteries of the World's Oldest Symbols*. New York: Atria Books.

Petzinger, G. von, and A. Nowell. 2014. "A Place in Time: Situating Chauvet Within the Long Chronology of Symbolic Behavioral Development." *Journal of Human Evolution* 74: 37–54.

Pfeiffer, J. E. 1982. *The Creative Explosion: An Inquiry into the Origins of Art and Religion.* Cambridge: Harper & Row.

Pinker, S. 1997. *How the Mind Works.* New York: Norton.

Pinker, S. 2002. *The Blank Slate: The Modern Denial of Human Nature.* London: Penguin.

Pinker, S. 2007. *The Stuff of Thought: Language as a Window into Human Nature.* New York: Viking.

Pinnington, N. J. 2019. *A New History of Medieval Japanese Theatre: Noh and Kyōgen from 1300 to 1600.* Palgrave Studies in Theatre and Performance History. Cham: Springer.

Rappaport, R. A. 1999. *Ritual and Religion in the Making of Humanity.* Cambridge: Cambridge University Press.

Reznikoff, I. 2013. "La dimension sonore des grottes paléolithiques et des rochers à peintures." In *L'art pléistocène dans le monde = Pleistocene Art of the World: Actes du Congrès Ifrao, Tarascon-sur-Ariège, septembre 2010,* edited by J. Clottes, CD: 45–56. *Palethnologie* 5: 2060.

Reznikoff, I., and M. Dauvois. 1988. "La dimension sonore des grottes ornées." *Bulletin de la Société Préhistorique Française* 85 (8): 238–246.

Roebroeks, W., M. J. Sier, T. K. Nielsen, D. de Loecker, J. M. Parés, Arps, C. E. S., and H. J. Mücher. 2012. "Use of Red Ochre by Early Neandertals." *Proceedings of the National Academy of Sciences of the United States of America* 109 (6): 1889–1894.

Roeck, B. 2017. *Der Morgen der Welt: Geschichte der Renaissance.* München: C.H. Beck.

Roldán García, C., V. Villaverde Bonilla, I. Ródenas Marín, and S. Murcia Mascarós. 2016. "A Unique Collection of Palaeolithic Painted Portable Art: Characterization of Red and Yellow Pigments from the Parpalló Cave (Spain)." *PLOS ONE* 11 (10): e0163565.

Ross, J., and I. Davidson. 2006. "Rock Art and Ritual: An Archaeological Analysis of Rock Art in Arid Central Australia." *Journal of Archaeological Method and Theory* 13 (4): 305–341.

Rossano, M. J. 2012. "The Essential Role of Ritual in the Transmission and Reinforcement of Social Norms." *Psychological Bulletin* 138 (3): 529–549.

Rossano, M. J. 2015. "The Evolutionary Emergence of Costly Rituals." *PaleoAnthropology* 2015: 78–100.

Saito, A., M. Hayashi, H. Takeshita, and T. Matsuzawa. 2014. "The Origin of Representational Drawing: A Comparison of Human Children and Chimpanzees." *Child Development* 85 (6): 2232–2246.

Salz, J., ed. 2016. *A History of Japanese Theatre.* Cambridge: Cambridge University Press.

Sauvet, G. 2019. "The Hierarchy of Animals in the Paleolithic Iconography." *Journal of Archaeological Science: Reports* 28: 102025.

Sauvet, G., and A. Wlodarczyk. 1992. "Structural Interpretation of Statistical Data from European Palaeolithic Cave Art." In *Ancient Images, Ancient Thought: The Archaeology of Ideology*, edited by A. S. Goldsmith, S. Garvie, D. Selin, and J. Smith, 223–234. Calgary, Canada: University of Calgary Archaeological Association.

Sauvet, G., and A. Wlodarczyk. 2000–2001. "L'art pariétal, miroir des sociétés paléolithiques." *Zephyrus* 53–54: 215–238.

Schechner, R. 1974. "From Ritual to Theatre and Back: The Structure/Process of the Efficacy-Entertainment Dyad." *Educational Theatre Journal* 26 (4): 455–4.

Schellenberg, E. G., and S. E. Trehub. 1996. "Natural Musical Intervals: Evidence from Infant Listeners." *Psychological Science* 7 (5): 272–277.

