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# The Origins of Visual Culture?

## Psychological Foundations of Upper Palaeolithic Figurative Cave Art in Northern Spain

Isobel Claire Wisher

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### Abstract

Upper Palaeolithic cave art is enthralling; the depiction of animals by our most ancient ancestors captures the imagination. It is no surprise that this art has been subject to extensive academic attention, with a breadth of perspectives that attempt to understand why people drew animals in caves. Fundamentally, this previous research focused on the aesthetic form of the art and attempted to explain it with singular explanations: from art for art's sake through to the shamanic. This thesis argues that these "grand narrative" approaches are unsatisfying, and instead shifts focus to explore the *meaning within the making* of Upper Palaeolithic figurative cave art. A biographical framework that integrated novel digital techniques and insights from visual psychology was developed, to evaluate the making of depictions within three cave art sites situated around Monte Castillo (Cantabria, Spain). This revealed the fundamental role of visual psychological responses, triggered in the immersive and low-light conditions of caves, as influencing this making. When understood through the biographical framework, it was revealed that these responses may have facilitated a dialogue between the artist, the cave wall, light, pigment, and the depicted animals. The material engagement involved in completing the animal depictions, evaluated through high resolution images and digital tracings, further supported this. The application of pigment appeared to directly relate to visual phenomena experienced in caves, tracing natural topographic features of cave walls to capture the intangible visual images that the artist may have perceived. When taken together, this thesis emphasises the role of the visual system as central to the making of Upper Palaeolithic figurative cave art. It reveals intimate moments of human interaction embedded within the art, from visceral perceptual experiences in caves through to the playful manipulation of light to add dynamism to animal forms.

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# **The Origins of Visual Culture?**

## **Psychological Foundations of Upper Palaeolithic Figurative Cave Art in Northern Spain**

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*Bison depictions at El Castillo cave (Cantabria, Spain). Image: Author.*

Volume 1 of 2

Isobel Claire Wisher

PhD Thesis

Department of Archaeology, Durham University

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# Chapter 1.

## Introduction

---

*Why did they draw in those caves?* (Clottes 2013). This question is perhaps *the question* for Palaeolithic cave art research, perceived almost as philosophically weighty as “*what is the meaning of life?*” or “*what makes us human?*”. One can picture it being uttered by the Abbé Henri Breuil as his gaze fell upon the swirling mirage of depictions at Lascaux, or asked by the young Maria Sanz de Sautuola to her father after she had discovered the bison on the ceiling of Altamira. It is deceptively simple yet, like most philosophical questions, hints at a greater meaning, a deeper intellectual truth which might shed light on who we are and how we got here. *Why did they draw in those caves? Why did they create art? Why do we make art?* And as with many philosophical questions, one could spend an academic lifetime pondering this one question and employing metaphysical, intangible perspectives to reach unsatisfying answers. The search for *the answer* to this question has arguably been ongoing for over a century since Palaeolithic cave art was first recognised by the Western European academic community.

Although somewhat facetious, there are two important considerations here that allude to the way Palaeolithic art tends to be approached. The first, as addressed in Chapter 2 of this thesis, is that *the question* will lead to *the answer*. The assumption made, either explicitly or implicitly, by many in Palaeolithic art research is that there must be one single answer for why Palaeolithic people decided to create art in caves. The proliferation of grand narrative explanations for the tens-of-thousands of years of behaviour represented by Palaeolithic art hints at the second consideration - that *the question* might not be a fruitful question to ask, or at least requires some reframing to produce fruitful answers. This question encourages responses that homogenise Upper Palaeolithic cave art, condensing a huge breadth of cultural behaviours in the process. By doing so, an implicit consequence is explanations that are removed from the archaeological evidence – drawing out only general trends that do not pertain to any particular examples, but rather touch on loose points of resonance between temporally and spatially distinct artistic behaviours. Whilst these kinds of interpretations have been useful in the past, there is perhaps a need now to reframe approaches and ask different questions of the art to appreciate the nuance embedded within it, shifting towards tangible understandings that are grounded within the archaeological evidence.

As will be explored throughout this thesis, these considerations may be a consequence of how we tend to approach Palaeolithic cave art, which is far removed from

the way it was encountered by our Palaeolithic predecessors. Even how we usually *see* cave art – brightly and homogeneously lit as 2-dimensional images that feature the depictions in centre-frame - is divorced from the way it was seen through Palaeolithic eyes. The focus on the aesthetic attributes of the art is perhaps a consequence of how we engage and most often perceive it; it is easy to place aesthetic value on a glossy, high-resolution image of these depictions, but aesthetic attributes are difficult to discern when viewing art under a small flickering flame within the encompassing darkness of a cave. These aesthetic-centric approaches limit interpretations of cave art, encouraging perspectives that collapse and homogenise artistic behaviours, starkly contrasting with how it was likely understood and engaged with in the Upper Palaeolithic. As addressed in Chapter 3, moving away from these Westernised perceptions of art may allow for more meaningful insights into aspects of Upper Palaeolithic figurative cave art. Refocusing approaches towards the making of the depictions, rather than their final form, has great potential for revealing the narratives embedded within each brush stroke or tactile engagement of a depiction. Employing interdisciplinary approaches with visual psychology infuses this approach with tangible insights into how people may have responded to the evocative environments of caves and how, in turn, these visual responses informed the making of cave art. Together, this research allows a glimpse into the discrete and distinctly *human* interactions involved in the making of cave art: the whispered thoughts, playful motives, and intimate moments of connection and creativity.

## 1.1. Introducing the Monte Castillo Sites

This research focuses on three cave art sites located around a single mountain, Monte Castillo in Puente Viesgo (Cantabria, northern Spain): Las Monedas; La Pasiega; and El Castillo. The Monte Castillo sites all have exquisite depictions of a breadth of different fauna, with the depictions demonstrating both intra- and inter-site variability in the form and style of the animals. This therefore makes for an interesting case study to evaluate the different processes which may have been involved in the production of these depictions, revealing nuance in the meaning and variation of this art. Additionally, El Castillo has an extensive stratigraphic sequence which is well-documented and nearby contemporaneous sites, such as El Mirón, have extensive palaeo-environmental data (Pike-Tay *et al.* 1999, 289; Cuenca-Bescós *et al.* 2009; Bernaldo de Quirós *et al.* 2015; Iriarte-Chiapusso *et al.* 2015; Jones *et al. in press*). Thus, the ecological and cultural milieu that contextualises the production of these depictions can be confidently discussed, particularly with regard to how this context may have shaped visual and perceptual responses within cave environments (explored in Chapter 4). The sites have been subject to extensive research (see Chapter 5), but this tends to be constrained to recording the art within the caves or separate studies into the occupation of the caves. There have been few grounded, site-specific

interpretations regarding the making of the art within the sites, and its potential significance to the Upper Palaeolithic groups that produced it. Therefore, not only do these sites represent well-documented and suitable case studies, but are also in overwhelming need of a novel approach to reveal in-depth insights into the nature of their depictions.

## 1.2. Defining Key Terms

Before discussing the specifics of this research in the following section, terms that have previously been contentious in Palaeolithic art research need to be defined; namely, what we mean by “art” and who is being referred to as responsible for the art. There have been extensive debates regarding the terms used in Palaeolithic art research, with different terminology evoking certain connotations. It is necessary to outline the specific intention behind the use of certain terms here, to clearly lay out the particular rationale for their use in this thesis.

### 1.2.1. Defining art

The use of the term “art”, and particularly “cave art”, in Palaeolithic research has been contentious, with many fairly arguing that “art” evokes Western connotations and that terms such as “visual culture”, “visual information”, or “visual imagery” would be more appropriate (Conkey 1987, 413; White 1992, 538; Corbey *et al.* 2004, 359; Moro Abadía and González Morales 2013, 287). Whilst undoubtedly the uncritical use of the term art is a valid and necessary critique of Upper Palaeolithic art research, the replacement of the term with visual-centric terminology arguably does little to negate these issues. As will be explored in Chapter 3, a much deeper analysis of the historic roots of the discipline is needed to fully address the kinds of issues alluded to with critiques of the term art. The term is not necessarily the crux of the problem. Instead, it is the definition and approach towards art that informs the connotations implicitly associated to this behaviour that may bias interpretations. A potential way to negate these issues is discussed in Chapter 3, where art is explored and redefined through a non-Western lens. In short, however, art is defined and understood throughout this thesis as a multifaceted, relational process that emerges through the engagements and, *sensu* Gell (1998), tensions between artist, environment, pigment, lighting, and animal subject. The appreciation of art beyond its visual, aesthetic form enables the exploration of the sensory attributes of art making to be appreciated, lending insight into the role of the visual and perceptual system within the process of art production.

Additional terminology is used throughout this thesis to refer to specific features of the art. *Depiction* or *motif* are used interchangeably to refer to a specific representation of an animal, following Ingold’s (2000, 111) definition of a depiction as an animal-like figure drawn, painted, or engraved. Although this may carry the connotation that the art

represents an animal with anatomical accuracy and as static, akin to a photograph, this is not intended by the use of the term here. Instead, it is understood that a depiction may be dynamic, partial, or may not necessarily accurately represent its subject. “Cave art” is intentionally used to refer to the art made within caves as representing a distinct phenomenon in the Upper Palaeolithic. Although some (e.g. Bednarik 1993, 4; Bednarik 1996, 126; Bahn 2001, 158) argue this draws an unnecessary division between open-air rock art and art within caves, this thesis presents the perspective that certain aspects of cave art is unique, and must be appreciated to some extent as a distinct behaviour. The extraordinary lengths taken to depict within the depths of caves when suitable surfaces existed in more accessible locations emphasises this. The specific environments of caves and the psychological phenomena that this may trigger, further stresses the need to treat art within caves as exceptional.

### 1.2.2. Defining the artists

This thesis interchangeably uses the term “Upper Palaeolithic people/artists” and “Cro Magnons” to refer to those that produced the Upper Palaeolithic art within Las Monedas, La Pasiega, and El Castillo. The aversion to using “anatomically modern human” (AMH) is intentional, and will be concisely explained here.

Cro Magnon stems from the fossils found at the Cro Magnon rock-shelter in Les Eyzies (France) in 1868 by Louis Lartet (Ingold 1995, 188) and was first adopted to refer to the population of humans in Upper Palaeolithic Europe, that were still perceived as somewhat distinct to modern humans today. The term fell out of use after it was established there were no significant differences between Cro Magnons and modern humans, with AMH used instead. However, the past decade of drastic advances in DNA research blurred boundaries between AMH and other contemporary hominin species, demonstrating modern humans today are the consequence of multiple interbreeding events between *Homo sapiens*, *Homo denisovans*, and *Homo neanderthalensis* (Green *et al.* 2010; Reich *et al.* 2011; Sankararaman *et al.* 2012; Fu *et al.* 2015; Slon *et al.* 2018; Villanea and Schraiber 2019). Physiological differences between these species appear to be the result of adaptations to different environments (e.g. Neanderthals to northern latitude environments: Sánchez-Quito and Lalueza-Fox 2015; Wroe *et al.* 2018) rather than fundamental biological species-level differences. Consequently, it is perhaps no longer useful to use the term AMH which conceives of only one group of late Pleistocene humans as our direct ancestors.

Cro-Magnons are therefore defined here as the group of humans which arrived in Europe as early as c.45,000 years ago (Cortés-Sánchez *et al.* 2019), and had interbreeding events with Denisovans and Neanderthals. They were therefore no longer explicitly *Homo sapiens*, nor were they initially the only “anatomically/culturally modern humans”. The use

of this term also intends to instil an awareness that we cannot equate our behaviours with those of Upper Palaeolithic people. Whilst it is occasionally useful to share an affinity with Cro Magnons, infusing *humanity* into Palaeolithic research, we must be aware that our experiences will be drastically different to theirs. This is particularly pertinent for contextualising the psychological elements of this research. As explored in Chapter 4, whilst the biological cognitive mechanisms were likely the same in Cro Magnons as people today, this does not necessarily mean they experienced the world in the same way.

### 1.3. Thesis Overview

#### 1.3.1. Research aim

This research intends to reimagine approaches to Upper Palaeolithic figurative cave art, moving away from a focus on aesthetic form to appreciate the complex and meaningful processes of making. This focuses on the role of the visual system within this making, and aims to determine the specific psychological mechanisms that influenced the theme, style, and placement of figurative depictions in the caves of Las Monedas, La Pasiega, and El Castillo.

#### 1.3.2. Research objectives

Within this overarching aim, there are several research objectives:

1. To evaluate the historical and previous approaches to Palaeolithic art, determining the key themes in previous research and the potential issues associated with particular approaches.
2. To develop a theoretical framework for understanding the making of art and the role of the visual system within this, infusing insights from ethnography and visual psychology.
3. Employ digital techniques to record the cave art in Las Monedas, La Pasiega, and El Castillo, creating a detailed digital repository for selected figurative art at each site.
4. To develop a novel methodology for exploring the role of light in the visual perception of cave art walls, to generate hypotheses regarding how this may have informed the making of cave art.
5. To pilot a psychology experiment that integrates virtual reality to determine how modern participants visually respond to perceiving cave walls under simulated lighting conditions, testing hypotheses that emerge from objective 4.

#### 1.3.3. Overview of chapters

**Chapter 2** addresses objective 1. It provides an overview of the previous historical and recent approaches towards cave art, evaluating some of the systemic issues rooted in the discipline from its inception in the mid-19<sup>th</sup> Century and how the discipline has developed

since. The trends in approaching Palaeolithic art are discussed, highlighting some of the issues with attempting to apply grand narrative explanations for thousands-of-years of human behaviour. The more recent shifts in the field are explored, and used to inspire the particular approach within this thesis, which refocuses on understanding the meaning within the making of Upper Palaeolithic figurative art.

**Chapter 3** addresses objective 2, by evaluating the unusual way we interact with cave art in modern, Western societies and unpicking how this conceptualisation of art has impacted our understanding of art in the Palaeolithic. It recalibrates perceptions of art through employing non-Western perspectives from modern small-scale societies. Art is redefined through a non-Western lens, inspired the development of a theoretical framework that appreciates its relational nature. A biographical framework for understanding the making of Upper Palaeolithic cave art is proposed, which situates the visual and perceptual response as integrated within the physical production of depictions.

**Chapter 4** continues to address objective 2, through building on the theoretical framework outlined in Chapter 3. It introduces visual palaeopsychology as a novel approach to understanding the role of the visual system within the making of cave art. This chapter first explores whether Upper Palaeolithic people “saw” the world as we do, and how visual information is processed. The importance of appreciating the mind as embedded within the world, rather than a bounded, isolated mechanism, is emphasised. This feeds into a discussion of the specific responses that may be triggered within cave environments, and how this may have influenced the making of art.

**Chapter 5** builds contextual information regarding the three case study sites, situating them within the broader climatic and ecological conditions of the Upper Palaeolithic. This chapter addresses the importance of appreciating the specific contextual information that would have shaped the minds and visual system of Upper Palaeolithic people. The ethological context of the sites is evaluated, focusing on the behaviours and characteristics of the most common species present throughout the Upper Palaeolithic in northern Spain providing an insight into the animal features that Upper Palaeolithic people may have had visual expertise in. The socio-cultural context is also discussed, to determine the particular cultural behaviours and “norms” related to art making that existed elsewhere in the Upper Palaeolithic world. This contextual background frames and provides deeper insight into the biographical discussion of cave art making in the subsequent case study chapters.

**Chapter 6** addresses objectives 3 and 4, and introduces the first case study, Las Monedas. A desk-based approach for understanding the making of depictions within this site is developed. Available publications and digital repositories of images are used for this study, allowing for a detailed picture of the placement, space, and topography of the art. 3D

photogrammetry models are produced through using available images of the art, and the models are subsequently manipulated within virtual reality lighting simulations. These simulations are utilised to determine the particular visual and perceptual effects of a low lumen light source on cave topographies, providing a tangible insight into this aspect of the cave art making. Digital tracings are also utilised to evaluate how the initial material engagement and application of pigment to draw out animal forms related to the potential visual effects experienced in the cave.

**Chapter 7** addresses objectives 3 and 4, introducing the second case study, La Pasiega, and building on the approach presented in Chapter 6 through integrating primary observations made during fieldwork. A similar approach is adopted, with the use of 3D photogrammetry models producing during fieldwork in VR lighting simulations. Higher resolution is facilitated through the primary observations available for La Pasiega, enabling a deeper exploration of the particular role of the visual and perceptual system in the making of art within this site.

**Chapter 8** addresses objective 5 and introduces the third case study, El Castillo. It further builds on the approaches presented in Chapters 6 and 7, by piloting VR psychology experiments. The experiments recorded participant's particular visual response to viewing cave art panels from El Castillo within a VR environment that simulates the lighting conditions likely experienced by Upper Palaeolithic people. This pilot demonstrates the potential of the interdisciplinary approach, allowing for tangible insights into the visual psychology involved in the making of cave art.

**Chapter 9** reflects on the approaches employed throughout this thesis, comparing the insights generated by each stage of the approach and conceptually discussing the potential implications of this approach for Upper Palaeolithic art research more broadly. The strengths and limitations of the approach are evaluated, and new avenues for future research are discussed.

## Chapter 2.

### Literature Review

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#### 2.1. Introduction

Parietal art was a ubiquitous behaviour throughout the Upper Palaeolithic world, and may be indicative of a flourish of creativity by Cro-Magnons. This has invited a breadth of diverse interpretations regarding the art, representing movements in archaeological theory that have influenced different approaches to understand this behaviour. Overarching this diversity in approaches is an emerging shift in conceptions of Palaeolithic art. Prior researchers argued art was unique to Cro-Magnons, and thus represented their cognitive or cultural complexity in contrast to their Neanderthal contemporaries (Mellars 1973; Marshack 1989, 2; Lindly and Clark 1990; Bar-Yosef 2002, 368; Mithen 2005; Mithen 2014, 9). This echoed the sentiments of early perceptions of Palaeolithic art, rooted in the Victorian dichotomy of craft vs. art / simple vs. complex, which is explored further in section 2.2.2., and reflected a linear evolutionary narrative. However, recent research has demonstrated Neanderthals also engaged in this behaviour, prior to evidence of parietal art production in Cro-Magnons (Hoffmann *et al.* 2018a; Bello 2021; Martí *et al.* 2021). In light of this new evidence, the perceived superiority of Cro-Magnons due to their artistic capabilities is more fragile than ever. This evidence also directly challenges umbrella theories which assume a single explanation for the art; the evidence of another species producing cave art shatters ideas of cultural continuity implied by some of these interpretations. Palaeolithic art research is thus at the threshold of a revolution in understandings, facilitated by new, innovative approaches that critique the previous orthodoxy of umbrella theories.

This chapter summarises the development of different approaches to Palaeolithic art, and the emergence of the current diversity of interpretations. This first contextualises approaches to Palaeolithic art, through discussing the social milieu in which it was first discovered, and ultimately shaped the initial reactions and foundations of Palaeolithic art study. Consequently, this provides a “history of prehistory”, discussing how the early discovery of Palaeolithic art, during a time where the antiquity of humans was still poorly understood, had lasting ramifications which shaped the early attitudes towards Palaeolithic art. These laid the foundation for a diversification of approaches in the latter half of the 20<sup>th</sup> Century which, in turn, appear to result in the emergence of three different modes of approaching the art, each drawing influence from other disciplines and different theoretical movements in archaeology. The literature reviewed is thus grouped according to each mode, providing a cross-section of Palaeolithic art research to be critically evaluated. The

conceptual issues which emerge from this critique are discussed, facilitating the proposal of a novel approach towards Upper Palaeolithic art which addresses these issues. This is introduced at the end of this chapter and fully developed in Chapter 3, and emphasises the importance of understanding the process of art making for developing context-sensitive interpretations.

## 2.2. Historical Context

To understand the roots of Palaeolithic art research, it is necessary to trace approaches back to the initial discoveries and interpretations in the 19<sup>th</sup> Century. Early discoveries of Palaeolithic art emerged approximately at the same time as Darwin's seminal books *Origin of Species* (1859) and *Descent of Man* (1871), and thus understandings of human origins and Palaeolithic art evolved in tandem, each shaping and being shaped by the other. Furthermore, as archaeology was still establishing itself as a discipline during this time, early interpretations attracted contributions from different disciplines. Notably, this included art history and anthropology which brought distinct, but complimentary, approaches. Art history approaches were concerned with artistic capabilities, bringing terms such as *technique*, *style*, *perspective*, and *naturalism* to Palaeolithic art research (Moro Abadía and González Morales 2013, 271), laying the foundations for later structuralist approaches. Anthropological approaches, by contrast, were more focused on the *purpose* of the art, contributing theories regarding hunting magic based on ethnographic observations of contemporary groups. This section briefly discusses attitudes and understandings in the 19<sup>th</sup> century which framed the discovery of Palaeolithic art. This presents an insight into the first interpretations of this art, and the diversification of approaches which emerged to understand it. The key players in Palaeolithic art during the 20<sup>th</sup> Century are discussed with reference to their influence on the study of Palaeolithic art. Their influence is still prevalent today, and thus this historical context contributes important context for evaluating particular approaches in contemporary research.

### 2.2.1. Understanding the antiquity of humans

The 19<sup>th</sup> Century saw a revolution in the understanding of human antiquity. It had long been believed that the Earth had been created in 4004BC, as infamously calculated by James Ussher in the 17<sup>th</sup> Century (O'Connor 2007, 1). However, this was soon to be overturned. Several discoveries by notable geologists laid the foundations for debates surrounding human antiquity, prior to the publication of Darwin's seminal works or Lyell's (1863) *The Geological Evidences of the Antiquity of Man*. In 1847, inspired by recent developments in geology, Boucher de Perthes discovered handaxes in the gravels of the River Somme (France) (McNabb 2012, 32). His publications claimed they were associated to extinct animals, thus suggesting ancient human origins, but the poor quality of his

illustrations combined with assertions that contrasted with Lyell's (1832) work on gradual geological change resulted in the rejection of his conclusions (O'Connor 2007, 7; McNabb 2012, 32; Moro Abadía 2015, 4). However, further work began to corroborate his discoveries. In 1858 at Brixham Cave (England), Pengelly and a team of prominent geologists (including Prestwich and Evans) discovered stone tools associated with extinct animals under a thick stalagmite layer (Pettitt and White 2011, 31; Moro Abadía 2015, 4). In the same year, Prestwich and Evans discovered an *in situ* handaxe at St Acheul (France) within deep gravels. This work, despite being met with scepticism (e.g. Whitley 1878), verified Boucher de Perthes work and confirmed the anthropogenic origins of these ancient stone tools (Davies 2009, 130; McNabb 2012, 33; Moro Abadía 2015, 4; Needham 2017, 16). The validation of this work sparked interest from the wider scientific community and inspired other archaeologists to search for prehistoric artefacts.

1859 was a notable year for changing perceptions on human antiquity. Darwin's *On the Origin of Species*, although famously only fleetingly mentioning the evolution of humans, stimulated discussions regarding human evolution, including those regarding race and the perceived superiority of white, Western societies (McNabb 2012, 27). This, combined with the discoveries of stone tools by Prestwich and Evans the year prior, began to paint a picture of ancient origins for humanity. Lyell's (1863) *The Geological Evidences of the Antiquity of Man* provided, for the first time, a comprehensive evaluation of the evidence for human antiquity with relation to geological chronologies. Notably, Lyell (1863), discusses the fossil evidence of Neanderthals from Neander Valley (Germany) and Engis (Belgium). His own work on these fossils, in collaboration with Huxley, provided a direct comparison between the dimensions of the Neander Valley and Engis skull and human skulls (specifically stated as those of a European and Indigenous Australian) and a chimpanzee skull. Although this serves as an example of the growing acceptance of human evolution and antiquity, it also demonstrates that the foundations of Palaeolithic archaeology were inseparable from the racist perceptions on human variation during this period.

This ultimately enabled the theory of evolution to be more palatable for a Victorian audience; a narrative was spun of humanity advancing from its brutish past to achieve the sophistication of modernity. Consequently, this served to legitimise colonialism and racism; non-White and non-Western societies were considered "primitive", abhorrently portrayed as living fossils, frozen in past ways from which the ancestors of Western society had escaped (Wylie 1985, 66-68; Kelly 2013, 6). Non-Western societies were perceived as representative of the conditions and lifeways of Palaeolithic societies, as characterised by this quote from an article published in 1894: "The Tasmanians... [give] an idea of the conditions of the earliest prehistoric tribes of the Old World, at a somewhat less advanced

stage of stone implement making than were the men of the Mammoth Period in Europe” (Tylor 1894, 143). Victorian society had thus accepted the narrative of evolution as progression; their society was perceived as the pinnacle of a process which had been ongoing for millennia and this belief was rooted deep within their worldview, replacing religious, creationist beliefs (McNabb 2012, 2). This perception is characterised both by Lubbock’s (1865) *Prehistoric Times*, which describes humanity as progressing from savagery to modern civilisation, and the rapid adoption of Thomsen’s “Three Age System” which assumed technology evolved on a linear trajectory from stone, to bronze, to iron (Moro Abadía 2006, 124). It is important to be sensitive to the role archaeology and anthropology played in enabling this perception, through drawing direct comparisons between Palaeolithic material culture and that of contemporary non-Western societies. This framed the discovery of Palaeolithic art, influencing the responses and interpretations of it from academics at the time. Thus, one must be aware of the political intention of early interpretations, and how this has quietly informed current interpretations of Palaeolithic art unchallenged.

### 2.2.2. *Discovering Palaeolithic art*

The early excavations by Prestwich and Evans encouraged more excavations to search for evidence of ancient humans. In 1864, a publication by Lartet and Christy (published in full in 1875) described the first Palaeolithic art objects discovered at the sites of La Madeleine and Laugerie (Dordogne, France). This included an engraved mammoth on mammoth ivory from La Madeleine, which irrefutably demonstrated humans lived contemporaneously with extinct, Pleistocene animals (Figure 2.1) (Laming 1959, 15; Paillet 2011, 224). In the same year, a female anthropomorphic figurine was discovered at Laugerie-Basse by de Vibraye, which was followed by subsequent discoveries of similar figurines at Grimaldi in 1883 and 1892 and Brassempouy in 1892 (Moro Abadía 2015, 4).

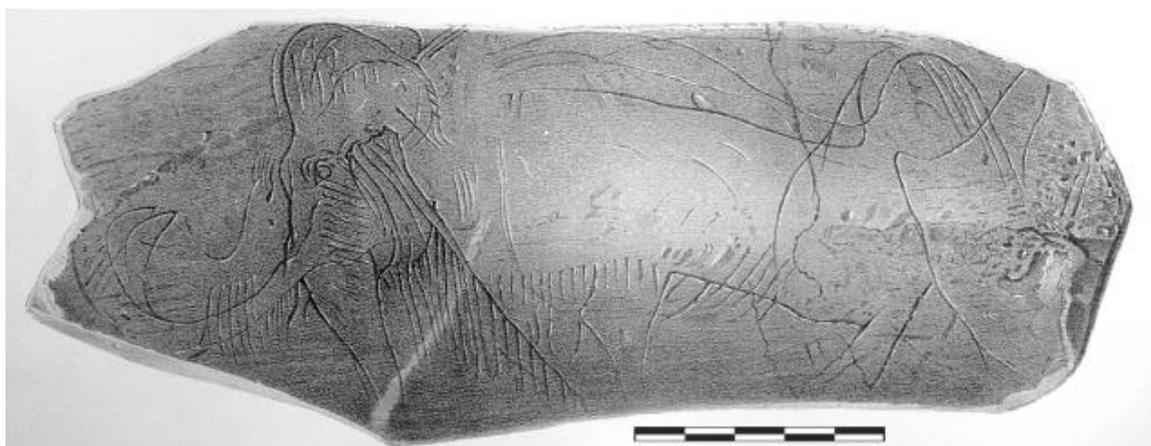


Figure 2.1. First tracing of the mammoth ivory portable art object from La Madeleine, by Lartet and Christy. Image: Paillet 2011, 234.

These discoveries of portable art caused a progress paradox; if humanity developed from its primitive beginnings to contemporary society, how could something as sophisticated as art be present in these primitive societies? (Moro Abadía 2006, 124). This challenged the evolutionary narrative, but did not completely undermine it. The concept of “arts vs. craft”, rooted in Renaissance and Enlightenment thinking and culminating in the 18<sup>th</sup> Century, formed one of the founding principles of 19<sup>th</sup> century society (Moro Abadía 2006, 121; Moro Abadía and González Morales 2013, 274). Craftspeople were perceived as only imitating behaviour within their trade and relying on practical knowledge. By contrast, fine art was perceived as the pinnacle of high society; artists captured beauty, through incorporating naturalism within their work. Thus, portable art was perceived and interpreted as craft, evoking connotations of crudeness and primitivity. Prominent academics at the time, such as de Mortillet and Piette, began to favour interpretations of portable art objects as the product of “impulses of leisure”, and thus were nothing more than art for art’s sake (Richard 1993, 62; Moro Abadía 2006, 121).

Anthropology and racist comparisons with contemporary cultures served to further support this perception. During the same time as the discovery of portable art, “primitive art” from contemporary cultures were being housed and systematically organised in museums, from the most abstract to the most naturalistic (Moro Abadía 2015, 2). Consequently, Palaeolithic art was soon compared to contemporary non-Western art, both becoming synonymous with the term “primitive art”. The most notable example which reflects these attitudes is the comparison between female anthropomorphic figurines, such as those discovered at Laugerie-Basse, Grimaldi and Brassempouy, to Saartje Baartman, a Khoisan woman. In the early 19<sup>th</sup> Century, she had been convinced to tour as a live human exhibit, and billed as the “Hottentot Venus” with her steatopygic fat deposits piquing the interest of scholars (Needham 2017, 14). This inspired later comparisons between the dimensions of the figurines from Palaeolithic sites and Saartje Baartman (e.g. MacCurdy 1924a, 29; MacCurdy 1924b, 472; Hornblower 1929, 30), and thus the term “Venus” figurine was coined (White 2006, 263). This further fuelled Victorian ideas of progress, through suggesting to Victorian audiences that their distant origins were comparable to that of their “savage” contemporaries.

This widespread, although deeply problematic, acceptance of Palaeolithic portable art in the 19<sup>th</sup> Century was undermined by a surge of forgeries produced throughout the world. These attempted to replicate the engraved mammoth artefact from La Madeleine, to varying degrees of success. Notably, American researchers in 1890, frustrated at the Eurocentric focus of Palaeolithic discoveries, forged several Palaeolithic portable art objects, including an engraving of a mammoth on a perforated 1,500-year-old shell

fragment (Figure 2.2) (Paillet 2011, 239). Subsequently, this caused considerable issues for Palaeolithic research. Palaeolithic portable art was a new concept, and the most prominent example depicted an unfamiliar, extinct species. Thus, how can one distinguish between a forgery and the authentic artefact? This interference distorted the Palaeolithic record, and quickly researchers had to become critical of the surge of artefacts emerging, carefully analysing new discoveries for signs of forgery.

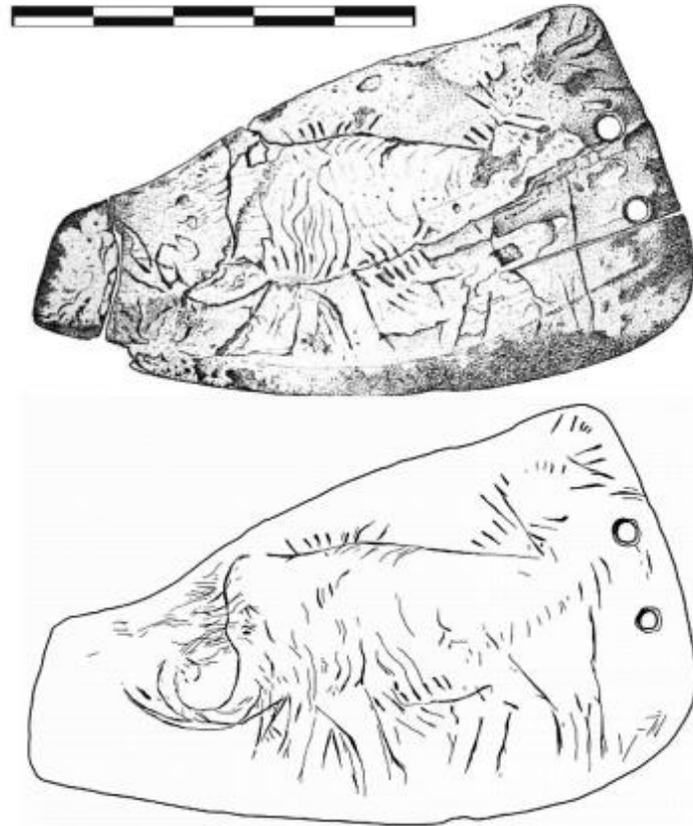


Figure 2.2. Forgery of a marine pendant with a mammoth engraving. Image: Paillet 2011, 240.

The scepticism which was instilled within the discipline due to these forgeries, combined with the arts vs. craft division in the Victorian worldview, provides some insight into the response of the first reported Palaeolithic cave art. In 1879, the discovery of cave art at Altamira sparked controversy, as its highly naturalistic attributes appeared to fit the Victorian definition of fine art (Moro Abadía 2006, 128; Conkey 2010, 273). Altamira was not the first Palaeolithic cave art to be “discovered” *sensu stricto*; paintings from other sites were known, but were either overlooked or not paid any attention. For example, in 1864, Garrigou visited Niaux Cave and upon observing the paintings only noted “There are some paintings on the wall: what on earth can they be?” (Laming 1957, 16). Altamira was, however, the first site to be considered of prehistoric origin. Vilanova was convinced the art was produced during the Palaeolithic period, and presented this conclusion to an international congress in Lisbon in 1880 (Davies 2009, 132). Most were not convinced, or merely disinterested, in the antiquity of Altamira and it was quickly dismissed as a hoax.

Cartailhac was notably sceptical of its authenticity, Evans was requested to visit the site but appeared to not respond, and Harlé pronounced the art as a modern forgery in 1882 (Laming 1957, 17; Davies 2009, 132).

Despite this rejection, numerous discoveries of Palaeolithic art emerged over the following years, continuing to challenge previous evolutionary narratives. Léopold Chiron reported engravings in Chabot cave in 1889, Rivière presented the cave art at La Mouthe to the Académie des Sciences in 1895, the engravings at Pair-non-Pair were reported in 1896, the Marsoulas paintings in 1897, and Les Combarelles and Font-de-Gaume in 1901 (Myers 1917, 100; Laming 1957, 17). This mounting evidence of Palaeolithic cave art placed pressure on those sceptical of their authenticity. Cartailhac's (1902) publication *Mea Culpa d'un Sceptique* accepted the cave paintings at Altamira as legitimate. Following this publication even more cave art sites were reported, representing a change in attitudes towards Palaeolithic art (Table 2.1). Thus, the turn of the century reflects a growing appreciation for the complexity of Palaeolithic society, facilitated both by anthropological studies which demonstrated the complexity of contemporary "primitive" societies, and by the increasing evidence of complex behaviours in the Palaeolithic (Moro Abadía 2006, 130).

Table 2.1. Sites reported between the end of the 19th Century and start of the 20th Century.

Site	Year of Discovery
Altamira	1879
Chabot	1889
La Mouthe	1895
Pair-non-Pair	1896
Marsoulas	1897
Les Combarelles	1901
Font-de-Gaume	1901
Le Mas d'Azil	1901
La Ferrassie	1902
Bernifal	1902
El Castillo	1903
Covalanas	1903
Hornos de la Pena	1903
Teyjat	1903
El Pendo	1905
Niaux	1906
Le Cap-Blanc	1910
La Pasiéga	1911
Le Tuc d'Audoubert	1912

Les Trois-Frères	1912
Santimamiñe	1916

### 2.2.3. Early approaches and conceptual issues

This backdrop framed the emergence of responses to Palaeolithic art. The wealth of evidence emerging within Europe of Palaeolithic parietal art demanded methodological and theoretical frameworks to understand this behaviour. In particular, and perhaps influenced by the emphasis on evolutionary progress during the Victorian period, there was a focus on attempting to develop chronologies for the art. Abbé Henri Breuil, a prominent figure who pioneered the detailed recording of Upper Palaeolithic art, was notably influenced by work in the 19<sup>th</sup> Century. Breuil used style as a method for producing chronologies for Palaeolithic art, drawing on his training as an art historian (Moro Abadía 2015, 12). He proposed a unilinear evolutionary theory for Upper Palaeolithic art, and initially suggested it developed through four phases of progressive continuity from crude, abstract drawings in the Aurignacian to highly naturalistic depictions by the Magdalenian period (Moro Abadía and González Morales 2008, 533; Moro Abadía 2015, 12). This was later revised to propose two cycles of Upper Palaeolithic art: the Aurignacian-Perigordian cycle; and the Solutrean-Magdalenian cycle. This approach was adopted as a method to date Palaeolithic art. For example, the use of polychrome and fine detail was perceived as the pinnacle of Upper Palaeolithic art, defining later styles, and thus all depictions that reflected these features were attributed to the Magdalenian (e.g. Riddell 1942, 136). Breuil's influence during the first half of the 20<sup>th</sup> Century enabled art history to actively shape approaches to Palaeolithic art. Consequently, terms from art history became frequently used to describe Palaeolithic art, and several researchers emphasised the importance of analysing Palaeolithic art from an art history perspective (Moro Abadía and González Morales 2013, 271).

Whilst this approach focused on the form and style of the art, and tracing its development throughout the Palaeolithic, emerging anthropological approaches were simultaneously attempting to understand the *role* of the art with past societies (Palacio-Pérez 2013, 702). Thus, direct comparisons between rock art produced by contemporary non-Western societies and Palaeolithic rock art were encouraged. This inspired the emergence of hunting magic as a popular explanation for the role of Palaeolithic art, initially proposed by Reinach (1899) with reference to portable art, and in his seminal publication *L'art et la magie* in 1903 (Palacio-Pérez 2010, 9). The frequency of prey species was noted in descriptions of Palaeolithic art, suggesting this may reflect totemism, and attempts to increase hunting success. These interpretations used direct analogies with contemporary non-Western societies, heavily drawing on ethnographic accounts of San, Inuit, Indigenous Australian, and Native American societies (e.g. Fry 1910; Myers 1917, 106; Burkitt 1921,

185; Mac Curdy 1924, 27; Breuil 1930; de Laguna 1932). Additionally, the association of arrow-like shapes to animal depictions in Palaeolithic art and the interpretation of “shamans”, often characterised as anthropomorphic depictions with zoomorphic elements, in the art further supported these interpretations (MacCulloch 1906, 488; Myers 1917, 109; Moro Abadía and González Morales 2013, 280).

#### *2.2.4. A sign of the times? Emerging disparities in approaches to Palaeolithic art*

The emerging approaches towards Palaeolithic art in the 20<sup>th</sup> Century thus saw two different modes of understanding art: 1) influenced by art history, a focus on the form and style of the art; and 2) influenced by anthropology, a focus on the role and function of the art in past societies. Although these two approaches are not mutually exclusive, and thus were initially complementary, theoretical movements within archaeology resulted in a more pronounced disparity between the two.

The first mode of understanding was shaped by Breuil’s stylistic approach, which heavily influenced later structuralist approaches that dominated during the mid- to late-20<sup>th</sup> Century. Leroi-Gourhan (1968) work, in particular, was inspired by Breuil’s approach. Although Leroi-Gourhan critiques Breuil’s chronology, his own stylistic chronology for phases of development in Upper Palaeolithic art (Figure 2.3) is clearly influenced by the same unilinear evolutionary theory initially introduced by Breuil. Breuil’s art historian approach which focuses on form and style also influenced Laming-Emperaire’s (1959) structuralist work, later adopted by Leroi-Gourhan, on Upper Palaeolithic art. This infusion of art history in Breuil’s work perhaps inspired Laming-Emperaire’s perceptions of Palaeolithic art as intentional compositions; the depictions were believed to be placed in deliberate relationships to one-another which followed the underlying structure of certain binaries, such as male-female opposition (Laming 1959, 198; Moro Abadía and González Morales 2013, 280). The structuralist approach became favoured over “hunting magic” interpretations, and this was likely a consequence of contemporary theoretical movements. New Archaeology and processualism which emerged in the 1950’s and 1960’s, represented a conceptual shift towards attempting to model and predict past behaviours (Whitley 1998, 4). Consequently, it resonated well with the models provided by structuralism.

YEARS B.C.	CULTURE	PERIOD	EXAMPLE
5,000			
10,000	LATE MAGDALENIAN V-VI	CLASSIC (STYLE IV)	
	MIDDLE MAGDALENIAN III-IV		
15,000	EARLY MAGDALENIAN I-II	ARCHAIC (STYLE III)	
	SOLUTREAN		
20,000	INTER-GRAVETTIAN- SOLUTREAN	PRIMITIVE (STYLE II)	
	GRAVETTIAN		
25,000		PRIMITIVE (STYLE I)	
30,000	AURIGNACIAN		

Figure 2.3. Leroi-Gourhan's system for categorising Upper Palaeolithic art according to style. Image: Leroi-Gourhan 1968, 63.

The critique of processualism and a re-emphasis on social behaviours in the post-processualist movement since the late 1970's returned to emic anthropological approaches, through focusing on symbolic and interpretive approaches (Hodder 1985; Leone 1998, 51; Shanks and Hodder 1998, 69). This saw a resurgence of conceiving of Palaeolithic art as a product of, and reflecting, socio-cosmological beliefs. Although the term "hunting magic" fell out of use, it was replaced with concepts of shamanism and ritual as the impetus for producing the art. The most notable advocator for the re-introduction of shamanic interpretations of Palaeolithic art was the anthropologist Lewis-Williams. His interpretations, like the "hunting magic" interpretations of his predecessors, heavily relies on drawing analogies with ethnographic accounts of one non-Western group, the San (e.g. Lewis-Williams 2002). Lewis-Williams' attempt to provide a singular explanation for Upper Palaeolithic art characterises the emergence of broad umbrella theories during this time. This "big-thinking", although beneficial for encouraging the consideration of social and

cultural context, problematically generalised a suite of temporally and spatially widespread behaviours.

Consequently, it is apparent that the rich historical context of the discipline has influenced the plethora of current interpretations of Upper Palaeolithic cave art, which are continuing to follow the trajectory of understanding and approaches founded in the early 20<sup>th</sup> Century. New approaches have also emerged onto the scene which attempt to move away from focusing on the final form of the art to understand the *process* involved. These resonate with, and are influenced by, recent relational theories in archaeological discourse, which perceive people and things as entangled, continuously in *processes of becoming* (e.g. Ingold 2008a; 2008b; Hodder 2011; 2012; 2014; Gosden and Malafouris 2015). Consequently, it is argued here that current research can be categorised within the following conceptual approaches:

**1) Fixating on form.** This research follows the trend of art history approaches from the early 20<sup>th</sup> Century and structuralist approaches, focusing exclusively on the final form of the depictions.

**2) Accessing function.** This research follows the trend of anthropological approaches, particularly those which re-emerged with the post-processual movement in the late 1980's/early 1990's, and attempts to understand the role of the art within past societies.

**3) Understanding process.** This research appears to be a response to the issues of the prior two categories, following the recent emergence of relational theories in the past decade, and attempts to use interdisciplinary approaches to understand processes involved in producing the art, rather than focusing on the final product.

The following sections of the literature review will thus conform to these aforementioned categories. Each category will be first defined in terms of its perceived historical roots, establishing the protagonists in pioneering the approach, and an overview of the trajectory of research since the 20<sup>th</sup> Century. Research which has been attributed to these categories is then evaluated, reviewing both the trends of interpretation, and critically evaluating the benefits and limitation of the approach. Only research from the past 40 years will be evaluated; this limit represents the start of post-processual critique, and thus intends to obtain a representative sample of different approaches towards Palaeolithic art. The research evaluated here is focused on that which discusses Upper Palaeolithic cave art; however, often it is not discussed exclusively and thus publications which reference other forms of Upper Palaeolithic art are also included.

## 2.3. Approaches to Palaeolithic Art: Fixating on Form

Stemming from the art historical approaches of the 20<sup>th</sup> Century, conceptual approaches which fixate on the form of the art are defined here as attempting to produce objective analyses of specific attributes of the art. These are thus heavily influenced by Breuil, Leroi-Gourhan and Laming-Emperaire's work, and have a trajectory of categorising and modelling Palaeolithic art. However, this approach also draws some influence from anthropology, primarily through the use of structuralism. There appears to be three prevailing categories within which this is conducted. The first focuses on the stylistic and technical aspects of the art, continuing to use approaches from art disciplines to provide more in-depth understanding. In some cases, researchers are formally trained artists with a limited background in archaeology, highlighting the extent art history has influenced this form of approach. The second category, drawing some influence from structuralist approaches, attempts to assess the placement of the art, perceiving the art as a deliberate composition. The third category, reminiscent of 19<sup>th</sup> Century ideals of fine art, focuses on the naturalistic attributes of the art and the different methods used by Palaeolithic artists to capture animal form.