Schjoedt, U., J. Sørensen, K. Laigaard Nielbo, D. Xygalatas, P. Mitkidis, and J. A. Bulbulia. 2013. "Cognitive Resource Depletion in Religious Interactions." *Religion, Brain & Behavior* 3 (1): 39–55.

Schmidt-Salomon, M. 2006. *Manifest des Evolutionären Humanismus: Plädoyer*

für eine zeitgemäße Leitkultur. 2. ed. Aschaffenburg: Alibri.

Schmidt-Salomon, M. 2014. *Hoffnung Mensch: eine bessere Welt ist möglich.* München: Piper.

Setchell, J. M., and E. J. Wickings. 2005. "Dominance, Status Signals and Coloration in Male Mandrills (*Mandrillus sphinx*)." *Ethology* 111 (1): 25–50.

Slone, D. J., and W. W. McCorkle, Jr., eds. 2019. *The Cognitive Science of Religion: A Methodological Introduction to Key Empirical Studies.* Scientific Studies of Religion: Inquiry and Explanation. London: Bloomsbury Academic.

Smedt, J. de, and H. de Cruz. 2010. "Toward an Integrative Approach of Cognitive Neuroscientific and Evolutionary Psychological Studies of Art." *Evolutionary Psychology* 8 (4): 695–719.

Smith, M. 2007. *The Total Work of Art: From Bayreuth to Cyberspace.* New York: Routledge.

Snowdon, C. T., and D. Teie. 2010. "Affective Responses in Tamarins Elicited by Species-Specific Music." *Biology Letters* 6 (1): 30–32.

Solomon, A. 2018. "Rock Arts, Shamans, and Grand Theories." In *The Oxford Handbook of the Archaeology and Anthropology of Rock Art*, edited by B. David and I. J. McNiven, 565–585. New York: Oxford University Press.

Sosis, R. 2019. "Do Religions Promote Cooperation? Testing Signaling Theories of Religion." In *The Cognitive Science of Religion: A Methodological Introduction to Key Empirical Studies*, edited by D. J. Slone and W. W. McCorkle, Jr., 155–162. Scientific Studies of Religion: Inquiry and Explanation. London: Bloomsbury Academic.

Sosis, R., H. C. Kress, and J. S. Boster. 2007. "Scars for War: Evaluating Alternative Signaling Explanations for Cross-Cultural Variance in Ritual Costs." *Evolution and Human Behavior* 28 (4): 234–247.

Steele, T. E., E. Álvarez Fernández, and E. Hallett-Desguez. 2019. "A Review of Shells as Personal Ornamentation During the African Middle Stone Age." *PaleoAnthropology* 2019: 24–51.

Stodiek, U. 1993. *Zur Technologie der jungpaläolithischen Speerschleuder: Eine Studie auf der Basis archäologischer, ethnologischer und experimenteller Erkenntnisse.* Tübinger Monographien zur Urgeschichte 9. Tübingen: Archaeologica Venatoria.

Tanner, J. 2006. *The Invention of Art History in Ancient Greece: Religion, Society and Artistic Rationalisation.* Cambridge: Cambridge University Press.

Tarr, B., J. Launay, E. Cohen, and R. I. McDonald Dunbar. 2015. "Synchrony and Exertion During Dance Independently Raise Pain Threshold and Encourage Social Bonding." *Biology Letters* 11: 20150767.

Tatarkiewicz, W. 1979. *Geschichte der Ästhetik: Bd. 1: Die Ästhetik der Antike.* Basel: Schwabe.

Tennie, C., and C. P. van Schaik. 2020. "Spontaneous (Minimal) Ritual in Non-Human Great Apes?" *Philosophical Transactions of the Royal Society B* 375: 20190423.

Terberger, T. 1997. *Die Siedlungsbefunde des Magdalénien-Fundplatzes Gönnersdorf Konzentrationen III und IV.* Stuttgart: Franz Steiner.

Texier, P.-J., G. Porraz, J. Parkington, J.-P. Rigaud, C. Poggenpoel, C. Miller, C. Tribolo et al. 2010. "A Howiesons Poort Tradition of Engraving Ostrich Eggshell Containers Dated to 60,000 Years Ago at Diepkloof Rock Shelter, South Africa." *Proceedings of the National Academy of Sciences of the United States of America* 107 (14): 6180–6185.