### 2.3.1. *Style and technique*

During early chronologies of Upper Palaeolithic art in the mid-20<sup>th</sup> Century, stylistic and technical attributes of Palaeolithic cave art were an integral feature to analyse, particularly when secure direct-dating of art was lacking, as characterised by Leroi-Gourhan (1968, 59):

*"let us imagine an art historian who must arrange in their correct chronological order 1,000 statues belonging to every epoch from 500 B.C. to A.D. 1900. Imagine further that his only points of reference are five or six of the statues that are by chance correctly dated. The prehistorian's position is the same - or worse".*

The influence of art history was thus crucial to enable the development of chronologies for art. The definition of style by the art historian Schapiro (1953, 287) as a system of forms which make visible the artist's personality and a group's worldview perhaps encouraged the use of style to distinguish temporal differences within the art (Moro Abadía and González Morales 2007, 114). However, recent advances in dating methods have enabled direct dates to be obtained which appear to suggest the development of Upper Palaeolithic parietal art was more complicated. The Aurignacian dates obtained through AMS radiocarbon dating for three Chauvet depictions (Valladas *et al.* 2001), although contentious (Pettitt and Bahn 2003; 2015; Jouve *et al.* 2020), enabled this narrative to be initially challenged. More reliably, the Sulawesi babirusa depiction, dated to 36,900 B.P. by U-Series (Aubert *et al.* 2014) encourages a reconsideration of the stylistic development of Upper Palaeolithic art. Although disputed (White *et al.* 2020), recent evidence of Neanderthal

production of art (Rodríguez-Vidal *et al.* 2014; Hoffmann *et al.* 2018a) serves to demonstrate one can no longer perceive parietal art as a phenomenon that is restricted to, and subsequently progressively evolved within, Cro-Magnons.

Thus, there is a debate surrounding whether stylistic approaches are still relevant within current research (Moro Abadía and González-Morales 2007, 110; Pigeaud 2007, 409). Notably, Von Petzinger and Nowell (2011, 1170-1173) coherently demonstrate the current issues with stylistic dating, particularly the lack of using directly dated sites as anchor points for stylistic comparison. However, Von Petzinger and Nowell (2011, 1180), and others (Pigeaud 2007; Groenen and Groenen 2017; Ochoa *et al.* 2018), argue that stylistic approaches still have a place when used critically, particularly in determining more nuanced cultural changes in depicting animals and as both AMS radiocarbon and U-Series dating have their limitations. For example, through critically evaluating stylistic categories, and eliminating attributes of depictions that likely reflect natural variation in horses (e.g. elongated or “duck-billed” noses), Pigeaud (2007) provides an in-depth analysis of stylistic attributes of horse depictions. This is applied to depictions at Parpalló and identifies a subtle shift in depicting horses during the Solutrean, which appears to correspond to a shift in subsistence (Pigeaud 2007, 420).

Similarly, Groenen and Groenen (2017) utilised stylistic analysis at El Castillo to understand the specific placement and chronology of the depictions. Through classifying the depictions according to their technical attributes (e.g. painted, drawn, engraved) and their form (e.g. non-figurative, anthropomorphic, specific animal representations), Groenen and Groenen (2017) identified El Castillo is unlikely to be a composition, but rather the product of several sets of small iconographic ensembles that are formally and stylistically distinct. This enables in-depth insight into the intentional association of certain animals e.g., the nesting of a horse inside an aurochs, both of which are engraved and stylistically similar (Groenen and Groenen 2017, 136). Furthermore, it enabled the uneven distribution of motifs to be suggested as the product of intentional decisions of Palaeolithic artists not to occupy the same space as their predecessors (Groenen and Groenen 2017, 141). Ochoa *et al.* (2018) further demonstrate the importance of stylistic dating when, as proposed by Von Petzinger and Nowell (2011), it is based on securely dated examples. They identify three portable art pieces that are confidently attributed to the Gravettian and determine the stylistic features exhibited within these examples. This provides characteristics which may be representative of Gravettian art in northern Spain which have not previously been determined (e.g. simple outline, disproportioned anatomical features) (Ochoa *et al.* 2018, 8 – 9). This stylistic evaluation therefore enables future research to stylistically attribute both

parietal and portable art from this region to the Gravettian, providing an alternative dating method to identify pre-Magdalenian art.

However, although this research demonstrates some of the benefits of approaching Palaeolithic art through style and technique, there are conceptual issues with interpretation where research remains confined by a structuralist approach. For example, Fritz and Tosello (2007) discuss the methods for documenting and understanding art, and present research which reconstructs the order of strokes used to depict the confronting rhinoceros at Lascaux. Utilising imaging techniques, this presents a detailed insight into the production of the art, and the stylistic approach used to depict the animals. Despite the vast potential depth of information that can be acquired through this approach, Fritz and Tosello's interpretation remains limited to a fixation on the form and structure of the art. They openly adopt a structuralist approach, and perhaps overlook some of the limitations in doing so (Fritz and Tosello 2007, 69). Their fair critique of the Western connotations of the term "art" (Fritz and Tosello 2007, 48) could be argued to be the same issues as adopting a structuralist approach, where binary dichotomies and structures that are frequent in Western worldviews are assumed to be universal. Their interpretation perceives the art as representing the intentional actions of an artist producing a preconceived composition and consequently does not appreciate the deeper nuances within the making of the art.

This is arguably a Westernised perception of art production; in many contemporary non-Western societies (see Chapter 3), art production is social, often featuring as an intrinsic part of a group-wide behaviour. Additionally, they assume that the superimposition of animals, whilst preserving their form, must be the consequence of an artist intentionally fusing these two figures together, rather than considering other, more plausible, explanations (Fritz and Tosello 2007, 72). For example, if one considers numerous people were involved in the production of the art, the art may represent the product of social interactions, with fused animals reflecting intimate relations. Similar style, as suggested by Fritz and Tosello (2007, 63) themselves, does not necessarily reflect the same hand producing the art, but rather a specific cultural convention for depicting certain animals. Perhaps as a result, their interpretation is speculative and unclear, broadly suggesting the depictions may represent either a narrative or a mythical universe (Fritz and Tosello 2007, 77). This serves to demonstrate the limitations of employing a structuralist approach; despite potential for nuanced understandings grounded in stylistic and technical attributes, it is limited by perceiving art as a composition produced by a single person.

### *2.3.2. Placement and compositions*

Subsequently, interpretations which heavily rely upon a structuralist approach and concern themselves with the placement or composition of Palaeolithic cave art are likely to

be intrinsically limited by the constraints of this approach. Unsurprisingly, terms derived from structuralism, such as “scene”, “composition”, and “association” have been critiqued by Dobrez (2012), who conceptually argues that they are the product of a subjective perspective where one may see relationships between depictions that do not exist. There are only a few examples, critiqued here, where this terminology and a structural approach are used explicitly. Instead, it appears these approaches have gradually permeated a suite of Upper Palaeolithic art research, and is particularly apparent in those which seek to provide a universal explanation for the function of cave art (see section 2.4.).

One of the examples which interprets Upper Palaeolithic art as representative of structural binaries based on placement and composition, is Gonzalez-Garcia’s (1987) analysis of depictions at the Monte Castillo sites. Gonzalez-Garcia (1987, 128) categorises the panels in which depictions are placed as either convex, concave, flat, or various-forms. This appears to reveal horses as being consistently placed on concave panels and bison on convex panels. Thus, this suggests horses have a negative influence of the cave space and bison have an imposing influence, evoking sentiments of Leroi-Gourhan’s (1968, 61) binary association between horses as male and bison as female. However, this dichotomy is problematic. Through seeking a binary pattern within the art, the depictions are assumed to be contemporaneous with one-another – very likely not the case for the Monte Castillo art - and depictions of other animals that fall outside of the pattern are overlooked. It also assumes that binary oppositions, frequent in the Western world but less so in other societies, are universal and existed in deep past societies.

Similarly, Sauvet and Wlodarczyk (1995; 2008), heavily influenced by Leroi-Gourhan and Laming-Emperaire’s structuralist approach, used statistical analysis to evaluate the relationships between certain animals in Upper Palaeolithic art. They analysed over 3,000 depictions across 85 sites, to draw out patterns of co-occurrence between different depicted animals. This approach assumes compositions exist in Upper Palaeolithic art, and overlooks the likelihood of the art being a palimpsest of extensive temporal depth. They propose a “formal grammar” to the art, suggesting all Upper Palaeolithic art conforms to a specific set of rules, and argue depictions follow a small subset of combinations (e.g. horse-bison-ibex). This overgeneralised interpretation of Upper Palaeolithic art has been heavily critiqued; the statistical analysis appears to intentionally create patterns, even when associations between depictions are limited, and other forms of art were ignored (Davidson 2018, 6).

### *2.3.3. Naturalism and capturing animal form*

The use of naturalism to explore the techniques used to capture animal form is an interesting alternative application of art historical approaches, and emphasises the in-depth

knowledge Palaeolithic hunter-gatherers had of the animals they depicted. Although this still focuses on final form, this research adopts ethology to provide a comparison between Pleistocene animals and depictions, demonstrating that what is often perceived as “style” is in fact an accurate representation of animals. A notable example that overturns previous assumptions regarding stylistic attributes is the genetic analysis of Pleistocene horses by Pruvost *et al.* (2011) which argues the coats depicted in Palaeolithic art represents the variation of different coats in Pleistocene horses (Figure 2.4). Thus, horse depictions that were previously perceived as highly stylised are in fact an accurate representation of these animals. This is a somewhat reductionist explanation against style, which overlooks the extension of the proposed coat-pattern beyond the body of the horse, as with the “spotted horses” of Pech-Merle.



Figure 2.4. Comparison of genetic reconstruction of horse coats to the variation of horse coats depicted in Palaeolithic cave art. French cave art sites from which the horse depictions are from (left to right): Lascaux; Chauvet; Pech-Merle. Image: Pruvost *et al.* 2011, 4.

Ethological approaches have enabled nuanced insight into the information embedded within Upper Palaeolithic art. An impressive example is the interpretation by Aujoulat (2004) of the depictions of animals at Lascaux reflecting different seasons, evident in the particular way features of the animals were depicted to capture seasonal variation (e.g., coat variation, presence of antlers). In the same vein, Azéma (2009; 2010) provides an extensive evaluation of the specific attributes of Pleistocene animals, including their physical form, behaviours, and movements and compares this to the attributes of animal depictions. This provides insight into the specific animal movements and behaviours that are being captured in Palaeolithic art, contributing nuance to the significance of the *form* of depictions. However, Azéma’s (2008) publication takes a more overtly structuralist approach in the naturalistic analysis of depictions, discussing the specific themes that present themselves in Palaeolithic art, and the models in which these themes appear to conform. Although providing the depth of nuance achieved in Azéma (2009; 2010), it is

constrained by this use of structuralism. In stark contrast to Aujoulat's (2004) grounded approach at one site, Azéma (2008) divides a vast suite of Upper Palaeolithic parietal art sites into specific geographical "zones", which overlooks the temporality that inherently divides these depictions. Grouping in this manner fosters generalisations, and thus restricts the interpretations that emerge. Consequently, the results which demonstrate aggressive movements or behaviours dominate in depictions over non-aggressive or hunting behaviours (Azéma 2008, 135), lacks pertinence; it does not determine how this may vary panel-to-panel, site-to-site, or period-to-period. Although this is discussed with relation to specific sites (e.g. Chauvet, Trois-Frères), it does so only in the context of providing examples for the generalisations made.

However, naturalistic generalisations can be useful when providing a "key" to understanding the movements encapsulated in Upper Palaeolithic art. For example, Guthrie (2005) intricately assesses the naturalistic features of Palaeolithic art, comparing the features to those of the animals and their movements. Guthrie (2005) systematically identifies the anatomy, movements, behaviours (e.g. mating competitions), seasonality, natural variations (e.g. in coat, antlers/horns) of Pleistocene animals that are depicted in Palaeolithic art. This assessment demonstrates the immense naturalistic knowledge encapsulated within each depiction, and the astounding attention to detail of Palaeolithic artists. The impressive detail provided by Guthrie serves to highlight the frequency by which contemporary researchers overlook or mistake naturalistic features for a form of style. Guthrie (2005, 100-107) identifies numerous depictions interpreted as hybrids, shamans, or mythical animals that may simply be a consequence of novice artists, who unintentionally depict certain anatomical features (legs, horns etc.) in a way that appears anthropomorphic or mythical. This level of detail is also highlighted by Cheyne *et al.*'s (2009) evaluation of the dimensions of cave art. This demonstrated that the most diagnostic (or salient) features of an animal are likely to be over-emphasised in cave art depictions, thus potentially reflecting the intuitive ability of Palaeolithic people to identify certain animals according to their most recognisable features.

Another feature of cave art identified by researchers is its cinematic or animated properties; both Wachtel (1993) and Azéma and Riviere (2012) independently comment upon this feature. Wachtel (1993), inspired by the Impressionist, Cubist, and Futurist movements in art, discusses Palaeolithic art which appears to "come alive" when observed through a limited or flickering light-source. The description of observing depictions at La Mouthe under these conditions provides a vivid picture of how Palaeolithic art may have been intended to appear animated to the observer, with superimposed lines concealing features of animals that appear and disappear in flicking light (Wachtel 1993, 137). Azéma

and Riviere (2012) also discuss the breadth of techniques used by Palaeolithic artists to capture the movement of animals. Specifically, they note the superimposition of multiple anatomical features of an animal in slightly different positions (Figure 2.5), suggesting a “flick-book” style of capturing movement. If this depiction was observed under a flickering light source, one position of the animal would be visible, and then another, giving the appearance of movement. Additionally, they note this technique is not limited to cave art and is used on both plaquettes and rondelles; for the latter, their experimental research reconstructing the rondelle from Laugerie-Basse proposes that as the object spins, it would animate the depicted animal (Azéma and Riviere 2012, 322). Both examples serve to provide an alternative perspective to understanding and perceiving Upper Palaeolithic art.

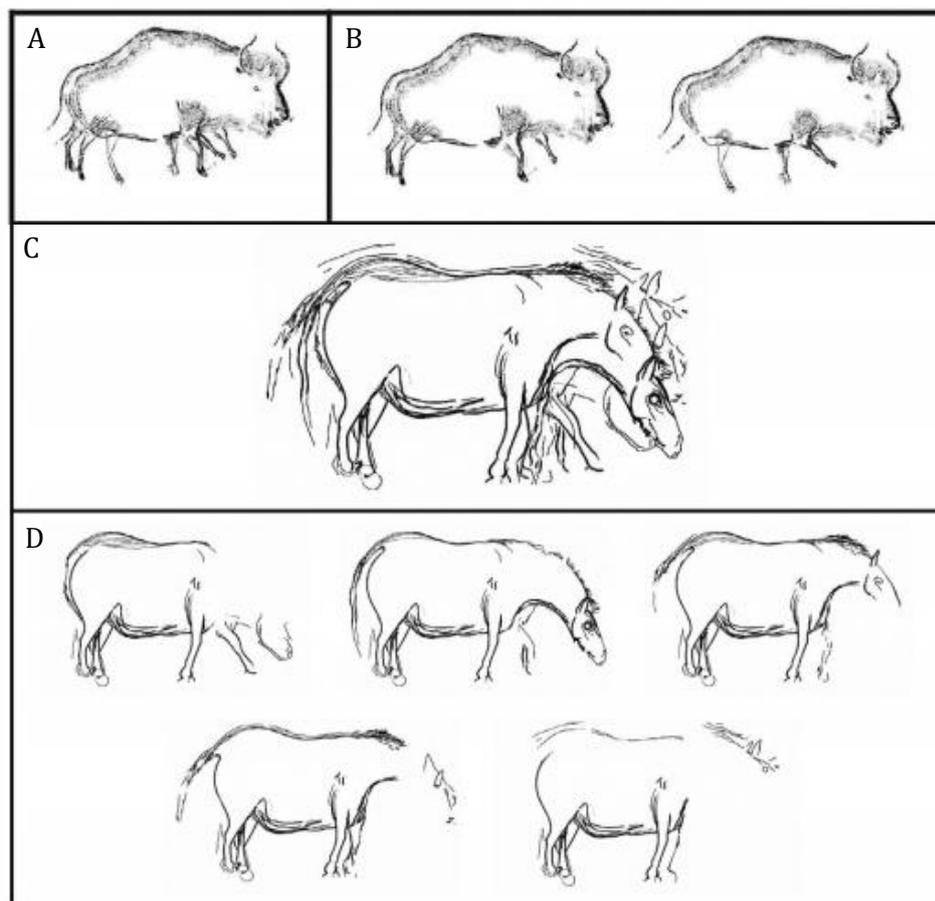


Figure 2.5. Superimposition of animal forms to give the impression of movement. A) Bison depiction from Chauvet Cave. B) Breakdown of the superimposed depictions from A. C) Horse depiction from plaquette at La Marche. D) Breakdown of superimposed figures from C. Image after: Azéma and Riviere 2012, 319.

The naturalistic and ethological attributes of Upper Palaeolithic art are thus important to recognise, as demonstrated by the aforementioned authors. When used in a structuralist manner to produce a generalised pattern or model for the art, this approach is problematic and cannot achieve in-depth insight into the specific naturalistic features of depictions. However, when used to enable researchers to identify naturalistic features in specific examples of art, it can reveal nuanced insight regarding intentionality behind the

specific animals depicted. Fixation on final form remains an issue, but the honest use of approaching art in this way renders critiques of this approach inconsequential. These approaches do not attempt to read meaning or function into the art, but rather provide a different perspective; one where the immense knowledge of Palaeolithic hunter-gatherers reflected in their art is appreciated.

#### *2.3.4. Fixating on form: Conceptual issues?*

There is a trend in research that approaches Palaeolithic art through entrenched art historical methods to over-emphasise the importance of the final form of the art. This fixation on form can occasionally restrict interpretations, particularly when research attempts to access the wider socio-cultural context of the art through this approach. This approach fundamentally places the broader context as secondary, with the attributes of the art as primary. This is not inherently problematic, but is an issue if research attempts to discuss social context; it is added only as an embellishment to the analysis, rather than being an integral research question which drives the analysis. This perhaps characterises the overarching conceptual issue with art historical approaches. As an approach fundamentally derived from a Westernised conception of “art”, it does not always appreciate the multitude of social behaviours intertwined with the production and use of art within societies. This is more pronounced in approaches which adopt structuralism, and thus actively employ the binary oppositions which are prominent within the Western worldview, but rare in other societies (Blocker 2001, 5; Dobres 2001, 47). Thus, the uncritical application of a Western perspective thus becomes problematic when one attempts to understand the Palaeolithic hunter-gatherer world, and may result in speculative interpretations regarding social context, such as with Fritz and Tosello (2007).

However, an art historical approach can be beneficial to answer certain research questions which do not attempt to read meaning or significance into the art from its final form. Research which aims to determine geographical or temporal trends within the art, or its naturalistic attributes, employ this approach in a critical manner. This enables detailed evaluations of the specific attributes of the art, providing nuanced information regarding the naturalistic knowledge within each depiction. An art historical perspective therefore can foster interpretations grounded within detailed insights of the art, providing greater appreciation for the immense skill of Palaeolithic hunter-gatherers, and their intimate knowledge of their surroundings. It is divorced from the social, but this perhaps can allow for more objective observations and analyses. Inherently, this may restrict the extent the research can comment upon the social role or meaning of the art, but this is appropriate when the research question does not invite a consideration of these factors.

## 2.4. Approaches to Palaeolithic Art: Accessing Function

Anthropology has influenced approaches to Palaeolithic art in numerous ways, but primarily through shifting focus to consider the function or role the art may have performed in Palaeolithic society. As aforementioned in the previous section, structuralist concepts derived from anthropology were readily employed to access the function of the art and understand its meaning, which structuralism argues resides in the interrelationships between depictions (Shanks and Hodder 1998, 72). Specifically, those which draw on linguistic theories are heavily influenced by a structuralist way of conceptualising the art to understand its function and tend towards an etic approach to model behaviour. This has been previously defined as a *formal* approach (Whitley 2011, 101). By contrast, *informal* approaches derived from anthropology adopt an emic perspective, and thus heavily relies on ethnographic analogies with contemporary societies to access the symbolic meaning and social context of the art. Thus, within each of the sub-sections of interpretations here, both emic and etic approaches have been employed. Naturally, some interpretations are primarily the product of one approach rather than the other; for example, one can expect interpretations of shamanism and ritual have adopted an emic perspective. Interpretations of the function of art in Palaeolithic society are categorised here as: art as encoding and communicating information; the art as populating or “socialising” a landscape; art as a form of language, and thus representing specific signs and symbols; and art as performing an integral role in shamanic rituals.

### 2.4.1. Communication and information encoding

Anthropology and linguistic theory, particularly during the post-processual movement, influenced a surge of interpretations that considered both portable and parietal art as systems for long-distance communication. Specifically, information exchange theory originating with Wiessner’s (1984) work on the Kalahari San, and Wobst’s (1976; 1977) work on modelling Palaeolithic group dynamics, inspired the perception of the stylistic elements of art as encoding specific information within cultural groups. Consequently, a suite of research attempted to understand and characterise Upper Palaeolithic art from this perspective.

This research can be characterised as perceiving “art as information”; it serves only to communicate information and has no other practical (or otherwise) role within a society (Sieveking 1991, 33). This suggests specific attributes of the art, such as its style, conveys pertinent information amongst hunter-gatherer groups. The information is often considered to be relating to resource availability, and consequently the art may be analysed in terms of its naturalistic attributes, arguing it is intentionally encapsulating information about animals in the region (Rice and Patterson 1986; Mithen 1988). The art is thus

perceived as a mechanism through which group relations are maintained and negotiated; as information to other groups is transferred in this medium, relationships are forged with other societies (Jochim 1983, 213; Barton *et al.* 1994, 186). Parietal art, as a static anchor-point within the landscape, is therefore perceived as an integral feature of information exchange (Bradley 1997, 13). It is argued to act as an adaptive mechanism, both ensuring the cultural reproduction of a society and allowing groups to be aware of the resources in another region (Clark *et al.* 1996, 241).

Other “art as information” interpretations perceive sites with numerous examples of different motifs, such as Altamira, as representative of aggregation sites with different styles perhaps reflecting the presence of different groups (Conkey 1980). In addition, the art as information interpretations have led to perceptions of Upper Palaeolithic art as functioning to populate, or “socialise”, the landscape. These interpretations emphasise the socio-cultural aspects of “art as information”, rather than perceiving art explicitly as an adaptive mechanism. This is inspired, to an extent, by Ingold’s (1992; 1993) “landscape learning”, which suggests when groups enter unfamiliar territory, they begin a process of imbuing meaning into features of the landscape to better enable the navigation and location of vital resources within the surrounding area (Langley 2013, 615). Art as information, therefore, forms part of this process; meaning is imbued into certain locales through depictions (Taçon 1994, 117; Nash and Chippindale 2002, 2; Riede 2005, 22).

Although these are alluring interpretations which maintained popularity throughout the 1980’s and 1990’s, there are several issues which are not addressed in research which adopts this perspective. These are characterised by Barton *et al.*’s (1994; Clark *et al.* 1996) research, which is influenced by Wiessner (1984) and stems from similar research by Gamble (1982; 1991), and thus is appropriately representative of the “art as information” interpretation. This interpretation associates the trends in art frequency to climatic and demographic events, perceiving art as an adaptive medium that communicated information and enabled the replicative success of societies. They adopt three subdivisions of the Upper Palaeolithic, also employed by Gamble (1991, 7). The first, the downturn interval (30,000 – 21,000 B.P.), is characterised by climatic deterioration where population is low and thus Palaeolithic art is infrequent (Gamble 1991, 8; Barton *et al.* 1994, 192). The second, the refuge interval (21,000 – 13,000 B.P.), corresponds to the Last Glacial Maximum (LGM) and a concentration of populations in the Franco-Cantabrian region. It is proposed, therefore, that art is used to negotiate relationships between groups during this interval (Gamble 1991, 11; Barton *et al.* 1994, 192). The third, the upturn interval (13,000 – 7,000 B.P.) is argued to represent a dispersal of populations and thus parietal art becomes infrequent again (Barton *et al.* 1994, 193). There are numerous issues with this model. The

first is the chronology adopted; for example, the dates provided for the refuge interval spans both the LGM, but also a period of gradual climatic amelioration after the LGM (Lambeck *et al.* 2014, 15301; Lowe and Walker 2014, 414). The second is relying on the stylistic dating of parietal art, and the third is the lack of explanation for the method used to determine population density and dynamics. Although these issues may be a consequence of limited information at the time of publication, the most overt problem is attempting to provide a generalised model to explain approximately 20,000 years of human behaviour. Although the “art as information” interpretation has fallen out of popularity in recent years, this issue of modelling behaviour in this manner is a common occurrence throughout anthropologically influenced research, and one that needs to be critically addressed.

#### *2.4.2. Signs, symbols, and language*

The proliferation of semiotics, linguistic theories, and iconography within archaeological discourse during the latter half of the 20th century (Moro Abadía and Nowell 2015, 960) saw an increase in discussions of Upper Palaeolithic depictions as “symbols”; this has recently seen a resurgence through the perception of non-figurative art as encoding a “hidden language” (Von Petzinger 2017). Several authors have argued Palaeolithic art reflects the origin of language, as it represents the first examples of the attachment of meaning to specific motifs, symbols, or figures (Marshack 1981; Marshack 1991). Thus, research tends towards attempting to identify patterns in the use of signs and symbols in Palaeolithic art. For example, Igarashi and Floss (2019) compare the association of non-figurative signs to animals in both Aurignacian portable art from the Swabian Jura and the proposed Aurignacian parietal art from Chauvet Cave. This forms a small dataset of 20 figurines from Vogelherd, Hohlenstein-Stadel, Geissenklösterle, and Hohle Fels and 10 figurative depictions from Chauvet, from which they attempt to argue there are consistent trends in the association of specific signs to animals, with some variation observed in the Chauvet depictions. This interpretation thus extrapolates a broad-scale pattern from limited data, of which the evidence has questionable dating and may be separated by thousands of years.

Such an approach has often attracted interpretations from researchers outside the discipline. Miyagawa *et al.* (2018), a team of linguists, propose that explicitly cave art in the Upper Palaeolithic, with little explanation for overlooking other forms of art, is an externalised form of language. With little elaboration and based on the assumption that cave art was used for communication, they argue that cave art depictions inherently represent the ability to transfer symbolic thinking into sensory stimuli. As with Igarashi and Floss (2019), Miyagawa *et al.* (2018) attempt to find trends in the evidence, thus resulting in generalisations. Unfortunately, this appropriately encapsulates the issues of employing a

linguistic approach to understand Palaeolithic art. Linguistic approaches favour the synthesis of vast amounts of data to identify patterns; an approach which is appropriate when dealing with the abundance of contemporary evidence, but inappropriate when implementing this to understand a fragmentary archaeological record. Consequently, thousands of years become condensed to produce enough data to identify patterns, at the expense of nuanced temporal and spatial trends. This issue can be observed in the use of linguistic approaches to understand other artistic behaviours, such as Vanhaeren and d’Errico’s (2006) proposed ethno-linguistic groups based on Aurignacian personal ornaments, critiqued by White (2007) for the same aforementioned reasons.

Despite these issues with implementing a linguistic approach, there has been valuable research which explores the use of signs and symbols. The abstraction of figurative representations is apparent in a breadth of Upper Palaeolithic art, thus leading to the suggestion that the progressive abstraction of a

figurative depiction may result in a symbol *sensu stricto* (i.e. a mark used in place of something else). This does not necessarily suggest a “hidden language” encoded within all non-figurative depictions, but rather that certain depictions appear to be a short-hand way of



representing an animal. For example, a mammoth can be recognisably depicted through its dorsal line alone (Figure 2.6). Lorblanchet (1989) summarises this perception, proposing multiple ways a specific depiction may progressively transform, and become incorporated into, other figurative and non-figurative depictions (Figure 2.7). This interpretation is difficult to refute, particularly due to the abundant examples of schematised animal depictions. Inherently, it is difficult to predict or model the ways in which a figurative depiction may have evolved into a more abstract “sign”, particularly in the context of extensive temporal periods in the Upper Palaeolithic; thus, Lorblanchet’s proposed model should not be taken literally. Nevertheless, the concept has value, and may provide interesting insights when applied discretely to understand the motifs within specific sites.

Figure 2.6. Incomplete mammoth depiction from Rouffignac cave. Image: Halverson 1992a, 395.

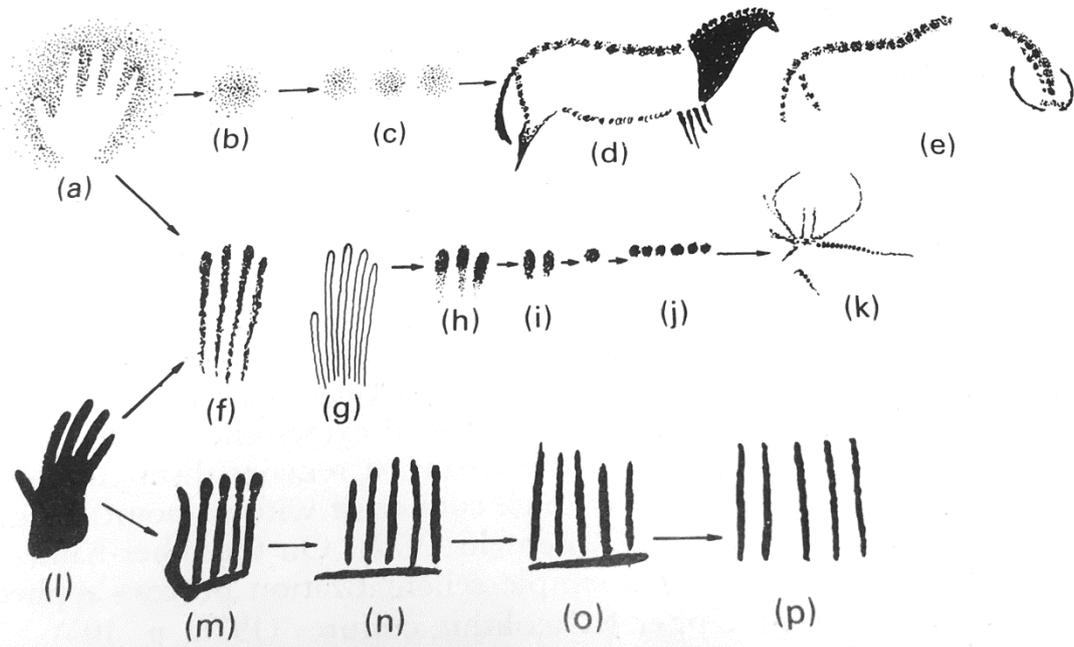


Figure 2.7. Lorblanchet's proposed model for the development of handprints into animals and signs. A-D, F, and K: Pech Merle; E: Marcenac; G: Cougnac; H-J; Cougnac and Les Fieux; L, and N-P: Altamira; M-N: Marsoulas. Image: Lorblanchet 1989, 134.

### 2.4.3. Shamanism and ritual

However, the most prominent interpretation influenced by anthropology is the perception of Upper Palaeolithic art as either a product or an integral aspect of shamanic and ritual behaviours. Arguably, these interpretations evoke similar sentiments to hunting magic interpretations of the early 20<sup>th</sup> Century and are heavily reliant upon anthropology and ethnographic analogy. The use of ethnography is often uncritical; for example, Davenport and Jochim's (1988) assumption that the bird-headed man from the Lascaux shaft scene represents a shaman. They assert this with little explanation for using the term "shaman" nor cultural sensitivity paid to the specific role of shamans in contemporary small-scale societies. Further, they tend towards using ritual behaviours as an uncritical, catch-all explanation for behaviours which are perceived as "othered" in some manner, and despite using ethnography to support these arguments, nuanced signatures in contemporary ritual behaviours are overlooked (Ross and Davidson 2006, 306).

The shamanic interpretation of Upper Palaeolithic art was spearheaded by the anthropologist Lewis-Williams, stemming from his research into San rock art production where he explores the social context of San art production (Lewis-Williams 1981; 1982; 1986; 1987). This suggests San art was produced during shamanic rituals, whereby shamans experienced visual (or entoptic) phenomena induced by altered states of consciousness (Lewis-Williams 1986, 174; Lewis-Williams 1997a, 323; Lewis-Williams 1997b, 813; Lewis-Williams 2004). Further stages of altered states of consciousness may

alter the entoptic phenomena, making the shaman perceive abstract shapes and figures. These figures rotate, merge, transform, and blur into one another, and subsequently these hybrid depictions become encapsulated in the art (Lewis-Williams and Dowson 1988, 203; Lewis-Williams and Clottes 1998, 19). Lewis-Williams's argues the visual phenomena experienced during this process is comparable to motifs in Upper Palaeolithic art, and thus implies the art may have been produced by shamans during, or shortly after, the experience of a stage 2 or 3 altered state of consciousness (Lewis-Williams 1997a, 326). He further suggests that caves, in this context, serve as a membrane between different spirit worlds which shamans navigate during trances (Lewis-Williams and Clottes 1998, 16). Hence, the use of natural features of the cave, with a few modifications, to depict animals represents shamans coaxing animals from the spirit world through this membrane (Lewis-Williams and Clottes 1998, 17). Thus, this attempts to provide a universal explanation for the production of certain depictions within Upper Palaeolithic art, that appear shamanic (Clottes and Lewis-Williams 1996, 138).

As aforementioned, attempting to explain a suite of human behaviour by one umbrella explanation in this way is problematic. Even if one is capable of overlooking intrinsic issues with umbrella interpretations, the approach undertaken by Lewis-Williams to produce the model is flawed. In the first instance, the use of ethnographic analogy is dubious. Southern San groups who produced rock art no longer exist and contemporary Kalahari San do not produce rock art (Lewis-Williams 1982, 429; 430 – 432), and thus understandings of the social context of the rock art are assembled from oral histories, contemporary Kalahari San behaviours, and antiquated 19<sup>th</sup> Century ethnographic observations of these groups. This patchwork approach is perhaps appropriate if this were the extent of the study, as it enables the best insight of the social context of San rock art one can provide with fragmentary evidence. However, when this is used as the foundation for creating a model to understand an even more fragmentary record, the seams where assumptions have been used to draw together limited evidence begin to pull apart. This model becomes further unstable through the questionable implementation of psychology, particularly with regard to an oversimplification and inaccurate use of psychological phenomena when discussing altered states of consciousness or “trance” states (Helvenston and Bahn 2003, 214). Thus, this model uncritically assumes San rock art was produced by shamans, for which there is no direct evidence (Lewis-Williams 1982, 434; Ross and Davidson 2006, 308; Bednarik 2013a, 492) and is primarily based on the assumption that the anthropomorphic depictions in San rock art represent shamans, which Solomon (1997) critiques. The broad application of such an unreliable model to explain a breadth of Upper Palaeolithic art is, therefore, disconcerting.

Despite these issues, and valid critiques of Lewis-Williams's shamanism model by archaeologists and anthropologists alike (Bednarik 1990; Bahn 1997; Solomon 1997; Hodgson 2000; Quinlan 2000; Kehoe 2002; Helvenston and Bahn 2003; Hodgson 2006; McCall 2007; Solomon 2008; Bednarik 2013a; Wallis 2019), this approach has been adopted by several researchers, who further explore this shamanic interpretation of Upper Palaeolithic art (e.g. Winkelman 2002; Dowson and Porr 2003; Winkelman 2004; Dowson 2009; Sauvet *et al.* 2009; Bullen 2011; Hayden and Villeneuve 2011). Occasionally, this research overlooks the caution that Lewis-Williams and colleagues urge in applying a shamanic model to interpret depictions; they themselves admit this model cannot explain *all* depictions (Lewis-Williams and Dowson 1988, 208; Clottes and Lewis-Williams 1998; Lewis-Williams 2003). This is particularly apparent in publications by non-specialists (e.g. Pizzato 2013, 117; Sidky 2017, 80), but also in those by Palaeolithic researchers. For example, Sauvet *et al.* (2009) attempt to test the shamanism theory through proposing the frequency and variability of depictions at sites represents either shamanism or totemism in some capacity (Figure 2.8). This groups together a breadth of Upper Palaeolithic cave art, in addition to ethnographic examples of rock art, to predict the production of the art. Unsurprisingly, this approach resulted in confused and insignificant results which appear to only demonstrate Upper Palaeolithic and ethnographic art were produced in different social contexts (Sauvet *et al.* 2009, 333). This is likely both a consequence of attempting to explain culturally, spatially, and temporally diverse art through one model, and a gross misunderstanding of the kind of art produced in totemism. For example, Indigenous Australian totemism refers to a belief that the land provides all beings with life, and all beings return to the land in death (Ingold 2000, 108; Bird-David 2006, 35). Their art, therefore, is concerned with either the land (e.g. depictions reflect tracks that animals leave in the land) or the internal nature of animals that reflect the life imbued within them by the ancestral spirits of the land (e.g. X-ray depictions) (Bird-David 2006, 35). Thus, Indigenous Australian totemic art will reflect certain motifs with higher frequency than others, or motifs present at more than one site; it is the specific features of the motif that reflect totemic ontology, not the distribution. Additionally, this approach suffers from attempting to implement a universal explanation for parietal art and consequently, serves to highlight the issues with doing so.

Frequency	Distribution	
	<i>Each motif only appears in certain sites</i>	<i>The same motifs are present in nearly all sites</i>
<i>Certain motifs are present at least twice as frequently as the mean for other motifs</i>		Shamanic [C]
<i>All motifs have low or similar frequencies</i>	Totemic [A]	Secular [B]

Figure 2.8. Criteria used to determine whether the art was shamanic, totemic, or secular. Image: Sauvet et al. 2009, 322.

By contrast, research which explores the association between cave acoustics and the placement of art depictions presents a more grounded approach to understanding the ritual significance of Upper Palaeolithic art. Waller (1993; 2019) suggest that the placement of cave art is intrinsically linked to the acoustics of caves and proposes that echoing within caves may have been used to recreate the sound of hoofs during rituals to summon game. Waller's (2019) recent research appears to further support this hypothesis, presenting results for the measurement of sound reflection in the French cave art sites of Niaux and Cougnac. This appears to show a relationship between areas of the caves with the highest sound reflection, and the concentration of hoofed animal depictions. Similarly, Fazenda *et al.* (2017) attempt to determine the association between the placement of art and acoustics in the Spanish sites of El Castillo, La Pasiega, La Garma, Las Chimeneas, and Tito Bustillo, through examining the acoustic response in different sections of the cave. Their results demonstrate a statistical, but weak, association between motifs and acoustic response, which they believe does not immediately suggest acoustics were the causal factor for the placement of art. Rather than dismissing their hypothesis, however, they argue more work needs to be undertaken to better determine this relationship.

Attempting to understand the ritual significance of cave art in this manner is alluring; it allows for data to be obtained directly from the cave, and therefore superficially appears to be an empirical way to test hypotheses relating to ritual behaviours. However, acoustics are sensitive to several factors, which can significantly change the way sound reflects and reverberates within a space. For example, the number of people in the space, presence of materials on the floor and walls (e.g. rugs, furs), level of sedimentation, and natural changes to the cave morphology over time, leave no archaeological trace but can drastically alter the acoustics (Elliott *pers. comm.*). Consequently, any contemporary evaluation of acoustics in caves cannot predict or model for these factors, and thus they are unlikely to be reflective of the acoustics in the Upper Palaeolithic. Nevertheless, this approach serves to demonstrate the ritual significance of caves and art can be explored in a somewhat more substantiated way, without the need to apply an umbrella theory.

#### 2.4.4. Accessing function: Conceptual Issues?

This mode of understanding art through attempting to access its function (or role) within past societies appears to be reactive against the limitations of perceiving art from an art historical perspective. However, it still uses the final form of the art (i.e. as one observes it in the contemporary) to understand function. Process, where discussed, is only approached from this perspective, resulting in a conceptual disparity between the approach and the research question. One can argue function cannot be understood without an appreciation of the behaviours involved in producing the art, and the temporality related to the making of art within different sites. For example, one can anticipate that sites which appear to be a composition produced in a short time interval, such as Lascaux, would have served a vastly different function to sites which have depictions which may have gradually accumulated over an extensive period of time. This is particularly pertinent to research which argues for a communicative or information-transfer function for Upper Palaeolithic art, which often assumes the art within, and across, sites is contemporaneous.

This amalgamating of a vast temporal depth of behaviours appears to encourage the production of universal explanations, or general models, to explain a huge variety of Upper Palaeolithic art. Pettitt (2016, 12) appropriately characterises the issue with these umbrella theories:

*“such ‘explanations’ inevitably reveal more about our own concerns than they do about Palaeolithic society. Umbrella theories may sell popular books but are intellectually lazy, and almost as pointless as asking a random sample of people across the world today to define the ‘function of art’ on the back of a postcard”*

Despite this critique, umbrella theories appear to remain a popular approach to explain the function of Palaeolithic art. Surprisingly, although the majority of umbrella theories use ethnographic analogy which demonstrates that the behaviours described (such as shamanism) are highly sensitive to socio-cultural context, this is ignored. Thus, Upper Palaeolithic societies are homogenised, echoing 19<sup>th</sup> and early 20<sup>th</sup> Century perceptions of hunter-gatherers which assumed they all think and relate to nature in the same way (Conkey 1984, 260). This has the dangerous consequence of legitimising ludicrous theories by non-specialists that have poor knowledge of the archaeological record (e.g. Sweatman and Coombs 2019), undermining the analytical depth and nuance achieved by numerous Palaeolithic art specialist. There is an overwhelming need to critically challenge, if not dismiss entirely, umbrella theories; one cannot account for thousands of years of human behaviour by one explanation.

#### 2.5. Approaches to Palaeolithic Art: Understanding Process

Although the previous two approaches, heavily influenced by anthropology and art history, attempt to understand the art through its final form, there has been a recent

movement which attempts to decentre away from a fixation on the visual. This represents a shift towards understanding *process*, inspired by recent theoretical movements in archaeology (often referred to as the “ontological turn”: Alberti 2016; Harris 2016; Whitley 2021), including post-humanism, new materialism, and relationality, which emphasise the importance of understanding *processes of becoming* of past material (and visual) culture (e.g. Brown and Walker 2008; Knappett and Malafouris 2008; Coole and Frost 2010; Conneller 2011; Watts 2014; Crellin *et al.* 2020). Moro Abadía and Gonzalez-Morales (2020) coherently discuss this shift in approaches towards Pleistocene and Holocene art, recognising this as the product of the “ontological turn” in archaeological theory, an integration and deeper appreciation of Indigenous knowledge, and developments in techniques towards recording and dating rock art.

Approaches that are influenced by this ontological turn and place emphasis on process have been increasingly employed for Neolithic and Bronze Age rock art, but are rare for approaches to Upper Palaeolithic art. Díaz-Guardamino (2020), for example, adopts a process approach to re-evaluate the making and lives of Bronze Age stelae. Díaz-Guardamino’s (2020) appreciation of material agency of the boulders on which motifs were carved as shaping human action, and understanding these monuments as active entities that were repeatedly engaged with, perhaps in the context of ritual or funerary practices, reinvigorates this rock art; it was the *making* of these motifs that held significance. Díaz-Guardamino (2021) further explores these ideas, challenging the idea that stone is a fixed and stable material, intrinsically linked to ideas of enduring temporality, and instead the vibrancy of stone should be appreciated in the context of rock art making. Díaz-Guardamino (2021, 101) discusses how, when exposed to the elements, stone is perhaps a more dynamic and changing material than is usually appreciated by Western perspectives. Stone actively responds to other non-human agents (e.g. light, weathering) and this may have, in turn, infused rock art with a similar vitality in prehistoric societies and landscapes (Díaz-Guardamino 2021, 101 – 102). This research explicitly moves away from the more traditional approaches to petroglyphs, that are primarily concerned with style and spatial distribution (Díaz-Guardamino 2020, 2), and instead appreciates material agency and processes of becoming embedded within the motifs.

These process perspectives to Neolithic and Bronze Age art are also explored by Bacelar Alves (2020) and Valdes-Tullett (2020) within Back Danielsson and Jones’s (2020) volume *Images-in-the-making*. Bacelar Alves (2020) challenges the traditional approaches towards rock art, that seeks only to classify and analyse its stylistic character, and instead proposes a holistic appreciation of process and technical gestures can yield much deeper insights into the significance of its making. Bacelar Alves uses the example of tracing the art

as a tool for which researchers can embody themselves within that technical making, and thus gain an understanding of how rock art making may have been embedded with meaning. Valdes-Tullett (2020) similarly, albeit on a different scale, evaluates Atlantic rock art making through shared characteristics of its making, moving beyond a focus on stylistic comparisons of form. By utilising network analysis, Valdes-Tullett (2020) demonstrates that aspects of process in the rock art's making reveals insights into regional connectivity and variation in the way motifs were produced, painting a much richer perspective of the interconnected nature of Atlantic rock art.

Although this research discusses later prehistoric art, it resonates with the embedded issues in Upper Palaeolithic art research discussed in this literature review. This research comprehensively demonstrates the vast potential of process approaches in moving away from a focus on aesthetic form or "grand narrative" perspectives. Whilst this research readily and explicitly adopts perspectives from process theories, Upper Palaeolithic art research, by contrast, often only does so indirectly. Upper Palaeolithic art research does not explicitly state that the approach is attempting to understand process, but instead focuses on an aspect of the process of producing art. The following sections review some examples of how process perspectives are beginning to emerge in Upper Palaeolithic art research. This research is grouped into the following categories: research which attempts to understand authorship; the physical process of creating a representation; and the psychological phenomena which may be involved in the cognitive process during art production.

### *2.5.1. Authorship*

The question of who produced Upper Palaeolithic art is often overlooked in the aforementioned approaches; the notable, but problematic, exception being Lewis-Williams' shaman model. However, it is a pertinent question that needs to be addressed. Understanding authorship enables insight into the significance of depictions, for example was a depiction the product of personal, individual actions, or representative of a social, group-wide behaviour? Certain research has provided nuanced understanding in this respect. Finger-flutings, in particular, have received attention regarding their authorship (Bednarik 2008). The nature of finger-flutings lends themselves to a grounded approach for understanding authorship, allowing direct data to be obtained from finger-flutings that can be used to determine the age of the authors. Sharpe and Van Gelder's research (2006a; Van Gelder 2015), through this approach, have suggested children and adolescents were involved in the creation of finger-flutings at El Castillo, Las Chimineas, Rouffignac, and Gargas. In some cases, this reveals intimate insights into the flutings; at Gargas, Van Gelder (2015) proposes the height of some finger-flutings suggest a young child would have been

carried at the hip while making them, corroborated by the association of an adult female finger-flutings made with the left hand at the same height.

Additionally, some research has employed a multi-disciplinary approach, to suggest certain attributes of authors. For example, Spikins and Wright (2016) suggest Palaeolithic depictions may be the product of individuals with autism, comparing drawings by autistic children that display extraordinary attention to detail to some examples of Upper Palaeolithic art with similar features (Figure 2.9). The shared features between Upper Palaeolithic art and art produced by children with autism included perspective, observational skill, foreshortening, and a primary focus on the outline (with shading being secondary). Arguably, the similarities shared between the art of autistic children and Palaeolithic art are limited and may be merely coincidental; aspects such as observational skill and perspective could also be the product of a hunter with extensive familiarity with the animals they are depicting. Although Spikins and Wright (2016) only use this to suggest what archaeological evidence may be representative of conditions like autism, this particular example encourages a deeper consideration of the *author* in discussions of Palaeolithic art. However, this interpretation must be used critically to ensure it does not lean towards the pitfalls of umbrella theories; if one is convinced by Spikins and Wright's (2016) proposition, one cannot assume all Upper Palaeolithic art was produced by individuals with autism.



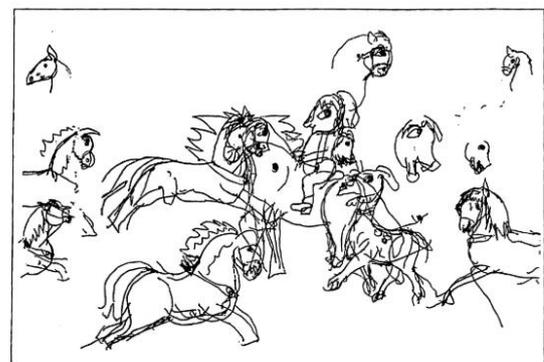
Horse depictions at Chauvet Cave



Horses drawn by Nadia



Horse depictions at Lascaux Cave



Horses drawn by Nadia

Figure 2.9. Comparison between Palaeolithic art depictions and the drawings of a child with autism, Nadia. Image: Spikins and Wright 2016.

### 2.5.2. *Creating representations*

Another interesting facet of understanding the process of producing Upper Palaeolithic parietal art is the negotiation between perceiving something in reality and translating it into a depiction. This process is often not considered, particularly as contemporary Western researchers are so familiar with the concept of a 2D image or depiction representing a real thing. Several authors (Guthrie 2005, 93; Malafouris 2007; Dobrez and Dobrez 2013) have conceptually argued that Upper Palaeolithic figurative art represents for the first time, people mediating between something that exists in 4 dimensions (movement and time, representing the 4<sup>th</sup>) and capturing these dimensions within another medium. Depictions therefore encapsulate a complex cognitive process of determining the features necessary to incorporate to enable the identification of an animal, and often also includes the reduction of these features to their minimum components for identification (e.g. a partial outline) (Dobrez and Dobrez 2013, 79). Further, this suggests that the art is not always intended to be perceived as a 2-dimensional thing directly representing something in reality, but as something that is to be interacted with and reacted to in different ways as if it were existing within 4 dimensions, which has been alluded to by research discussing the movements captured within depictions (see section 2.3.3.). Although this process is only discussed theoretically in this research, it enables one to consider aspects of creating representations that Western researchers may have previously taken for granted. It also encourages the considerations of the dimensionality of the art and the shifting interpretation of the observer.

Additionally, the *technical* process of producing representations is often not considered in broader discussions of its significance. Most notably, the procurement of pigment and the different pigments used in the art is often not a factor considered in the analysis of the depictions. Chalmin *et al.* (2003) used technical analysis (including scanning electron microscopy with energy dispersive spectroscopy (SEM/EDX), particle-induced X-ray emission (PIXE), X-ray diffraction (XRD), transmission electron microscopy (TEM), and infrared spectroscopy) to determine the specific pigments and recipe used to produce the art at Lascaux and Ekain. Through examining both the geographical origin of the pigment, and the specific materials it was mixed with to allow it to bind to the cave wall, the homogeneity between depictions at a site can be discussed. This leads Chamin *et al.* (2003, 1595) to suggest that differences in the recipe of black pigment used in the Scene du Puits (shaft scene) and Grand Taureau (Hall of the Bulls) at Lascaux may imply that the representations were produced at different times. Further, within the Scène du Puits, the manganese oxide used for the rhinoceros depiction has a different crystal morphology to the other depictions, suggesting this pigment was sourced elsewhere. Thus, it may have been depicted at a different time, which corroborates the observation of a stylistic

difference in the rhinoceros. At Ekain, the analysis suggested homogeneity between all the black depictions, corroborating with the stylistic analysis. Through analysing the technical process of producing the art this research enabled nuanced insight into the phases of depiction within Upper Palaeolithic art sites.

Another area of research which enables insight into the technical process is experimental archaeology and ethnographic analogy, the former being rarely employed in parietal art research. Dobrez (2014) uses a combination of previous experimental archaeology studies and analogy with Indigenous Australian hand stencil production to shed light on the process in the Upper Palaeolithic. This enables certain proposed methods to be discounted, such as the “two-tube” method (Dobrez 2014, 371), and insight into the potential pigment procurement and processing method required prior to painting.

### 2.5.3. *Psychological phenomena*

Beyond Lewis-Williams’ altered states of consciousness model, interdisciplinary approaches with psychology have provided insight into the *cognitive process* which may be involved in the production of depictions. Most notably this has been explored by the psychologist Hodgson and colleagues (2006; 2008; 2012; Hodgson and Watson 2015; Hodgson and Pettitt 2018), in reaction to Lewis-Williams’ model, who propose there are several other psychological phenomena that are more likely to be triggered in caves, during art production. This primarily concerns hyper-imagery; a phenomenon distinct from hallucinations, and caused by a heightened arousal state, induced by states such as mental/physical fatigue, hunger or fear (Hodgson 2008, 344). In contrast to hallucinations, hyper-imagery draws on and elaborates external visual inputs, thus a suggestive rock shape in a cave may be literally “seen” as a horse, a process known as “seeing-in” (Hodgson 2012, 188; Hodgson and Watson 2015, 781; Hodgson and Pettitt 2018, 597). Additionally, hyper-imagery cannot always be distinguished from reality; this is known as the Perky effect (Hodgson 2008, 342). Thus, during this process a person may see an animal in the cave wall and be convinced that animal *was there* for a brief period of time. Furthermore, as Upper Palaeolithic people are already highly sensitive to animal forms, this phenomenon may have had even greater potency (Hodgson 2006, 32; Hodgson 2008, 346). The cave wall may be active in scaffolding what animals are “seen” during this process, and therefore, art was perhaps an embodied phenomenon, drawing on external visual cues (Hodgson 2012, 189; Hodgson and Pettitt 2018, 599). Hodgson further argues this phenomenon occurs due to the way in which the visual system has evolved, e.g. it is much safer to assume an uncertain shape *is* a potential threatening animal, rather than presume it is not (Hodgson 2012, 187). This provides insight into the cognitive process that may occur prior to the production of figurative art, and although this is yet to be tested directly against the archaeological record,

the infusion of psychology in this research presents a way to test and falsify this theory (Hodgson and Pettitt 2018, 605).

Similarly, Halverson (1992a; 1992b) discusses the psychological processes which may be determining the form of the art. Halverson (1992a, 402; 1992b, 224-225) argues that a mental representation of an animal is based on characteristics that are known to pertain to that animal, and consequently the animal usually appears in canonical perspective as this maximises the information about the animal. Additionally, and in contrast to Hodgson, Halverson (1992b, 228) proposes that suggestive contours within a cave may result in the projection of a mental image but distinguishes this as “looking-like” rather than “seeing-in”. It is proposed that the process of producing art would involve recognising a contour as resembling a feature of an animal, and subsequently completing the animal through engraving or painting with pigments (Halverson 1992a, 399). Although a valid point, Halverson (1992b) appears to overlook the context in which the art was produced which, as discussed by Hodgson (2008), is more likely to result in the more involved processes of “seeing-in” and hyper-imagery. Halverson (1992a, 398) further discusses Gestalt principles, such as “good continuation” which both may have shaped the form of the depictions and affects how the depictions are perceived. This enables animals to be recognised in the depictions, despite them being frequently incomplete, thus provides insight into the operation of the visual system with regards to figurative representations.

Although psychological approaches to Upper Palaeolithic art provides persuasive interpretations regarding the cognitive processes which may be involved, this approach falls short of providing an explanation for the impetus behind *depicting* the animals which have been visualised. Consequently, the material engagement with the cave, and the socio-cultural significance of this process is lacking from psychological approaches. This is an area which may be elucidated by a grounded interdisciplinary approach between psychology and archaeology, to determine the translation between the cognitive process to the technical process and its potential importance to past societies.

#### *2.5.4. Understanding process: Conceptual issues?*

The research reviewed here which attempts to understand aspects of the process of producing art represent a movement towards emphasising the importance of art making. This reaction against focusing on the final form of the art provides an interesting perspective, revealing intimate details primarily regarding the people who produced the art. Consequently, this has vast potential to provide additional detail previously not revealed by other approaches. Although this certainly represents a step in the right direction, the research here still has conceptual issues. By virtue of the research evaluated here not explicitly intending to evaluate the process of art making in the Upper Palaeolithic,

only one aspect of the process is understood. This fragmentary understanding prevents an appreciation of how different aspects of the process may relate to each other, for example how psychological responses like hyper-imagery translates to the technical production of art. Furthermore, despite these approaches shifting away from a focus on the art's final form, one cannot overlook the aesthetic properties of the art altogether. Arguably, and as demonstrated by research evaluating naturalistic attributes of the art, the final form is still significant; both within the social context of past hunter-gatherer societies, and as a body of evidence for contemporary research.

## 2.6. Summary: Towards a New Approach

The literature review demonstrates there are a suite of different approaches to Upper Palaeolithic art, which provide an extensive number of interpretations regarding the attributes, function, significance, and meaning of the art. Some of the research discussed is arguably still rooted in anachronistic perceptions of art, derived from mid-late 19<sup>th</sup> Century worldviews, and uncritically employs similar approaches as the early 20<sup>th</sup> Century that stemmed from art history and anthropology. This results in interpretations with conceptual issues, particularly those which propose umbrella theories. Consequently, the full potential of Upper Palaeolithic art as a body of evidence which can provide insight into Cro-Magnon's behaviours is not realised.

However, this literature review also demonstrates that when approaches are used critically, they can provide nuanced observations and interpretations of the art. Recent approaches which consider aspects of the process of producing art, have begun a trajectory within Upper Palaeolithic parietal art research to decentre away from aesthetic form. Although there are still issues within this research, it has importantly demonstrated that there is potential to understand the process of making art. This movement is underway in other domains of Palaeolithic art research; portable art and personal ornamentation studies are considering the *chaîne opératoire* and object biographies, revealing intricate understandings of the social lives and relationality imbued within the art (e.g., Farbstein 2011a; 2011b; Needham 2017; Wisner 2018). An appreciation of process can enable non-Western viewpoints of art to be articulated, directly critiquing the inherent Westernised perception of art which permeates throughout current approaches. Applying this perspective to parietal art, therefore, has vast potential to address the issues with the previous orthodoxy and provide new insights.

Digital techniques may also offer one way to facilitate these kinds of approaches; the use of 3D models and other digital methods (e.g. RTI) has been demonstrated to be effective at capturing aspects of the sensory experience of art, such as texture, colour, and light, and even capturing past haptic engagements with the art (Papadopoulos *et al.* 2019). These

sensory elements can be manipulated using 3D models too, to gain a greater appreciation for how changing light conditions or texture may affect the sensory process of making the art. Additionally, as demonstrated by Fritz and Tosello (2006), highly detailed recording through digital imaging can also enable the specific techniques used to produce the depictions to be determined, and the order in which strokes occurred, to better understand the technical making of the art. Therefore, the combination of detailed imaging techniques and an interdisciplinary approach can enable grounded understanding of the processes that influenced the theme, placement, and style of art depictions within specific sites. This nuanced approach can enable the multifaceted nature of art to be appreciated, breathing agency into the sensory stimuli within a cave environment in shaping depictions and crucially considering the primary role of the visual system in responding to these stimuli. A creative theoretical framework that refocuses attention on the process of making figurative art in caves is needed. This is developed in the following chapter, and aims to address some of the conceptual issues identified in the literature reviewed in this chapter.

## Chapter 3.

# Meaning in the Making: A Theoretical Framework for Understanding Cave Art as a Dialogical Process

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### 3.1. Introduction: Addressing the roots of the issue

*“[T]he study of (prehistoric) art seeks meaning in form and end-product to the near exclusion of concern with how images were made meaningful during the social act of their physical production”*

*(Dobres 2001, 47)*

The perspective presented by Dobres (2001) characterises the trends in Palaeolithic art research identified in Chapter 2: the exclusive focus on the final form of the art; and a shift towards attempting to understand its meaningful production. Despite Dobres presenting this view 20 years ago, it is only in more recent years that “meaningful making” is becoming established as an approach to Palaeolithic art, facilitated in part by broader shifts in theoretical discourse towards new materialist and relational approaches (e.g. Conneller 2011; Knappett 2007; Van Oyen 2016; Harris and Cipolla 2017; Crellin *et al.* 2020; Knappett 2020). Meaning making has been extensively discussed as part of theoretical discourse more broadly in archaeology; for example, with regards to semiotics and how we may understand how meaning is constructed (Preucel and Bauer 2001; Swenson and Cipolla 2020). However, the use of the term “meaningful making” here is concerned less with how specific meanings may have emerged or were attributed to objects or motifs, and instead generally refers to how the act of making objects/signs/visual culture itself may have been meaningful, and perhaps even more so than the final aesthetic form. As Gosden and Malafouris (2015) coherently discuss, and as is explored through non-Western perspectives within this chapter, “meaningful making”, as it is understood in this thesis, is thus not necessarily a fully articulated linguistic or semiotic process, with meanings consciously attributed to the finished aesthetic form of an object (e.g., a particular symbol having an indexical meaning associated to it). Instead, it refers to the process of making where meaning is generated; through tensions and engagements between body and material (Gosden and Malafouris 2015, 707).

Although the movement towards appreciating the *meaning within the making* in Palaeolithic art research is reactive against problematic grand narratives and aesthetic interpretations, it does not always necessarily critically evaluate the crux of this issue;

namely, a dominance of the Western<sup>1</sup> perspective that provides a limited and prescribed view of “art”. This perspective offers only one reading of the archaeological record which conforms to ideals of Palaeolithic art as a ritualised or embellished behaviour, unique to *H. sapiens*. Recent research has demonstrated aspects of this perspective are inaccurate, particularly parietal art being a unique behaviour of our species (e.g. Rodríguez-Vidal *et al.* 2014; Hoffmann *et al.* 2018a; Bello 2021; Martí *et al.* 2021) but it has yet to be matched with a theoretical framework that accommodates for a re-conception of Palaeolithic artistic behaviours. The lack of space in the theoretical discourse surrounding Palaeolithic art, particularly parietal art, is perhaps why discussions of art making by other species are limited to evidencing cognitive and behavioural complexity (e.g., Langley *et al.* 2008; Zilhão 2012; Morin and Laroulandie 2012; Leder *et al.* 2021) or are rejected for not conforming to the previous narrative of art exceptionalism in Cro Magnons (e.g. Mellars 2010; White *et al.* 2019).

There is an overwhelming need to address the biases inherent within Palaeolithic art research, to allow for a critical awareness of the potential limitations of a Western researcher approaching a behaviour as culturally sensitive as art. To achieve this, the Western worldview is first evaluated and defined as one that seeks to catalogue the world in terms of bounded units and binary oppositions. The impact of this worldview on Palaeolithic art research is discussed, identifying this the potential crux of the conceptual issues identified in the literature review. Non-Western worldviews are articulated as a more useful framework for thinking about past human behaviours, particularly those of Palaeolithic hunter-gatherers and their art. This does not intend to draw any comparisons between contemporary societies and Palaeolithic societies, but instead emphasise the diversity of worldviews and how these manifest in artistic behaviours. This allows for an appreciation of “art” that moves beyond the confines of a Western perspective, to appreciate the diversity of this behaviour. A theoretical framework is then developed that directly uses these insights to appreciate art as an active, dialogical process. Relational and new materialist theories are brought into the fold, to further articulate the insights from non-Western perspectives and develop this into a coherent framework for approaching Upper Palaeolithic figurative cave art. This concerns building a biographical approach that shifts focus onto the meaningful making of the art. The visual system is placed as a fundamental stage within this making, and one means by which to yield deeper, tangible insights into the dialogical processes involved in Upper Palaeolithic cave art.

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<sup>1</sup> Western and westerner are used to refer to people from capitalist, industrial societies in Europe and non-Indigenous peoples (i.e. product of former European colonies) in Northern America, Australia, and New Zealand.

## 3.2. Recalibrating Perceptions of Upper Palaeolithic Cave Art

### 3.2.1. *Western perspectives*

In recent years, assumptions of the universality of the Western experience have been critiqued across the social sciences and humanities, highlighting the fundamental issues in imposing Western perspectives and biases in research. In particular, Henrich *et al.* (2010a; 2010b) discuss the pervasiveness of using Western Educated Industrial Rich and Democratic (W.E.I.R.D.) participants as proxies for universal human behaviours, when these individuals are by no means representative of the majority of contemporary human populations. This parallels the critiques made by indigenous, feminist, and queer archaeology (e.g. Engelstad 1991; Dowson 2000; Conkey 2003; Atalay 2006; Dowson 2009; Arthur 2010; Blackmore 2011; Weismantel 2013; Nicholas and Watkins 2014; González-Ruibal 2016; Rutecki and Blackmore 2016) that highlight some of the issues with imposing Western assumptions onto the past. However, a fundamental issue within archaeological discourse is the casting of these critiques as “alternative archaeologies”, preventing them from fully being adopted into the mainstream of the discipline. Without the robust evaluation of Western bias offered by these critiques, one risks assuming the Western worldview as the norm and imposing Western perspectives onto the past.

Western perspectives are problematic when reading the Palaeolithic record, enforcing dichotomies and unilinear evolutionary progression narratives onto the past that are engrained within Western science, but are rare in non-Western worldviews (Blocker 2001, 5; Dobres 2001, 47; Watts 2013, 3). These issues have already been briefly outlined in Chapter 2 and of pertinence to this research, primarily concern the Western assumption that art is a consumable commodity and a luxury, thus cannot be more than a mere embellishment to society. This evokes sentiments of Maslow’s (1943) hierarchy of needs; within a Western mindset, creative behaviours are only expressed once basic, subsistence needs have been met. Western thought is deeply rooted throughout interpretations of Upper Palaeolithic art, and needs to be carefully addressed to appropriately mitigate this bias.

Western thought is characterised by the *Mechanos* worldview, rooted in Enlightenment thinking and the Industrial Revolution, which primarily concerns the evocative metaphor of a clockwork, mechanical universe; the real world is made from real things that are governed by natural causal laws (Reason 1998, 42; Ashton and Kubik 2009, 282; LaFreniere 2012, 126). This was defined within the context of classical physics by those such as Bacon, Decartes, and Newton. Thus, concepts such as the Cartesian mind/body dualism, the division of the world into separate, binary oppositions, and the perception of human progress as dependent on the progress of science, are integral aspects of this modern

Western worldview (Kern 2000, 96; Matthews 2006, 8; Ashton and Kubik 2009, 284; Coole and Frost 2010, 13; Rose 2017, 494).

Within this worldview, humans are placed in opposition to nature and are perceived as exploiting the world to enable their own progression (Scott 2013, 863). They are bounded from the natural world, operating as objective minds that only engage with the natural world in a systematic, mechanical way. This divorces humans from an intimate dependent relationship with other resources and suppresses relatedness (Ingold 2000, 288; Hornborg 2006, 31); for example, food, clothes, and tools come pre-formed, and very few Westerners are required to procure materials and produce their own things. The hierarchical ontology which places humans as superior, agential beings, prevents the appreciation of “others” behaving in active ways and manipulating the actions of other non-humans and humans alike. This invents the *object* as a non-agential thing and imposes it onto beings perceived as inferior to humans (Hornborg 2006, 27). Although post-modernism has challenged some aspects of this worldview in Western thought (Agger 1991, 117; Docherty 1993; Annells 1996, 389), it still remains a predominant and pervasive mindset in the Western world.

The impact of this Western worldview is evident in Upper Palaeolithic art research: animals depicted in art are perceived as exploitable resources (e.g. Rice and Paterson 1985, 98; Mithen 1988a, 287; Mithen 1988b, 689; Eastham and Eastham 1991, 126 – 127; Gamble 1991, 4); the cave is perceived as a blank, inactive canvas (e.g. McDonald 2006, 60; Morriss-Kay 2010, 164); art is an embellished socio-cultural behaviour produced by exceptional individuals (e.g. Lewis-Williams 1997; Whitley 2009; Spikins and Wright 2016); binary oppositions are imposed onto features or themes of the art through approaches like structuralism (e.g. Leroi-Gourhan 1968; Fritz and Tosello 2007); and the aesthetic, final image takes focus (e.g. Clottes 1996). One can appreciate how Western dualistic concepts such as nature/culture, human/animal, and functional/aesthetic are imposed onto narratives of Upper Palaeolithic artistic behaviours. The implicit division between human = active and non-human = passive is unhelpful, enforcing an unnatural binary onto past societies which may have had a multifaceted understanding of what constituted the agential beings within their worlds (Brittain and Overton 2013, 134).

However, as Western researchers, we are often reluctant to appreciate that non-humans may have agency and act in meaningful ways that influence our own behaviour, let alone that this may have been something recognised and understood by societies in the deep past. The following short anecdote, inspired by Ingold (2011, 19; 32), perhaps articulates the issues with a Cartesian division of the world. Consider a damp pebble lying on the beach; it appears a vibrant colour and lustrous, and we might be tempted to collect

it, placing it in our pocket to carry home. By the time we've transported it home, often to our dismay, it has dried out and no longer has the appealing lustrous qualities that motivated us to initially pick it up, appearing dull by comparison. We may then discard the pebble, *but we have not actively changed our relationship with the pebble*. The pebble itself, and the commingling of pebble, water, and heat, has transformed its apparent properties which in turn affects the way we interact with the pebble. We must allow, therefore, for the pebble to have had some agency over our behaviour by virtue of its material properties which have shaped the way we interact with it: it cannot be understood fully if we perceive it as a passive, inert thing that cannot affect us. If Western Cartesian divisions of the world begin to crumble with a damp, undecorated pebble, one can appreciate how this way of categorising the world is even more insufficient for appreciating caves, pigments, dynamic light, and animals which all commingle in the making of cave art.

Western, Cartesian approaches thus risk stifling context-sensitive discussions of the deeper, integral socio-cultural significance of the art, and often tend to foster dismissive perceptions of art as a bounded, separate aspect of society: merely "art for art's sake" (Halverson 1987). Art is defined and interpreted in the Western world in terms of its aesthetic attributes which are ascribed by art historical approaches. This superficial definition of art means a binary perception of what is and is not art can be imposed; anything with the features valued by art history *is* art, and this art can be interpreted in a prescribed way. Consequently, this perspective portrays a pretence of objectivity, *sensu Mechanos*, but is actually heavily biased towards a specific way of identifying, categorising, and seeing the world. In order to address this Western bias, non-Western worldviews must be articulated, enabling different perspectives of art to be informative in the interpretation of Upper Palaeolithic cave art.

### *3.2.2. Non-Western perspectives: Animism and totemism*

It is clear, therefore, that the perception of art through a Western worldview, that paints it as a passive, consumable commodity, is unhelpful for understanding Palaeolithic artistic behaviours. Non-Western ontologies, *sensu lato*, may offer a more useful perspective for a Western researcher to reconceive art by moving beyond their implicit connotations associated to art. Following Hallowell (1964, 49 – 50), ontologies are understood here to be the way people relate to, and understand the nature of, their world; ontology is perceived as synonymous to worldview. Although ontology has been previously harnessed in prehistoric art research to ask questions about how this art reflects or relates to past understandings of the world (e.g., Hussain and Floss 2015; Jones and Díaz-Guardamino 2017; Moro Abadía and Chase 2021), ontology is used primarily here to emphasise how the Western perspective of the world (and art), as bounded and determined by causal laws, is

just one way of understanding it. Art within a Western ontology perhaps can only ever be perceived as an aesthetic commodity. Non-Western ontologies are thus utilised here to offer alternative perspectives to Western worldview, encouraging a “broadening of horizons” and allowing for “art” to be redefined through a different ontological lens. Non-Western ontologies, for example, often appreciate non-human things as being vibrant and agential, and thus art is not merely a commodity, but may operate in agential ways or emerge through dialogues between humans and non-humans. The use of ontology within this theoretical framework thus perhaps more closely aligns with Cipolla’s (2019) definition of the first orientation within the “ontological turn”; using ontology as a worldview focused approach that seeks to understand non-Western worldviews, in turn enriching perspectives of certain behaviours (i.e., art) beyond the Western perspective. Inherently, by using ontology in this way and defining art through non-Western worldviews aspects of relational thinking also become embedded; this is discussed further in sections 3.2.3. and 3.3.1.

For heuristic purposes, non-Western ontologies are presented as an alternative to the Western perspective (Figure 3.1). This seeks only to broadly explore different ways of thinking about the world, to subsequently inform how art may be considered differently and redefined through this alternative lens. It is an inherently coarse approach towards discussing “non-Western worldviews”, identifying broad trends and similarities in indigenous thinking, and consequently does not appreciate all the nuances of the epistemological and socio-cultural behaviours of these societies. Nevertheless, the purpose of discussing these worldviews here is to fundamentally challenge assumptions held by Westerners about the world, which are distinctly W.E.I.R.D. (Henrich *et al.* 2010a). The broad sweep approach here too intentionally aims to avoid problematic direct-historical analogies between contemporary and deep past societies.

Cartesian dualism	Relational non-dualism
Western modernity	Indigenous non-Western world
Immaterial vs material	Animism
Mind/soul vs body	Perspectivism
Subject vs object	Relationalism
Ideal vs real	Intensive and extensive multiplicity
Culture vs nature	Flux
Human vs animal	Fractality
Animate vs inanimate	Participation
Law of non-contradiction	Transformation
Essentialism	Motility
Stasis	Flat ontology
Science	Immanence
Transcendence	Reciprocity
Hierarchy	Balance
Imperialism	Wonder-sustaining
Ecological exploitation	
Wonder-occluding	

Figure 3.1. Non-Western ontologies which can serve to challenge Western Cartesian ontologies. Image: Scott 2013, 862.

Animism is one worldview that is common within small-scale societies, particularly those with hunter-gatherer subsistence economies. It pertains to one where animals, object, materials, plants, and landscapes are often treated as non-human persons; they have agency, personalities, and are perceived as acting in autonomous, unique ways (Pederson 2001, 414; Hornborg 2006, 24; Hill 2011, 408). It is often perceived as a flat ontology where all things are perceived as equally agential (Willerslev and Ulturgasheva 2012, 49; Scott 2013, 864), but there are examples of animistic societies (e.g. Yukaghir, Shipibo) that perceive certain non-human entities as having more, or less, agency than others (Pedersen 2001, 416; Halbmayer 2012, 14). For example, within the Anishinaabe (a group of culturally related Native American societies) animist worldview, a certain rock may necessitate one engaging in a dialogue with it as if it were a person, but another may not, and not all rocks are perceived as being sentient, only *some* (Anderson 2017, 135).

This ontological perspective and its apparent universality in small-scale societies is perhaps by virtue of the intimate relationship these societies have with their surrounding landscape and other beings. One can appreciate how the close observation of animals, or an in-depth appreciation of subtle ecological changes, may manifest as an understanding of autonomous beings that have equal agency to humans in the world. Thus, this worldview is an *orientation* that affects people's negotiation and reception of other beings in the world, and the interplay of animal-human-object-landscape relations (Pederson 2001, 414; Ahmed 2010, 235). It stands in stark contrast to the Western worldview, particularly when thinking about the categorical boundaries drawn in Western societies between human = active vs. object/animal = passive. As such, it is perhaps little surprise that it was misunderstood when it was first defined in the 19<sup>th</sup> Century by Tylor (1871, 99) and painted as a primitive

belief system that objects and non-humans have “souls”, akin to childish perceptions of the world (Harvey 2005, 8; Insoll 2011, 1005; Porr and Bell 2012, 162). In this sense, animism has been perceived as fanciful and “false” and Western science and worldviews revealed fundamental “truths” (Bird-David 1999, S68). Although this perspective is a hallmark of Western worldviews drawing false boundaries and dismissing different ways of thinking, it in turn opens a path for allowing the Western worldview to be challenged by exploring the animist worldview.

Animism manifests in a multitude of different, complex ways across distinct societies, and undoubtedly any general overview will not appreciate the subtle cultural nuances within this ontology. Exploring some of the ways it manifests, though, can allow for a broadening of the Western perspective beyond the confines of a Cartesian, *mechanos* world. In many Indigenous Northern circumpolar societies, animism is expressed as a mutual relational understanding between human and non-human beings; life generates forms, and thus it is possible to shift between different forms with the world (Bird-David 2006, 35). An animal can become a human, and a human can become an animal. For example, within Yukaghir and Koryak society, hunters frequently blur the boundary between human/animal through becoming a not quite animal, but not-*not* animal; you can wear animal skins and become an animal, but equally the animal can wear your skin and become you (Pedersen 2001, 421; Willerslev 2007, 98). In Yukaghir society, this process is conducted with extreme caution as it carries the risk of crossing too far into the animal world and permanently becoming this form (Willerslev 2004, 634). Similarly, in Chukchi society, during the first sacrifice of a reindeer in the Autumn, the blood will be used to paint the faces of members of the society; this process entwines the identity of the animal and the human, suggesting the human becomes the animal victim and loses some aspect of their self (Willerslev and Ulturgasheva 2012, 62).

Relations with non-human entities in animistic societies are fundamentally based on ideas of reciprocity, bargaining, and exchange, which deliberately shift and manipulate the relationship between humans and non-human entities. As non-human entities are perceived as having equal status, or perhaps even superior status, to humans, practices such as hunting must be negotiated in a way that is sensitive to this relationship. This may occur through deception to ensure there are no negative consequences or vengeful actions from non-human entities, e.g. the Yukaghir mimicking crow sounds and pecking the eyes of a bear they have killed, placing the blame of the bear’s death on other animals, or the Eveny using children to carry hunted animals, to give the illusion that the death of the animal was a voluntary sacrifice to a child (Willerslev 2007, 130; Willerslev and Ulturgasheva 2012, 55; Willerslev 2013, 51). Additionally, this may occur through a continuous dialogue with non-

human entities. The Chukchi, for example, operate on a system of reciprocity whereby reindeer are gifted by spirits, but equally these spirits will require sacrifices of reindeer related to the original doe gifted, as the spirits are the “true” owners (Willerslev and Ulturgasheva 2012, 59). This demonstrates how animism operates as a dialogue between human and non-human entities. As an ontology, therefore, animism closely aligns humans and non-humans, blurring the boundary between the two, and permeates throughout all aspects of society, influencing the way humans inter- and re- act to non-human entities.

This type of perspectivism is also present in societies which are more typically conceived as totemic, such as Indigenous Amazonian (e.g. Wari', Yudjá), Australian (e.g. Yolngu, Warlpiri), North American (e.g. Ojibwe) and South American societies (e.g. Akuryió, Campa), all of which similarly blur the Western perceived boundary between animal and human (Costa and Fausto 2010; Peterson 2011; Rival 2012, 70; Viveiros de Castro 2012, 49-51; Wallis 2013, 22; Pomedli 2014). The word totemism is derived from the Ojibwa word *ototeman*, meaning “they are my relative” (Passariello 1999, 18), thus inherently refers to a kinship expressed between humans and a totem. This totem may take the form of an animal, a plant, or the land itself (Passariello 1999, 18; Ingold 2000, 112; Insoll 2011, 1007). The most common connotation of totemism is, unsurprisingly, its manifestation in certain Native American societies, whereby a society will have a totemic animal that is the ancestor of the members of the society (Fogelson and Brightman 2002, 306). In Ojibwe society, one-sixth of Ojibwe clans adopt the bear token which serves to define their identity; members of bear clans are perceived by other Ojibwe clans as having personalities akin to bears (e.g. ill-tempered, aggressive), and even as having physical characteristics similar to bears (e.g. thick, dark hair) (Pomedli 2014, 135). Bears are regarded by the Ojibwe as intelligent beings and kin, and occasionally perceived as superior to humans (Pomedli 2014, 119).

Whilst totemism is often presented as the alternative ontology within Indigenous groups to animism, there are points of resonances between the two ontologies. In totemism, rather than all human and non-human beings having relations between each other (intra-relationality), humans perceive themselves as descended from an ancestor that resides within a specific non-human entity and only relate to this entity (e.g. specific animal species or a geological feature; inter-relationality). Some societies blur aspects of these two ontologies. Within the Eveny, there is a constant asymmetric dialogue of bargaining between the living and the ancestral spirits. Children's souls are vulnerable to being “taken” by the ancestors during this dialogue, and consequently children are provided with a guardian reindeer which will sacrifice themselves knowingly and intentionally in this situation, but this is unidirectional (Willerslev and Ulturgasheva 2012, 52). The dialogue,

therefore, suggests an animistic ontology, but the asymmetry between humans and ancestral spirits implies aspects of totemism.

Indigenous Australian societies provide an example of an alternative manifestation of totemism; within their ontology, the land is inhabited and was formed by ancestral spirits, during a period known as *Dreaming* (Ingold 2000, 113; Insoll 2011, 1010). The land therefore gives life to all forms which inhabit it; humans have a specific relationship with the land, but not with non-human forms within the land (Ingold 2000, 113; Rose 2013, 130). The land is interacted with as if it were sentient, and therefore may appear to be an animist ontological perspective, but in fact involves the understanding that ancestral spirits inhabit the land. For example, Mangarrayi interact with trees by directly linking them to living descendants of the creator figure which made the locality in which the tree exists (Peterson 2011, 172). The tree is not perceived as a person, in the same way that an animist may perceive it, but rather is interacted with because of the particular ancestral spirit which inhabits the land surrounding it.

Fundamentally, and in contrast to Western perceptions of the world, these ontologies emphasise the importance of relationships between human and non-human beings. This perspective can enable a better appreciation of Upper Palaeolithic artistic behaviours. Upper Palaeolithic societies were dependent on specific animals and landscape resources for survive. Consequently, their ontological understanding likely featured this dependent relationship, permeating throughout their material and visual culture. This does not intend to suggest Cro-Magnons were ontologically orientated in the same way as contemporary societies. Instead, this point serves to demonstrate that these ontologies are a more useful perspective to take when approaching Upper Palaeolithic behaviours, far more so than if one were to view these behaviours from an uncritical Western perspective. Animism and totemism emphasise the relationality between humans, animals, and other non-human beings, which is particularly important to consider with Upper Palaeolithic figurative cave art. These ontologies allow not only for intimate human-animal relationships to be appreciated in the context of art production, but also for non-human agency to be appreciated, giving way for an active role of all non-human entities, such as animals, pigments, tools, and the cave wall, in shaping depictions. Through this perspective, two definitions of art can be inferred: 1) as a medium for negotiating relations; and 2) as a non-human entity in its own right, which is interacted and related to accordingly. Additionally, this stresses that there is a *dialogue* that occurs between humans and non-humans, whereby these relations are continuously renegotiated, as part of an extensive *process of becoming*. Consequently, these ontologies propose a third definition of art: 3) art is a process, and its significance derives from the biograph(y/ies) of its making.

### 3.2.3. Non-Western perspectives: Defining art as an active, relational process

*“Art is not a noun; it is a verb, [a] process.”*

*(Gormley 2004, 131)*

These perspectives explicitly challenge those assumptions held by Western researchers; objects are active in shaping the world, and are not merely consumable commodities. Art can be redefined through this perspective. Reviewing how participatory and dialogical interactions with non-humans manifests in art making, from a breadth non-Western contexts, can enable art to be understood beyond the Western perspective. The examples discussed here serve to both appreciate how different agents can commingle in art making, informing the development of a theoretical approach later that aims to articulate this.

Engaging in a dialogue with non-human agents appears to be a frequent theme in non-Western ontologies, with art becoming a tangible medium in which to negotiate this. This concerns both abstract and figurative representations of non-human actors in art, and the use of parts of non-human actors to produce an art object. Within Australian Aboriginal societies (e.g. Yanyuwa, Alawa, Worora, Wunambal, and Ngarinyin), for example, body art, bark paintings, and rock art reflect abstract representations of ancestral spirits (Layton 1985, 436; Layton 1988; Brady and Bradley 2014). Although all art forms depict the same motifs, it is rock art that is revered as being a medium in which one actively engages in a dialogue with the ancestral spirits, through allowing the spirits to speak through a person during the production of the art (Layton 1988, 439). This seems to be fundamentally bound to an understanding that the oldest motifs were produced by ancestors; the palimpsestual nature of the art is a tangible manifestation of different generations engaging with a specific place in the landscape, and this temporal depth imbues these motifs with their significance (Layton 1988, 439; Taçon 1989, 324).

In some cases, and in stark contrast to Australian Aboriginal rock art, the art as a tangible form is not of relevance. Instead, emphasis is placed on the cultural process surrounding the emergence and deposition of the art. For example, within Papua New Guinea, indigenous groups use sculpture, *Malangan* art, as an intrinsic part of mortuary practices. Whilst they are formally defined as a funerary monument, the viewing of these sculptures is confined to the few hours of their public display before they are disposed of within the forest (Küchler 1992, 95). Instead, it is the intangible nature and memory of these sculptures that is of importance, evoking a “memorised visual culture” (Küchler 1988, 627; Küchler 1992, 95). Despite the fleeting nature of the physical form of this art, it still has significant relational resonances. During mortuary practices, the *Malangan* sculpture is

understood to replace the skin of a deceased person, and thus houses their life force (Küchler 1987, 240). The image and the deceased person become entangled, both creating an ancestral presence and imbuing power into the *Malangan* image (Küchler 1987, 240; Küchler 1992, 102). The sculpture must be destroyed as part of this process, to ensure the ancestral power associated to the sculpture is released and reconstituted into the memory of the *Malangan* image (Küchler 1987, 240). The memory of a *Malangan* image is subject to exchange, just as physical objects might be exchanged, and consequently becomes integrated into the fabric of social memory (Küchler 1992, 97). The sculpted version of this image is therefore a temporary reconstruction which embodies the biography of exchange of the *Malangan* image, but does not contribute to it. The artist that produces a *Malangan* sculpture is trusted to know the intricacies of the image; recalling this image is further aided by inducing visions through potions and by elders describing it (Küchler 1992, 103). This demonstrates that art can be deeply embedded in social practice and memory, with the aesthetic object being rendered less important than the enchainment relations with the art's biography.

In a similar vein, numerous Inuit societies use art to express their ontological understanding that humans and animals have a dual existence, and thus can shift from one form to another. For example, masks are frequently used to express this and are perceived as revealing the true form of a person, rather than concealing it (Oosten 1992, 113). These are used in Inuit societies to represent the fundamental form of both humans and animals, and the true nature of them, referred to as *inua*. Shamans produce these masks, often based on their own understanding and experience of an animal's *inua* (Oosten 1992, 123). Fundamentally, therefore, this art form refers to the relational understanding of humans and animals in the Inuit world. Other Inuit art forms, such as amulets, also encapsulate a relationship between humans and animals. Amulets are often made from animal parts, and thus aim to capture the essence of an animal which can be drawn upon, but also are intended to draw that animal to a hunter wearing the amulet (Hill 2011, 415). Utilising an amulet can have a breadth of relational understandings for just one animal; for example, an amulet of raven "whiskers" added to a drum is thought to improve the drummer's singing voice, but amulets made of raven parts can also summon the raven as a protective spirit if the wearer is in danger (Oosten and Laugrand 2006, 191; 198). These examples serve to demonstrate the multifaceted, plural ways in which art may be used to negotiate relations between humans and animals.

The common thread throughout these examples is the multifaceted and varied understanding that *art is not merely aesthetic, but an active medium for negotiating relations*. Although some of the aforementioned examples discuss the process of making art, very few

ethnographic accounts focus on this exclusively. Those which do recall the process of art production allude to this being an intimate dialogue. This is apparent in accounts of the production and role of figurines amongst the Aivilik, an Inuit group in northern Canada. The theme which runs throughout Aivilik art is one of *nalunaikutanga*, which literally means “important de-confuser”, pertaining to the concept of ‘distinctive’ or ‘salient’ features which enables one to identify something (Graburn 1976, 1). The *nalunaikutanga* of a species is rarely the most prominent feature, but instead is a feature of an animal that is both characteristically and behaviourally unique to that species. Therefore, the *nalunaikutanga* of a polar bear is its teeth, claws, and tongue, as these encapsulate the attributes and behaviours of the polar bear. *Nalunaikutanga* is a key concept during the production of art, as discussed by Graburn (1976, 11):

*“When [the Aivilik set] out to carve stone or to draw on paper (for an eventual print) he (or she) starts with an air of puzzlement nalulukpuk. Rarely does he start with subject or object in mind. He turns the stone over and over, chips away at certain parts with a series of ideas, ishuma, flashing through his mind. He is looking for gross form, for ability of the particular rock to carry an image (or of paper to contain one) and suddenly he can attack the rock (or the surface) with the complete plan in mind. He has its essential nalunaikutanga in mind, and often starts to sketch or to shape these first, or at least prepare to fit them into the medium. Generalized action turns into purposive action, and this action is what provides pleasure and satisfaction.”*

The artist does not start the process with a predefined idea of the final form of the art, but instead engages in a dialogue with the material, allowing the hidden, true form of the art to “reveal” itself (Layton 1991, 32). Unlike Australian Aboriginal art, where art production engages in a dialogue with ancestral spirits and materials are the medium through which this dialogue is communicated, this dialogue is with the material itself. The material is thus active; it is not a blank canvas in which forms are imposed, but rather an actor concealing its true form.

The example of Aivilik art production emphasises the significance of the pareidolic experience of seeing significant forms in random patterns during art production. It is the process and act of revealing the hidden form of the material that has significance to Aivilik people (Layton 1991, 33), and the final form is rarely given any value:

*“Art to the E\*\*\*\*o (Aivilik) is an act, not an object; a ritual, not a possession. Art to them is a transitory act, a relationship. They are more interested in the creative activity than in the product of that activity. Once carved [...] it may be passed from hand to hand, then dropped indifferently, or simply lost”*

*(Carpenter 1973, 63; 75 cited in Graburn 1976, 10. Slur censored from original text)*

From the above, it is clear that art and art objects are rarely commodified “things” appreciated only for their aesthetic final form, but instead are active within their cultural

milieu; they are engaged with, manipulated, related to, and used as a communicative medium. They are not passive and cannot be fully appreciated from a perspective that initially presents them as such. All stages of making art are bursting with creative, agential engagements that give the art its significance and purpose within a society. Certain theoretical approaches in the anthropology of art also appreciate and present this definition (e.g. Morphy 1989; Gell 1998; Hoskins 2006; Morphy 2010; Ingold 2013; Sansi 2015). Notably, and often cited by these theoretical approaches, Gell's (1998) *Art and Agency* argues for an understanding of art that considers the interplay between the artist, the subject of the art, the audience, the materials, and the art itself as tensions in agency; every relationship between these entities is a negotiation that occurs during art production, which ultimately shapes the social role and final form of the art. Drawing on the aforementioned examples, the most potent of these relationships may occur when art is created in conditions that encourage psychological phenomena to be triggered, particularly pareidolia. In this instance, the material has tangible agency in manipulating the artist's perspective and is interpreted as responding to the dialogue within which material and artist are engaged.

It is apparent, therefore, that it is the process of art production that imbues meaning into the art: meaning is certainly in the making. By employing non-Western perspectives, both in an ontological sense and specifically with art production, this chapter demonstrates that art should be defined by the relations it embodies and mediates, and these relations are entwined with its creative production. Notably, the tensions of agency described here engage psychological phenomena, like pareidolia, which appear to be a medium through which these tensions are received, understood, and responded to by the artist(s) and are especially important in developing the theoretical approach below. In order to articulate these insights from non-Western ethnographies, a new theoretical approach is developed which attempts to provide a way to evaluate the processes involved in cave art production, particularly psychological processes, and appreciate the relational, active nature of these processes.

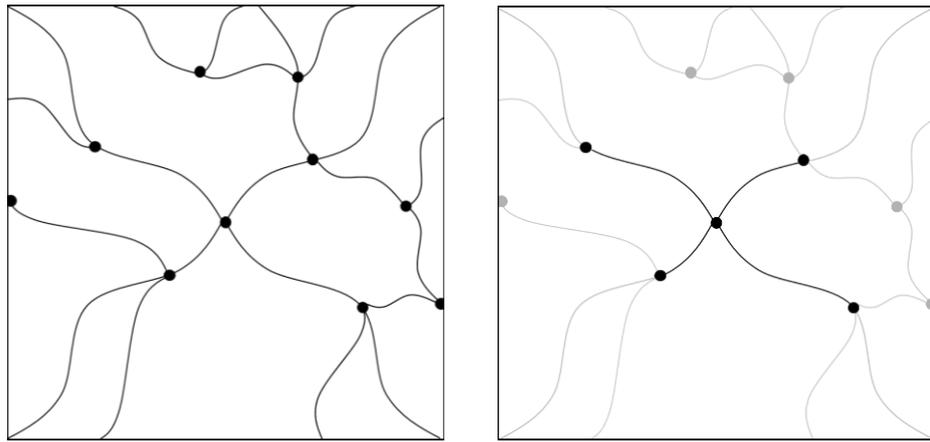
### 3.3. Theoretical Framework

The redefinition of art through a non-Western lens as an active, relational process naturally invites the adoption of the recent theoretical turn in archaeology towards relational thinking and new materialism (Thomas 2015). These theories fundamentally encourage more holistic, context-sensitive approaches that shift focus from *being* to the processes involved in *becoming* (Deleuze and Guattari 1977; Braidotti 2002; Lucas 2012; Fowler 2013). This is vital for this theoretical framework; as demonstrated by non-Western perspectives in this chapter, art is highly responsive to its specific cultural milieu, which

compels a reflection of the very process – the artist’s mind and society – which created it (Dickie 2004, 61; Donald 2006, 5).