Thompson, B. N., and T. R. Goldstein. 2019. "Disentangling Pretend Play Measurement: Defining the Essential Elements and Developmental Progression of Pretense." *Developmental Review* 52: 24–41.

Till, R. 2014. "Sound Archaeology: Terminology, Palaeolithic Cave Art and the Soundscape." *World Archaeology* 46 (3): 292–304.

Tomasello, M., A. P. Melis, C. Tennie, E. Wyman, and E. Herrmann. 2012.

"Two Key Steps in the Evolution of Human Cooperation." *Current Anthropology* 53 (6): 673–692.

Tylén, K., R. Fusaroli, S. Rojo, K. Heimann, N. Fay, N. N. Johannsen, F. Riede, and M. Lombard. 2020. "The Evolution of Early Symbolic Behavior in *Homo sapiens*." *Proceedings of the National Academy of Sciences of the United States of America* 117 (9): 4578–4584.

Tymula, S. 1995. "Figures composites de l'art paléolithique européen." *Paléo* 7 (1): 211–248.

Uthmeier, T. 2017. "Bestens angepasst: Jungpaläolithische Jäger und Sammler in Europa." In *Klimagewalten: Treibende Kraft Der Evolution*, edited by H. Meller and T. Puttkammer, 283–317. Darmstadt: Theiss.

Vanhaeren, M., F. d'Errico, K. L. van Niekerk, C. S. Henshilwood, and R. M. Erasmus. 2013. "Thinking Strings: Additional Evidence for Personal Ornament Use in the Middle Stone Age at Blombos Cave, South Africa." *Journal of Human Evolution* 64 (6): 500–517.

Varella, M. A. C., A. A. L. de Souza, and J. H. B. P. Ferreira. 2011. "Evolutionary Aesthetics and Sexual Selection in the Evolution of Rock Art Aesthetics." *Rock Art Research* 28 (2): 153–186.

Veblen, T. 1899. *The Theory of the Leisure Class: An Economic Study of the Evolution of Institutions.* New York: Macmillan.

Villa, P., L. Pollarolo, I. Degano, L. Birolo, M. Pasero, C. Biagioni, K. Douka, R. Vinciguerra, J. J. Lucejko, and L. Wadley. 2015. "A Milk and Ochre Paint Mixture Used 49,000 Years Ago at Sibudu, South Africa." *PLOS ONE* 10 (6): e0131273.

Villaverde Bonilla, V. 1994. *Arte paleolítico de la Cova del Parpalló: estudio de la colección de plaquetas y cantos gabados y pintados.* València: Diputació Servei d'Investigació Prehistòrica.

Voland, E., and K. Grammer, eds. 2003. *Evolutionary Aesthetics.* Berlin, New York: Springer.

Waitt, C., M. S. Gerald, A. C. Little, and E. Kraiselburd. 2006. "Selective Attention Toward Female Secondary Sexual Color in Male Rhesus Macaques." *American Journal of Primatology* 68 (7): 738–744.

Waitt, C., A. C. Little, S. Wolfensohn, P. Honess, A. P. Brown, H. M. Buchanan-Smith, and D. I. Perrett. 2003. "Evidence from Rhesus Macaques Suggests That Male Coloration Plays a Role in Female Primate Mate Choice." *Proceedings of the Royal Society B* 270 (Suppl. 2): S144-S146.

Waller, S. J. 2019. "Hear Here: Prehistoric Artists Preferentially Selected Reverberant Spaces and Choice of Subject Matter Underscores Ritualistic Use of Sound." In *Between Worlds: Understanding Ritual Cave Use in Later Prehistory*, edited by L. Büster, E. Warmenbol, and D. Mlekuž, 251–264. Cham: Springer.

Watson, B. 2009. *Universal Visions: Neuroscience and Recurrent Characteristics of World Palaeoart.* PhD diss., University of Melbourne.

Watts, I. 2009. "Red Ochre, Body Painting, and Language: Interpreting the Blombos Ochre." In *The Cradle of Language*, edited by R. Botha and C. Knight, 62–92. Oxford: Oxford University Press.