### 3.3.1. *The contribution of relational thinking and new materialism*

Relationality and materiality have much to contribute to the development of a theoretical framework that resonates with non-Western perspectives. Relationality has recently gained much ground in archaeological theory, contributing to new perspectives that appreciate “things” are rarely neatly bounded and isolated in the world, but instead part of a messy mesh of relations (Ingold 2013). Relational thinking is ultimately inspired by ontological perspectives from non-Western societies, most notably Strathern’s (1988) work on Melanesian communities and the relational construction of personhood and identity. Within archaeological theory, relationality has multiple permutations that ultimately stem from the core concept that *things* (humans, objects, landscapes, materials, animals etc.) are grafted together from multiple relations that weave and interact to form other *things*, shaping how people interact and engage with their world. Hodder (2011; 2012; 2014; 2016) conceives this as entanglements, discussing the co-dependency of things on other things and perceiving relations as being constructed between pre-existing things. Ingold (2008a; 2008b; 2012), by contrast, envisages relationality as a complex meshwork, with knots in relations coming-together as the points where *things* emerge but the *thing* is not divorced from its relations, they are intertwined; akin to a spider and its web (Ingold 2008b; see also Japyassú and Laland 2017). Inspired by DeLanda (2016), Jervis (2018) perceives things in the archaeological record as a complex assemblage, and thus the “thing” as we know it does not necessarily exist. Despite extensive debates over the validity of one perspective of relationality over another (e.g., Ingold 2008b; Hodder and Mol 2016; Hamilakis and Jones 2017, 80), ultimately relational thinking offers the perspective that past phenomena can be better understood through its relations (Figure 3.2), rather than drawing false divisions and binaries between things-in-the-world; divisions which are not always recognised in contemporary societies, and may not have been recognised by past people.



*Figure 3.2. A visual representation of relationality. Image (left): represents the entire web or ‘meshwork’ of relations between entities (represented as black dots). Image (right): a visual demonstration of applying specific relational perspectives, that focus in on how relations come together to form a certain thing within the web. Images: Author.*

Relational thinking offers a way to articulate non-Western perspectives in evaluating the making of cave art in the Upper Palaeolithic. The use of the term “relational thinking” here perhaps best resonates with Harris’s (2020, 16-17) characterisation of relations as epistemology; inspired by non-Western perspectives, relations are understood here to be the knowledge system that Cro Magnons may have used to orientate themselves and engage with the world. Within the context of figurative cave art production, therefore, this offers the perspective that the depiction of animals may have been layered with a deeper understanding of fundamental human-animal relations that existed in the Upper Palaeolithic world. Animals may have been understood and engaged with in a specific way, therefore demanded a certain approach to representing their form. It encourages a consideration of the broader context within which artistic behaviours sit: the lifeways of Cro Magnons are an important epistemological consideration. This importance of situating the production of cave art is further emphasised by a psychological approach in this research. As further explored in Chapter 4, the mind is plastic and shaped by the lived experience of a person; vision is particularly susceptible to this. Relational thinking offers a way for this research to appropriately consider the relations embodied within the art, as integral to understanding its making.

New materialism provides a further layer to the theoretical framework, which encourages the emphasis of non-human agency and dialogical interaction as inherent within art making. Materials have shifted in archaeological perception from being understood as having an innate “brute materiality”, which may have given certain affordances in terms of its usage by humans but certainly had no agency of itself, to vibrant, lively agents that participate in dialogues with other agents (Bennett 2010; Conneller 2011; Jones and Alberti 2013, 16; Thomas 2015, 1289). Following Harris (2020), if “relational thinking” is “relations as epistemology”, then new materialism is “relations as metaphysics”;

the inherent material properties of an object shape the relations that are built with it (Conneller 2011; Harris 2020, 22). Rather than leaping to the existential meaning of things, new materialism invites grounded perspectives that start with the properties and affordances of materials; the materiality of a thing takes primacy (Witmore 2014, 204). From this start point, one can consider how materials may have actively shaped or constrained human action in an ongoing dialogue with human-material interactions framing socio-cultural behaviours (Conneller 2011, 3).

Taken together, relational thinking and new materialism represent two relational knowledge systems that are pertinent to understanding the processes of cave art making. The epistemological perspective of relations offers a way to understand, perhaps intangible, relations between humans and other agents in their world. The metaphysical perspective encourages a consideration of the tangible, physical properties of materials and how these properties imbue materials with vibrant agency and the capacity to “act back” in interactions with humans. To articulate these two theoretical concepts, consider the use of ochre in the Upper Palaeolithic. Ochre may have been understood epistemologically (relationally) as being an index of a certain area in the landscape, where the ochre was sourced, or, as in some contemporary contexts, perceived as representing blood and “life force” by virtue of its colouration (Wreschner 1980, 631; Taçon 2004, 33; Nicholls 2008, 4; Telban 2017, 243; Siddall 2018, 6). From a metaphysical (new materialist) perspective, it may have also been understood in terms of its material properties: it stains other things, irreversibly transforming the appearance of the skin of humans, animals, and rock. It also has certain physical affordances, such as antimicrobial properties or its powder form when ground, which lends itself to being used for a wide range of cultural activities such as tanning hides or being mixed with adhesives (Lombard 2006; Rifkin 2011; Hodgskiss 2012, 100). This layers the understanding that ochre was a culturally stained material, intrinsically linked to a breadth of cultural behaviours, and in turn has the capacity to culturally stain other things. This kind of thinking integrated within a theoretical framework not only provides the potential opportunity to discuss the deeper meanings imbued into the art, but crucially provides a way to contextualise psychological phenomena related to this process, situating this experiential aspect of the art making within the lived, relational experience of the artist.

### *3.3.2. The contribution of extended cognition perspectives*

Perspectives on extended cognition, stemming from Clark and Chalmers (1999), help to activate both the epistemological and metaphysical in relation to cognitive and psychological approaches. This shifts away from Cartesian perspectives of the mind and towards a more relational understanding of cognition and mental processes as

incorporating aspects of the material world. Typical examples of extended cognition include a person with Alzheimer's who relies on a notebook to recall information (Clark and Chalmers 1999, 12 – 13), or the blind man's stick where a blind person relies on their stick to gain information about the world (Malafouris 2008, 403 – 404). An unusual take on extended (or distributed) cognition discusses spider cognition as extended to include the spider's web, arguing against the idea of cognition as a centralised system that occurs within the mind alone (Japyassú and Laland 2017). This resonates with ideas of distributed cognition, where not only does the mind flexibly extend to incorporate materials, but aspects of cognitive processes are scaffolded on and emerge through interactions with external objects in the world (Sutton 2010; Sutton 2020); just as the spider's "mind" is distributed throughout both its body and web. In all examples, cognition does not occur in the mind alone and materials are actively incorporated into the cognitive process. Studies related to peripersonal space have demonstrated the plasticity of the mind when it comes to including objects within cognitive processes. The mind extends peripersonal space (the space we can readily reach when we extend our arms, which our minds map as closely associated to our bodies) to include the length of an object when the object is used to reach something (Holmes *et al.* 2004; Malafouris 2008, 408). Malafouris (2015, 359; 2016, 290; 2019, 4) also discusses extended cognition in the context of Material Engagement Theory (MET); materials are active in scaffolding and shaping the mind, as they constrain and embody mental processes.

Extended cognition and MET encourage a deeper consideration of materiality and material interactions as a component of cognition. Through this perspective, cognition is not a bounded process that occurs within the mind alone, but a dialogue that occurs between the mind and external material forms. As Malafouris (2010) discusses in the context of flint knapping - the decision about where to place the next blow and the force to use is not one taken by the flint knapper alone, but rather is an intention that emerges through an interaction with the stone itself. An experienced flint knapper will only know where to place this next blow through turning over the stone and exploring its materiality; it is through this dialogue that the decision about where to place a blow emerges. This in turn affects the knapper's cognitive process, as they flexibly adjust and respond to the material properties of the stone. Amateur flint knappers will often ignore this dialogue, frustratedly and often randomly hitting the stone with force to try to produce a flake. The stone is unyielding to this brute approach, and often the results are disappointing, causing internal fracturing, blunting of edges, or the destruction of once perfect platforms. Knapping also includes the extension of the mind and the body into the hammerstone used. The vibrations felt through the hammerstone are felt and interpreted by the mind as if the stone were a part of the body. The material interactions within flint knapping articulate how

materiality and relationality becomes a key aspect of cognition, creating a system of interaction between the mind, body, and external material forms (Overmann and Wynn 2019, 458).

These perspectives offer a unique way to situate relational thinking within cognitive processes, demonstrating how relations and materiality may affect psychological responses. Not only does this realise cave art depictions as embodiments of past cognitive processes, but also demonstrates the importance of a holistic approach to understanding the role of the visual system in the making of cave art. The mind cannot be perceived as an isolated, bounded agent that objectively imposes action onto inert materials. It is fundamentally affected, shaped, and scaffolded by lived experience and relational interactions with other agents in the world.

### *3.3.3. A novel biographical approach*

Whilst theoretical perspectives undoubtedly provide important insights into the process of making cave art in the Upper Palaeolithic, they need to be coherently framed within an approach that is useful for understanding this art. Tracing the sequential stages involved in making offers one way to achieve this, allowing a coherent narrative thread through the messy, warping mesh of relations that commingle in cave art. A *chaîne opératoire* is a traditional way to follow the stages of making, but often have been critiqued for the rigidity within which they impose fixed stages of making, often preventing the appreciation of more nuanced dialogues involved in the craft of making (Sellet 1993; Joy 2009). Biographical approaches (Kopytoff 1986; Gosden and Marshall 1999; Joy 2009), by contrast, have demonstrated their usefulness in being able to trace relationality and materiality through an object's, a building's, or an assemblage's life (e.g. Mytum 2003; Crawford 2009; Joy 2010; Morris and Jervis 2011; Jones *et al.* 2016; Little *et al.* 2017; Needham 2018; Thompson and Doonan 2019; Falci *et al.* 2020; Kay 2020). Valid critiques have been raised of biographical approaches that argue biographies share similar issues with *chaîne opératoire* approaches in imposing rigid stages (Shanks 1998; Burström 2014). However, the reworking and expansion of biographies (or "itineraries") to encompass modes of recycling, re-births, fragmentation and other complex processes that things are often subject to (Joy 2009; Joyce 2015; Joyce and Gillespie 2015) and to accommodate for "multiple-objects", where one particular thing may have been concurrently used, related to, and/or understood in many different ways (Jones *et al.* 2016; Jones and Díaz-Guardamino 2017), demonstrates the flexibility of this approach.

For cave art, *chaîne opératoire* and biographical approaches are often difficult to employ; secure chronologies are often a necessity for these kinds of approaches, and cave art is notoriously difficult to date, let alone tease out isolated instances and sequences in

behaviour. Where chaîne opératoire approaches are employed to understand the making of Palaeolithic art, these tend to focus on the technical gestures involved (e.g. Fritz and Tosello 2007; Farbstein 2011b; Rivero 2016; Rivero and Garate 2020). To coherently discuss the making of this art, and crucially the extent psychological mechanisms informed this making, a relative chronological sequence is proposed (Figure 3.3); one that sits partially between a chaîne opératoire and biographical approach. This utilises a narrative structure to “talk through” the making of the art within a particular site, starting with the socio-cultural framing that happens before entering the cave, through to the enduring relations that are created with the reception and perception of the final form of the art. Time is partially collapsed in this approach and it must be stressed that the sequence of events discussed is relative; in reality, they may have occurred concurrently or even been separated by millennia. Thus, this is intended only as a useful framework to discuss the different processes of making involved in figurative cave art, rather than fully capturing the complexity and cultural nuances that were likely embedded within these processes.

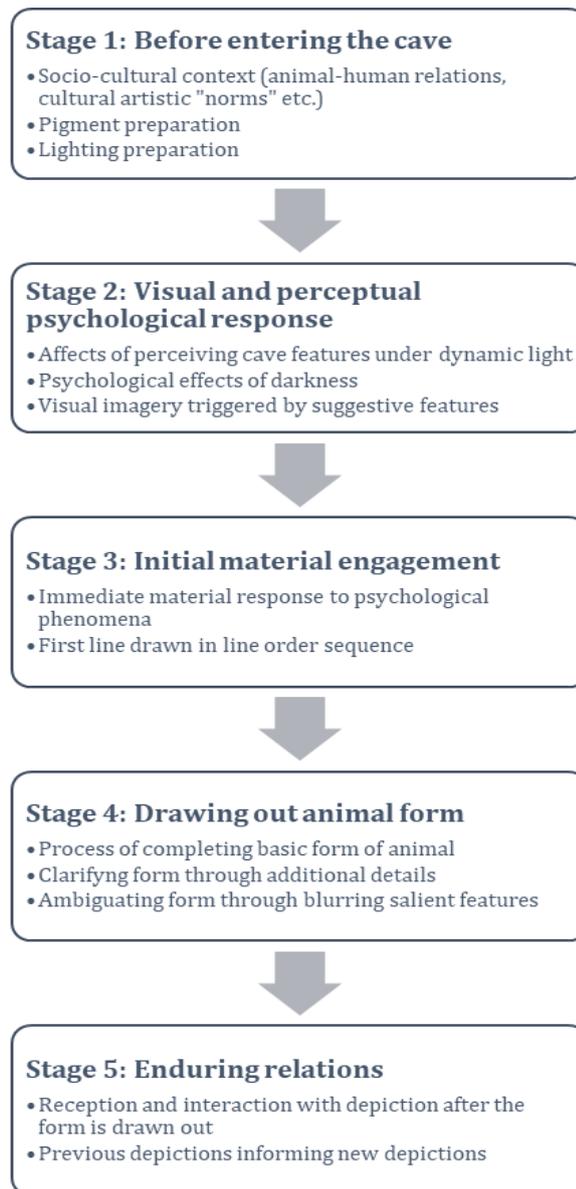


Figure 3.3. Proposed relative chronological sequence for discussing the making of cave art. Image: Author

The framework proposed here, therefore, is a relative sequence that takes elements of a chaîne opératoire and a biographical approach through focusing on one aspect of the cave art's biography – its production – and appreciates this as a dialogical process. The stages proposed here both bring into focus different process involved in the making of cave art, but allows flexibility for these processes to blur and tangle together whilst simultaneously providing a coherent thread through which to understand this making. It also proposes that the making of cave art was a collaborative process – a conversation – that occurred between the cave wall, the artist(s), the pigments, the dynamic light, and the animals represented. Emphasis is placed on the psychological response of the artist as one means to explore this making, but this does not intend to diminish the contributions of other agents in this process; on the contrary, these agents are important considerations for understanding the artist's psychological response. The framework intends to resonate with

the non-Western perspectives offered throughout this chapter, appreciating Palaeolithic cave art as an active, dialogical process instead of an embellished commodity produced by a human agent alone.

### 3.4. Summary

Working within the theoretical framework developed throughout this chapter allows for some of the implicit issues with previous approaches to Palaeolithic art to be addressed and mitigated. The focus on different stages of making figurative cave art prevents a fixation on final form, but more importantly ensures that the insights generated for this art are context-sensitive and rooted within the archaeological evidence. The socio-cultural milieu, the visual effects of light cast across complex wall morphologies, and even the physical application of pigment to the cave surface are thus placed as being as important, if not more so, than the final aesthetic form of the art. The flexibility and breadth of this framework also has the potential to reveal more nuanced insights into the meaning behind this making. By appreciating art as an active, relational, and participatory process, it opens avenues for understanding how this process may have been understood within Upper Palaeolithic societies. The starting point is no longer the Western assumption that art is an embellishment to society and a frivolous activity, but instead that art can be intrinsic to societies, active in mediating relations between humans and non-humans, and can embody a particular ontological understanding. Centring the making on the artist's own experience through an interdisciplinary approach with visual psychology – further developed in the following chapter – enables these facets of figurative cave art to be tangibly explored and tested against the archaeological record.

## Chapter 4.

# Visual and Perceptual Psychology: Application to Upper Palaeolithic Cave Art Research

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### 4.1. Introduction

The theoretical framework provides a useful lens for which to calibrate Western biases attached to the value of art and shift focus away from anachronistic “grand narrative” explanations of artistic behaviours in the Palaeolithic towards more nuanced insights into the making of the art. The framework further demonstrated that understanding the psychological foundations of Upper Palaeolithic cave art may provide one means to access the meaning behind the making, through providing a tangible way to access the experiential aspects of this phenomenon. Yet a theoretical lens alone, no matter how useful, is limited in the pertinent outputs it can generate, and without direct application to specific examples from the archaeological record, risks producing the same generalisations it intended to mitigate against or problematically assuming direct parallels between contemporary small-scale societies and Upper Palaeolithic societies. This is where integrating insights and approaches from psychology comes to the fore.

Vision is universally the primary sense in humans; we usually derive the majority of the information we know about the world from visual stimuli (Wade and Swanston 2013). It is perhaps unsurprising, therefore, that humans are often understood in perceptual psychology as “undeniably visual creatures” (O’Callaghan 2011). Although vision does not operate in isolation to other senses (Wade and Swanston 2013), visual stimuli often dominate with respect to other senses (i.e., if conflicting information occurs between vision and another sense, vision often prevails: Stokes and Briggs 2015, 351). To appreciate aspects of the sensory experience of the process of making Upper Palaeolithic cave art, it is thus key to understand visual and perceptual responses. Visual and perceptual psychology has already been demonstrated to produce meaningful and specific insights into aspects of Upper Palaeolithic art (termed “visual palaeopsychology”: Meyering *et al.* 2020; Pettitt *et al.* 2020; Hodgson 2021) and has the potential to further elevate approaches to Palaeolithic art to access aspects of its making. Whilst visual psychology has often, in the past, conformed to Cartesian ideals and assumed the Western experience is universal (Henrich *et al.* 2010a; Henrich *et al.* 2010b), there has been a greater understanding in recent years that vision and perception are diverse, embedded processes, that occur distributed throughout the body and in interaction with the physical world (e.g., Foglia and Wilson 2013; Proffitt 2013; Zhang *et al.* 2016; Korbach *et al.* 2019). The use of visual psychology in this research intends to complement the theoretical lens provided by non-Western ontological perspectives and

provide a tangible way to explore the dialogical making of art through the archaeological evidence. Hypotheses generated through the theoretical framework regarding the interaction and response of the artist to other agents (the cave wall, pigment, light) can be tested through visual and perceptual psychology, by evaluating the effects of these agents commingling on the artist's perception.

This chapter builds on the theoretical framework by integrating visual and perceptual psychology as a tool for better understanding the role of the visual system in the dialogical making of cave art. Visual palaeopsychology is first presented as a branch of cognitive archaeology that provides the opportunity to meaningfully test hypotheses regarding vision and perception against the archaeological record. Its specific application to this research is then discussed, evaluating how this approach can enable the hypotheses generated in Chapter 3 can be tested for Upper Palaeolithic cave art in northern Spain. The universal biological mechanisms of vision, that were likely the same in Upper Palaeolithic people, are then evaluated to provide an overview of how our species receives and processes visual information. The way visual perception may have altered in cave environments is then discussed, providing an insight into the potential phenomena that may have influenced cave art making and how these phenomena are shaped by specific cultural experiences. This allows for a series of additional hypotheses to be generated, building from those presented in Chapter 3. These hypotheses provide avenues for which the role of the visual system in cave art making can be tested against the archaeological record.

## 4.2. Visual Palaeopsychology

### 4.2.1. *Defining visual palaeopsychology*

The use of interdisciplinary approaches with psychology or neurology are, unsurprisingly, not new to archaeological research and have its roots within the cognitive archaeology theoretical movement (Renfrew 2012). Cognitive archaeology utilises theories and concepts from the cognitive sciences to understand the “archaeology of the mind” (Barrett 2013); how certain aspects of cognition may be evidenced in the material record (Renfrew *et al.* 2008; de Beaune 2009, 1-2; Coolidge *et al.* 2015; Coolidge and Wynn 2016; Currie and Killin 2019). Cognitive archaeology arguably produces the most fruitful insights when taking an interdisciplinary approach. Fully integrating methodologies from the cognitive sciences has generated meaningful insights into past behaviour, such as determining differences in cognitive processes between Oldowan and Achuelean technologies (Stout *et al.* 2008; Stout *et al.* 2015; Stout *et al.* 2021) or the neural correlates of tool use and language (Frey 2008). However, cognitive archaeological approaches primarily concerned with theoretical interpretations – through borrowing concepts from the cognitive sciences – have their limitations. This use is perhaps understandable when

dealing with fossil hominins where evidence for their cognitive functioning can *only* be derived conceptually from material remains, but is perhaps unsatisfactory for understanding the cognition of our own species in the deep past.

Visual palaeopsychology builds on cognitive archaeology to produce an interdisciplinary approach to understand the psychology behind Upper Palaeolithic visual culture. Predicated by the fact that people in the Upper Palaeolithic likely had the same visual system as humans today (as discussed in following sections, see 4.3.1.), it uses research methods well-established in visual and perceptual psychology to determine how predisposed the visual system was to making art. Consequently, it does not merely “borrow” concepts from the cognitive sciences, but actively integrates rigorous approaches to test hypotheses about the visual psychology of past behaviour (Pettitt *et al.* 2020). It has been pioneered by Meyering, Pettitt, Kentridge and colleagues (Meyering *et al.* 2020; Pettitt *et al.* 2020 (and papers therein); Sakamoto *et al.* 2020) to understand how certain aspects of vision, such as perception or saliency, may have informed the features represented in Palaeolithic figurative art both in open-air and cave art sites. Meyering *et al.* (2020), for example, utilise the “bubbles” method - a program that visually distorts images, providing only a keyhole view that reveals a particular feature - to demonstrate the most salient features for identifying bison or horse. Through this, they provide tangible evidence for a long-held assumption in Palaeolithic art research; the most salient features of the animals (e.g. the cervico-dorsal line) were the most commonly depicted in the open-air Palaeolithic art sites of the Côa Valley (Portugal). Sakamoto *et al.* (2020) similarly utilise insights from psychology and perception to demonstrate that for depictions in certain cave art sites in northern Spain, the apparent distortion of features is related to the angle they were intended to be viewed from. Depictions are visually resolved from certain perspectives, providing new insights into the reception and interaction with cave art depictions: termed “instillation art” (Sakamoto *et al.* 2020).

The application of visual palaeopsychology therefore provides tangible evidence for aspects of vision and perception in Palaeolithic art, but does not diminish the importance of the cultural nexus from which the art emerged and is situated. Instead, both examples discussed here are sensitive to this milieu: Meyering *et al.* (2020) use their results to suggest hunters may have been visually trained to recognise salient features, and thus are likely to have been the artists in the Côa valley sites; and Sakamoto *et al.* (2020) use the perspective of the depictions to suggest their orientation and placement imply that within certain caves in northern Spain, the depictions were made by and for the artist, rather than with a large audience in mind.

### *4.2.2. Application*

Despite the paucity of the Palaeolithic art record, visual palaeopsychology is demonstrating its potential to yield new insights into aspects of the art, beyond its aesthetic features, to realise the person behind the depiction. If, as proposed by the theoretical framework presented in Chapter 3, art is a dialogue – a conversation – then visual palaeopsychology provides one means to “listen in” to this conversation, piecing together the dialogue through understanding how the artist(s) interacted, engaged with, and responded to the visual stimuli generated by other “participants” (e.g. light, cave walls, pigments).

Although the insights and shift in focus provided by the theoretical framework and a more empirical psychological approach may superficially appear juxtaposed, they can be complementary to one another, providing a balanced approach that intends to mitigate issues of adopting either an explicitly theoretical or scientific methodology. Theoretical approaches are often limited in the tangible insights they can provide, and may risk producing generalisations as a consequence. Scientific approaches by contrast are limited by a prescribed, Western perspective of the world and may produce oversimplifications that lack a nuanced appreciation of the cultural milieu. Evoking the example of figurine making in the Aivilik presented initially in Chapter 3 demonstrates how the theoretical and scientific can work alongside one another. From a theoretical perspective, the making of a figurine might be understood as a dialogically mediated interaction where the material is perceived as an active agent, “concealing” and “revealing” form to the person. Employing a scientific (or visual palaeopsychology) perspective, might allow us to delve deeper to understand exactly how the perception of random patterns in the initial material interaction is visually resolved by the person to perceive a salient feature of an animal, and what mechanisms are at play during this interaction. One can appreciate, therefore, that these two approaches complement each other, with the visual palaeopsychological approach enhancing the insights provided by the theoretical approach and grounding them in tangible and testable hypotheses.

As with any approach, this is far from perfect; using a theoretical framework inspired by non-Western ontologies does not completely mitigate issues with empiricism in Western science, and some sensitivity must be urged with using non-Western ontologies in this way. However, this allows for this research to be conscious of the issues with Western research and allow for results generated to be mindfully calibrated through the theoretical framework.

## 4.3. The Visual System

### 4.3.1. *Did they see like us?*

Visual palaeopsychology is grounded in visual and perceptual psychology, and thus to appropriately evaluate aspects of vision and perception, it is useful to first provide an overview of the biological mechanisms involved in the visual system. A fundamental question that first needs answering for an approach that attempts to understand the role of the visual system in the making of cave art is *did they see like us?* Different aspects of cave art making – pigment composition, line order, and even the subsequent engagement with the depiction – can, to some level, be determined through the archaeological evidence alone. Vision and perception, however, are more ephemeral and difficult to appropriately understand from the archaeological record. The visual system is complex and remarkably varied amongst extant primates, and thus it is important to establish whether we can appropriately compare the functioning of the visual system in modern humans to Upper Palaeolithic people.

Vision across extant old-world primates, although varied, shares a number of commonalities that likely emerged from a common ancestor. Old-world primates have trichromatic vision; like humans, they have 3 types of cone cells that allow them to see the same spectrum of visible light. This likely emerged to enable frugivore primates to identify ripe fruit against a foliage background (Osorio and Vorobyev 1996; Barton 1998, 1936), and was likely a characteristic shared with the last common ancestor of old-world primates and the *Homo* lineage. Visual acuity is very high in primates, with a remarkable ability to determine detail, depth, and movement (Kay and Kirk 2000). The organisation of the visual system in old-world primates is similar to modern humans, with a parvocellular pathway for analysing detail and colour and a separate magnocellular pathway for determining movement, which transfer information to the primary visual area of the cortex (V1), and subsequent specialised areas for processing specific visual information, such as movement (V5 area) (Barton 1998). This allows for very high visual acuity in primates and humans, with a remarkable ability to distinguish subtleties in detail, depth, colour, and movement. However, modern human populations have a relatively small V1 area to overall brain size for primates, and this appears to have been a feature of the hominin lineage, reflecting a restructuring of the brain that likely occurred to accommodate for a larger prefrontal cortex but did not affect visual acuity (de Sousa *et al.* 2010; Pearce and Dunbar 2012). Fundamental biological features of the visual system appear to be shared across all higher-order primates, and would have been shared with people in the Upper Palaeolithic.

The vision of Upper Palaeolithic people was therefore likely to be near-identical to that of modern human populations. Upper Palaeolithic people were “anatomically modern”

and thus the similarity of their cranial and orbital features to modern humans today further indicates they likely had a very similar, if not identical, visual system to us. Whilst there is variation in modern populations in orbital size, which likely scales to different sizes of visual centres in the brain (Andrews *et al.* 1997, 2866), this variation appears to be the result of adaptation to lower light levels in higher latitude areas (Pearce and Dunbar 2012; Pearce *et al.* 2013). This variation does not affect visual acuity nor the processing of visual information (Pearce and Dunbar 2012); rather, the variation is to ensure visual acuity is not compromised. This variation was likely present in Upper Palaeolithic populations, particularly as people dispersed and adapted to higher latitude areas, but it is highly likely they had the same biological underpinnings for vision as us and processed visual information in the same way.

Yet it is important to keep in mind that whilst their visual system likely operated in the same way as ours this does not necessarily mean they “saw” exactly as we see today. As discussed in subsequent sections in this chapter, a large component of vision and perception is predicated on past experience; “seeing” is more than just passively absorbing visual information. Consequently, one cannot assume that our own visual perceptual experiences can be directly mapped onto those of Upper Palaeolithic people, and any interpretations that discuss the role of the visual system in the making of cave art must be situated within the contextual background of Upper Palaeolithic lifeways.

#### *4.3.2. Biological mechanisms for processing visual information*

Vision is an active process that attempts to make sense of the world; rather than providing a true reflection of our surroundings, it provides the necessary information that enables us to appropriately interact with or react to stimuli (Snowden *et al.* 2006, 3). The eyes pay attention to specific objects within our visual field, looking at one thing then the next, rather than keeping everything in focus at once. These patterns of eye movement are often referred to as saccades, and occur unconsciously (Land *et al.* 1999, 1311; Liversedge and Findlay 2000; Concetta Morrone 2005, 950). This is a result of the structure of the eye (Figure 4.1). In bright conditions, the constriction of the pupil results in light being received and processed in the fovea. Due to the small size of the fovea, the eye can only focus on specific things within our visual field at once and the muscles within our eye facilitate very accurate, small movements that shift our focus rapidly from one thing to the next (Gegenfurtner 2016, 1334). The fovea contains specialised cells that allow for visual information to be yielded from the light entering the eye. It contains a high concentration of cone cells that are adapted to respond to either long wavelengths (L-cones, or the red photoreceptor), medium wavelengths (M-cones, or the green photoreceptor) and short wavelengths (S-cones, or the blue photoreceptor) (Hulbert 1997, 400; Snowden *et al.* 2006,

32). Colour perception is not only useful for providing additional information about objects, but also enables for better object recognition and to help determine movement (Snowden *et al.* 2006, 147 – 148).

In dim light, the dilation of the pupil results in light being received across the retina where rod cells are concentrated. Rods are activated by a lower threshold of light, but become bleached and inactive in bright light (Gegenfurtner 2003, 559). These are achromatic and are responsible for vision in darkness and low light conditions (Kelber and Lind 2010). Whilst these cells are poor at identifying detail and colour, they are well-adapted to identifying movement (Gegenfurtner 2003, 559; Aliakseyeu *et al.* 2016, 210). Additionally, although rod cells are achromatic, they are most sensitive to green light (or medium-length) wavelengths, meaning green appears relatively brighter in dim light than other colours (Snowden *et al.* 2006, 33). Other cells within the retina, ganglion cells, are adapted to collect certain information, such as the edges of things within the world based on the contrast in light (Snowden *et al.* 2006, 55). Together, these cells enable detail, colour, and movement to be determined.

Visual information produced by the excitation of cells within the retina and fovea, is then passed along the optic nerve to the visual cortex, where certain regions are dedicated to processing this information, such as movement (V5 area) (Antal *et al.* 2004, 521) or colour (V4/V8 areas) (Snowden *et al.* 2006, 163). The visual system has a predisposition towards 3D information, interpreting shadows, occlusion, haze, distance, motion, and disparity in stereoscopic vision, as cues to the depth and dimensions of objects (Snowden *et al.* 2006, 213 - 221). This preference for 3D information often results in 2D images being interpreted as three-dimensional, resulting in different visual illusions and the distortion of visual information.

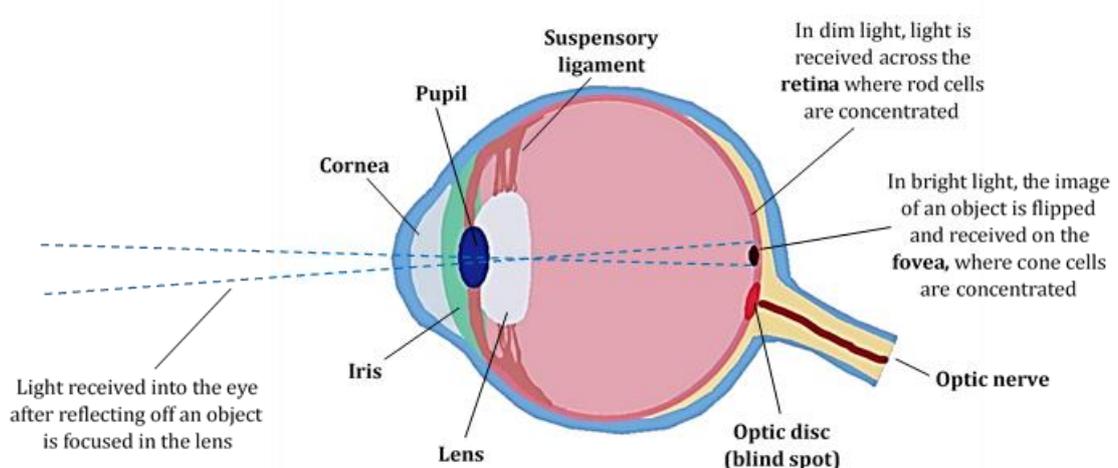


Figure 4.1. Anatomy of the eye demonstrating how light is received on the fovea within the eye during bright light, and across the retina as the pupil dilates in dim light. Image: Author.

### 4.3.3. Embodied process

Visual perception is also a cognitive process that is embodied and embedded within the external world (Wilson 2010); it does not occur within the mind alone. Active movement, in particular, is a key embodied behaviour that affects visual perception. Active movement affords the continual engagement of, and adjustment to, external visual stimuli, mitigating the desensitisation effects of unchanging or similar stimuli (Overmann and Wynn 2019, 460). For example, a perceptual psychology experiment that gave two groups of participants goggles that inverted their view demonstrated those that could actively move around their space adapted quicker to the inverted view than those participants that were passively moved around the space in a wheelchair (Snowden *et al.* 2006, 250). Material tactile interactions also seem to affect visual perception in a similar way, having tangible effects on the way we understand and perceive stimuli by virtue of facilitating active engagement with visual stimuli (Wilson 2010, 279). If we perceive something visually ambiguous or intangible, for example, our response may be to try and reach out to touch and interact with that perceived thing to assess its distance from us, depth, and other physical characteristics, reinforcing or challenging our visual interpretation (Ernst and Banks 2002; Helbig and Ernst 2007; Gaissert and Wallraven 2011; Jansson-Boyd 2011; Björkman *et al.* 2013). An aspect of our vision, therefore, is embodied and extended, requiring tactile interaction to garner more information about perceived visual images. This demonstrates that the theoretical concepts of extended cognition and Material Engagement Theory (MET) discussed in Chapter 3 are not only interesting perspectives to adopt when interpreting artistic behaviours, but rather a key feature of how visual cognition works in humans. Human cognition is not simply a process that occurs within the mind, but rather a system of interaction between the mind, physical and visual stimuli experienced by the body, and external material forms (Overmann and Wynn 2019, 458). Consequently, vision and perception are influenced by lived experiences. For example, schizophrenic individuals are more likely to perceive meaning in random visual stimuli (Partos *et al.* 2016), women are more susceptible to experiencing face pareidolia (Proverbio and Galli 2016) (although gender does not seem to significantly affect visual perception in general: Shaqiri *et al.* 2016), and cultural experiences influence aspects of perception, e.g. differences in how readily a farmer vs hunter-gatherer can distinguish a simple figure from a complex scene (Cěněk and Cěněk 2015). These considerations are important to keep in mind when discussing the role of the visual system in making cave art; the lived bodily experience and tactile interaction with the cave wall and material forms are crucial. Further, this emphasises that any results from modern participants cannot be directly equated to the experience of Upper Palaeolithic people nor assumed to be universal; peoples lived, embodied experience also would have influenced their visual and perceptual responses within caves.

## 4.4. Upper Palaeolithic Vision in the Cave?

The basic biological mechanics of vision were likely the same for Upper Palaeolithic people: their eyes would have been finely tuned to quickly and efficiently focus on precise visual information; they would have interpreted the same wavelengths of light to perceive a world rich in colour; and they would have received deeper insight into the visual world by actively moving and interacting with it. However, normal vision in bright daylight is very different to the experience of navigating through a cave and the psychological responses this may have elicited. The visual ambiguity inherent in perceiving unusual calcite formations and complex wall morphologies under a dynamic, low lumen light source in complete darkness would have caused particular visual and perceptual psychological responses. Unlike biological mechanics, these are perhaps more likely to be shaped by experience of being within the world, rather than a consequence of anatomical physiologies.

It must be noted here too that cave environments likely stimulated other sensory responses to humidity, acoustics, smell, and tactile interactions, and that perception is influenced by sensory stimuli beyond the visual, often with multiple sensory stimuli coalescing to form a perceptual understanding of the world (Duizer 2001; Ernst and Banks 2002; Helbig and Ernst 2007; Gaissert and Wallraven 2011; Jansson-Boyd 2011; Björkman *et al.* 2013; Gan and Lou 2014). The sensory experience of caves has been explored previously in relation to Upper Palaeolithic cave art, particularly with regard to acoustics (e.g., Till 2014; Fazenda *et al.* 2017), but many of these attributes are often difficult to accurately simulate for Palaeolithic caves, particularly alongside simulating visual experiences (i.e., how does one know what a cave smelled like 15,000 years ago? How can this be integrated into a visual simulation of cave environments?). This research thus primarily focuses on the visual aspect of psychological and perceptual responses, as the majority of our sensory understanding of the world is derived from visual stimuli (Wade and Swanston 2013), but where possible will intend to consider other sensory stimuli (in particular, tactility – under certain conditions tactile sensory inputs may replace vision as the primary sense: Graven 2009). The likely visual psychological responses to being within these particular environments are explored here, and it is tentatively suggested how these may have been manifested for Upper Palaeolithic people.

### 4.4.1. *Pareidolia and hyper-imagery*

*“What I perceive are not the crude and ambiguous cues that impinge from the outside world onto my eyes and my ears and my fingers. I perceive something richer – a picture that combines all these crude signals with a wealth of experience” (Frith 2007, 132)*

It is important to keep in mind that the complex series of interactions involved in the visual system very rarely produces a faithful or accurate representation of the world.

Instead, it attempts to efficiently focus the visual system on important information, shaped by cultural experience, to prevent it from being overwhelmed by information which may not be vital for determining how one should react to a certain situation (Chun 2000, 170; Snowden *et al.* 2006, 3). This means that our perception can frequently make mistakes about the world, as it attempts to make sense of visual cues and resolve ambiguous stimuli by what it predicts to be in the world around us (Frith 2007, 132), and this was likely the case for Upper Palaeolithic people too. These “mistakes” are perhaps most apparent today in the visual psychological phenomena of pareidolia, hyper-imagery and, at the extreme, hallucinations (Table 4.1).

Pareidolia refers to the phenomenon where random patterns are interpreted as apparently meaningful forms and appears to be universally experienced; almost everyone has perceived clouds as looking like familiar objects, or has seen a face in an inanimate object. It frequently manifests as a propensity for perceiving faces or anthropomorphic features in objects and this ability emerges early on in human development, perhaps being a consequence of, but also certainly triggering, our empathetic response (Kato and Mugitani 2015; Proverbio 2017; Correa Varella 2018; Zhou and Meng 2020).

Hyper-imagery, or pseudo-hallucinations, are a phenomenon less established in the psychological literature. As the term “pseudo-hallucination” is often used to refer to a breadth of different visual and auditory phenomenon in psychology (Berríos and Dening 1996, 753; Moeller and Lempert 2007, 813; Sanati 2012, 42; Turner 2014, 270), following Hodgson (2008, 3) “hyper-imagery” is used instead. A hyper-image appears to be more potent than pareidolia, and is defined here as a visual phenomenon that causes the observer to misinterpret visual stimuli under certain ambiguous visual conditions. A familiar example of a hyper-image might be waking in the night and interpreting a coat hanging on the back of a door as a person standing in your room – this is only a fleeting experience, but in the moment can trigger a visceral, emotional response. Although hyper-images are still informed by visual stimuli in the real world and recognised by the observer as not being “real”, thus cannot be considered a full hallucination (Hodgson 2008), it not only causes the observer to perceive an object or face in a random pattern, but literally “see” this object or face, however fleeting this perceptual image may be. As proposed by Hodgson, hyper-images may occur on a gradating scale in the potency of visual psychological responses, and can still evoke a potent emotional response (Hodgson 2008, 3). Halverson’s (1992b) characterisation of pareidolia as a “looking like” phenomena, inspires the perspective that semantics indicates the key difference between hyper-imagery and pareidolia; a person experiencing the former might say “x is a face” whereas a person experiencing the later might say “x looks like a face”. The perceptual mechanisms responsible for both pareidolia

and hyper-imagery are likely similar; they both involve a person perceiving something familiar in a random pattern, but occur at different potencies.

Table 4.1. Summary of the characteristics of different perceptual phenomena, expanding on the table by Hodgson 2008, 3.

<b>Pareidolia</b>	<b>Hyper-imagery</b>	<b>Hallucinations</b>
<ul style="list-style-type: none"> <li>• Intangible, subjective, and not perceived as an image</li> <li>• Location in subjective inner space</li> <li>• Indefinite, incomplete (but may be completed by perceived pattern)</li> <li>• Only experienced voluntarily</li> <li>• Imaginative flavour</li> <li>• Not experienced in another sensory modality</li> </ul>	<ul style="list-style-type: none"> <li>• Inner eye-pictorial, subjective</li> <li>• Location in subjective inner space</li> <li>• Indefinite, incomplete</li> <li>• Neutral or dim elements</li> <li>• Tendency to face</li> <li>• Sometimes experienced as voluntary</li> <li>• Ideational flavour</li> <li>• Not experienced in another sensory modality</li> </ul>	<ul style="list-style-type: none"> <li>• Experience is concrete, tangible, objective and real</li> <li>• Location in outer objective space</li> <li>• Good definition</li> <li>• Sensory wealth</li> <li>• Constant</li> <li>• Independent from volition</li> <li>• Perceptual flavour</li> <li>• Experienced in another sensory modality</li> </ul>

Whilst face pareidolia is the most common form of pareidolia in the Western world, pareidolia can also concern the perception of patterns looking like common objects or animals (Maranhão-Filho and Vincent 2009, 1117; Bracci *et al.* 2019, 6514). Pareidolia appears to be related to visual cognitive processes that attempt to resolve, order, or “fill-in” visually ambiguous information (Hong *et al.* 2013, 79; Ward 2008, 18). Although in pareidolia someone is often aware something only “looks like” something else, rather than explicitly mistaking something for something else, this still triggers a response that mirrors the reaction if the person had actually seen the perceived thing, e.g. face-like or animal-like pareidolia elicits a response as if the person is viewing a face or an animal (Bracci *et al.* 2019, 6523; Zhou and Meng 2020, 1).

In modern, Western humans there is a predisposition towards face pareidolia; humans, and particularly women, appear to be experts in identifying faces in random patterns and process faces holistically, rather than piecemeal (as with other types of visual information) (Maurer *et al.* 2002; Hoehl and Peykarjou 2012, 767; Proverbio and Galli 2016; Zhou and Meng 2019, 2). Whilst this has prompted discussion within psychology that faces are special and our visual system has evolved to pay more attention to faces (Carmel and Bentin 2002, 25; Hong *et al.* 2013, 79; Zhou and Meng 2019, 3), there is some discussion about whether this is a result of visual expertise (Tovée 1998, 1239; Joyce and Cottrell 2004, 127; Rossion *et al.* 2004, 14521; Harel 2016). Visual expertise is defined by the ability of

people to discriminate members of an object category as individuals as quickly as they are to discriminate the category membership, through holistically processing the visual information of the object (Joyce and Cottrell 2004, 128). Therefore, rather than the visual system being fundamentally predisposed towards recognising human faces, visual expertise argues that any category of object that requires the same fine level discrimination of visual information as faces can become a category within which humans gain visual expertise (Joyce and Cottrell 2004, 134 - 135; Harel 2016, 89). Consequently, modern Western humans are experts at recognising faces due to our high exposure to this type of visual information, and the importance placed on social engagement within a society with a highly dense population. Yet equally, if a person existed in a society where it was more important to process visual information of the behaviours and features of a specific animal rapidly and holistically, particularly if human population density was low, then they would become visual experts in identifying individual animals in a herd.

This level of visual expertise has been observed amongst people that spend extended amounts of time paying attention to the specific features of animals; birdwatchers, for example, can efficiently identify birds at different levels of specificity based on their visual characteristics, to the same level that people can discriminate individual faces (Harel 2016, 90). One would expect, therefore, that people that have visual expertise in another category (e.g. birds) would have similar pareidolic responses as most people have with faces. This appears to be reflected in the artistic behaviours of some small-scale non-Western societies where they frequently recognise animal forms, rather than humanoid face forms, in the random patterns observed in certain materials (see Chapter 3, section 3.2.3).

Clearly, visual expertise has evolutionary advantages; the ability to train the visual system to become predisposed to the subtle visual cues of animals that may be camouflaged or in the distance, would have been beneficial to hominin species as they both learned to avoid predators, and become more skilled hunters (Melcher and Bacci 2008, 351; Bednarik 2017, 102). Yet visual expertise can also manifest as a consequence of socio-cultural context. Lifeways may train people to become visual experts in certain categories, such as face pareidolia manifesting in our world of intensive sociality and high population density, or indeed people intentionally training themselves to become visual experts by frequently observing a certain type of visual stimulus, as with the birdwatcher example. Pareidolia, shaped by visual expertise, therefore operates in a way that it assumes the most likely cause of the visual ambiguity, based on pre-existing information the visual cognitive system already knows about the visual world. Expectation further enhances this pareidolic response; if one anticipates perceiving a certain object or animal in a visually ambiguous

environment, they are more likely to see that particular category of stimulus, and less likely to detect unexpected stimuli (Takashi and Watanabe 2015, 11).

For people in the Upper Palaeolithic, who likely had the same biological mechanisms for vision and thus were also predisposed to the visual system making interpretative assumptions about ambiguous stimuli, pareidolic or hyper-imagery responses likely would have been shaped by their specific experiences and visual expertise. Understanding the ecological and socio-cultural context for periods throughout the Upper Palaeolithic (see Chapter 5) can provide some insight into experience that may have shaped this response and the forms that may have been common in this visual imagery. In general, given the visual expertise required by Upper Palaeolithic people to identify, track, and hunt animals and their rich material culture that was both literally made from and depicted animals, it is likely they resolved ambiguous visual stimuli to resemble animals, rather than other objects or faces – particularly as population density was sparse.

#### *4.4.2. Perceptual effects of darkness*

The mechanisms involved in visual perception and specific phenomena, such as pareidolia and hyper-imagery, are crucial considerations when understanding the specific conditions that might trigger certain responses in the visual system. Of pertinence to this research, this primarily concerns the effects of low light conditions and darkness on visual perception, and how this might exacerbate or trigger certain psychological responses. As proposed by Hodgson (2008), it is anticipated the darkness and the uncertain visual environment of a cave would have had tangible effects on the perception of Cro Magnons, including heightened states of arousal and some level of disorientation or unease within this environment. In addition to these more general feelings of unfamiliarity, darkness and low flickering light can distort our visual perception processes.

Darkness, as one might expect, has significant effects on visual perception and causes certain psychological responses. Darkness and low light reduce our ability to distinguish detail; we become more likely to process an object holistically, focusing on its general form rather than its individual features (Steidle *et al.* 2011, 174; Steidle *et al.* 2013, 276). Whilst this may seem obvious – low light invariably makes it difficult to distinguish detail in comparison to bright lighting conditions – this fundamental aspect of darkness on our perception has intriguing affects for how we conceptualise and understand visual stimuli in the dark. Not only does darkness increase the ambiguity of visual stimuli, thus encouraging pareidolia and hyper-imagery responses as our visual system attempts to “fill in” the missing visual information, but it also causes a construal level effect (Steidle *et al.* 2011). Construal level pertains to the relationship between psychological distance, which occurs in four different dimensions (temporal, spatial, social, and hypotheticality), and

concerns whether someone thinks about an object or event in a concrete or abstract way (Steidle *et al.* 2011, 175). For example, if something is psychologically proximal, someone is likely to think about it in a concrete way, focusing on its detail and practicalities: this is referred to as a low construal level.

In the dark, as our ability to distinguish the detail of objects diminishes, we begin to think about the visual stimuli we are presented with in a more abstract way, encouraging our vision to form more abstract representations and rely on its own predictions about the world (Trope and Liberman 2010, 441 – 442; Steidle *et al.* 2011, 180). Additionally, higher construal levels and perceiving things in a more global way increases creativity (Zmigrod *et al.* 2015), with darkness playing a key role in improving creative output due to its construal level effect (Steidle and Werth 2013, 68). This suggests a potential relationship existing between the perceptual effects of darkness, and the visual phenomena of pareidolia and hyper-imagery. Within pareidolia, people are likely to focus on the detail of the pareidolic image; for example, which features look like the eyes/mouth/nose of a face. However, with hyper-imagery, the visual image is more abstract: people see the general form of a person or animal. It can be tentatively proposed therefore, that these perceptual phenomena are related to construal level (Figure 4.2). Furthermore, as higher construal levels triggered by objects in the darkness become more dependent on the visual system’s ability to predict the stimuli responsible for the ambiguous visual information, it further implies hyper-imagery is associated to a higher construal level.

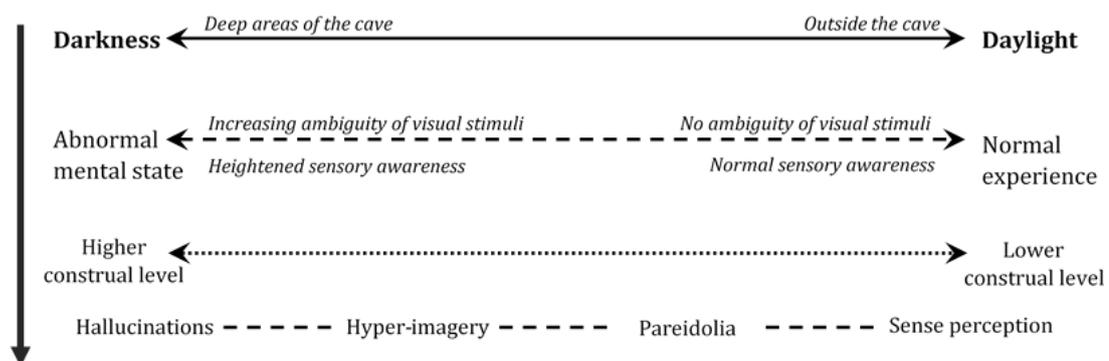


Figure 4.2. Proposed relationship between darkness and its effects on mental state and construal level, which in turn trigger certain psychological phenomena. Image: Author, after Hodgson 2008, 344.

This perceptual effect of darkness, in the context of Cro Magnons exploring cave systems, becomes contrasted with the perceptual effects of a low, warm, flickering light source cast from a small flame. Certain features of this type of light source have specific perceptual and psychological effects. Warm, dim light sources have been demonstrated to increase cooperation and social behaviour, through creating a warm, intimate atmosphere that encourages the extension of the self to include others (Kombeiz *et al.* 2017). Whilst

Kombiez *et al.*'s (2017) study concerns the modern perception and psychological effects of lighting conditions, one can anticipate the warm light cast from a flame evokes similar conceptual associations of sociality and comfort to Upper Palaeolithic people: fires and hearths were likely the focal point of social interaction (Dunbar and Gowlett 2014, 277). Visual stimuli illuminated by this light source may therefore feel familiar and comforting, but also more concrete; illuminating an object within a dark environment draws it into focus and reduces its visual ambiguity. This paints a picture of the exploration of a cave being dependent and characterised by the perceptual effects of the low light conditions. Objects poorly lit in the darkness would be cast as unfamiliar, ambiguous, and abstract, whereas once an object is fully illuminated by the light source it becomes fixed, concrete, and familiar.

The edge of the light cast from a small flame, therefore, may be where perception is increasingly ambiguous. As discussed, eyes are predisposed to identifying contrast in light as a way to determine edges in the world, with ganglion cells in the fovea specifically adapted to identify this contrast. A low flickering light source would not only create an artificial boundary in our vision, but a stark contrast between objects illuminated by the light source and those lurking in the darkness. The high luminosity of the light source in contrast to the absolute darkness of the surrounding cave would present the eye from fully adjusting to the darkness: the pupil would remain constricted. This would result in colour and detail being discernible in the centre of the light cast from the flame, but the lower illumination towards the periphery of the light's range would prevent these details from being distinguished. This effect may even be exacerbated, with rods close to central vision being bleached by the relatively bright light of the flame, and peripheral vision extending to include areas of dim light towards the outer range of the light source. Central vision in turn would become constrained by the range of the light source, limiting the ability of the visual system to react normally.

One can therefore expect that anything illuminated directly by the light source becomes the focus of the fovea, anything fully in the darkness would be imperceptible, and anything that is partially illuminated at the edge of the light cast are the most visually ambiguous. The dynamic nature of the flickering light would cause these partially illuminated objects to shift in and out of vision, giving the impression of movement and liminality as shadows rove around and consume the object. This movement would attract the excite rod cells and attract visual attention (Aliakseyeu *et al.* 2016, 211), perhaps causing a person to be constantly alert about things potentially moving in the darkness. Whilst the objects immediately illuminated by a flame might seem concrete, those in this peripheral region of low illumination, by contrast, may seem even more abstract and ambiguous, particularly as the eye preferentially "trusts" visual information received by the

fovea over the periphery (Gloriani and Schütz 2019). It is anticipated that this region is where hyper-images may emerge in vision; the partial illumination, the perceived shifting nature of objects, and construal level effects caused by low lighting all contribute to the likelihood of specific visual phenomena occurring. This is a key consideration when reconstructing lighting conditions and the visual effects of lighting, with emphasis placed on the liminal boundary between light and darkness.

#### 4.5. Summary

Understanding the mechanisms involved in vision and perception, and how these may have been affected under low lumen lighting conditions within caves enables this research to tangibly explore the conceptual insights provided by Chapter 3. Visual palaeopsychology is thus a powerful tool employed here, complementing aspects of the theoretical framework and elevating these insights, to test specific hypotheses related to the influence of the visual and perceptual response on the making of cave art. These insights into the mechanisms involved in the visual system, in addition to the conceptual insights provided by Chapter 3, emphasises the importance of situating the making of cave art within the specific contextual background. Understanding the way Upper Palaeolithic people may have related to animals, the particular visual expertise they may have had in identifying animal species, and the broader socio-cultural milieu of art making during this period is thus crucial. This will be established through the following chapter, which provides a comprehensive background for the case study sites of Las Monedas, La Pasiega, and El Castillo.

The new approach developed through Chapters 3 and 4 also necessitates a gradual development of a methodological approach for understanding the role of the visual system in the dialogical making of Upper Palaeolithic cave art. Chapters 6, 7, and 8 will build a methodology for understanding this for each of the case study sites. Firstly, Chapter 6 establishes a desk-based approach for understanding the art of Las Monedas cave. It explores the effects of low lumen light conditions on the topography of cave walls, the visual and perceptual responses that may have been triggered under these conditions, and how this, in turn, may have influenced the production and reception of depictions. Chapter 7 builds on this approach, integrating primary observations to provide deeper insights into the making of art at La Pasiega cave. The final stage of developing the approach pilots a VR psychology experiment to establish how modern participants respond to viewing cave art panels from El Castillo under low lighting conditions.

## **Chapter 5.**

### **The Monte Castillo Sites in Context**

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#### **5.1. Introduction**

The milieu surrounding the making of Upper Palaeolithic figurative art cannot be overlooked within this research. As outlined in the previous chapter, many facets of understanding the psychological processes involved in cave art production hinge on the socio-cultural context. Visual expertise and the mind of the Palaeolithic artist are inherently shaped by the environment, particularly with regards to which animals were prevalent and focused on by a society. To understand this visual expertise, and thus appropriately understand the role of the visual system in cave art production, the ecology and ethology of the period must be evaluated. Additionally, despite Descartes' best efforts, the mind does not operate in a bounded, isolated space; it is remarkably plastic and responds to the particular cultural surroundings it finds itself in. Consequently, the cave art must be situated within the extensive repertoire of artistic and cultural behaviours expressed in the Upper Palaeolithic. Cultural idiosyncrasies in the stylistic form of the art must be considered, particularly to tease out whether a particular facet of a depiction is due to the effects of the visual system or was merely the cultural norm of depicting an animal. This holistic approach towards understanding the making of art is influenced by the theoretical framework outlined in Chapter 3; art embodies different strands of relations with, and tensions in agency between, materials, animals, societies, and humans.

With this in mind, the following chapter will fully evaluate the contextual background surrounding the Palaeolithic cave art sites of Monte Castillo (Puente Viesgo, Cantabria). The site background provides the necessary site-level frame of relations, that can be unravelled to explore the broader relational fabric of the Upper Palaeolithic world in northern Spain. Regionally specific reference sites are utilised to reconstruct the ecological and socio-cultural context of the Upper Palaeolithic, and how particular conditions shifted throughout this period. This serves to build a contextual framework of relations through which the results for each site can be interpreted in subsequent chapters. Fundamentally, this provides important context for understanding the visual perception of Upper Palaeolithic artists during the making of cave art within the Monte Castillo sites. Chapter 4 demonstrated vision is an active, embodied process influenced by social and cultural factors and consequently, the context of these sites must be well-established to allow for appropriate insights into the visual perception of Upper Palaeolithic artists.

## 5.2. The Sites of Monte Castillo

### 5.2.1. Overview of the sites

This research focuses on three sites situated within Monte Castillo: Las Monedas, La Pasiega, and El Castillo. Monte Castillo (Puente Viesgo, Cantabria) is a karstic conical-shaped mountain located with the Pas River Basin, bordered to north by the Cantabrian coast and to the south by the Cantabrian Range (Ortega Martínez and Ruiz-Redondo 2018, 805: Figure 5.1). There are five caves within Monte Castillo: El Castillo; La Pasiega; La Flecha; Las Chimeneas; and Las Monedas. All except La Flecha contain Upper Palaeolithic parietal art. The unique shape and visual dominance of the mountain perhaps meant it was a well-known feature within the Upper Palaeolithic landscape. It is also strategically located for targeting migrating animal herds, with the river basin acting to funnel herds past Monte Castillo and providing vistas of the majority of the surrounding landscape from each cave (Ortega Martínez and Ruiz-Redondo 2018, 807-809). Unsurprisingly, therefore, there is a long stratigraphic sequence that stretches from the Lower Palaeolithic through to late prehistoric deposits within the rock-shelter opening of El Castillo cave, and a similarly long, albeit less complete, sequence within La Pasiega cave.



Figure 5.1. Location of Monte Castillo in Cantabria, Spain. Image: Author. Base map of Cantabria: Esri. Map of Spain: Wikimedia commons.

The cave art sites of El Castillo, La Pasiega, and Las Monedas in Monte Castillo (Figure 5.2) are famed for their extensive collection of Palaeolithic parietal art. El Castillo and La Pasiega are the two richest cave art sites in the mountain, and exhibit an impressive

array of different artistic styles that likely represent a breadth of different phases of artistic activity. Las Monedas, by contrast, has a relatively small number of figurative depictions that were likely produced during one phase. Collectively, therefore, the Monte Castillo sites consist of a representative sample of cave art making throughout the Upper Palaeolithic, representing both sites that were frequently revisited throughout the Upper Palaeolithic and reflect a long tradition of art making, and sites whose cave art may reflect only a brief instance of artistic activity. These sites provide the unique opportunity to both compare the artistic behaviours across different periods, but also artistic behaviours expressed within contemporaneous depictions across the four sites. In the latter case, the ecological and socio-cultural conditions remain the same, with the only variable being the different cave environment, therefore enabling the exploration of the extent to which the specific visual and perceptual phenomena experienced within different cave environments influenced the theme, style, and form of depictions.

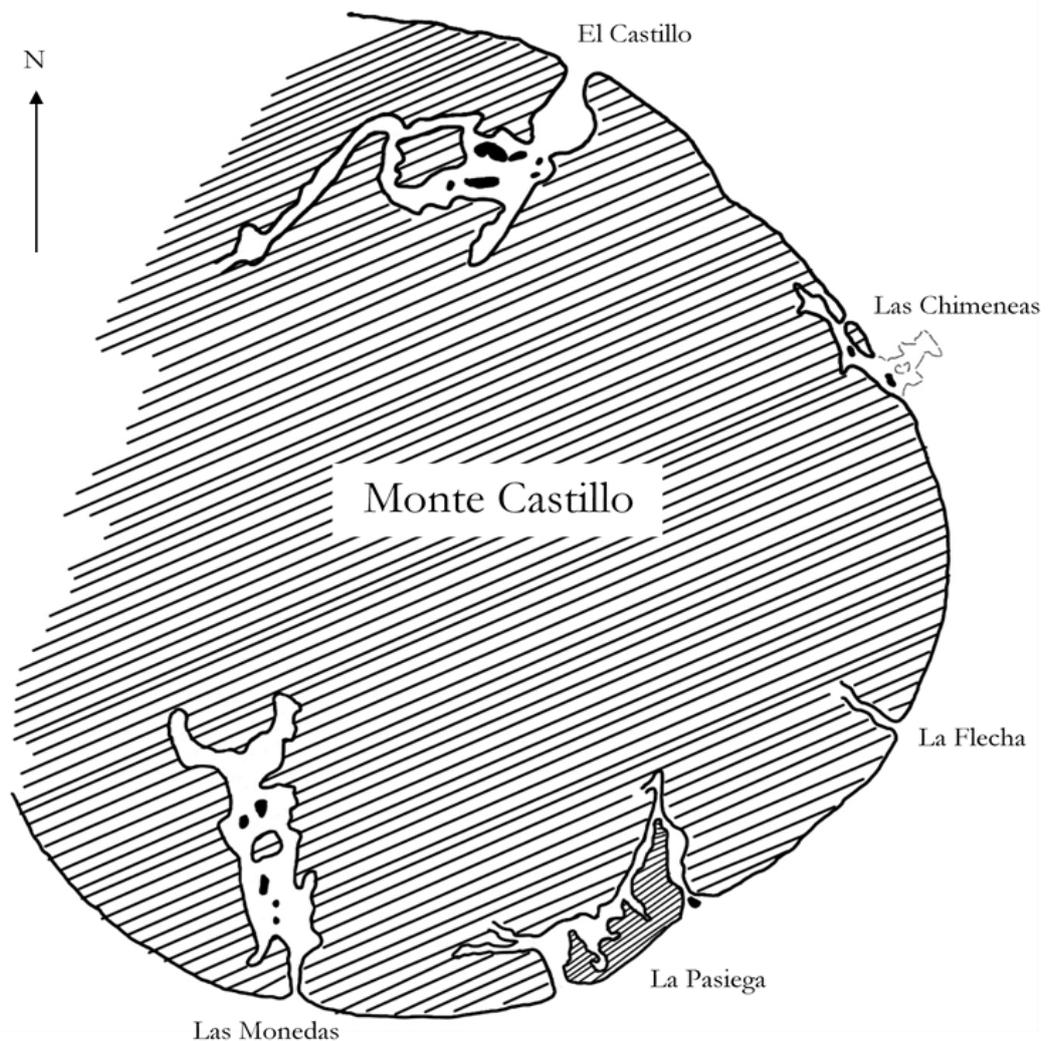


Figure 5.2. The Monte Castillo caves, and their approximate position around the mountain [not to scale]. Image: Author, digitally traced after Ripoll Perello 1980, 11.

### 5.2.2. Overview of the sites: Las Monedas

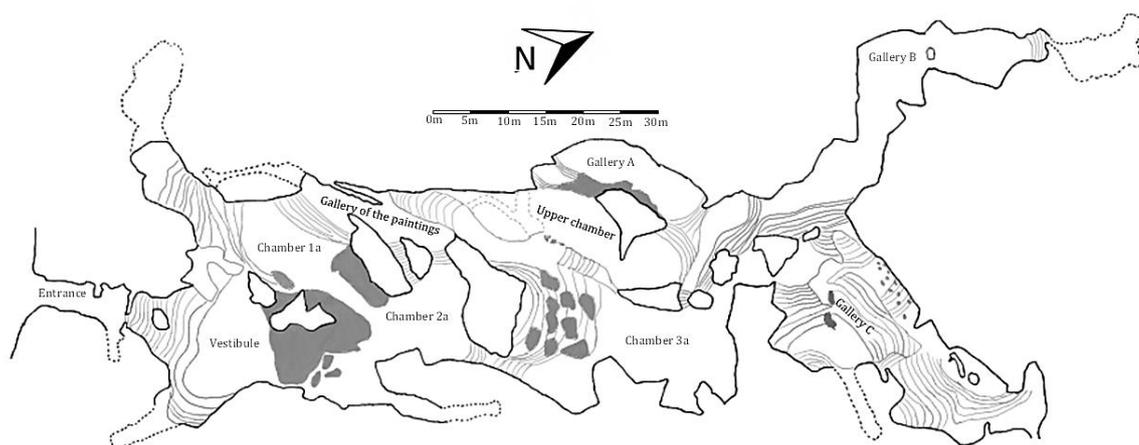


Figure 5.3. Map of Las Monedas cave with topography detailed. Image: Author, digitally retraced after Ripoll Perelló 1980.

Las Monedas is the furthest cave in Monte Castillo and is complex, with numerous different chambers and galleries. Despite the large size of this cave, the depictions are constrained to one small gallery approximately 40m from the entrance (Figure 5.3). It was discovered by Isidoro Blanco in 1952 during works to clear the surrounding area to allow tourists to visit El Castillo and La Pasiega (Ripoll Perelló 1980, 8; Ochoa 2017, 297; Ochoa *et al.* 2017, 132). It was subsequently studied by Ripoll Perelló and González Echegaray who published a series of papers describing figurative and non-figurative depictions within the cave (González Echegaray 1952; Ripoll Perelló 1952a; 1952b; 1953) and attributed an early Magdalenian date to the art based on its stylistic features (Ripoll Perelló 1952a, 183). The full monograph of the art was published 20 years later, by Ripoll Perelló, with a revised stylistic attribution to the middle or upper Magdalenian (1972; English translation: 1980). The Magdalenian cultural designation of the art was later confirmed by AMS radiocarbon dates of two depictions undertaken by Moure Romanillo *et al.* (1996; Amormino 2000; González and Balbín Behrmann 2007); ibex depiction 16, with two dates of 13,766 - 13,248 cal. B.P. and 14,811 - 13,791 cal. B.P., and horse depiction 20, with a date of 14,076 - 13,519 cal. B.P. (95.4% confidence; García-Diez *et al.* 2021). This places the art within the mid-late Magdalenian period, broadly corresponding to the Older Dryas; a period that saw a brief return to glacial conditions during the Bølling-Allerød interstadial. During initial excavations, remains of cave bear were discovered initially coining the name *Cueva de Los Osos* (Cave of the Bears) for the site (García-Diez *et al.* 2021, 310). A collection of 23 coins dating to 1503 were subsequently discovered deep within the cave, likely accidentally left by a person exploring the cave in the early 16<sup>th</sup> Century, giving the cave its current name *Las Monedas* (The Coins). Apart from a lithic collection attributed to the Mousterian and a brief mention of an Aurignacian flint point found amongst remains of cave bears (Carrión

and Baena 1998; Ochoa 2017, 298), there have been no further archaeological materials or deposits discovered at the site. The lack of materials attributed to the Magdalenian in Las Monedas indicates the site may not have been habitually occupied during the same period as the cave art depictions. Whilst it has been suggested archaeological deposits may be present under the calcite floor in the entrance hall (García-Diez *et al.* 2021, 311) it is possible that, given the proximity of La Pasiega and El Castillo, and the late Upper Palaeolithic deposits in the latter (Cabrera Valdés 1984), the people who produced the depictions within Las Monedas resided within these nearby caves (Ortega Martínez and Ruiz-Redondo 2018, 804).

### 5.2.3. Overview of the sites: La Pasiega

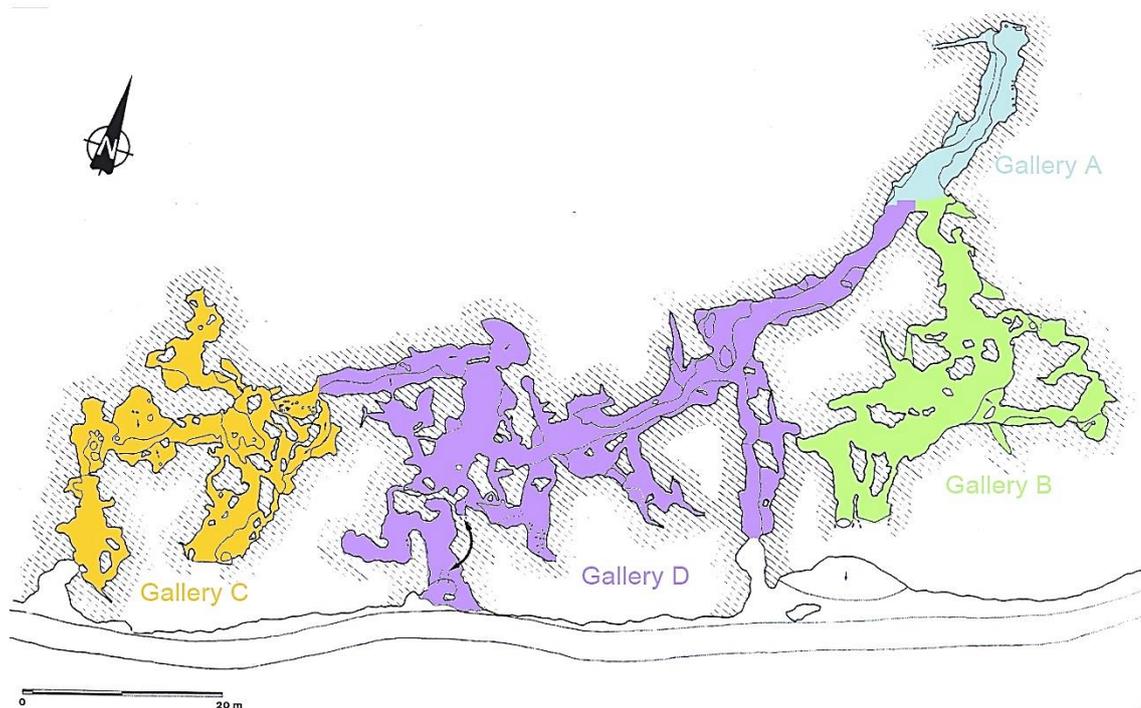


Figure 5.4. Map of La Pasiega cave, with the different galleries labelled. Image: Ochoa *et al.* 2017, 134.

La Pasiega is a large cave system (Figure 5.4) with an extensive variety of cave art depictions, but unlike El Castillo, the depictions are primarily figurative; the cave is dominated by depictions of horses and cervids, followed by ibex, bison, and aurochs, with several depictions of animals that do not typically feature in the parietal art of northern Spain (e.g. reindeer, mammoth, fish) (Table 5.1). The cave was discovered in 1913 by Breuil and Obermaier, during their work at El Castillo cave (Ochoa *et al.* 2017, 132), but the majority of academic work within this cave was undertaken and published between 1952 and 1985 led by Carballo (e.g. 1952), González Echegaray (e.g. 1964; 1971), and Ripoll (e.g. González Echegaray and Ripoll 1953) (González Sainz *et al.* 2013, 106; Ochoa 2017, 171; Ochoa *et al.* 2017, 132). This revealed a series of archaeological levels attributed to the Mousterian, the Solutrean and Magdalenian (Ochoa 2017, 173). Within the Solutrean and

potentially lower Magdalenian levels, 14 perforated deer tooth beads and several geometric decorated portable art pieces were recovered (Ochoa 2017, 174). Although there has been some debate surrounding the cultural attribution of the archaeological levels at La Pasiega (Ochoa 2017, 171), it appears that the majority of the archaeological material corresponds to the Solutrean (Straus 1979, 200).

The cave has a complex structure, consisting of large, open chambers in the east of the cave, particularly gallery B, and a more maze-like series of narrow chambers towards the west, in galleries C and D. Groenen and Groenen (2019) also conducted a formal study of the distributions of depictions at La Pasiega and, as with El Castillo, found the depictions were distributed unevenly throughout the cave; certain galleries (e.g. Gallery A) have large concentrations of depictions, but others (e.g. Gallery D) have comparatively very few. This study revealed the structuring of depictions within each gallery varies; for example, Gallery A reflects an increasing intensity of depictions as one progresses through the gallery, but Gallery B shows a different logic of organisation altogether, with the intensity of depictions decreasing towards the back of this gallery (Groenen and Groenen 2019, 9 - 10). The techniques used for depictions also varies between galleries; ochre pigments were predominately used within La Pasiega, but the few black depictions present are concentrated within specific areas of Gallery A and Gallery C (Groenen and Groenen 2019, 8). Additionally, there is a large variety of themes and styles both within and between galleries, which further suggests the art within La Pasiega has an extensive temporal breadth and was produced in multiple phases, rather than representing a cohesive composition.

The presence of depictions in both easily navigable, open chambers (Gallery B) and much narrower passages (e.g. Gallery A), suggests an interplay between the public vs. private display of depictions within this site. This is further implied by the association of some motifs to habitation areas of the cave; Gallery B, for example, has several depictions closely associated to the original entrance, which also yielded archaeological deposits dating between 22,000 - 15,500 B.P. (García-Diez 2018). These depictions, unlike those placed in deeper areas of the cave, would have been visible in daylight (Groenen and Groenen 2019, 9) and likely played a more prominent social role, as they were interacted with frequently as a visible feature in the tempos of daily life. The making, and subsequent reception, of depictions in La Pasiega is thus likely to vary between different galleries.

*Table 5.1. Summary of the figurative depictions in La Pasiega cave. Data from García Diez et al. 2018, 209.*

<b>Animal depiction</b>	<b>Number</b>	<b>Percentage</b>
Horse	78	26.1%
Hind	72	24.1%

Indeterminate	42	14%
Ibex	34	11.4%
Stag	28	9.4%
Bison	18	6%
Aurochs	14	4.7%
Cervid	3	1%
Reindeer	2	0.7%
Bovid	2	0.7%
Carnivore	1	0.3%
Chamois	1	0.3%
Mammoth	1	0.3%
Megaloceros	1	0.3%
Bird	1	0.3%
Fish	1	0.3%

#### 5.2.4. Overview of the sites: El Castillo

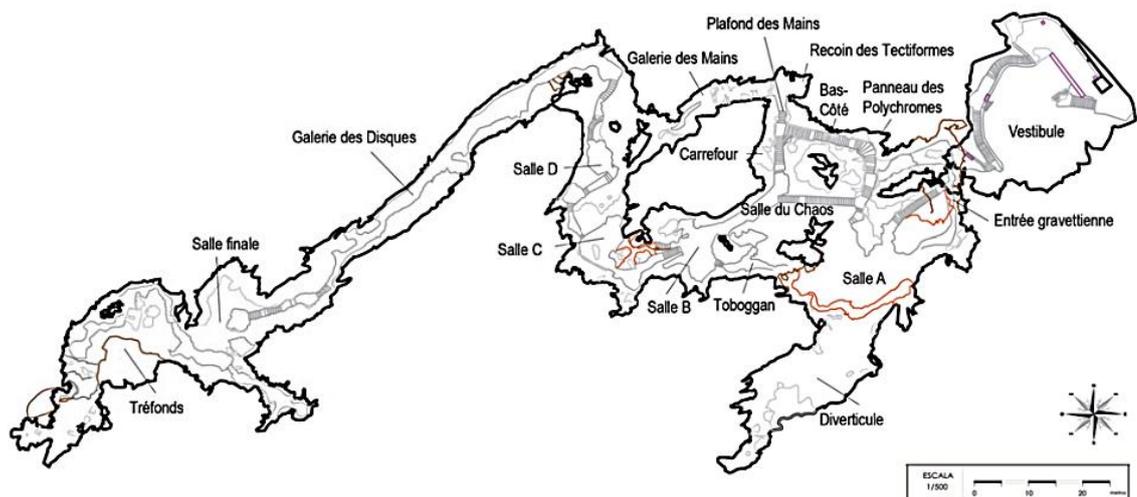


Figure 5.5. Map of El Castillo. Image: Groenen and Groenen 2017, 133.

El Castillo is home to a breadth of figurative and non-figurative depictions, exhibiting a wide range of different techniques and styles (González Sainz *et al.* 2013, 90). The cave consists of a number of chambers and galleries (Figure 5.5) each with different parietal art panels. Non- and proto-figurative depictions (e.g. hand-stencils, discs, abstract signs) dominate the artistic assemblage within this site, but there are a number of figurative depictions (Table 5.2). Hinds are the most common animal motif; these are primarily engraved or small painted depictions. By contrast, although smaller in number, bison appear to visually dominate the space within this cave; some bison depictions are large and placed within visually prominent areas.

Table 5.2. Summary of the figurative depictions in El Castillo. Data from Groenen and Groenen 2019, 3.

Animal depiction	Number	Percentage
Hind	90	25.1%
Herbivores (indeterminate)	55	15.4%
Horse	38	10.6%
Indeterminate animals	36	10.1%
Bison	33	9.2%
Ibex	31	8.6%
Stag	25	7%
Cervids (indeterminate)	15	4.2%
<i>Bovinae</i> (indeterminate)	14	3.9%
Aurochs	11	3.1%
Mammoth	7	1.9%
Reindeer	1	0.3%
Lion	1	0.3%
Bird	1	0.3%

The site has an extensive archaeological sequence, dating back to the Mousterian period (Bernaldo de Quirós 2015, 410), and its repeated occupation over a long duration of time is likely a consequence of its strategic location in the landscape and the suitability of the rock-shelter entrance of the cave for human occupation. It was initially discovered in 1903 by Hermilio Alcade del Rio, and was subsequently excavated by Alcade del Rio, along with Henri Breuil and Hugo Obermaier between 1910 – 1914 (Fernández Vega *et al.* 2010, 67; González Sainz *et al.* 2013, 90; Groenen 2014, 195). The excavations revealed the extensive archaeological sequence and yielded several *art mobilier* objects from the Magdalenian levels, including a decorated *bâton percé* made from an antler tine (Figure 5.6) (Breuil and Obermaier 1912). The variety of cave art at the site enabled Breuil to develop a chronology based on stylistic attributes (González Sainz *et al.* 2013, 90). Consequently, El Castillo attracted a significant amount of academic attention for its art. Further studies by Ripoll Perelló (1956, 1971-1972, 1972), González Echegary and García Guinea (1966), Cabrera Valdéz and Ceballos del Moral (1980's), and Tosello *et al.* (2007) provided additional information regarding the nature of the art (González Sainz *et al.* 2013, 90 – 91).



Figure 5.6. Engraved stag on a bâton percé from the Magdalenian level of El Castillo. Image: Breuil and Obermaier 1912, 4.

More recently, research by Groenen and colleagues (Warzée *et al.* 2007; Groenen 2008; Groenen 2014; Groenen and Groenen 2017) has attempted to reveal new information about the site, and provide a comprehensive evaluation of the art through digital imaging techniques. This research demonstrated that non-figurative and figurative depictions are distributed unevenly throughout the cave. Non-figurative depictions appear more frequently deeper into the cave, whereas figurative depictions are absent in these deeper sections and are more common towards the central areas of the cave. This suggests the art is a palimpsest of multiple phases of artistic activity throughout the Upper Palaeolithic. Interestingly, these phases appear to be represented spatially throughout the cave, with depictions grouped within specific recesses and chambers (Groenen and Groenen 2017, 135; Groenen and Groenen 2019, 4). U-Th dating corroborates the palimpsestual nature of the art, and the apparent non-figurative/figurative divide within the phases of art production. A red disc on the *Panel de los Manos* (Panel of the hands) was dated to a minimum age of 41,000 B.P., potentially representing Neanderthal authorship (Pike *et al.* 2012, 1410; Zilhão 2013, 22; García-Diez *et al.* 2015, 11), but the figurative depictions appear to be significantly younger. The oldest date obtained for a figurative depiction is 22,800 (min) B.P.; this features an indeterminate black animal figure from the nearby *Techo de los Manos* (Ceiling of the hands) (Pike *et al.* 2012, 1410). This suggests that within El Castillo, specific spaces of the caves were layered with meaning by different Cro Magnon groups; it is unlikely the art was produced as a predetermined composition, but instead through a series of specific individualised interactions with certain spaces and features of the cave.

### 5.2.5. Dating the art

Before discussing the ecological and socio-cultural context that frames the production of the art in Monte Castillo, it is important to first evaluate the dating of these depictions. Cave art is notoriously difficult to date, and for the decorated caves of Monte Castillo, very few depictions have been directly dated through AMS radiocarbon or U-Th

dating (Table 5.3). Whilst the art in Las Monedas may have been produced within one phase, it is clear El Castillo and La Pasiega reflect an extensive temporal depth to the cave art, corroborated by palimpsests and a breadth of variety in artistic style. In particular, several dated depictions within these sites were much older than expected; this presents unique difficulties with trying to determine the age of non-dated depictions.

In order to enable depictions within the Monte Castillo sites to be appropriately dated, where a direct date is not available, a database was compiled of 183 different dates obtained directly from depictions across 38 cave art sites in Europe. This database served as the primary “anchor point” for which to compare and date other depictions, following von Petzinger and Nowell (2011). However, as the database represents a relatively small percentage of known Upper Palaeolithic art, securely dated anchor points were also sought out in portable art pieces from nearby sites in northern Spain. An overview of the stylistic features of securely dated portable and parietal figurative art is provided in section 5.4.3. and evaluated for individual depictions within each subsequent case study chapter; this provides a robust way to attribute a cultural designation to the art of Monte Castillo.

Table 5.3. Summary of all directly dated depictions from the Monte Castillo cave art sites. Please note, for U-Th dates, the corrected age only is shown. Radiocarbon dates were all calibrated in OxCal 4.3., using the uncalibrated dates from the original publications.

Site	Depiction	Date (B.P.)	Calibrated date (95.4% probability)	Method	Reference
El Castillo	Red circle	40,8000	n/a	U-Th	Pike <i>et al.</i> 2012
	Handprint	37,300	n/a	U-Th	Pike <i>et al.</i> 2012
	Stippled negative hand stencil	24,340	n/a	U-Th	Pike <i>et al.</i> 2012
	Indeterminate animal	22,880	n/a	U-Th	Pike <i>et al.</i> 2012
	Large red stippled disc	41,400	n/a	U-Th	Pike <i>et al.</i> 2012
	Bison 18a ( <i>Depiction 1.07</i> )	12,630 +/- 110	15,332 – 14,352	AMS Radiocarbon	Valladas <i>et al.</i> 2001
		13,060 +/- 200	16,237 – 15,098	AMS Radiocarbon	Valladas <i>et al.</i> 2001
		13,520 +/- 130	16,721 – 15,898	AMS Radiocarbon	Valladas <i>et al.</i> 2001
	Bison 18b ( <i>Depiction 1.05</i> )	12,910 +/- 180	16,020 – 14,827	AMS Radiocarbon	Valladas <i>et al.</i> 2001
	Bison 18c ( <i>Depiction 1.06</i> )	10,510 +/- 100	12,690 – 12,080	AMS Radiocarbon	Valladas <i>et al.</i> 2001
		11,270 +/- 80	13,296 – 12,996	AMS Radiocarbon	Valladas <i>et al.</i> 2001
		10,720 +/- 100	12,790 – 12,518 <sup>2</sup>	AMS Radiocarbon	Valladas <i>et al.</i> 2001
		10,740 +/- 100	12,818 – 12,520 <sup>3</sup>	AMS Radiocarbon	Valladas <i>et al.</i> 2001
	Bison 19 ( <i>Depiction 1.10</i> )	13,520 +/- 120	16,695 – 15,920	AMS Radiocarbon	Valladas <i>et al.</i> 2001
		13,570 +/- 130	16,810 – 15,981	AMS Radiocarbon	Valladas <i>et al.</i> 2001

<sup>2</sup> 90.6% probability

<sup>3</sup> 92.5% probability

		13,710 +/- 140	17,016 – 16,163	AMS Radiocarbon	Valladas <i>et al.</i> 2001
		14,090 +/- 150	17,557 – 16,635	AMS Radiocarbon	Valladas <i>et al.</i> 2001
	Horse 27/28	16,980 +/- 180	20,949 – 20,030	AMS Radiocarbon	González and Balbín Behrmann 2007
		19,140 +/- 230	23,614 – 22,510	AMS Radiocarbon	González and Balbín Behrmann 2007
	Ibex 56	13,900 +/-130	17,261 – 16,387	AMS Radiocarbon	González and Balbín Behrmann 2007
		14,640 +/-140	18,174 – 17,475	AMS Radiocarbon	González and Balbín Behrmann 2007
La Pasiega	Bison 88	12,460 +/- 160	15,190 – 14,074	AMS Radiocarbon	González and Balbín Behrmann 2007
		11,990 +/- 170	14,384 – 13,445	AMS Radiocarbon	González and Balbín Behrmann 2007
	Ibex 67	13,730 +/-130	17,012 – 16,209	AMS Radiocarbon	González and Balbín Behrmann 2007
	Ibex 67 (humic)	13,890 +/- 200	17,430 – 16,258	AMS Radiocarbon	González and Balbín Behrmann 2007
	Ladder sign	79,660 +/- 14,900	n/a	U-Th	Hoffmann <i>et al.</i> 2018
Las Monedas	Ibex 16	11,630 +/- 120	13,740 – 13,246	AMS Radiocarbon	Amormino 2000; González and Balbín Behrmann 2007
		12,170 +/-110	14,544 – 13,750	AMS Radiocarbon	Amormino 2000; González and Balbín Behrmann 2007
	Horse 20	11,950 +/-120	14,100 – 13,544 <sup>4</sup>	AMS Radiocarbon	Amormino 2000; González and Balbín Behrmann 2007

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<sup>4</sup> 94.8% probability

## 5.3. Ecological Context

### 5.3.1. Climate

To begin constructing the contextual background surrounding the Monte Castillo sites, it is first necessary to briefly summarise the climate changes that occurred in this region throughout the Upper Palaeolithic and characterised the conditions of cultural stratigraphic periods in Spain (Table 5.4). Throughout these periods, the environment was subject to vast changes, affecting the nature of landscapes and animal populations. This was particularly marked in northern Spain, where the diversity of the landscape resulted in micro-climatic conditions and fragmented, ecologically distinct regions (Uzquiano 2014, 154; Jones *et al.* 2019, 1029).

Table 5.4. The chronological limits of cultural units in northern Spain. Dates were obtained from Straus (2005, 147) and calibrated using OxCal 4.3. This serves only as an approximation for the limits of cultural periods in this region, and to provide clarity for the date range that is referred to with the cultural terminology.

Cultural period	Chronological limits (uncal. BP)	Chronological limits (cal. BP)
Early Aurignacian	~40,000 – 35,000	~43,500 – 39,000
Late Aurignacian	~35,000 – 28,000	~39,000 – 31,500
Gravettian	~28,000 – 20,000	~31,500 – 24,000
Solutrean	~20,000 – 17,000	~24,000 – 20,500
Lower-Mid Magdalenian	~17,000 – 13,000	~20,500 – 15,500
Upper Magdalenian	~13,000 – 11,500	~15,500 – 13,300
Azilian	~11,500 – 9,000	~13,300 – 10,200

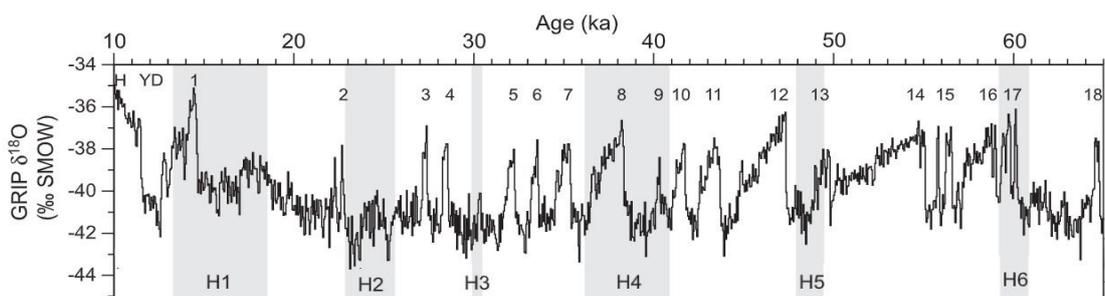


Figure 5.7. NGRIP data for the Upper Palaeolithic, representing fluctuating temperatures and a series of Dansgaard-Oeschger events (numbers above curve) and Heinrich events (shaded grey and labelled with H numbers). Image modified after: Roucoux *et al.* 2005, 1644.

The climate during the European Upper Palaeolithic in general, is characterised by a gradual environmental shift from Marine Isotope Stage (MIS) 3, through MIS 2, to the beginning of MIS 1, interjected by short, dramatic climate events (Figure 5.7). These short climatic changes were the result of both Dansgaard-Oeschger events, which caused brief increases in temperatures, and Heinrich events, which caused rapid cooling due to

significant ice-rafting (Lowe and Walker 201, 403 - 405; Woodward 2014, 128). MIS3 began approximately ~60,000 B.P. (Van Meerbeeck *et al.* 2009, 33), and saw a reduction of global ice volume, but did not fully achieve interglacial conditions (Woodward 2014, 103 – 104). Nevertheless, the climate was more ameliorable and likely supported some floral populations and ecological conditions more common in interglacial periods (Figure 5.8). The onset of the Aurignacian therefore experienced slightly more favourable conditions, with a gradual deterioration of climatic conditions throughout the period towards the full glacial conditions of MIS2. This began approximately ~27,000 BP, and involved particularly harsh environmental conditions. The ecology for much of the Gravettian and Solutrean can be characterised by open steppe, tundra-style environments with very restricted arboreal species (e.g. *Pinus*, *Betula*) (Uzquiano 2014, 156). The Magdalenian saw a gradually ameliorating environment after the Last Glacial Maximum (LGM), although punctuated by some cold snaps caused by Heinrich events. The warmer, more humid conditions supported an increasingly varied floral and faunal population, and an increase in Cro Magnon populations with more extensive social networks across Europe (Langlais *et al.* 2012, 143; Langley and Street 2013).

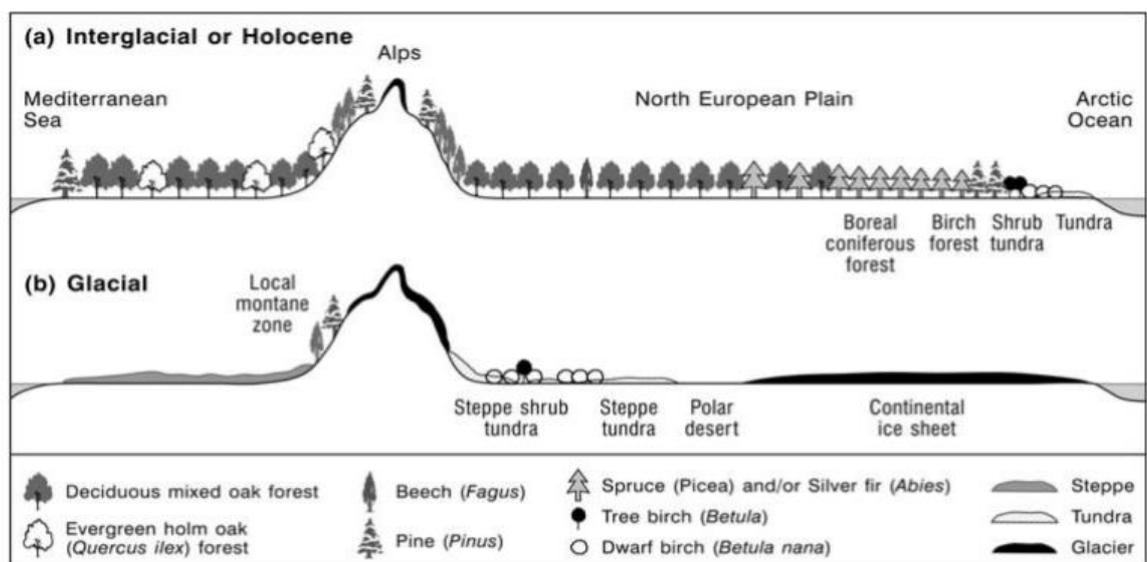


Figure 5.8. Overview of the different environmental conditions during glacial and interglacial periods as a cross-section across Europe. Northern Spain supported both local montane and steppe environments. Image: Woodward 2009, 207.