Watts, I., M. Chazan, and J. Wilkins. 2016. "Early Evidence for Brilliant Ritualized Display: Specularite Use in the Northern Cape (South Africa) between ~500 and ~300 Ka." *Current Anthropology* 57 (3): 287–310.

Weiner, J. F. 1998. "1993 Debate: Aesthetics Is a Cross-Cultural Category." In *Key Debates in Anthropology*, edited by T. Ingold. Reprint, 249–293. London: Routledge.

Weitz, M. 1956. "The Role of Theory in Aesthetics." *The Journal of Aesthetics and Art Criticism* 15 (1): 27–35.

Wellman, H M. 2014. *Making Minds: How Theory of Mind Develops.* Oxford: Oxford University Press.

Westergaard, G. C., and S. J. Suomi. 1997. "Modification of Clay Forms by Tufted Capuchins (*Cebus apella*)." *International Journal of Primatology* 18 (3): 455–467.

White, R. 1992. "Beyond Art: Toward an Understanding of the Origins of Material Representation in Europe." *Annual Review of Anthropology* 21 (1): 537–564.

Whitehouse, H. 2022. *Ritual Animal. Imitation and Cohesion in the Evolution of Social Complexity.* Oxford: Oxford University Press.

Whitehouse, H. 2013. "Explaining Ritual." In *A New Science of Religion*, edited by G. W. Dawes and J. Maclaurin, 81–99. New York: Routledge.

Whitehouse, H., and J. A. Lanman. 2014. "The Ties That Bind Us: Ritual, Fusion, and Identification." *Current Anthropology* 55 (6): 674–695.

Whitley, D. S. 2011. *Introduction to Rock Art Research.* 2nd rev. ed. Walnut Creek: Left Coast Press.

Wittgenstein, L. 1953. *Philosophical Investigations.* Oxford: Blackwell.

Wolf, S. 2019. "Die Deponierung der Aurignacienzeitlichen Löwenmensch-Figur aus dem Hohlenstein-Stadel, Südwest-Deutschland: Eine rituelle Handlung?" In *"All der holden Hügel ist keiner mir fremd …": Festschrift zum 65. Geburtstag von Claus-Joachim Kind*, edited by M. Baales and C. Pasda, 197–209. Universitätsforschungen zur prähistorischen Archäologie 327. Bonn: Dr. Rudolf Habelt.

Wolf, S., N. J. Conard, H. Floss, R. Dapschauskas, E. C. Velliky, and A. W. Kandel. 2018. "The Use of Ochre and Painting During the Upper Paleolithic of the Swabian Jura in the Context of the Development of Ochre Use in Africa and Europe." *Open Archaeology* 4 (1): 185–205.

Wu, Y., J. Lu, E. van Dijk, H. Li, and S. Schnall. 2018. "The Color Red Is Implicitly Associated with Social Status in the United Kingdom and China." *Frontiers in Psychology* 9: 1902.

Wynn, T., and T. Berlant. 2019. "The Handaxe Aesthetic." In *Squeezing Minds from Stones: Cognitive Archaeology and the Evolution of the Human Mind*, edited by K. A. Overmann and F. L. Coolidge, 278–303. New York: Oxford University Press.

Wynn, T., and F. L. Coolidge, eds. 2017. *Cognitive Models in Palaeolithic Archaeology.* Oxford: Oxford University Press.

Xygalatas, D., U. Schjoedt, J. A. Bulbulia, I. Konvalinka, E.-M. Jegindø, P. Reddish, A. W. Geertz, and A. Roepstorff. 2013. "Autobiographical Memory in a Fire-Walking Ritual." *Journal of Cognition and Culture* 13: 1–16.

Zeki, S. 1999. *Inner Vision: An Exploration of Art and the Brain.* Oxford: Oxford University Press.

Zilhão, J., D. E. Angelucci, E. Badal-García, F. d'Errico, F. Daniel, L. Dayet, K. Douka et al. 2010. "Symbolic Use of Marine Shells and Mineral Pigments by Iberian Neandertals." *Proceedings of the National Academy of Sciences of the United States of America* 107: 1023–1028.