### 5.3.2. Floral and faunal population

With the dramatic climatic fluctuations that occurred throughout the Upper Palaeolithic emerges distinct changes in the floral and faunal population; the presence of specific taxa ebbed and flowed with the oscillating temperatures. In the majority of Europe, the cold climatic downturn of MIS2 resulted in open steppe, tundra environments where floral populations were restricted to dwarf shrubs and heath grasses, and faunal

populations were dominated by large, cold-adapted ungulates (Tarasov *et al.* 2001; Woodward 2014, 134; Chytrý *et al.* 2019). This is the typical environment one imagines when discussing the last glaciation; one that was harsh and unforgiving, with human populations struggling to survive. However northern Spain, and particularly the Cantabrian region, benefitted from micro-climatic conditions that did not conform to the aridity experienced in the rest of Europe (Straus 2005; Jones *et al.* 2019, 1030).

As demonstrated by local references in northern Spain (Table 5.5), a breadth of floral and faunal populations was supported within this region throughout the Upper Palaeolithic. These reflect a fairly moderate environment for much of the Upper Palaeolithic, with the presence, albeit declining, of some deciduous trees and mesophilous floral taxa (e.g. rowan, ash, pine, birch) during the Aurignacian which in turn supported the presence of forest-adapted species. Climatic conditions deteriorated somewhat with the onset of MIS2, indicated by the presence of cold-adapted fauna such as steppe bison (*Bison priscus*), megaloceros (*Megaloceros megaloceros*), woolly rhinoceros (*Stphnorhinus hemitoechus*), and reindeer (*Rangifer* sp.). However, northern Spain continued to benefit from its local humidity and dispersed woodlands. The ameliorating environment with the Bølling-Allerød interstadial saw an expansion of forest environments (Cuenca-Bescós *et al.* 2012, 131) and a return of some deciduous tree taxa. The continued presence of some cold-adapted fauna and flora may reflect the Older Dryas, which saw a brief return to glacial conditions during this interstadial. Towards the end of the Upper Palaeolithic there is a high presence of deciduous trees in northern Spain, with an increase of species such as oak, beech, and ash. There may have also been the presence of linden, hazel, and elder in lowland coastal areas of this region as the climate continued to ameliorate (Power *et al.* 2015, 40). It is clear, therefore, as many have previously discussed (e.g. Jochim 1987; Clark *et al.* 1996, 241; Straus *et al.* 2000, 554; Straus 2015a, 261), that Cantabria was a refuge for floral, faunal, and human populations throughout the Upper Palaeolithic and thus benefitted from a locally diverse ecology.

Table 5.5. Summary of prominent floral and faunal taxa throughout the Upper Palaeolithic from the pollen, charcoal, and faunal records of sites in northern Spain.

Period	Climatic conditions	Dominant flora	Other flora	Dominant fauna	Other fauna	Site reference
Initial / Early Aurignacian	MIS3	<i>Sorbus</i> ; <i>Betula</i> ; and <i>Pinus</i> dominant	<i>Asteraceae</i> ; <i>Poaceae</i> ( <i>declining</i> ); <i>Fabaceae</i> ; <i>Ericaceae</i>  Some presence of deciduous trees, but decreasing	<i>Cervus elaphus</i> ; <i>Capra</i> ; and <i>Rupicapra</i> dominant	Presence of <i>Bos/Bison</i> ; <i>Capreolus capreolus</i> ; <i>Sus scrofa</i> ; and <i>Equus</i>	El Castillo, levels 18b and 18c (Dari and Renault-Miskovsky 2001, 127; Jones <i>et al.</i> 2019, 1039)  El Esquilleu cave (levels XIII – V) (Uzquiano <i>et al.</i> 2012)
Aurignacian	End of MIS3	<i>Pinus</i> and <i>Betula</i> dominant	Presence of <i>Ulmus</i> ; <i>Jugulans</i> ; <i>Poaceae</i> ; land shrub; and some deciduous plants	<i>Cervus elaphus</i> dominant	<i>Equus</i> ; <i>Capreolus capreolus</i> ; and <i>Bos/Bison</i>	Covalejos (Level B) (Jones <i>et al.</i> 2019, 1039)
Gravettian	Onset of MIS2	<i>Pinus</i> and <i>Juniperus</i> dominant	<i>Presence of Betula</i> ; <i>Gramineae</i> ; <i>Umbelliferae</i> ; <i>Labiatae</i> ; <i>Ericaceae</i> ; <i>Plantago</i> ; <i>Compositae</i>  Some deciduous trees present at El Mirón	<i>Cervus elaphus</i> ; <i>Equus caballus</i> ; and <i>Rupicapra rupicapra</i> dominant	High presence of <i>Bos/Bison</i> ; <i>Capra pyrenaica</i> ; <i>Capreolus capreolus</i>  Presence of <i>Vulpes</i> ; <i>Rangifer</i> ; <i>Megaloceros</i> ; <i>Sthphanorhinus hemitoechus</i> ; <i>Panthera</i> ; <i>Ursus</i> ; <i>Canis lupus</i>	Flora only: Santimamiñe (Level Arg-o) and El Mirón (Iriarte-Chaipusso <i>et al.</i> 2016, 62 - 63)  Fauna only: El Castillo (Level 12 and 14) (Pike-Tay <i>et al.</i> 1999, 294; Bernaldo de Quirós <i>et al.</i> 2015a, 465)

Solutrean	MIS2	<i>Juniperus</i> Cytisus; and <i>Salix</i> dominant	Presence of <i>Pinus</i> ; <i>Sorbus</i> ; <i>Abies</i> ; <i>Ulex</i> ; <i>Quercus</i> (deciduous); <i>Hippophae</i> ; <i>Abrutus</i> ; <i>Erica</i> ; <i>Fabaceae</i>	<i>Equus</i> and <i>Cervus elaphus</i> dominant.  Abundance of <i>Capra</i> and <i>Rupicapra</i>	Presence of <i>Bos primigenius</i> / <i>Bison priscus</i> ; <i>Ursus sp.</i> ; <i>Vulpes vulpes</i> ; <i>Panthera spelea</i> ; <i>Canis lupus</i> ; <i>Stthphanorhinus hemitoechus</i>	Flora only: El Linar (Level B-3); Altamira (Level III) and Cibrante (Level 4/3) (Uzquiano 2014, 157)  Fauna only: El Castillo, level 10 (Bernaldo de Quirós <i>et al.</i> 2015b)
Lower - Mid Magdalenian	End of LGM. Henrich event 1.	<i>Juniperus</i> ; <i>Chenopodiaceae</i> ; and <i>Salix</i> dominant	Presence of <i>Pinus</i> ; <i>Castanea</i> ; <i>Hippophae</i> ; <i>Cytisus</i> ; <i>Ericaceae</i> ;	<i>Cervus elaphus</i> dominant	Presence of <i>Bos/Bison</i> ; <i>Capra</i> ; <i>Rupicapra</i> ; <i>Capreolus</i> ; <i>Rangifer</i>	Altamira, level II (Uzquiano 2014, 157)  El Mirón (Levels 503 – 505) (Iriarte-Chiapusso <i>et al.</i> 2015, 68 – 69)
Upper Magdalenian	Bølling-Allerød interstadial	<i>Juniperus</i> ; <i>Betula</i> ; and <i>Picea</i> dominant	High presence of <i>Quercus</i> (deciduous) and <i>Fabaceae</i>  Presence of <i>Pinus</i> ; <i>Corylus</i> ; <i>Castanea</i> ; and <i>Sorbus</i>	<i>Cervus elaphus</i> ; <i>Equus</i> dominant	High presence of <i>Rupicapra rupicapra</i> ; <i>Bos/Bison</i>  Some presence of <i>Capreolus capreolus</i> ; <i>Capra pyrenaica</i>	Flora only: La Pila (Level IV) (Uzquiano 2014, 157)  Fauna only: El Castillo (consistent with pattern of Late Magdalenian sites in n. Spain) (Marín-Arroyo 2013, 3)
Azilian	End of Bølling-Allerød interstadial and onset of Younger Dryas	<i>Pinus</i> ; <i>Betula</i> ; and <i>Quercus</i> (deciduous) dominant	Presence of <i>Fagus sylvatica</i> ; <i>Fraxinus excelsior</i> ; <i>Hippophae rhamnoides</i> ; and <i>Crataegus monogyna</i>	<i>Cervus elaphus</i> ; <i>Capra pyrenaica</i> dominant	Presence of <i>Sus scrofa</i> ; <i>Capreolus capreolus</i> ; <i>Rupicapra rupicapra</i> ; <i>Equus</i> ; <i>Bos/bison</i>  Increase in targeting mollusc species	Flora only: Los Azules (Levels 3g – 3e) and El Carabión (Level 3) (Uzquiano 2014, 157)  Fauna only: Numerous sites in n. Spain (incl. La Paloma, El Pendo, El Mirón, Ekain) (Marín-Arroyo 2013, 3)

Invariably, the faunal record represented within Table 5.5 does not necessarily provide a representative sample of the fauna present in northern Spain during these climatic changes. Instead, it gives an indication of which species Cro Magnon groups were concerned with and, as the same species appear to be consistently exploited, it suggests the climate within this region did not dramatically affect the presence of certain taxa to necessitate drastic shifts in the subsistence of these groups. In particular, red deer (*Cervus elaphus*) appears to have retained a fairly prominent presence throughout the Upper Palaeolithic and was consistently targeted by Cro Magnon groups in this region (Turrero *et al.* 2010; Yravedra-Sainz de los Terreros *et al.* 2016, 784). Although red deer are a reasonably adaptable species (Geist 1998, 173), they tend to prefer woodland environments and struggle to survive within more open landscapes (Cornwall 1968, 49; Freeman 1973, 11). Consequently, red deer would have benefitted enormously from the dispersed woodland environments in Cantabria; their populations in nearby, but more open, landscapes dwindled during the Upper Palaeolithic and were replaced by steppe-adapted species such as reindeer (*Rangifer* sp.) or saiga antelope (Jones *et al.* 2019, 1030).

Additionally, the faunal record from Cantabrian sites is also likely subject to excavation, sampling, and preservation bias, particularly as many Cantabrian sites were excavated in the early 1900's. It is not surprising that medium and large ungulates are prevalent within these faunal records, and one must consider the significance of smaller game animals may be being overlooked. Research into the diet of Cro Magnon groups in the Magdalenian perhaps demonstrate the extent to which the faunal record does not appropriately reflect subsistence; several studies have increasingly demonstrated the importance of marine resources, game animals (e.g. rabbits and birds), and even fungi to Upper Palaeolithic diets (Adán *et al.* 2009; Álvarez-Fernández 2011; Cuenca-Bescós *et al.* 2012; Gutiérrez-Zugasti *et al.* 2013; Power *et al.* 2015). Nevertheless, this synthesis provides an indication of the species which Cro Magnons likely had developed a visual expertise in identifying. Larger ungulates require specialist knowledge to track and hunt, as explored in the subsequent section, and it is these species that Cro Magnons may have paid greater visual attention. The behaviours and characteristics of these species provides important context for understanding the visual and perceptual responses discussed in Chapter 6, 7, and 8.

### 5.3.3. *Ethological behaviours*

Outside of an anthropocentric perspective, and as evident in non-Western small-scale societies, animals have agency within the world and their behaviours shape complex relationships with humans. Recent theoretical discourse has emphasised the importance of appreciating animal's affects and agency within social worlds and in shaping past societies

(Conneller 2004; Brittain and Overton 2013; Hill 2013; Overton and Hamilakis 2013; Sykes 2014; Wisser and Kay 2020). These need to be appreciated to understand both the significance of animals to Upper Palaeolithic people and as outlined in Chapter 4, the individual characteristics of animal species that they would have been visual experts in identifying. The key characteristics and behaviours of prominent fauna that were dominant in the faunal assemblages from sites throughout the Upper Palaeolithic are summarised in Table 5.6, and can be used to draw out particular attributes of these animals that may have been paid particular visual attention by Cro Magnons. The physical attributes of animals were undoubtedly visually familiar to Cro Magnons, who likely were able to identify particular species from some distance in order to observe and track animals during hunting activities. A closer examination of the ethology of these species, however, reveals further behaviours and characteristics that were likely paid close attention.

For red deer, a species consistently exploited throughout the Upper Palaeolithic, the seasonal rhythms that affected both the physical appearance of these deer – from coat changes to antler growth – and the herd dynamics may have been key to structuring the rhythms of Cro Magnon life. In particular, the rutting season may have been paid particular attention by Cro Magnons, with the shift to harem herd structures, the increased presence of potentially aggressive stags, and perhaps an understanding associated to sustainably maintaining the herd's population, affecting how they interacted with this species during the season. Visual indicators of the rut, such as the onset of winter coats and cleaning antlers, may have been implicit indicators of this season that were culturally understood and their presence in cave art depictions may provide some indication of the potential cultural meaning layered onto the motifs. Further, there are more general behaviours that Cro Magnons were likely highly visually attuned to. The alerted state of hinds, with heads raised and ears rotated forwards, would have been an important behaviour to learn indicating whether the herd had become aware to the presence of a potential threat. Identifying the matriarch of a herd too, in order to quickly identify the potential dynamics and flight paths of a herd, would have been important and perhaps encouraged visual discrimination of red deer to the level of recognising particular individuals.

Table 5.6. Summary of the characteristics and behaviours of the most common species present in northern Spain throughout the Upper Palaeolithic.

Species	Physical characteristics	Seasonal changes	Herd structure	Preferred environment	Behaviours	References
<b>Red deer</b> <i>Cervus elaphus</i> (hinds)	Reddish-brown coat, with white underbelly and rear. Young have spots on their coat. Relatively long tail.	Thicker winter coat which appears greyer.	Matriarchal herds and during the rutting season, harems (one stag, several hinds). Matriarchs dictate movement of the herd, and hierarchy within hind herds remains stable.	Preference for woodlands, but adaptable to different environments. Browse on nutrient rich plants and do not necessarily conform to optimal foraging, seeking out preferential foods.	<b>Alerted:</b> rotate ears forwards, raise heads, stare, move head from side-to-side. Emit a short alarm “bark”. <b>Intra-group:</b> lower status hinds may challenge dominance through bites or kicks. Hinds will lower head and emit chattering vocalisation to display submissiveness to matriarch. Matriarch flares pre-orbital glands and raises head to display dominance. <b>General:</b> behaviourally plastic and learn evasive behaviours to hunting	Clutton-Brock and Guinness 1975; Clutton-Brock <i>et al.</i> 1979; Clutton-Brock <i>et al.</i> 1982; Geist 1998; Chevallier-Redor <i>et al.</i> 2001; Ceacero <i>et al.</i> 2012; Thurfjell <i>et al.</i> 2017
<b>Red deer</b> <i>Cervus elaphus</i> (stags)	As above, with asymmetrical antlers (particularly during low resource availability) that indicate seasonality and stag age.	Antlers are shed and regrow in spring, velvet sheds in late summer, and antlers are fully developed and clean by autumn	Bachelor herds of young males, harems during rutting season, or isolated. Bachelor herds remain on the periphery of territories and are often unstable.	As above	<b>During rut:</b> roaring of stags up to 8 times a minute, male-male competition with locked antlers.	Lincoln 1972; Clutton-Brock and Albon 1979; Georgii 1981; McComb 1991; Bartoš and Bahbouh 2005; Picavet and Balligand 2016; Langley and Wisher 2019

<p><b>Horse</b> <i>Equus sp.</i> (Przewalski horse used as modern comparison)</p>	<p>Distinctive tan coloured coat with dark brown dorsal and shoulder stripes. May have significant coat variation, with different shades of brown and spotted coats. Head and neck are a darker colour. Muzzle is light brown in colour. Upper lip may protrude in older individuals.</p>	<p>Thicker winter coat with longer mane and tail. Shedding of winter coat in summer results in patches of thick hair and a distinct m-shaped line, where belly is lighter colour.</p>	<p>Matriarchal, with harem structures during mating season. Harems are stable with one stallion, up to 6 mares, and offspring. Females remain dominant in harems. Young males may form bachelor herds. Strong social bonds in large herds, which are key to maintaining group stability</p>	<p>Preference for open landscape and remain within specific home ranges. Not territorial, with different herds aggregating to rare resource points.</p>	<p><b>Alerted:</b> raised heads, pointed ears, lip-curling. <b>Social:</b> grooming other individuals and maintaining personal space. <b>General:</b> less flighty, opting to conserve energy in cold environments. Defensive kicks to deter some predators, but will flee for larger dangerous animals. Dependence of olfactory and audio senses, with lip-curling and directing ears to detect stimuli.</p>	<p>Feh 1988; Boyd 1991; Houpt and Boyd 1994; Groves 1994; Goodwin 1999; Waran 2001; Saslow 2002; Goodwin 2002; van Dierendonck and Goodwin 2005; Pigeaud 2007; Pruvost <i>et al.</i> 2011</p>
<p><b>Ibex</b> <i>Capra pyrenaica</i> (Spanish) or <i>Capra ibex</i> (Alpine)</p>	<p>Large, spiralled horns that are smaller in females, and a good indicator of age in males. Spanish ibexes have curled horns, a narrower face, and hair underneath chin. Alpine ibexes have curved horns, squarer heads, and thicker coats.</p>	<p>n/a</p>	<p>Sex segregated groups up to 20 individuals, interacting only during rutting season. May graze in same area, but males usually in riskier, poorer environments. Strict dominance hierarchies in male herds, preventing aggressive male-male competition during rutting season (early winter).</p>	<p>Mountainous terrain, but may be constrained to lower altitudes or even woodlands in harsh cold conditions. Excellent spatial memory and migrate every 4 days within an area to maximise food availability, but will trade this off for relative safety.</p>	<p><b>Alerted:</b> herds split and flee up steep terrain, but flight path is predictable. <b>General:</b> males of similar status and age may butt heads during the rut to determine dominance.</p>	<p>Alados 1986, 145; Straus 1987; Villaret and Bon 1995; Grignolio <i>et al.</i> 2004; Ling and Milner-Gulland 2008; Acevedo and Cassinello 2009; Willisch and Neuhaus 2010; Shweiger <i>et al.</i> 2015</p>

<p><b>Chamois</b> <i>Rupicapra rupicapra</i></p>	<p>Distinctive facial markings, with dark stripes from the eye to the nose. Short, curved horns in both males and females. Little sexual dimorphism between males and females.</p>	<p>Seasonal rhythm in feeding behaviours, peaking three times in summer and twice in autumn</p>	<p>Sex segregated herds that occupy distinct spatial areas, coming together during the rutting season in early winter.</p>	<p>Occupy mountainous areas, but not well-adapted to this environment. Often graze in lower altitudes in open grassy areas or edges of woodlands, particularly in winter.</p>	<p><b>Intra-group:</b> violent behaviours in females to assert dominance by hooking horns into sides of other individuals. <b>General:</b> opt to conserve energy in cold conditions, increasing resting time and spending less time foraging</p>	<p>Freeman 1973; Bruno and Lovari 1989; Locati and Lovari 1990; Pérez-Barbería <i>et al.</i> 1997; Nesti <i>et al.</i> 2010; Pęksa and Ciach 2018</p>
<p><b>Bison and auroch</b> (European bison modern comparison for both species – descendant of hybridisation of <i>Bison priscus</i> (steppe bison) and <i>Bos primigenius</i> (aurochs): Soubrier 2016)</p>	<p>Steppe bison: thick, dark hair across forequarters and underbelly. Dark horns, that curve and project forwards. Denser skin around throats, cheeks, and frontal lobes as protection in male altercations. Distinct dorsal hump. Auroch: Flatter dorsal line, larger horns that project laterally with light colour. Males had darker coats, and females had lighter, reddish coloured coats.</p>	<p>n/a</p>	<p>Matriarchal herds dominated by older females. Increased male presence during rutting season (August to October). Males live in small bachelor herds or are solitary. Social relationships important to decision making and herd dynamics</p>	<p>Adaptable species that occupy grassy open landscapes, woodlands, and mountainous regions. Preferentially graze on herbaceous plants, supplementing with woody plants, moss and lichen.</p>	<p><b>Grooming:</b> Rub against trees, damaging bark and causing trees to topple. Lick theirs and others' coats, wallow, and tail switch to remove flies. <b>Rutting season:</b> Bellowing and head-butting between competitors. Grooming behaviours increase. <b>General:</b> Rest either lying or standing, will kneel to lower front first and curl legs under body when lying. Aggressive behaviours towards predators by hoofing the ground and swinging head as a warning, then charging to deter or attack predator. However, most common response to threat is fleeing.</p>	<p>Cabón-Raczynska <i>et al.</i> 1983; van Vuure 2002; Daleszczyk and Czykier 2010; Jenkins <i>et al.</i> 2012; Julien 2012; Bocherens <i>et al.</i> 2015; Ramos <i>et al.</i> 2015; Boeskorov <i>et al.</i> 2016; Haidt <i>et al.</i> 2018; Ramos <i>et al.</i> 2019; Beschta <i>et al.</i> 2020</p>

The particular characteristics of horses, another animal that dominates faunal assemblages throughout the Upper Palaeolithic, were also likely visually familiar to Cro Magnons. Similar to red deer, the matriarchal structure of horses would have perhaps encouraged the visual discrimination of individuals within a herd to identify the matriarch responsible for influencing others' behaviours, particularly in response to potential threats. The stable structure of these herds may have also encouraged an awareness of the social bonds within a group, with close observation of how horses interacted with each other to allow the matriarch and other high-status individuals to be identified. The pelage of different individuals and indicators of age, such as protruding lips, may have facilitated this visual discrimination. Visual attention may have also been paid to the distinctive seasonal changes in pelage, particularly m-shaped colouration. For ibex and chamois, the ability to visually discern these species within mountainous environments would have been crucial for hunting strategies. Visual familiarity may have been attuned to identifying particular distinctive characteristics of these species, such as the horns or facial markings. Close observation of herd dynamics too would have enabled flight paths to be predicted, based on both the surrounding terrain and the behaviours of dominant individuals. Similar attributes were likely focused on in aurochs and bison, with attention paid to the salient features of these animals (e.g. dorsal hump, horns, coats) and the behaviours of dominant individuals. The distinctive behaviours of these animals, such as lying down, wallowing, mutual grooming, or even aggressive head-butting, would all be indicators of the particular status of the herd (relaxed, alerted, aggressive), influencing how Cro Magnons subsequently responded to encounters with these animals.

The behaviours and characteristics of these species therefore demonstrate how Cro Magnons would have developed expertise in discriminating individuals in a herd, identifying particular behaviours, and being attune to seasonal rhythms. This milieu is important for understanding how these daily interactions and close observation of animals likely shaped the visual responses of Cro Magnons. As with the remarkable ability of many people today to distinguish other individuals and perceive faces in random patterns, Cro Magnons would have likely been equally skilled in distinguishing animals from subtle and fragmented visual stimuli. Their visual system was undoubtedly highly attuned to this, with an ability to rapidly resolve ambiguous stimuli as a particular animal. This is important for contextualising visual responses within the making of cave art, and also for understanding the potential significance of representing certain details or features of animals.

#### 5.4. Socio-Cultural Context

The environmental and ecological conditions of northern Spain throughout the Upper Palaeolithic provide the necessary backdrop for discussing the human populations

that interacted and inhabited this landscape. Animal *affects*, and the specific nature of the ecology within this region, would have invariably shaped the behaviour of human societies and in turn, influenced the material culture they produced in response to these conditions. Therefore, humans and their socio-cultural affects are the final piece that need to be explored in order to complete the picture of the contextual background of northern Spain.

#### 5.4.1. *Social groups, relationships, and networks*

The social groups and networks of Cro Magnons in northern Spain appears to be markedly diverse throughout the Upper Palaeolithic, as environmental conditions constrained and affected human population dynamics. Cro Magnons appear to arrive in northern Spain around 43,300 – 40,500 cal. B.P., and likely interacted with the pre-existing Neanderthal population in this region; the Châtelperronian persists in northern Spain until around 42,600 – 42,500 cal. B.P., suggesting a potential overlap of ~1,000 years between the two species (Marín-Arroyo *et al.* 2020, 24). Evidence for Cro Magnon social networks during the Aurignacian is sparse, and populations were likely very low during this period; it is estimated around 1,500 people inhabited Western Europe, with approximately 280 people living in northern Spain (Schmidt and Zimmermann 2019, 5). There appears to be some social networks existing between groups in northern Spain and south-west France, supported by evidence of raw material transport between the two regions (Schmidt and Zimmermann 2019, 11). However, this evidence is tentative and the paucity of the archaeological record during this period restricts discussion of potential social networks that may have existed.

During the Gravettian, as climatic conditions deteriorated, so too did populations within Europe; despite several assumptions regarding the migration of populations into northern Spain and south-west France during this period, it appears that instead populations in more northern latitudes suffered local extinction events (Straus 2015b, 466; Tallavaara *et al.* 2015, 8233; Burke *et al.* 2017, 217; Maier 2017, 91; Maier and Zimmermann 2017, 583). In northern Spain, the population seems to decrease throughout the Gravettian as climatic conditions worsened, with conservative estimates of a population between 86 – 164 people by the end of this period (Maier and Zimmermann 2017, 581). However, there still appears to have been some social relationships with nearby regions in the Pyrenees, Basque region, and south-West France, evident by raw material transport and similarities in cultural and technological typologies (Arrizabalaga *et al.* 2014, 254 - 255; Maier 2017, 88). The transport of materials across these distances was likely essential during this period; resources would have been low as the climate deteriorated, and populations may have had to expand their foraging range to accommodate for this. The social networks during the Gravettian perhaps also provided these refugia populations with some resistance

to genetic bottlenecks and local extinctions (Maier and Zimmermann 2017, 584); by interacting with other groups, these populations were able to maintain some genetic diversity.

As glaciation reached its peak during the Solutrean, populations had become stable within refugia areas, particularly in northern Spain and south-west France. Unsurprisingly, as populations condensed into regional locales, this fostered the emergence of regional cultures throughout Europe broadly contemporaneous to the Solutrean period, such as the Badegoulian, Salpétrian, Arenian, or Grubgraban (Maier 2017, 98). As the climate began to gradually recover from the harsh conditions of MIS2, during the same time the glaciers met their maximum size, resources began to gradually increase; most notably, this was driven by an increase in insolation (amount of solar energy per m<sup>2</sup>) and average temperature (Maier 2017 90 – 91). This supported a rise in animal biomass, creating more favourable conditions than the late Gravettian and supporting Cro Magnon population growth (Maier 2017, 91). Despite this increase in population, Cro Magnon groups remained largely within refugia areas and the number of sites within these regions, particularly within northern Spain, drastically increases from the late Gravettian to the early Solutrean period (Straus *et al.* 2002, 1407). Notably, there may have also been the emergence of potential aggregation sites during this period, suggesting an element of fission-fusion dynamics occurring within Cro Magnon populations where large meta-groups came together at certain points in the year, but largely lived in smaller mobile societies (Straus 1979, 200; Straus 2015b, 482). Small-scale social networks persisted during this period, and in particular the regional networks between northern Spain and south-west France continue to exist (Straus 1979, 199; Straus and González Morales 2012; Straus 2015b; Arrizabalga *et al.* 2021).

The ameliorating climate of the Magdalenian period allowed populations to disperse out from refugia to repopulate northern areas of Europe. Demographic estimates suggest the population increased from 5,885 during the LGM, to over 28,800 people (and potentially up to 40,000 people) by the start of the Magdalenian (Bouquet-Appel and Demars 2000, 568; Bouquet-Appel 2005, 1664). The expanse of Cro Magnons out of refugia in northern Spain and south-west France appears to have been supported by complex and extensive social networks; these may have acted as a safety net as populations migrated into unfamiliar territories, mitigating the potential risk of not knowing whether the resources in these new regions would be predictable (Whallon 2006, 260 - 261; Burke *et al.* 2015, 255 – 256). Long-distance raw material transport suggests these social networks spread at least across south-west France to the German Rhineland (Langley and Street 2013, 463 – 464), and with the pre-existing social networks between northern Spain and south-west France, it is plausible expansive networks existed that implicitly connected northern Spain to

central Europe. The interconnectedness of the Magdalenian world perhaps explains the relative homogeneity of material and visual culture during this period (Fuentes *et al.* 2019, 235; 238), with observable similarities in the form and style of art across Europe, even evident from similarities between the northernmost examples at Creswell Crags (UK) to sites in central Europe, such as Gönnersdorf (Germany) (Bahn *et al.* 2003, 228 – 230; Pettitt 2007, 121 – 123).

The extent of social relationships and networks throughout the Upper Palaeolithic provides an insight not only into the interconnectedness of populations during this period, but also of the geographical range we might expect cultural similarities to exist and thus providing a basis for stylistic comparisons between sites. For example, the exchange of raw material suggests that Cantabrian populations during the Upper Palaeolithic were perhaps more likely to interact and share cultural similarities with populations in the Basque country and south-west France, rather than other populations within Spain to the south or further west. Furthermore, this provides some indication of the mobility of people during this period and whether it is plausible certain animals were depicted, not because they were present in the immediate landscape, but were remembered from a different area further afield. Species such as *Megaloceros*, for example, were sparse in northern Spain but had a larger presence in south-west France. The material and visual culture of these periods can shed light on the extent of cultural similarities between northern Spain and nearby regions.

#### *5.4.2. Artistic behaviours and styles*

Cave art was not produced in an isolated cultural vacuum, and Upper Palaeolithic societies were producing a plethora of different artistic objects. The style of the art (i.e. the decision to depict certain features of animals in specific ways) was perhaps determined by existing cultural “norms” that existed across the social networks that sprawled across Europe. This is a vital consideration that will help to contextualise the role of the visual system in shaping artistic depictions; unpicking which features of the art can be attributed to pre-existing cultural styles will determine which features psychological phenomena might have been responsible for. Broad changes in the style of figurative representations are explored here to provide coarse context for the Monte Castillo art, but more specific and in-depth stylistic comparisons for depictions at each case study site are provided in the subsequent chapters.

Figurative art in northern Spain, both portable and parietal, appears to be absent in the early Upper Palaeolithic. During the Aurignacian (c. 43,500 – 31,500 cal. B.P.), there also appears to be a distinct lack of art in this region generally (Straus 2005, 149), with some questioning whether any art in northern Spain can be confidently attributed to the Aurignacian (Garate *et al.* 2015). The few portable art pieces that can be tentatively

attributed to this period are exclusively non-figurative, consisting of incised lines on stone or osseous materials (e.g. Bernaldo de Quirós *et al.* 2010, 301 - 302). This includes an engraved metapodial from El Castillo, a linearly engraved antler fragment and an engraved pebble from Labeko Koba and a few engraved pieces from El Pendo (Arrizabalaga *et al.* 2003, 420; Straus 2005, 149; Garate *et al.* 2015, 240). Recent U-Th minimum ages place some parietal art within at least the initial Aurignacian, but potentially older, such as the red discs and a handprint from El Castillo and red claviform signs at Altamira (Pike *et al.* 2012, 1410; Straus 2015a, 259). It appears, therefore, that Aurignacian art in northern Spain is limited to relatively simple non-figurative depictions. This is consistent with the art of south-west France; linear and geometric designs appear on decorated bones or stone such as Abri Blanchard (Tartar *et al.* 2014), and personal ornaments (Vanhaeren and d'Errico 2006; Tartar 2015; White and Normand 2015). Circular symbols with an indent or an intersecting line, referred to as “vulvas” or “hoofprints”, also appear in the Aurignacian, with securely dated examples from La Ferrassie (Mellars 2009, 177), Abri Blanchard (Bourrillon *et al.* 2018), Abri Castanet (Dordogne, France) (White *et al.* 2012), and Abri Cellier (White *et al.* 2018). There are examples of figurative representations in Europe during this period, but these are either further afield, e.g. figurines from the Swabian Jura (Germany) (Conard 2003), have issues with dating such as Chauvet (France) (Valladas *et al.* 2001; cf: Pettitt and Bahn 2003; Combiér and Jouve 2012) and Altxerri B (northern Spain) (González-Sainz *et al.* 2013; cf: Ochoa and García-Diez 2015, 274), or are rare, such as the engraved bird on a flint flake from Cantalouette II (Dordogne, France) (Ortega *et al.* 2015) or the zoomorphic representations on plaquettes from Abri Blanchard and Abri Castanet (Dordogne, France) (Bourrillon and White 2015).

The first figurative art in northern Spain appears to emerge within the Gravettian (c. 31,500 - 24,000 cal. B.P.), and there are several securely dated portable art pieces comprehensively evaluated by Ochoa *et al.* (2018). Ochoa *et al.* (2018, 8 - 9) identify stylistic features of this early figurative art in northern Spain, including the use of simple outline, the placement of limbs in anatomically incorrect positions, disproportionate elements of the body, and the static position of the animal. In addition, red finger-dots and depictions of horses with an elongated muzzle and “bun-shaped” mane can be added to the Gravettian art repertoire of northern Spain, in light of U-Th dates from Fuente del Trucho (Hoffmann *et al.* 2017). Although the red finger-dots at Fuente del Trucho are not used in the context of figurative art, it has been proposed that this particular style of producing a line emerged within the Gravettian, and became more widely used within figurative depictions during the Solutrean (Straus 2015a, 260). Indeed, García Diez and Ochoa Fraile (2012, 365 - 366) identified red hind depictions from Cualventi and Pondra (Cantabria, Spain) that utilise the red finger dot technique; at Pondra, thermoluminescence (TL) dating of over- and under-

lying calcite places this depiction between 32,946 ( $\pm$  3,440) and 26,972 ( $\pm$  2,747) B.P., firmly within the Gravettian period. In southwest France, figurative depictions that utilise black pigments and appear stylised have been directly dated via AMS radiocarbon to the Gravettian at several sites, notably for the dotted horse depictions at Pech-Merle (González and Behrmann 2007, 440; von Petzinger and Nowell 1171), but also for megaloceros depictions at Cougnac cave (González and Behrmann 2007, 440) and horse and bison depictions at Cosquer (Valladas *et al.* 2001, 980; González and Behrmann 2007, 440). Depictions in black pigment at Candamo also appear to date to the Gravettian, with a bison dating to 27,410 – 26,121 cal. B.P. (Ochoa *et al.* 2021), but it has been noted that dates at this site are inconsistent, raising questions about their validity (Pettitt and Bahn 2003; González and Behrmann 2007, 443). The presence of figurative representations during the Gravettian period in Cantabria appears to be few and far between, with those that do date to this period being often depicted as static and disproportionate and usually represented in red ochre.

The Solutrean period (c. 24,000 – 20,500 cal. B.P.) sees a greater increase in figurative representation, with a stylistic continuation of red finger dotted outlines – perceived as characterising the figurative art of this period (Straus 2005). There appears to be an increase in concern for depicting animal behaviours, moving away from the static nature of Gravettian figurative depictions; yet these representations appear to remain focused on the silhouetted outline of the animal, rather than any naturalistic detail. The changes towards more dynamic representations of animals are marked within the extensive collection of plaquettes at Parpalló (Pigeaud 2005, 10; Roldán García *et al.* 2016, 1). The shift towards this style of representation can also be observed in some depictions directly dated to the Solutrean in northern Spain. At Altamira, a horse depiction dating to 22,110 (min.) B.P. (Pike *et al.* 2012, 1410) features the characteristic use of a red finger-dotted outline that emerged in the Gravettian, but portrays the horse as dynamic: it appears to be galloping or leaping. Although not directly dated, the red-dotted depictions of horse, bovids, and red deer at Covalanas and La Haza (Cantabria) are frequently attributed to the Solutrean (Straus 2005, 152); these sites also have Solutrean deposits that support this cultural attribution to the art (Straus *et al.* 2005, 1407). These depictions also appear to capture the alerted behaviours of aurochsen and bison; the animals are depicted with their tails high, and heads raised. In addition to this more dynamic representation, specific stylistic traits emerge within Solutrean art, and most notably this includes the “stepped mane” feature of horse depictions. This is observed within both engraved and red painted horses in the Parpalló collection (Pigeaud 2007, 416 – 417; Roldán García *et al.* 2016, 5) and other securely dated Solutrean art sites elsewhere (e.g. Ambrosio cave: Ripoll López *et al.* 2015, 517), and is generally considered a key stylistic feature of Solutrean art throughout

western Europe. The twisted perspective of horns in aurochs and bison is another feature identified in the Parpalló plaquettes that appears shared across Solutrean depictions (Bicho *et al.* 2007, 103)

Towards the end of the Solutrean, and certainly throughout the Magdalenian, there appears to be a shift away from silhouette, outline depictions of animals and a focus on naturalism. Attention was paid to representing the specific coat and behaviours of animals, sometimes achieved through the use of different pigment colours to create striking polychrome motifs. The most famous cave art sites in the Franco-Cantabrian region encapsulate this style of depiction (e.g. Lascaux, Altamira, Tito Bustillo, Niaux) and have naturalistic figurative depictions attributed to the late Solutrean to Magdalenian periods through direct or indirect dates and stylistic comparison (Valladas *et al.* 1992; Pettitt and Pike 2007; Pike *et al.* 2012; García-Diez *et al.* 2013; Balbín-Behrmann *et al.* 2017; Ducasse and Langlais 2019).

In northern Spain, the vast majority of directly dated parietal art falls within the range for the Magdalenian period and is dominated by depictions of bison, red deer, aurochs, ibex, and horse (Straus 2005, 154), with a few examples of schematic representations of anthropomorphs at sites such as Palomera cave (Ojo Guarena, Cantabria) (Cacho *et al.* 2012, 45). This is perhaps best characterised by the numerous horse depictions at Ekain cave (Basque Country); these have been dated to the mid-late Magdalenian by AMS radiocarbon, with dates of 13,405 – 13,084 cal. B.P. and 15,161 – 14,275 cal. B.P. from two of the horses (Ochoa *et al.* 2021). They feature infilling of the coat, dorsal stripes, and the low positioning of the tail which Ochoa and García-Diez (2015, 279) identify as a characteristic of the “Pyrenean style”. This attention to detail is also observed in the characterful facial expression of a reindeer and the pelage of a horse dating to 14,076 – 13,519 cal. B.P. (95.4% confidence; García-Diez *et al.* 2021) from Las Monedas, and detailed representations capturing asymmetry in red deer antlers at Las Chimeneas dating to 18,633 – 17,966 cal. B.P. (95.4% confidence; Clottes 2008).

This particular Cantabrian artistic tradition of detailed, black outline depictions that date to the mid-late Magdalenian, share many characteristics with prominent sites in southwest France, such as Rouffignac (Dordogne) and Niaux (Ariège). These contain highly naturalistic depictions that detail the facial characteristics and pelage of the animals. The art of Niaux has been AMS radiocarbon dated to 12,890 +/- 160 B.P. (Valladas *et al.* 1992; Clottes *et al.* 1992), and Rouffignac, although not directly dated, is generally agreed to date to around 14,000 – 13,000 B.P. (Sanit *et al.* 2005; Sharpe and Van Gelder 2006b; Gay *et al.* 2020), placing both sites at a similar age to the depictions from the Cantabrian sites of Las Monedas, Las Chimeneas, and Ekain. The breadth of similarities across contemporaneous

examples of Magdalenian art throughout the Franco-Cantabrian region reflects the extensive social networks that existed during this period. It alludes to a rich cultural tradition of artistic representation in the Cantabrian Magdalenian period, that conformed to a series of cultural norms for the depiction of particular animals.

This coarse overview of the key stylistic features of figurative depictions provides important context for the art of Monte Castillo, enabling it to be appreciated within its wider cultural context. Specific depictions within each case study will be stylistically evaluated to provide an in-depth evaluation of some of the similarities or divergences in style, when compared to Franco-Cantabrian art more broadly. This will allow for features of the art that conformed to cultural norms to be teased out, allowing for an evaluation of those features that perhaps emerged by virtue of the specific engagements or visual responses of the artist to the cave wall during art making.

## 5.5. Summary

This contextual frame situates the Monte Castillo sites within the rich and diverse social worlds that existed throughout the Upper Palaeolithic, and provides the necessary milieu through which to understand the biographical making of depictions in subsequent chapters. In particular, the significance of certain faunal species and their behaviours can be utilised to provide insight into the potential visual expertise of Cro Magnon people in northern Spain throughout the Upper Palaeolithic. The context surrounding the artistic style of depiction in a diverse range of art forms can help to tease out the cultural “norms” that may have existed for depicting features of an animal. Crucially, this contextual framework ensures reasonable assessments can be made regarding the intentions of Cro Magnon artists: their minds; their behaviours; and their understanding of the animal subjects. The following chapters will bring together the theoretical framework, insights from visual psychology, and the contextual background to evaluate and interrogate the role of the visual system in the making of artistic depictions within the Monte Castillo cave art sites. This concerns developing a desk-based approach in Chapter 6 for evaluating the specific visual effects of lighting conditions that may have informed the production of depictions within Las Monedas cave. This approach is refined and developed in Chapter 7, integrating primary insights to provide higher resolution for understanding the making of depictions in La Pasiega. Finally, a pilot psychology experiment is presented to demonstrate the additional insights that may be yielded for the role of the visual system in the making of cave art, focusing on the case study site of El Castillo. Each chapter presents the making of the art as a biography, weaving together the sensitivity encouraged through the theoretical framework and the deeper insights obtained through visual psychology, into a cohesive narrative supported by a raft of interdisciplinary evidence.

## Chapter 6

# Phase 1: Developing a Desk-Based Approach for Understanding the Making of Cave Art in Las Monedas

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### 6.1. Introduction

The previous chapters have outlined the need for a new approach that shifts focus towards the making of Palaeolithic art and away from its aesthetic final form. Chapter 3 provided a theoretical framework within which to work to evaluate the making of cave art that mitigated some of the historical issues within Palaeolithic art research. Chapter 4 integrated insights from visual and perceptual psychology to evaluate how the particular environments of caves may have had tangible effects on artists, placing it as a crucial stage within the making of cave art. Chapter 5 provided important insights into the broader ecological and cultural context of the Upper Palaeolithic, and discussed how this context may have influenced the visual psychology of Cro Magnon artists. This chapter brings together the insights provided by each of these chapters to generate the first phase in developing an approach for understanding the biographical making of cave art. A desk-based approach is developed, utilising innovative digital techniques and integrating insights into both the universal mechanisms that underpin the human visual system (Chapter 4) and how these mechanisms may have been shaped by the experience of living in northern Spain during different periods of the Upper Palaeolithic (Chapter 5). This approach is applied to understand the biographical phases of producing figurative depictions within Las Monedas – a large cave characterised by a small number of charcoal depictions situated deep within the cave, approximately 60m from its entrance. New insights are generated which outline the potential visual and perceptual phenomena that may have been triggered within this environment, and how these phenomena appear to have then been integrated into the making of the art. The specific features of the figurative art in Las Monedas are subsequently understood to have emerged from a multifaceted interaction between the cave wall, light, the artist, and their response to ambiguous visual stimuli.

### 6.2. Methodology: Developing a Desk-Based Approach

#### 6.2.1. *Rationale*

The first phase involves developing a desk-based approach for understanding the psychological mechanisms that may be involved in the making of cave art. This phase emerged for two reasons: the impact of a global pandemic which prevented in-person fieldwork; and the logistical limitations of accessing cave art sites which may be inaccessible both due to geography (e.g. Cosquer cave, which is only accessible through diving) or to

preserve the atmospheric conditions within caves, preventing microbial damage to the art (e.g. Altamira, Lascaux). The ability to develop a desk-based approach that allows for the exploration of the role of the visual system in cave art making is therefore pertinent to the field of Palaeolithic cave art research, and has wide-ranging potential for answering research questions that may ordinarily be unanswerable due to practical or logistical issues.

Las Monedas was selected as a case study to apply this desk-based approach. Not only is it situated alongside other case studies (La Pasiiega and El Castillo) focused on in this research, allowing for appropriate comparisons to be drawn between these sites, Las Monedas also selected itself for two reasons. Firstly, the art within Las Monedas is clustered within a small chamber deep within the cave and the position of each depiction within this area recorded in good resolution. This allows for the immediate spatial context of the art to be understood, without necessitating in-person fieldwork. The monograph of the site (Ripoll Perello 1980) provides detail for each depiction, including its size, relationship to other depictions, stylistic features, and any other notable characteristics. Ochoa's (2017) analysis of the art within the site further supplements this information, giving an insight into the distance between the depiction and modern floor level (which has been modified by removing a maximum of 10cm of sediment; Ochoa *pers. comm.*). This also provides spatial information regarding the maximum number of people that could have been present in one given area to view the art, and the perspective from which they would have viewed the art. Secondly, an unpublished digital repository of images was generously provided by Dr. Blanca Ochoa from several years of her fieldwork at Las Monedas, which recorded each depiction in high-resolution, and allowed for the application of several digital methods. Together, these provided good resolution of each depiction within the site to subsequently explore the making of these depictions.

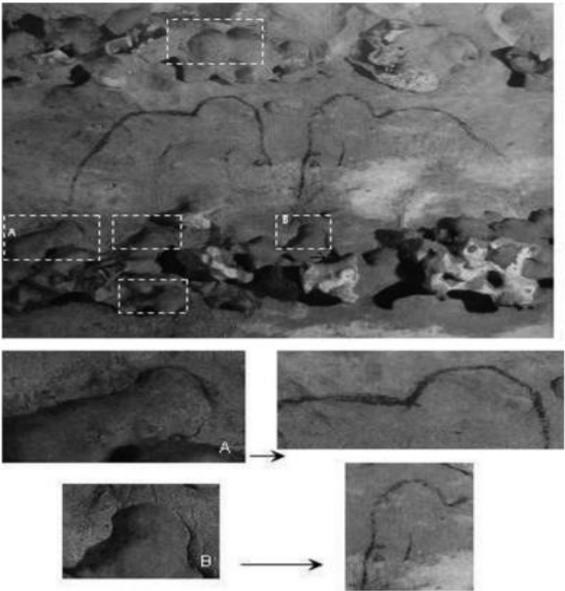
### *6.2.2. Preliminary evaluation*

A preliminary evaluation of the art was first undertaken, utilising available published information. This created a database for each depiction in the site (see Volume 2, Appendix 1) recording the following characteristics: date/dating method; animal depicted; maximum length; technique; pigment used; colour; approximate height from modern ground level; orientation; relationship to other depictions; general style; features depicted; stylistic description; association to cave wall; visibility; and panel morphology. This provided useful information for each depiction, and allowed for a preliminary analysis of the stylistic features of each depiction. This attempted to determine whether depictions significantly varied from the stylistic cultural "norm" for depicting certain animal species during the mid-late Magdalenian in Cantabria, which may indicate the depiction was shaped

by the specific visual and material engagement between artist, light, pigment, and the cave wall.

The preliminary recording of cave art depictions from Las Monedas also needed to consider the relationship between natural features and the depictions, to provide some initial insight into potential psychological mechanisms involved in the making of the art. Several categories to summarise the relationship between the depiction and the natural features of the cave wall were created in order to do this (Table 6.1). These categories are also provisionally associated to certain psychological phenomena. Following Hodgson (2008, 347), it is anticipated that hyper-imagery may manifest in cave art depictions as mimicking (“mimic” category) the shape of a nearby feature; the shape “primes” the artist(s), who then have an abnormal perceptual response and perceive this perceptual imagery as taking the form of an animal on a nearby area of the wall. Similarly, it is proposed that depictions that directly use a natural feature as part of the depiction (“direct” category) may also reflect hyper-imagery for the same reasons; this feature primes the artist(s), but rather than mimic the form elsewhere, they instead embellish the natural feature to capture the perceptual imagery they are experiencing. However, the direct category may also reflect potent pareidolic responses, whereby the natural feature is perceived as “looking like” an animal form and again is subsequently embellished to complete the animal form. Pareidolic responses may also manifest as part of the depiction running parallel to, but not directly using, natural features that were perceived as evocative as part of the animal (“parallel category”). For example, this may consist of the dorsal line of an animal being drawn underneath a crack and contour, following its shape. Finally, it is expected that any depictions that were not influenced by a perceptual psychological response are likely to have no or a very limited relationship to the natural topography of the cave wall.

Table 6.1. Categories used to characterise the relationships between natural formations and cave art depictions.

Category	Example	Description	Potential psychological response
Mimic	 <p><i>Example of "mimicking" natural features from Rouffignac cave. Image: Hodgson 2008, 347.</i></p>	<p>The depiction appears to mimic an unusual or suggestive natural feature of the wall</p>	<p>Hyper-imagery</p>
Direct	 <p><i>Bison depiction from El Castillo that integrates a natural crack to represent the dorsal line. Image: Author.</i></p>	<p>The depiction is directly mapped onto a suggestive natural feature</p>	<p>Hyper-imagery/ Pareidolia</p>
Parallel	 <p><i>A horse depiction from Las Monedas. The tail and dorsal line run parallel to the edge of the rock surface. Note, there is mesh fencing in front of this depiction. Image: Blanca Ochoa.</i></p>	<p>Lines of the depiction run parallel to natural features</p>	<p>Pareidolia</p>

<p>Limited/ None</p>	 <p>Stag depiction from Las Chimeneas, that seems to have no relationship with the cave wall. Image: The Wendel Collection ©</p>	<p>There appears to be a limited or no association between the depiction and the cave wall, or the relationship is difficult to assess (e.g. due to degradation of the depiction)</p>	<p>Normal visual response</p>
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These categories intended to provide an initial insight into the expected psychological response involved in the making of depictions. However, these categories are provisional; they were attributed to depictions based off 2D images, and therefore likely do not consider all relationships between the depictions and the cave topography. Furthermore, they do not consider the effect of lighting on the topography of the cave wall and how this may have influenced the psychological response. Consequently, it is necessary to utilise additional techniques to further evaluate the visual perceptual effects of viewing the cave wall under low light conditions, and how this may have influenced the making of the art.

### 6.2.3. Digital tracings

Line order was reconstructed through the use of high-resolution images of the depictions, the DStretch plugin of ImageJ to further enhance depictions, and the open-source imaging editing software, Krita. 2D digital reconstructions of this kind are a well-established approach and primarily adopts the following methodology: high resolution images are imported into an image editing software with DStretch images layered on top to enable better visibility for faded depictions, and the depiction is digitally traced using brush tools in a separate layer (Lerma *et al.* 2006, 148; Salazar *et al.* 2019, 4; Ruiz-Redondo *et al.* 2019, 300).

Although this approach is usually adopted to better visualise depictions that may be faded or covered with calcite, this methodology can be adopted to determine the order of strokes, by following Fritz and Tosello's (2007) work within cave art sites in France. Their integration of digital techniques with the traditional use of *relevés*, enabled them to reveal the sequential strokes involved in the production of depictions, which they apply to analyse the rhinoceros' depictions on the Panel of Horses in Chauvet cave. This is achieved through

using macro- and high-resolution photography to examine the start and end points of a stroke and to determine the order of intersecting lines, using some assumption regarding the order of depicting anatomical elements where lines do not meet (Fritz and Tosello 2007, 62). This is used by Fritz and Tosello (2007, 69) to suggest the gestures involved in the technical style of producing these depictions is comparable to that of similar depictions in securely dated Magdalenian plaquettes. However, this style of approach has potential applications beyond discussions of artistic style; it can be employed within this research to determine how the sequence of strokes might relate to the psychological phenomena experienced by the artist.

Overlapping lines were the main indicator used for line order. Where overlapping lines were not present or the order of the overlapping lines were ambiguous, line direction was used to indicate the likely order of lines. Line direction was determined by the width of the lines, with a heavy deposition of pigment indicating the start of the line and the gradual, continuous fading of this pigment within a line indicating the direction of the line. If the line direction indicated a general trend of left-to-right in painting the depiction, it was assumed the first features of the depictions to be drawn would be on the left, gradually moving towards the right or in a clockwise direction. Whilst this analysis involves some degree of speculation regarding line order, it provided some basis for discussing this in relation to the depiction's biography, that acknowledged some flexibility in the specific order of lines. This provided a direct way to relate the understanding of psychological processes to the tangible making of the art. The line order and direction provide potential insight into the initial response of the artist to visual phenomena; for example, determining whether the most salient features of an animal were drawn first, or if the first line continues a natural feature of the cave wall.

#### *6.2.4. Photogrammetry*

Photogrammetry was utilised in this research to produce, where possible, 3D models of the cave art in Las Monedas which could subsequently be manipulated to understand the relationship between the depictions and the cave surface. Photogrammetry is a relatively quick and inexpensive method for producing 3D models, and is well-established in Palaeolithic art research (Lerma *et al.* 2006; Lerma *et al.* 2010; Rivero *et al.* 2019, addressing the issues with 2D images distorting the dimensions of the art. It involves taking a series of photographs of the subject at 90-degree angles to the surface, with at least 60% overlap between each image. The images are then processed in the software Agisoft Metashape, which builds a fully textured model of the subject. Agisoft Metashape has some functionality for post-processing the model, to remove unnecessary sections or close holes in the mesh. RGB colour information is engrained in the texture map of the model, which

can be exported as a separate .jpeg image allowing it to be edited or entirely removed if necessary.

Photogrammetry usually requires in-person fieldwork or observation in order to take suitable images of the subject. However, it is possible to render models from secondary images if they meet the requirements for producing a photogrammetric model. An unpublished digital repository of images from Las Monedas provided by Dr. Blanca Ochoa provided sufficient variation in angles to yield 3D information, from different years of fieldwork capturing images of the same depictions. Images from this repository were sorted into folders for each panel, filtered for quality, and imported into Agisoft Metashape using the guided image matching function to increase the likelihood of the software appropriately matching points across images. As the number of images were limited, and not designed for use in photogrammetry, the models produced were of a lower quality than 3D models produced from images taken in-person (Figure 6.1). It is also expected some distortion is present in the models too, as not all surfaces were captured in images from the digital repository. The relative proportions of models were checked against recorded measurements of depictions for each panel, to ensure this distortion was not too significant. Any models that appeared to exhibit significant distortion or low confidence levels in the number of points used were omitted from the research. Whilst this approach has significant limitations, it enabled the research to adapt to the significant impacts of the pandemic and allowed for the relationship between depictions and the natural, three-dimensional features of the cave wall to still be evaluated.



Figure 6.1. Example of a photogrammetry model produced for a panel in Las Monedas, using the images provided by Dr. Blanca Ochoa. The position of the image thumbnails demonstrates there was enough overlap between images to yield some 3D information to produce the model. In normal circumstances where in-person fieldwork is possible, these images would be insufficient to produce an accurate photogrammetric model. Image: Author.

### 6.2.5. Virtual reality: Lighting simulations

To evaluate the effect of a flickering low light source on the perception of the natural features of the cave wall, the photogrammetry models were exported as .obj files and imported into Unity, an open-source gaming software. Unity allows users to build 3D Virtual Reality environments, with the flexibility to integrate 3D models with pre-existing assets available through the Unity Store. Notably, Unity also allows lighting within an environment to be manipulated; ambient lighting can be adjusted, and light sources can be created to emulate the warm, flickering nature of light cast from a small flame. Any assets within Unity receive light and cast shadows in the same way as real-world objects, allowing for this research to explore the real-time effects of a flickering low light source on the perception of cave art walls. To produce models with the cave art depictions removed, the RGB texture of the model was exported from Agisoft Metashape as a .jpeg image and edited within Krita, an open-source digital image editing software, to digitally remove the art but preserve the natural colour and texture of the wall. These .jpeg image textures were re-wrapped onto the 3D model mesh of the cave wall in Unity.

To explore the lighting effects in a systematic manner, 3D models of cave art walls were placed into a Unity environment that reflected the approximate ambient lighting expected to have been present within Las Monedas during the Palaeolithic. As the art within Las Monedas is situated deep within the cave with no direct connection to the entrance, it is likely no ambient daylight reached this area of the cave (Ochoa 2017, 300). Consequently, the ambient lighting in the VR simulation was set to 0, providing conditions of absolute darkness. A mobile, flickering light source was created that cast a warm light of 1850K over a diameter of 2.5m. This is consistent with experimental observations of the lower ranges for light cast from torch technologies made from juniper wood (Medina-Alcaide *et al.* 2021, S4 appendix) which was likely the dominant woody material available during the Older Dryas (see Chapter 5) – the period corresponding to the AMS radiocarbon dates obtained from the depictions in Las Monedas (García-Diez *et al.* 2021, 312). Lower ranges were selected to provide a conservative estimate for the light available, and to accommodate for the likelihood that the torch may have been lit for some time before the art was produced; Medina-Alcaide *et al.* (2021) demonstrated light quality depletes over time. The intensity of the light source was set to 0.5, and this fluctuated to emulate the flickering characteristics of light cast from a small flame. In Unity, light intensity does not correspond to real-world values; however, a light intensity of 0.5 was deemed suitable for the approximate light intensity produced by a small flame, particularly as this intensity increased to 0.75 and decreased to 0.25 as the light flickered. An appropriate light intensity allows for the simulation to perhaps appear more visually realistic, but the specific light intensity is somewhat irrelevant for determining how light interacts with the surface; only extreme and

inappropriate light intensities would prevent an accurate assessment of the interaction of light on a surface (Figure 6.2).

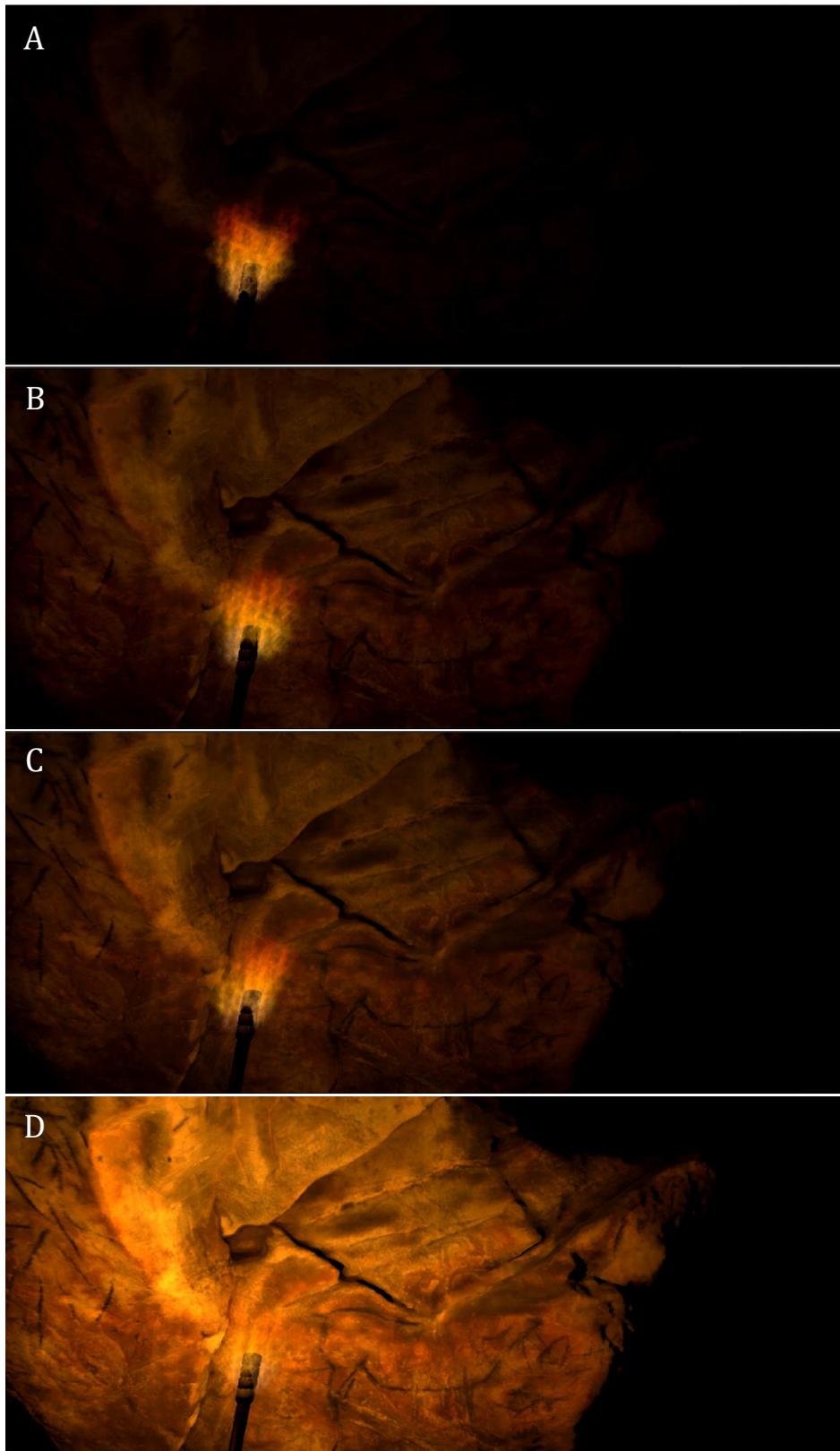


Figure 6.2 comparing light intensities of (A) 0.1, (B) 0.5 (C) 1 and (D) 10. Too low, light interaction is almost non-existent with the surface. Too high, the scene is flooded with light preventing an assessment of the interaction of light on the surface. 0.5 seemed appropriate for simulating the light cast from a small flame. However, between 0.5 and 1, one can appreciate how the interaction of light on the surface is similar, with the same amount of contrast between bright and dark areas. Images: Author.

As the light source used by artists within these caves was likely mobile - no contemporary hearths or lamps were found installed near the art panels in Las Monedas - the light source was placed at an approximate arm length away from the cave wall (40cm). The position of the light source was indicated by the line direction of the digital tracings, being offset either to the left or right of the depiction. For example, if the line direction was typically left-to-right it was assumed the artist used their right hand to draw, and held the light source in their left hand. The height of the light source depended on the height of the depiction, but where possible attempted to conform to either a height of 1m (approximate height of an arm resting, for a person around 1.75m tall), 1.5m (approximate height of an arm raised to shoulder height) or 1.9m (approximate height of an arm raised at a 45-degree angle above the head) (Figure 6.3). The camera capture height for the VR simulations was placed at 1.7m (approximate eye height). The lighting conditions were repeated for a model with the art visible, and again for the same model with the art removed.

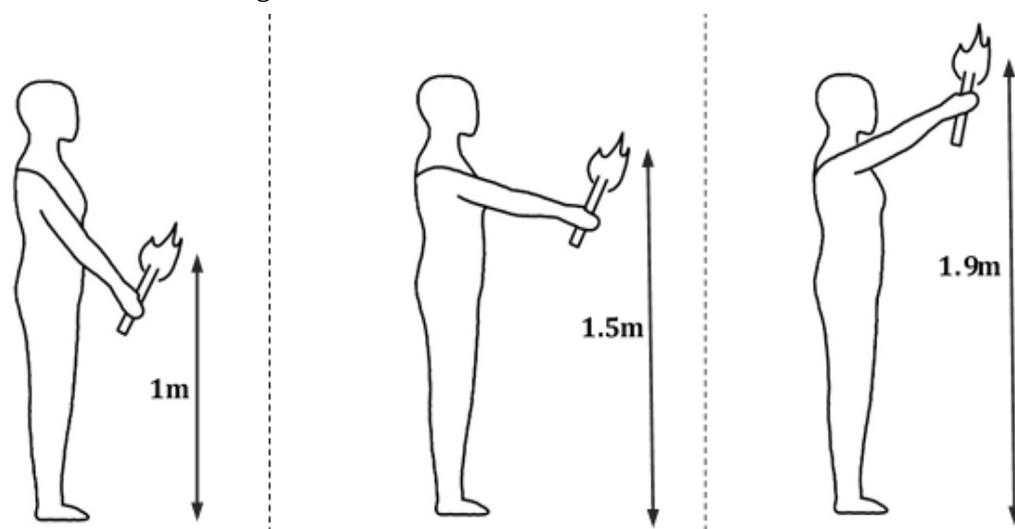


Figure 6.3. Approximate heights (not to scale) for different positions of holding a torch. Image: Author.

The visual effects of the lighting were recorded through still image screenshots and a screen-captured video recording, to capture the effect of the dynamic light source. To determine the relative brightness of different areas of the cave wall within the VR simulation, relative luminescence values (RLV) were calculated from still images that captured the brightest and dimmest points of flicker. RLV were calculated using RGB values for 5 different equidistant points across the area used to depict an animal, through the equation  $Y = 0.2126R + 0.7152G + 0.0722B$ , where Y is relative luminance. This formula weights the RGB colour values according to the human eye's perception of brightness; yellow-green wavelengths are perceived as brighter than red and blue (Snowden *et al.* 2006, 33). This enabled a discussion of the extent to which a flickering light cast over an undulating 3D surface varies, and whether this variation is likely to trigger certain perceptual psychological responses. It must be stressed that this is only a relative indication

of luminance, and will not correspond to real-world values experienced by Palaeolithic artists. Instead, this only provides an indication of how light interacts with a cave wall surface, demonstrating which areas may have appeared bright or dark due to the topography of the wall and how this may have shifted as the light source flickered or moved position.

### 6.3. Preliminary evaluation

#### 6.3.1. Art summary

Although Las Monedas is the largest of the Monte Castillo caves, with a comparable depth to El Castillo, the art only consists of 45 depictions: 30 figurative and 15 non-figurative (Ripoll Perello 1980, 24). It is constrained to a small area within the cave (Figure 6.4) and does not cover all available surfaces, suggesting the placement of each depiction was deliberate and not constrained by a lack of suitable surfaces. All figurative depictions appear to be superficially homogenous in theme and style. Horse depictions are the most numerous representing 50% (n = 15) of the figurative representations, followed by ibex (17%, n = 5) and reindeer (13%, n = 4) (Table 6.2) Unusually for the Magdalenian of northern Spain, bison depictions are rare with just one featuring in the art of this site. All depictions were drawn using a charcoal crayon, and mostly conform to detailed outlines which occasionally have partial infill or additional internal lines detailing pelage. Therefore, unlike the larger sites of La Pasiega and El Castillo, this art was likely produced within a short phase by a limited number of individuals. This presents the opportunity to compare a relatively short period of artistic activity within Las Monedas, to the more protracted periods of art making represented by La Pasiega and El Castillo. Despite the superficial homogeneity in the depictions, there are notable stylistic variation in the depiction of certain features of animals, evaluated below in section 6.2.3. For ease, the same numbers used by Ripoll Perello (1980) to label the depictions at Las Monedas are used in this thesis.

*Table 6.2. Summary of the figurative depictions in Las Monedas. Data from Ripollo Perello 1980, 24.*

<b>Animal depiction</b>	<b>Map number(s)</b>	<b>Frequency</b>	<b>Percentage</b>
Horse	6; 8; 10; 11; 12; 13; 17; 20; 22; 30; 31; 33; 34; 34a; 36	15	50%
Ibex	7; 15; 16; 28; 29	5	16.7%
Reindeer	2; 3; 14; 21	4	13.3%
Indeterminate	1; 18; 35	3	10%
Bison	5	1	3.3%
Cervid	26	1	3.3%
Bear	25	1	3.3%

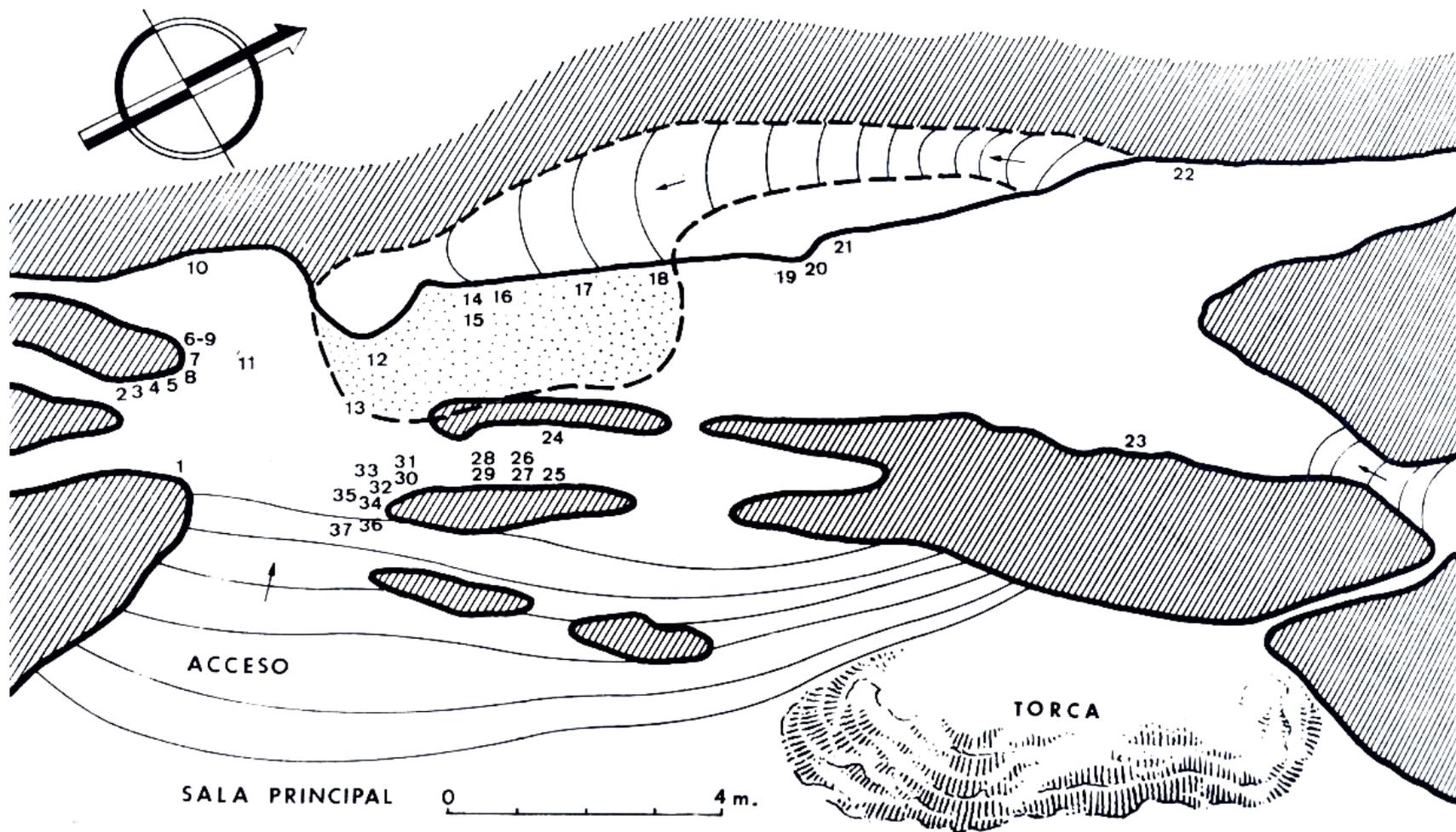


Figure 6.4. Map of the gallery of paintings in Las Monedas, with the position of each depiction indicated by numbers. For simplicity, the same numbers are used in this research to label each depiction. The modern entrance is visible on the left, and the possible original entrance to the gallery is indicated on the right. Image: Ripoll Perello 1980, 14.

### 6.3.2. Relationship to cave wall

The preliminary evaluation, although limited to making observations from 2D images of the cave art, appeared to identify a significant relationship between the art at Las Monedas and natural features of the cave wall morphology (Table 6.3). Over 70% of the figurative depictions (n = 20, out of 28 depictions analysed) appeared to have some form of relationship with the cave wall, with direct relationships (39%, n = 11) being the most common. In these cases, specific natural features of the cave wall (cracks, fissures, contours) appear to have been intentionally used to represent



Figure 6.5. Depiction 5 (bison) from Las Monedas. The dorsal line is represented by the edge of the rock surface.

Image: Blanca Ochoa

a certain feature of the animal, for example the edge of the rock face used to represent the dorsal line of a bison (Figure 6.5). This alludes to a prominent psychological response to natural features, where these natural features are perceived to be animals (or the parts of animals) and the act of drawing therefore “completes” the animal suggested by the natural cave morphology. Parallel relationships are the second most common (29%, n = 8), again alluding to a direct association between perceptual responses to the suggestive features of the cave wall and the animal depiction. Only one depiction appears to mimic the natural features of the cave wall; depiction 13 appears to imitate the shape of a calcite formation above it. This initial evaluation also appears to reflect a relationship between simple, incomplete depictions and a direct relationship to the cave wall. Of those depictions with a direct or parallel relationship to the cave wall, the vast majority (15/20) are simple in style, i.e., with no additional anatomical detail such as eyes, hair, or pelage. Equally, the majority of depictions with limited or no relationship to the cave wall (5/8) appear to be detailed. This perhaps indicates that the form and style of certain depictions were scaffolded onto visual imagery and influenced by a higher construal level effect, whilst others had a pre-determined form that was imposed onto a surface. This invites a deeper consideration of the psychological and perceptual interaction with the cave wall under low light conditions through the proposed biographical framework. For example, the lighting simulations can help evaluate whether natural features were visible or even emphasised by firelight, with the digital tracings indicating whether these natural features were then intentionally integrated into depictions.

Several interesting relationships, not fully covered by the broad categories, also emerged from this evaluation. In some cases, certain animal depictions appear to have been placed to appear as though they were emerging from cracks and fissures in the rock wall (Figure 6.6). In others, depictions appear to have been placed to make use of the undulating surface of the cave wall to give the animal depth and dimension. The placement of depictions on undulating surfaces warps the features of the animal, and may reflect a conscious use of the cave features to provide the animal with depth and dimension under a dynamic light source, even if the natural features themselves are not immediately evocative of certain anatomical elements of animals. Other depictions also appear to be intentionally placed on concave or convex areas of the wall, respectively shrinking or ballooning the depiction to the observer. Consequently, in addition to the visual perceptual response to natural features, there also appears to be a conscious interplay between the effects of light and shadow on the natural features of the cave wall and the placement of the figurative depictions. This may suggest, as proposed for depictions in other Cantabrian caves by Sakamoto *et al.* (2020), an installation element to the art; certain morphological features of the cave may have been deliberately selected with an awareness of the perceptual effects these features have on the reception of the depiction. In this case, it is important to consider the initial reception of morphological features and the psychological foundations or phenomena behind the perception of these features, to fully appreciate the deliberate placement and orientation of a depiction. In addition, the perceptual effects of light and shadow appear to have been utilised, consciously or not, to create narratives of animals creeping out of walls or disappearing into shadow, providing the depictions with a sense of movement and vitality. Again, this invites a deeper consideration of the reception and interplay of light and shadow through the biographical framework.



*Figure 6.6. Depiction 8 (horse) from Las Monedas. The depiction is placed to appear as if it is emerging from the fissure, an effect that would likely be heightened under a dynamic low light source. Image: Blanca Ochoa.*

Table 6.3. Summary of the preliminary analysis of figurative depictions at Las Monedas. 2 indeterminate figures, depictions 1 and 35, could not be identified and therefore are excluded from this analysis. Length values obtained from Ripoll Perello (1980) (not all depictions were measured by Ripoll Perello, resulting in some absent values). Height values obtained from Ochoa (2017).

#	Animal	Approx. length (cm)	Approx. height from modern ground level (cm)	Orientation	Relationship to other depictions	Anatomical features depicted	General style	Association to cave wall	Association comments	Visibility
2	Reindeer	36	130	Left, diagonally upwards	Row behind 3	Complete	Detailed outline with internal anatomical details	Limited/none	Shoulder, neck and head appear to be placed intentionally to give the animal depth	Visible
3	Reindeer	33	155	Left, diagonally upwards	Row in front of 2	Mostly complete, head missing	Detailed outline with internal anatomical details	Limited/none	Appears to be no apparent relationship, but the depiction may be placed to give the animal depth	Visible
5	Bison	50	135	Vertical, head up	Confronting 6, tiered above 7 and 8	Mostly complete	Simple outline with partial infill	Direct	Dorsal line is partially represented by the suggestive edge of the wall	Visible
6	Horse	40	135	Right	Confronting 5, tiered above 7 and 8	Complete	Simple outline with partial infill	Direct	Rear appears to be represented by a crack	Visible
7	Ibex	-	130	Right	Tiered under 5 and 6, and above 8	Cervico-dorsal line and front legs	Simple outline	Direct	Curvature of the horns follows the curvature of the cave wall	Visible
8	Horse	25	125	Left, diagonally downwards	Tiered under 5 - 7	Cervico-dorsal line	Simple outline	Direct	Appears to be intentionally placed to emerge from a crack in the wall	Visible

10	Horse?	12	137	Right	N/a	Complete	Simple outline	Parallel?	The cervico-dorsal line appears to run parallel to a crack/natural feature in the cave wall	Hidden?
11	Horse	51	300	Vertical, head down, legs left	N/a	Mostly complete, head missing	Simple outline	Parallel?	Front legs appear to be intentionally placed parallel to a natural crack	Visible
12	Horse	34	300	Right	N/a	Mostly complete, rear legs missing	Simple outline	Direct	Appears head is placed intentionally on a crack, front legs appear to be partially represented by a contour, rear leg/tail are suggested by a natural crack	Visible
13	Horse	25	190	Right, diagonally facing down	N/a	Complete	Simple outline with partial infill	Mimic	Appears to follow the suggestive edges of the rock, with the calcite above casting a shadow in the shape suggestive of a horse head.	Visible
14	Reindeer	60	150	Right	Tiered under 15, above 16	Mostly complete	Detailed outline	None	No apparent relationship, but placed near band of small rocks in wall	Visible
15	Caprid/ibex	42	170	Right	Tiered above 14	Complete	Simple outline	None	No apparent relationship, but placed near band of small rocks in wall	Limited
16	Ibex	28	110	Right	Tiered under 14 and 15	Mostly complete, head missing	Simple outline	None	No apparent relationship, but placed near band of small rocks in wall	Limited
17	Horse	28	170	Right	N/a	Mostly complete, head missing	Simple outline	Parallel (and direct?)	Dorsal line follows the natural curvature of the upper edge of the wall. Ventral line appears to be represented by natural crack	Visible

18	Indeterminate (horse/weasel)	-	125	Left	N/a	Cervico-dorsal line	Simple outline	Direct?	Appears the animal is depicted as intentionally emerging from the crevice in the wall, and some natural cracks may have been used to partially represent the ventral line	Hidden?
20	Horse	65	165	Vertical, head up, legs left	Mirrored with 21 (back-to-back)	Complete	Detailed outline with internal anatomical details	Parallel?	The rear leg appears to run parallel to a crack in the wall, and the dorsal line arguably runs parallel to the morphology of the wall	Visible
21	Reindeer	67	180	Vertical, head up, legs right	Mirrored with 20 (back-to-back)	Mostly complete, no ventral line or front legs	Detailed outline	Direct	Ventral line represented by natural crack	Visible
22	Horse?	77	85	Right	N/a	Cervico-dorsal line	Simple outline	Direct	Appears to utilise natural cracks in the rock	Visible?
25	Bear	-	170	Right	Tiered under 26	Cervico-dorsal line	Simple outline	Direct?	Depiction seems to be placed so the ventral line meets edge of the wall, and natural cracks appear to represent front leg	Prominent
26	Deer	-	130	Right	Tiered above 25	Head only	Detailed outline	None	Appears to be no apparent relationship	Visible
28	Ibex	-	85	Right	Row behind 29	Head only	Simple outline	None	Appears to be no apparent relationship between the depiction and the cave wall	Visible
29	Ibex	-	85	Right	Row in front of 28	Complete	Detailed outline with internal anatomical detail	Direct?	Depiction placed so that a crack seems to form the front leg, but unclear whether this association was intentional	Visible

30	Horse	56	100	Right	Stacked over 31	Mostly complete, head missing	Simple outline	Direct	Dorsal line is mostly represented by a natural curved edge of the cave wall. Depiction has been placed to make use of this highly suggestive natural feature	Prominent
31	Equid/horse	13	110	Diagonal, head up legs right	Stacked under 30	Complete	Simple outline	None	Appears to be no clear relationship	Limited
33	Horse	20	170	Diagonal, head up legs right	Tiered high above 34 - 36	Complete	Simple outline	Parallel	Dorsal line and rear follow natural contour of the rock	Visible
34	Horse	45	150	Right, slight diagonal facing downwards	Stacked under 34a and tiered above 36	Complete	Detailed outline with internal anatomical detail	Limited/none	Rear seems to run parallel to edge of the rock, but no clear relationship to natural features	Visible
34a	Horse	-	100	Vertical, head up, legs right	Stacked over 34	Complete	Simple outline	Parallel?	Rear seems to run parallel to crack n wall	Limited
36	Horse	43	100	Right	Tiered under 34	Cervico-dorsal line	Simple outline	None	Appears to be no apparent relationship with cave wall	Limited

#### *6.4.2. Stylistic analysis*

The incorporation of natural features into a majority of the depictions within Las Monedas encourages a consideration of the extent stylistic decisions appear to be shaped by the interaction with the cave wall. To determine this, a preliminary stylistic analysis was conducted to evaluate the distinctive traits of the depictions in this site and whether these appear to be a common shared feature across depictions within the caves, and conformed to a cultural style, or were features unique to one or two depictions, thus informed by a specific interaction with the cave wall. Features that might conform to a cultural style were determined by examining the features of other contemporary figurative depictions, to evaluate which features may have been culturally determined as necessary for constituting a figurative representation of a specific animal, e.g. for people in Western world today, the culturally determined features of a figurative representation of a house includes a triangle, representing the roof, positioned above a large square which has several internal smaller squares, representing windows and doors. Understanding the basic features of what culturally constitutes a “horse” or “bison” representation within the art of Las Monedas through identifying commonalities across depictions of the same animal, therefore, will better enable those features that do not conform, deviate from, or embellish these prerequisites to be identified.

In comparison to horse depictions found in portable and parietal art securely dated to the Magdalenian in northern Spain (Rivero and Sauvet 2014), the horse depictions at Las Monedas are much more simplistic in style (Figure 6.7). Unlike their contemporary counterparts, the Las Monedas depictions often do not include detail beyond the basic outline form of the art with features such as the mane, facial features, and pelage of the animal rarely depicted. Therefore, it appears as though a very basic form that consisted of a long, curved, and slightly concave dorsal line, with at least a tail, one rear, and one front leg was enough to suggest the form of a horse. Only two depictions significantly deviate from this over-simplified form of horse depictions at Las Monedas: depictions 20 and 34. Depiction 20, in particular, has been compared to other horse depictions in Magdalenian art, sharing features of m-shaped pelage, a distinct mane, and facial details (Ripollo Perello 1980, 27; Ochoa 2017).

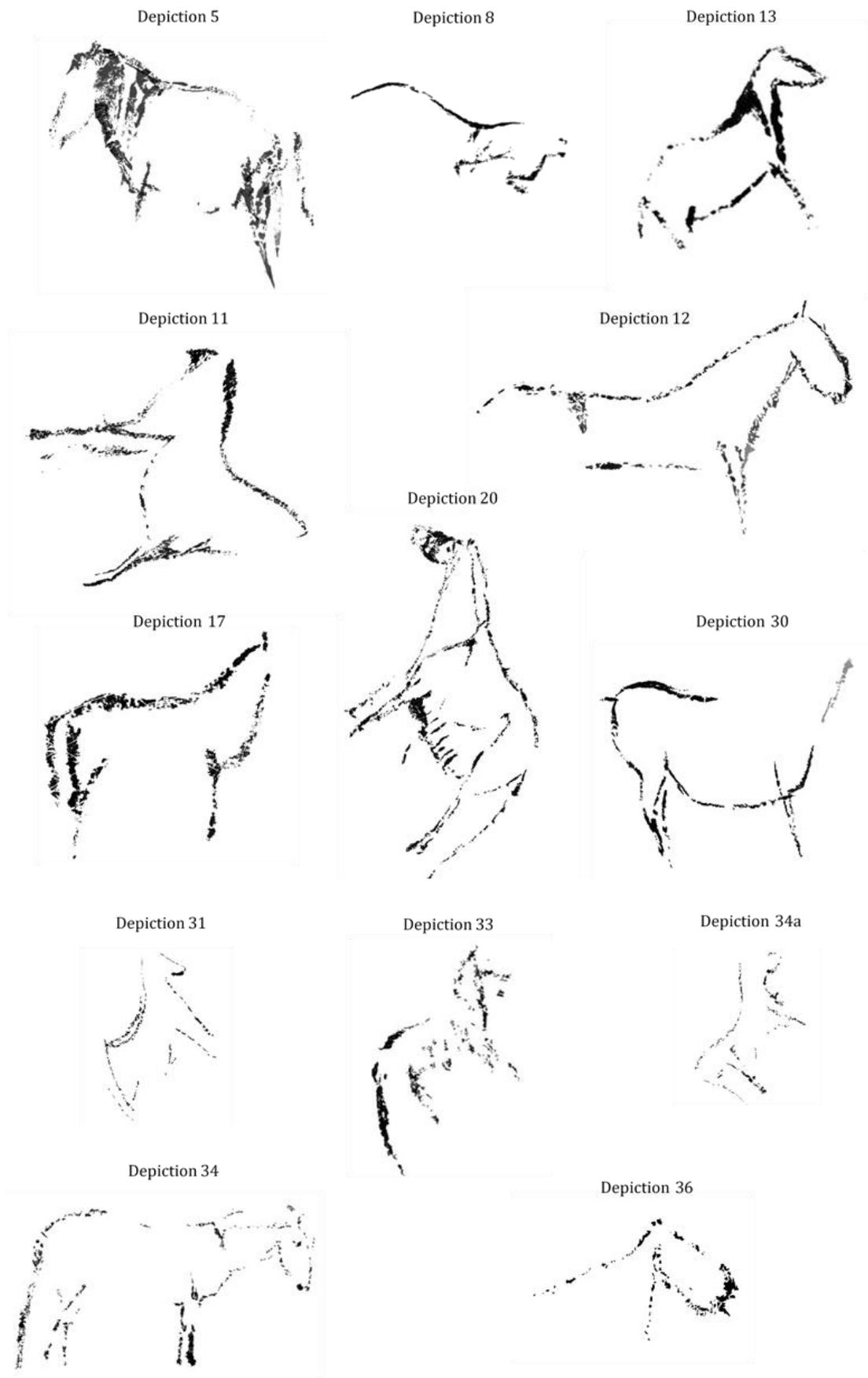


Figure 6.7. Digital tracings of horse depictions within Las Monedas. Image: Author.

Table 6.4. Stylistic features of horse depictions in Las Monedas. \* Indicates stylistic trait is shared by over 50% of the depictions. (?) after depiction number indicates the feature is difficult to identify, due to poor preservation.

Trait	Depiction no.
Long tail that continues dorsal line*	6, 10, 13, 17, 20, 22, 33, 34
Short, triangular tail	11, 30
Y-shaped rear leg*	6, 10, 11, 13, 17, 20, 30, 33
M-shaped ventral line	6, 11, 13, 20, 30, 31
Concave ventral line	10
Flat ventral line	12, 33, 34
Vertical stripes on ventral line	20, 33
M-shaped dorsal line	11, 30, 31, 33, 34a
Flat dorsal line*	6, 8, 10, 12, 13, 17, 20, 22, 34
M-shaped pelage	20
Dorsal stripe	12, 13
Partial infill	6, 13
Y-shaped front leg	10 (?), 11, 12, 20, 31, 33 (?)
Straight front leg	6, 13, 17, 30
Distinct mane	20, 34
No distinct mane*	6, 8, 10, 11, 12, 13, 17, 22, 33, 34, 34a, 36
Globular head	8, 12, 34a, 36
Triangular head	6, 10, 13, 31, 33
No head	11, 17, 22, 30
Facial features (e.g. eye, nostril, pelage)	20, 34

The simplifying of horse forms at Las Monedas implies a sense of immediacy to the art, with these depictions completed in a few strokes that capture the key features of a horse. The lack of detail further suggests that the final form was not of primary importance; rather, it may have been the process of drawing out the horse form from suggestive features in the cave wall that took precedence. Within this basic form there is a breadth of variation which may be the consequence of a subconscious interaction between the cave wall morphology, visual and perceptual responses to features of the cave wall. For example, heads may be depicted as a globular or triangular shaped, or not depicted at all, the ventral and dorsal lines may be flattened or curved, and there may occasionally be an application of pigment to partially infill features of the horse (Table 6.4). There appears to be no discernible pattern to the shared characteristics of these depictions in Las Monedas, which might indicate specific styles in representing horses. For example, two horse depictions may both have a globular shaped head, but one may be a complete depiction and the other may only partially represent the cervico-dorsal features of the horse. This implies the variation in basic

features of horses in Las Monedas is not merely the product of different artists and/or artistic styles, but rather a more nuanced interplay between the specific morphology of the cave wall and the artist's reception and interaction with these natural features.

Ibex depictions are the second most common at Las Monedas, and similarly show some variation in their stylistic features. Ibexes are a common theme in Magdalenian parietal and portable art in northern Spain, and often conform to a similar style, with a basic outline detailing long curved horns, a triangular shaped head, and narrow body (Table 6.5). In this respect, the ibexes at Las Monedas are stylistically similar to those found in other parietal art sites. However, there are distinct departures from this form in the few ibex depictions (n = 5) at Las Monedas (Figure 6.8). Depictions 7 and 15, for example, appear to have exaggerated narrow, long bodies that are out of proportion with the rest of the depiction, with a disproportionate and oversized y-shaped front leg. By contrast, depictions 16 and 29 are much better proportioned and consistent with depictions observed within Magdalenian portable and parietal art elsewhere.

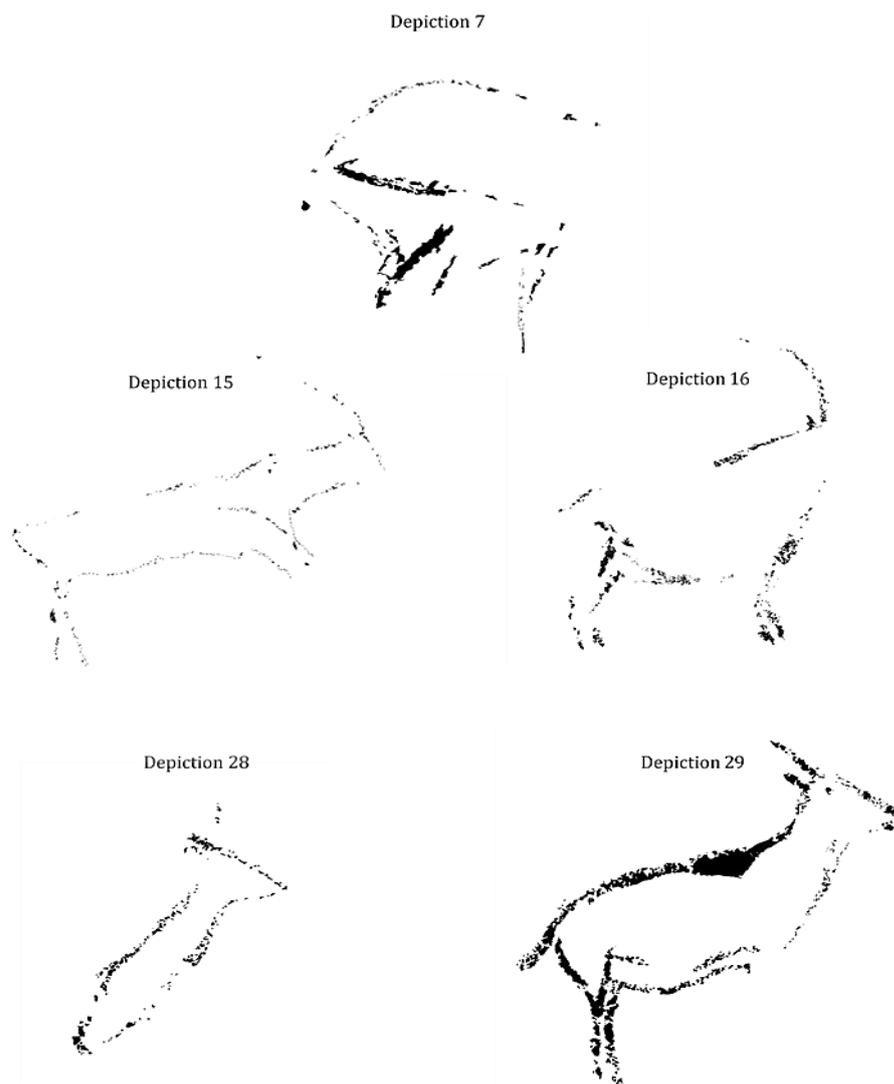


Figure 6.8. Digital tracings of ibex depictions in Las Monedas. Image: Author.

Table 6.5. Stylistic features of ibex depictions at Las Monedas. \* indicates where a stylistic trait is shared by more than 50% of the depictions.

Trait	Depiction no.
Long curved horns extending back	7, 15
Short, curved horns extending upwards	16, 29
Short line representing ear behind horns*	7, 15, 16, 28, 29
Triangular head*	7, 15, 28, 29
Facial features	7, 29
Y-shaped rear leg*	15, 16, 29
Y-shaped front leg	7, 15, 16
Tail represented by short line angling down	16, 29
Tail represented by short triangle	7, 15
Pelage depicted	16, 29

The exaggeration of different features of the animal may be accidental; in the case of depictions 15 and 28, there are more detailed and better proportioned depictions close by, which may indicate someone redrawing the ibex again. This is not intended to disregard depictions 15 and 28, but instead draw attention to the possibility the form of these depictions may be the unintended consequence of an initial interaction between the artist and the cave wall. This encourages a deeper consideration of these disproportioned depictions, to evaluate whether visual and perceptual effects may have contributed to this unusual form. It is intriguing to note too, that despite the detail and well-proportioned features of depiction 16, it has been depicted without a head. Headless ibexes appear to not be represented within any other Magdalenian portable or parietal art in northern Spain. In fact, a common theme within Cantabria during the late Upper Palaeolithic appears to have been frontal-facing ibex heads (Rivero *et al.* 2014); a theme that could not be more different to the ibex depictions at Las Monedas.

Cervid depictions are the third most common in Las Monedas. Four of these depictions appear to represent reindeer, whilst one depiction (depiction 25) is a little more ambiguous. There is a distinct variation in style of these depictions, with two (depictions 2 and 3) reflecting a similar detailed style of depicting an m-shaped pelage but this distinctive feature being absent in the other cervid depictions. Similarly, there is variation in the representing different anatomical elements from the shape of the head, to representing facial features, and the form of the legs (Table 6.6).

Table 6.6. Stylistic features of cervid depictions at Las Monedas. \* indicates where a stylistic trait is shared by more than 50% of the depictions.

Trait	Depiction no.
Antlers depicted as branching front and back from head*	2, 3, 14, 21
Short line behind antler representing ear*	2, 3, 14, 21, 25
Triangular head	25
Rounded head	2, 14, 21
No head	3
Facial features (e.g. eye, nostril)	2, 14, 21, 25
Vertical lines representing ruff at base of neck	14, 21
Straight front leg(s)	14, 21
Y-shaped front leg(s)	2, 3
Y-shaped rear leg(s)*	2, 3, 14, 21
Short vertical tail	3, 14, 21
Pelage depicted	2, 3

The high presence of reindeer depictions at Las Monedas is unusual for the Magdalenian of northern Spain: red deer depictions are more common (Straus 2005). However, this likely reflects the colder conditions of the Older Dryas. Whilst the micro-climatic and ecological conditions of this period in northern Spain, with relatively higher humidity and dispersed woodlands, would have been more conducive for the presence of red deer, the Older Dryas likely saw a brief return to cold, arid glacial conditions. Consequently, it is possible that this resulted in a decline of red deer species as areas of dispersed woodland reduced and temperatures plummeted, and a gradual increase of reindeer that perhaps migrated over from external areas that were cooler and more arid than north Spain, such as south-west France. The representation of reindeer at Las Monedas is intriguing, despite this climatic explanation for their presence in northern Spain. There are stylistic features between the reindeer depictions at Las Monedas and those further afield, such as in the parietal and portable art in south-west France (Figure 6.9). This may reflect the trend of increasing social networks in the Magdalenian, with greater transmission of cultural behaviours and styles across Europe.

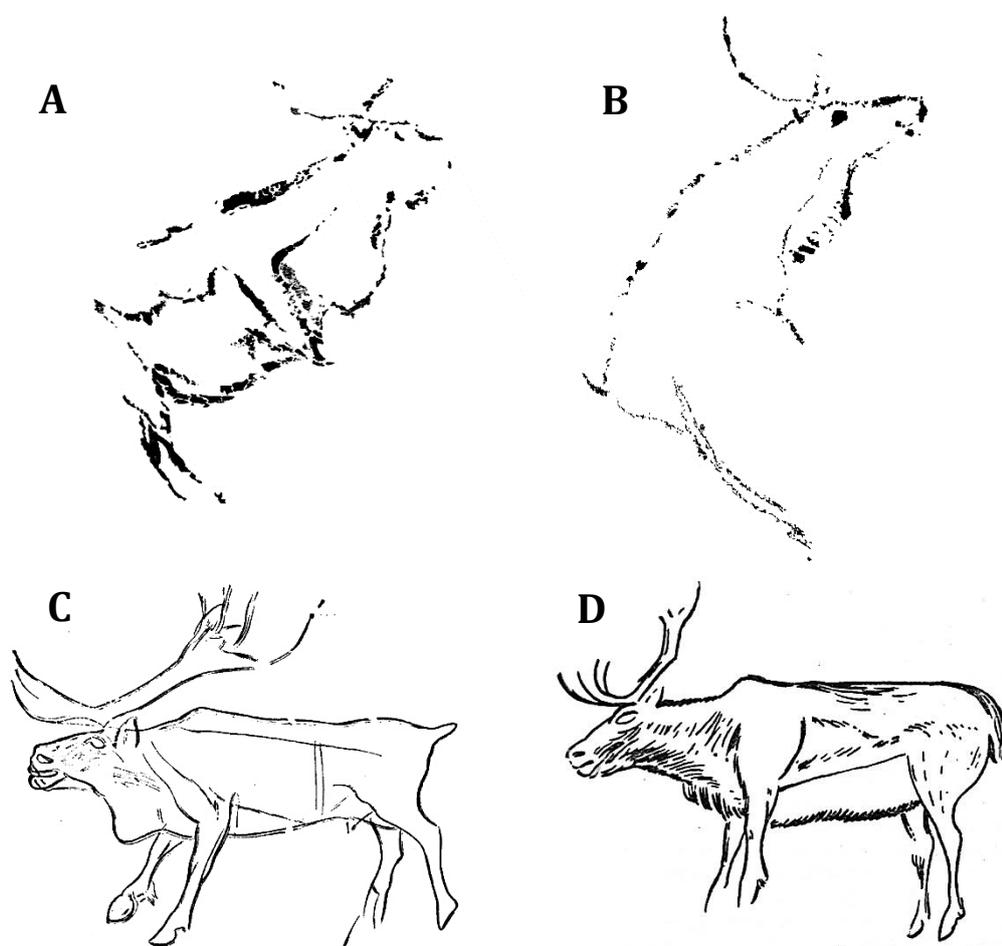


Figure 6.9. Depictions A) 2 and B) 21 compared to reindeer depictions from sites in south-west France C) Limeuil and D) Les Combarelles. Images A and B: Author. Images C and D after: Ripoll Perello 1980, 37.

The bison depiction (depiction 5) is unusual by virtue of its isolated nature; bison are numerous in the contemporary figurative art of the nearby sites El Castillo and La Pasiega. Its form is simplistic, and evocative of the horse depiction (depiction 6) next to it by virtue of the use of partial infill and simplistic fluid lines to complete the form. The simplicity places it in stark contrast to prominent examples of bison depictions from northern Spain; most notably, bison that date to the early-mid Magdalenian from Altamira and El Castillo are far more detailed, utilising several different pigment colours to infill the depiction. However, despite the highly naturalistic style of Magdalenian depictions of bison in this region, similar examples to depiction 5 can be observed. At El Castillo, a highly stylised large bison representation that has been stylistically attributed to the Magdalenian (Clottes 2013), represents a similar style to depiction 5 due to similarities between the abstractly represented head and static position of the bison. A poorly preserved bison depiction at Ekain also appears to share a similar abstract style to the bison depiction at Las Monedas (Figure 6.10).

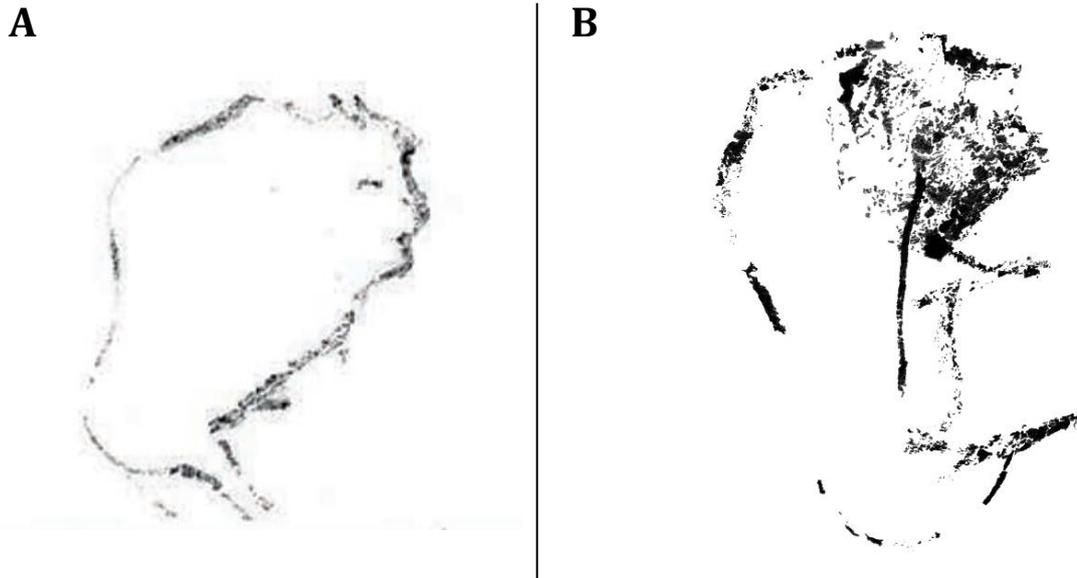


Figure 6.10. Bison depiction from (A) Ekain compared to (B) depiction 5 from Las Monedas. (A) after Ochoa et al. 2019, 69.

By contrast, the isolated nature of the bear depiction (depiction 25) is less surprising. Bears are rarely represented in parietal art in northern Spain and when they are represented, often appear in isolation, with a notable exception of the bear and cub depictions from Ekain. Ripoll Perello (1980, 31) attributes this depiction to *Ursus spelaeus* (cave bear) based on interpreting the features of the head as representing anatomical features of a cave bear skull. The depiction of a cave bear would question the late Magdalenian AMS radiocarbon date obtained for the Las Monedas depictions; cave bears were extinct by approximately 23,000 B.P. and consequently are unlikely to feature in Magdalenian art (Pettitt and Bahn 2015, 550). However, it is clear that the simplicity and incomplete nature of this depiction makes the attribution of a specific species to this depiction dubious, and certainly is not enough alone to revise the dates offered by the AMS radiocarbon dating for the art of Las Monedas.

This analysis identified features that appear to be intentional stylistic choices that perhaps might conform to a cultural norm and help to clarify details of the animal, such as depicting pelage or facial features. These features may help to identify where a person has spent a longer length of time depicting an animal and therefore indicates a scenario where the depiction is relatively brightly lit and held within the focus of the visual system for a prolonged period. However, more general stylistic changes to the overall form of the animal depiction or the decision not to depict certain key features of an animal (e.g. the head) may be shaped by a specific material and psychological interaction with the cave wall. The form of the animal outline is likely to be more susceptible to unconscious decisions that occur based on visual cognitive responses. In these cases, particularly when the depiction is

simple in form, it may indicate a depiction produced relatively quickly under limited lighting conditions. It is interesting to note the absence of heads in a number of the depictions at Las Monedas which occurs across different species. This contrasts with previous arguments that the cervico-dorsal line was the most salient feature of an animal, and thus the most likely feature to be represented in parietal cave art (Hodgson 2003; Meyering *et al.* 2021).

## 6.5. Results and Discussion

The preliminary analysis underlined key attributes of the art in Las Monedas: the prominence of direct relationships between the natural features of the cave wall and the depictions; and the intriguing stylistic features of certain depictions, which appear to deviate from the cultural norm of mid to late Magdalenian art in Cantabria. High resolution digital imaging and modelling techniques were employed to better understand aspects of the cave art's biography, particularly the potential psychological phenomena that may have influenced the art making. These pertain to the psychological responses outlined in Chapter 4, namely: hyper-images; pareidolia; construal level effect; and the perceptual effects of a warm, low lumen light source within a dark environment. The following section will discuss different stages of the process of making art in Las Monedas, drawing out notable examples which capture the variety and different dialogical relationships that occurred as the artist(s) produced each depiction. 3D photogrammetry models were successfully generated for the majority of figurative depictions in Las Monedas, which were placed within a VR lighting simulation<sup>5</sup>. These simulations aimed to determine how light cast from a low lumen light source interacted with the cave wall morphology. Relative Luminescence Values (RLV) were used to calculate the relative differences in brightness between different sections of the cave wall. Although RLV are not comparable to real-world lighting values, they provided the opportunity to ground discussions of the visual and perceptual responses within the real-time effects of a dynamic light source interacting with the natural features of the cave wall.

### 6.5.1. Stage 1: Before entering the cave

The first stage in the making of the art at Las Monedas happens before the artist(s) entered the cave, and concerns the particular social and cultural milieu which would have influenced both how individuals layered meaning onto cultural actions, but also the way their visual system may have interpreted ambiguous visual stimuli. Chapter 5 outlines how during the ameliorating climate of the Magdalenian period, populations were expanding out of the Franco-Cantabrian refugia (Schwendler 2012, 333) and there appears to have been an increase in species adapted to milder, humid environments with cold-adapted species in

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<sup>5</sup> The lighting conditions for a small number of depictions (depictions 10, 17, 18, and 22) were not simulated in VR due to limited available photographs, which resulted in inaccuracies in the photogrammetry models. See appendix 2 for all relative luminance values.

decline (Straus 1996, 92; Straus 2013, 250). However, AMS radiocarbon dates suggest the art of Las Monedas corresponds to the Older Dryas (Garcia-Diez 2021); a period that punctuated the gradual warming of the Bolling-Allerod interstadial, creating a brief return to cooler, more glacial conditions. As discussed in the stylistic analysis, the presence of cold-adapted species in the art of Las Monedas, such as reindeer, likely reflects these climatic conditions; these species disappeared from the Franco-Cantabrian region after the Older Dryas (Straus 1996, 92; Straus 2013, 250).

The artist(s) of Las Monedas likely had visual familiarity with certain species that occupied the Cantabrian landscape, with the change in climatic conditions perhaps necessitating a relatively rapid adjustment of generational knowledge of particular species – societies would have had to gradually “relearn” the behaviours and characteristics of colder-adapted species as climatic conditions deteriorated over millennia. Whilst the shift in climatic conditions was unlikely to be recognised within one generation, the knowledge systems of Upper Palaeolithic groups would have needed to gradually respond to this change. As with contemporary hunter-gatherer societies (Bird-David 1999, 74; Reyes-Garcia *et al.* 2020), Upper Palaeolithic people were likely highly attuned to their local ecological conditions, allowing them to detect subtle environmental changes and in turn adjust their knowledge to respond to these changes. This may have encouraged the restructuring of particular animal-human relationships for the artist(s) of Las Monedas, perhaps manifesting as developing visual expertise and familiarity with the cold-adapted species that they were becoming increasingly dependent on. Species suited to the open habitats and cold glacial conditions such as horses (Sandoval-Castellanos *et al.* 2017, 1816), would have remained stable or even increased in population during the cold turn of the Older Dryas, particularly as the population decline of horses towards the end of the Pleistocene is unlikely to have yet taken hold (Kaagan 2000, 70; Leonardi *et al.* 2018). This stability may have increased their importance to Magdalenian societies during the Older Dryas, that would have likely benefitted from generational knowledge to track, hunt, and exploit materials from horses. However, for other species, the conditions of the Older Dryas likely resulted in their disappearance (e.g. red deer, aurochs) or a change in animal behaviours. For example, and as discussed in Chapter 5, ibex in warm conditions often prefer higher altitudes as a natural defence against predators, but the colder conditions of the Older Dryas may have constrained this species to lower altitude. As a consequence, they may have become a more opportune species for Upper Palaeolithic people to hunt as ibex are easier to track and ambush in less mountainous terrains (Straus 1987). It is likely, therefore, that the Upper Palaeolithic artist(s) of Las Monedas had formed, or rapidly developed, visual expertise in recognising these key species.

The nature of the art at Las Monedas additionally gives some indication into the preparation of the artist(s) before they entered the cave. The art making within this cave is situated within a rich culture of art production, and as identified in the stylistic analysis, many facets of the art allude to this. Shared stylistic features between the depictions at Las Monedas and art elsewhere in the Franco-Cantabrian region reflects a deep knowledge of the appropriate techniques and styles to represent animal characteristics. The breadth of artistic expression throughout the Magdalenian period indicates this behaviour was practiced frequently and likely by all members of the social group: the art at Las Monedas was no isolated affair. The preparation of materials, both pigments and suitable lamps, further suggests the making of art within this cave was intentional and likely integrated within broader artistic practices. Whilst charcoal seems to have been used in a raw form (i.e. not ground to produce a powder or mixed with other materials to produce a paint) and may have been produced as a bi-product from other activities, the lack of hearths within Las Monedas suggest charcoal was intentionally transported to the site from elsewhere for the intention of creating art. Similarly, whilst stone lamps have not been recovered from Las Monedas, the placement of the art deep within the cave – beyond the reach of daylight – would have necessitated the preparation of some form of lighting technology, likely in the form of hand-held torches produced from wood, animal fat, and perhaps other organics (e.g. mushrooms) (Medina-Alcaide *et al.* 2021).

This stage of the cave art's biography, therefore, would have primed the artist(s) before entering the cave, influencing the particular visual and perceptual response they had to unfamiliar stimuli within the cave. The artist(s) at Las Monedas likely had visual familiarity and expertise in certain animals that occupied the immediate landscape of Cantabria (e.g. horse, red deer, ibex) which would have been observed and potentially interacted with as part of daily habitual activities. The degree of preparation of materials for pigment and lighting suggests the decision to venture into the cave to depict animals was premeditated, and perhaps reflects a degree of expectation regarding the tangible effect of cave environments on visual perception.

### *6.5.2. Stage 2: Visual and perceptual response*

Once entering the cave, the artist(s) would have encountered unusual calcite formations under the dynamic, low light source cast from their torch or lamp and, by virtue of the degree of preparation before entering, perhaps expected this encounter. The ambiguous nature of the visual stimuli perceived within this environment may have been an attractive motivation to enter the cave, layered with a broader cultural understanding associated to art mediating relationships with animals. Within the VR lighting simulations, it was apparent that the visual effects of the light were highly dependent on the

morphological features of the cave wall, with undulations, fissures, concavities and convexities all affecting how the light reflected and dispersed across the surface. Light and the cave wall commingled, causing visually confusing stimuli and teasing at the artist(s) perception, with the continuously shifting light and unusual formations resulting in visual stimuli appearing certain in one instance, but disappearing into darkness in the next. This would have caused a spectrum of visual and perceptual phenomena, with each unique response and its reception by the artist(s) informing the making of the art in different ways.

The RLV results from the lighting simulations (Table 6.7) appear to reflect a loose relationship between direct relationships to the cave wall and a low average RLV, which may reflect the form and placement of depictions being influenced by construal level effects and visual imagery. 47% (n=7, out of 15) of depictions that were simplistic in style and had a direct relationship to the cave wall received lower-than-average RLV (RLV average across all depictions simulated = 8.4%), compared to 0% (n=0, out of 5) of depictions which were detailed with a limited relationship, 60% (n=3, out of 5) of detailed depictions with a direct relationship, and 33% (n=1, out of 3) of simplistic depictions with a limited relationship. By contrast, the relationship between simple/direct depictions and high variation in RLV appears to be less distinct, with 33% (n=5) of simplistic depictions with a direct relationship to the cave wall had a higher-than-average variation in RLV (RLV average variation across all depictions = 14.9%), which is lower than the 80% (n=4) of depictions which were detailed with a limited relationship, 0% of detailed depictions with a direct relationship, and 67% (n=2) of simplistic depictions with a limited relationship. This therefore appears to support the hypothesis that low RLV may have triggered pareidolic or hyper-imagery responses, with the depictions subsequently scaffolded on natural features, and encouraged a higher construal level, where depictions are less detailed and represented in a more simplified, abstract way. However, fluctuating RLV does not always appear to be indicative of these psychological responses.

Table 6.7. Summary of the RLV results from the VR lighting simulations.

Depiction number	Style	Relationship to cave wall	Light position	Point 1: Bright	Point 2: Bright	Point 3: Bright	Point 4: Bright	Point 5: Bright	Point 1: Dim	Point 2: Dim	Point 3: Dim	Point 4: Dim	Point 5: Dim	Average RLV	RLV max. variation
2	Detailed outline with internal anatomical details	Limited/ none	Left	15.4%	16.4%	12.9%	8.8%	6.1%	9.4%	9.6%	7.1%	4.0%	2.8%	9.3%	13.6%
3	Detailed outline with internal anatomical details	Limited/ none	Left	23.8%	19.6%	12.5%	5.5%	1.7%	14.3%	9.4%	4.9%	1.5%	0.7%	9.4%	23.1%
5	Simple outline with partial infill	Direct	Left	29.9%	27.7%	19.6%	8.0%	4.3%	18.1%	18.3%	10.3%	2.1%	0.6%	13.9%	29.3%
6	Simple outline with partial infill	Direct	Left	23.2%	7.5%	8.3%	3.9%	1.9%	12.7%	1.8%	4.8%	2.0%	0.5%	6.6%	22.7%
7 + 8	Simple outline	Direct	Left	18.2%	12.7%	12.6%	8.0%	5.0%	12.1%	8.6%	7.9%	5.0%	2.4%	9.3%	15.8%
11	Simple outline	Parallel?	Left	18.5%	23.0%	15.5%	10.8%	9.3%	10.7%	13.2%	7.6%	5.6%	4.0%	11.8%	14.5%
11	Simple outline	Parallel?	Right	10.5%	14.7%	16.4%	17.0%	15.0%	4.3%	7.8%	9.5%	10.4%	8.2%	11.4%	12.7%
12	Simple outline	Direct	Left	8.1%	2.3%	4.6%	4.1%	3.1%	3.3%	0.9%	1.1%	1.2%	1.2%	3%	7.2%
13	Simple outline with partial infill	Mimic	Left	8.8%	14.1%	17.2%	12.3%	10.5%	3.4%	7.3%	7.2%	6.0%	4.0%	9.1%	13.8%
14	Detailed outline	None	Left	19.2%	18.4%	15.5%	7.7%	3.0%	10.6%	10.0%	5.3%	0.9%	0.7%	9.1%	18.5%

<b>14</b>	Detailed outline	None	Right	5.8%	6.6%	10.3%	12.9%	15.8%	2.1%	2.8%	4.6%	9.2%	9.1%	7.9%	13.7%
<b>15</b>	Simple outline	None	Left	22.1%	18.5%	12.9%	8.1%	6.3%	13.7%	9.8%	3.4%	3.9%	2.1%	10.1%	20.0%
<b>16</b>	Simple outline	None	Left	13.0%	11.8%	12.9%	8.2%	9.7%	7.6%	6%	7.5%	4.2%	6.2%	8.7%	8.8%
<b>20</b>	Detailed outline with internal anatomical details	Parallel?	Left	2.0%	5.2%	8.8%	4.4%	1.1%	0.6%	2.7%	5.0%	0.7%	0.2%	3.1%	8.6%
<b>21</b>	Detailed outline	Direct	Left	4.4%	8.3%	11.5%	9.8%	4.6%	1.0%	4.8%	5.0%	4.1%	0.9%	5.4%	10.6%
<b>21</b>	Detailed outline	Direct	Right	4.8%	10.3%	10.8%	10.2%	5.1%	1.7%	7.4%	7.5%	5.1%	1.8%	6.5%	9.1%
<b>25</b>	Simple outline	Direct?	Left	13.5%	10.1%	13.4%	8.8%	4.2%	8.8%	6.6%	5.3%	4.8%	1.9%	7.7%	11.6%
<b>26</b>	Detailed outline	None	Left	27.4%	20.9%	10.6%	9.7%	5.8%	16.5%	12.3%	6.0%	5.1%	2.7%	11.7%	24.7%
<b>26</b>	Detailed outline	None	Right	1.9%	7.2%	7.0%	14.5%	19.7%	0.5%	4.4%	5.2%	9.7%	13.8%	8.4%	14.0%
<b>28 + 29</b>	Simple outline (28) and detailed outline with internal detail (29)	Direct?	Left	2.6%	4.8%	1.3%	0.9%	1.2%	1.1%	2.2%	1.0%	0.8%	1.0%	1.7%	4.0%
<b>28 + 29</b>	Simple outline (28) and detailed outline with internal detail (29)	Direct?	Right	4.1%	4.7%	5.2%	11.3%	7.4%	1.1%	1.7%	3.1%	7.3%	4.3%	5.0%	10.2%

<b>30 + 31</b>	Simple outline	Direct (30), none (31)	Left	11.3%	11.6%	9.4%	7.4%	5.2%	4.7%	6.3%	5.3%	3.6%	2.7%	6.8%	8.9%
<b>33</b>	Simple outline	Parallel	Left	20.6%	23.8%	17.7%	15.9%	15.3%	14.8%	14.7%	10.4%	10.1%	9.1%	15.2%	14.7%
<b>34 -36</b>	Detailed outline (34), simple outline (34a and 36)	Parallel? (34a) and none (34, 36)	Left	29.3%	15.4%	11.7%	8.5%	3.8%	16.4%	5.6%	4.1%	1.0%	0.9%	9.7%	28.4%

The area of cave wall selected for depiction 5, for example, when viewed under a dynamic light cast from a small flame may have triggered a potent and visceral psychological response, indicative of perceiving a hyper-image. The lighting simulation emphasised suggestive features in the cave wall (Figure 6.11), brightly illuminating the edge of the wall used to represent the dorsal line of the bison depiction, and extending shadows over subtle cracks and concavities that suggest a general zoomorphic form. This area forms an edge to the cave wall, which may have further triggered visual effects by limiting the area of illumination and casting everything else in darkness. The several suggestive features of the cave wall morphology emphasised by the lighting, in conjunction with the large disparity in RLV across the wall (ranging between 29.9% to 4.3% at brightest point of flicker; 18.1% to 0.6% at the dimmest<sup>6</sup>) are perhaps conditions conducive to the artist perceiving a hyper-image. The bright illumination of convex sections of this area likely would have prevented the eye from fully adjusting to the lower, near-darkness luminance of the concave areas, causing these poorer illuminated areas to have seemed even more visually ambiguous. The visual preference for brighter areas of the cave wall would further cast psychological uncertainty regarding the visual stimuli within the darker areas, with the visual system mistrusting information from these peripheral areas. Under this low lighting too, the visual hyper-image likely would have held a high construal level within the psychological perception of the artist(s). Rather than perceiving a lifelike and concrete image of a bison, the concept and form of a bison may have seemed psychologically distant and thus, this hyper-image may have been perceived as a form that loosely held bison-like qualities.

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<sup>6</sup> See appendix 2 for all RLV results from the VR lighting simulations.

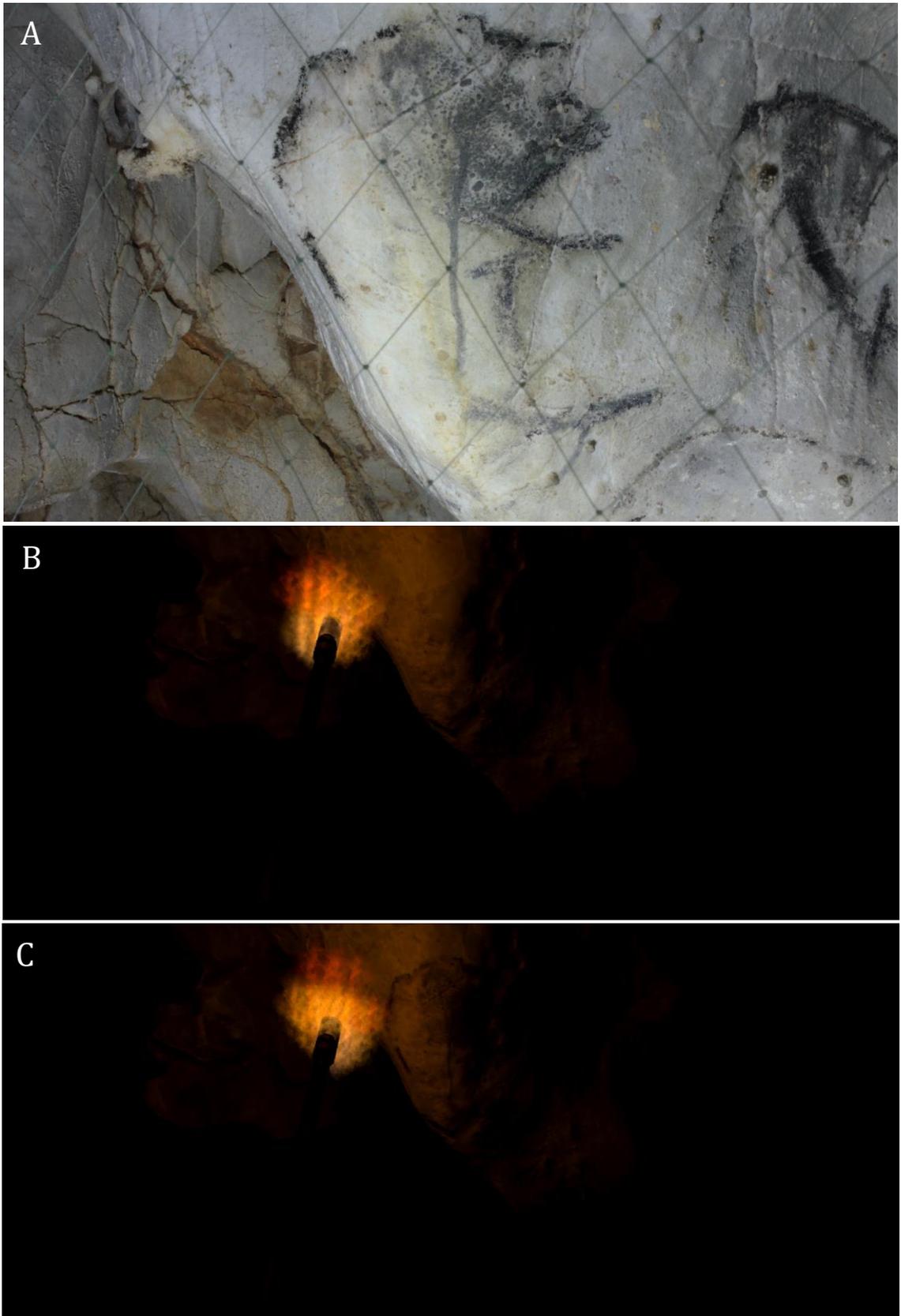


Figure 6.11. Effect of a virtual low lumen light source on the area of cave wall used for depiction 5. A) Image of depiction 5. B) Lighting effect on the blank wall with depiction 5 digitally removed. C) Lighting effects on the cave wall with depiction 5 visible. Image (A): Blanca Ochoa. Images (B and C): Author.

Similar potent psychological phenomena may have also been triggered elsewhere within Las Monedas, characterised by highly suggestive morphological features of the cave wall and disparities in the relative brightness across these features. The section of cave wall used for depiction 30, for example, has a pronounced curvature with concave regions, and the natural darker colouration of the limestone here poorly reflects the light cast from a low lumen light source (Figure 6.12). Consequently, the RLV ranged between just 11.3% and 5.2% at the brightest point of flicker, falling to between 4.7% - 2.7% at the dimmest point of flicker. It is possible, therefore, that sections of the cave wall here would flicker in and out of perception as the luminescence values dropped close to imperceptible darkness. The heightening of construal levels under this low lighting may have increased the likelihood of the ambiguous visual stimuli being interpreted in an abstract, psychologically distanced way. The ambiguity surrounding the visual stimuli under these conditions perhaps encouraged the visual system to make interpretive leaps regarding the origin of the stimuli, triggering a hyper-imagery response. Given the dominance of horse in the landscape and a socio-cultural milieu that may have been orientated towards this species, it is perhaps likely the artist perceived stimuli evocative of a horse, with the visual system conceptually associating the curvature of the rock face under the poor lighting conditions to the general anatomy of a horse.

However, the overt nature of the visual phenomenon experienced in these examples is perhaps an exception within the assemblage of parietal art at Las Monedas. Elsewhere in the cave, the visual perceptual phenomena experienced may have been less potent, but equally interpreted as evocative of certain animals. Depiction 12, for example, was depicted on a section of cave wall approximately 3m from modern ground level, and may have been selected due to the suggestive cracks that appear to have a zoomorphic leg form. The unusual height of this depiction would have necessitated an individual being lifted or sitting on the shoulders of another person to recognise and select this area of cave wall. The low luminosity of their torch and the concave nature of the cave wall here would have resulted in very low RLV, reaching a maximum luminosity of only 8.1% and falling to 0.9%. Under these conditions, visual stimuli would have likely been very difficult to discern, and the suggestive cracks may have triggered a pareidolic response which identified these as taking the form of part of a horse (Figure 6.13). Whilst the low luminosity is conducive to a potent psychological response, the subtle relationship between the depiction and the cave wall here suggests this was not the case. Rather than seeing a visually potent hyper-image that took the form of the depicted animal, it appears the artist may have deliberately sought out or consciously recognised the suggestive nature of the cracks as evocative of a horse's rear leg.

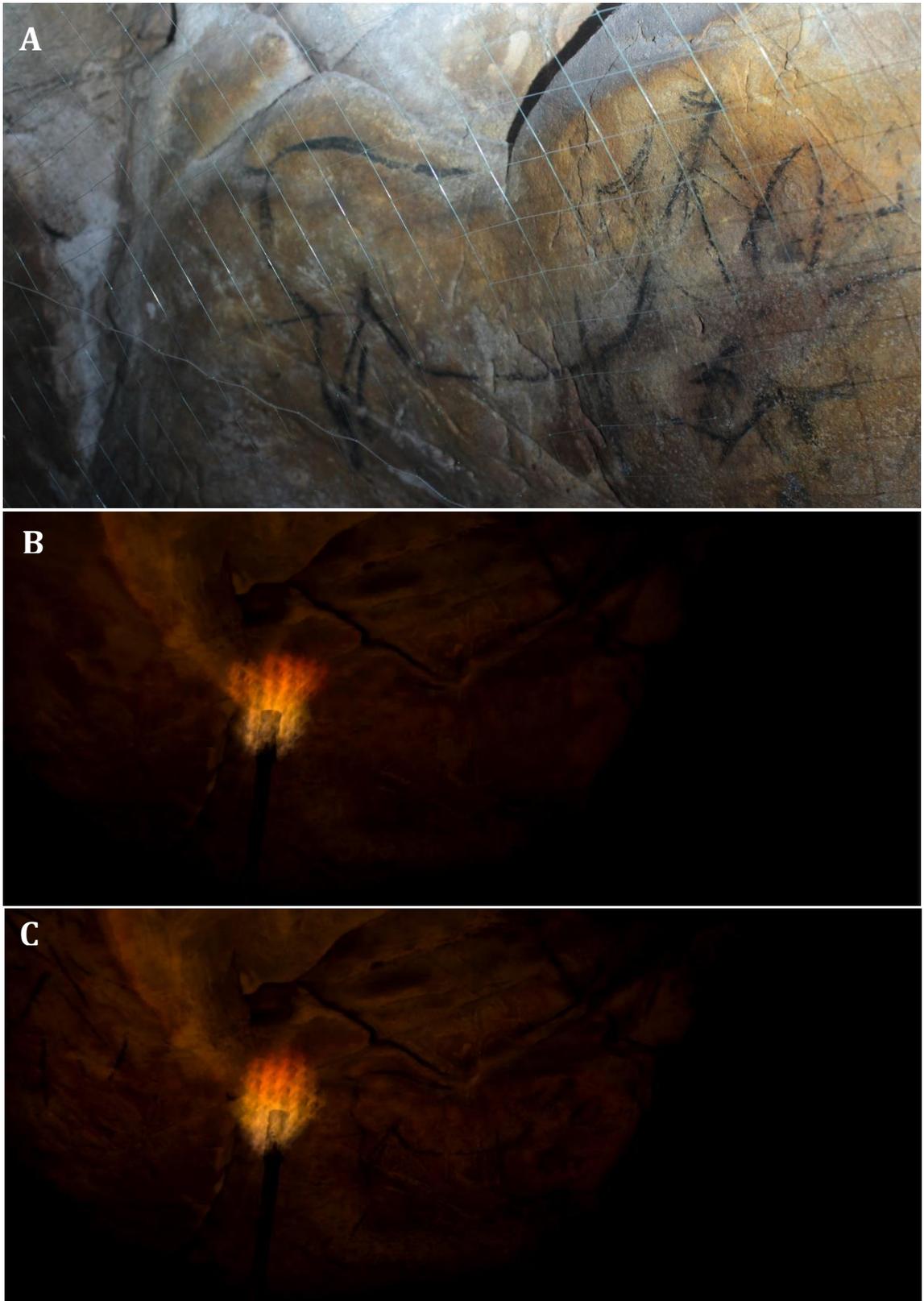
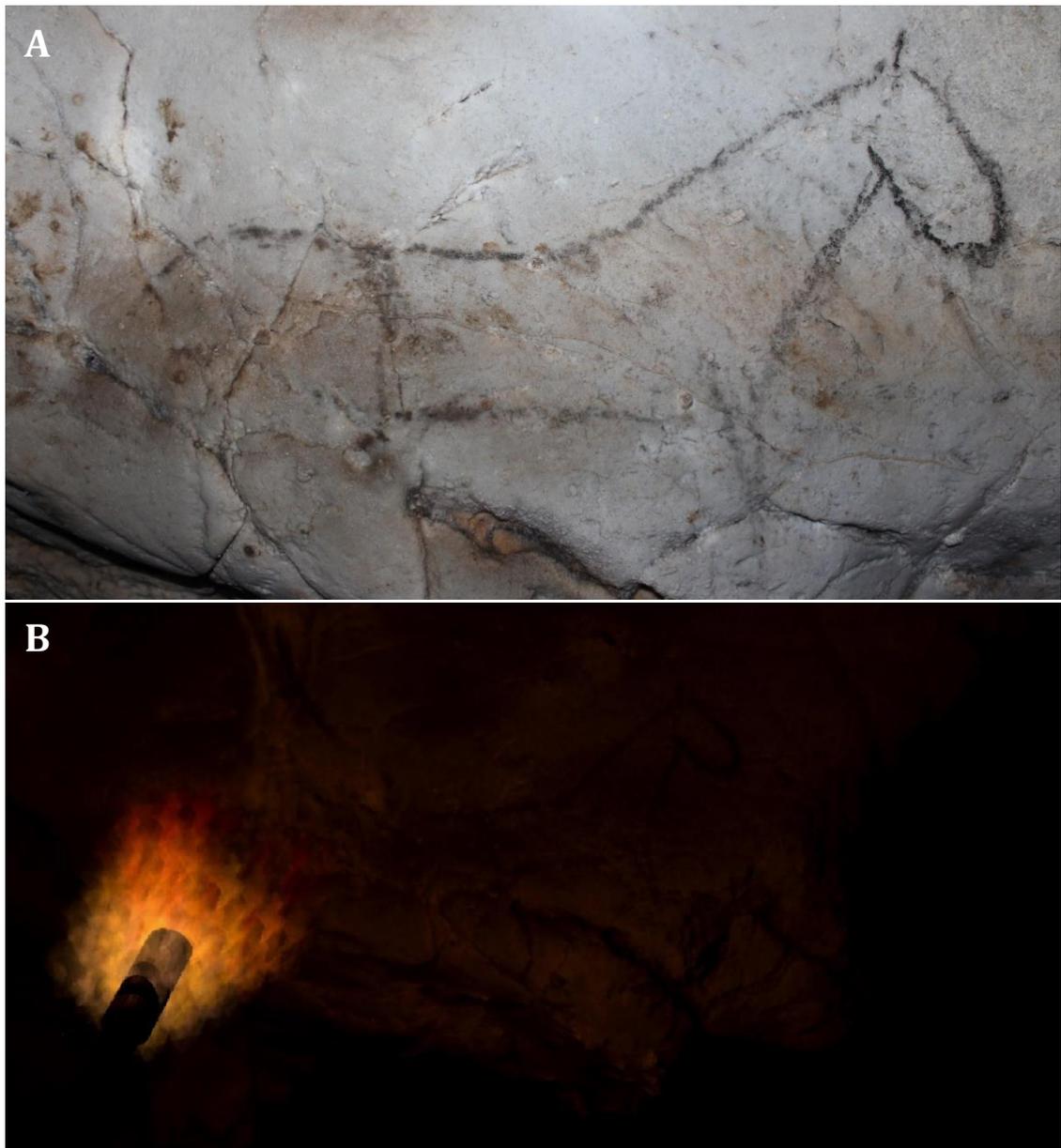


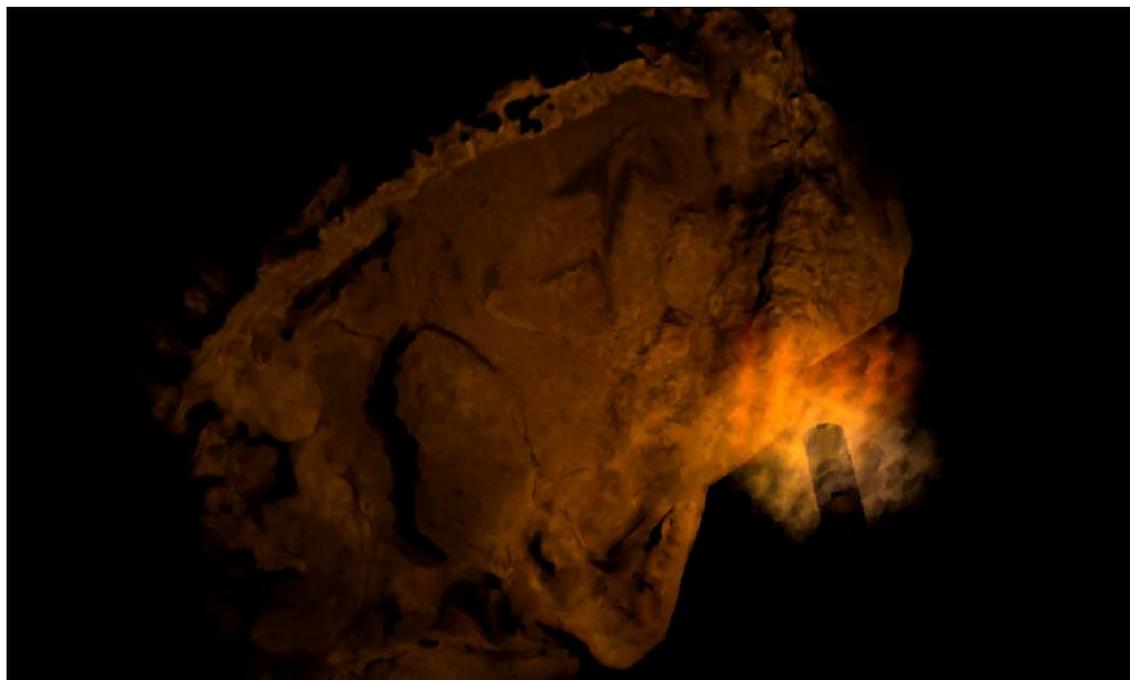
Figure 6.12. Depiction 30 viewed under a low lumen light source in the VR simulation. A) Image of depiction 30. B) Lighting effects on the cave topography, with depiction 30 digitally removed. C) Lighting effects on the cave topography with depiction 30 visible. Image (A): Blanca Ochoa. Images (B and C): Author.



*Figure 6.13. A) Depiction 12 and B) depiction 12 viewed under a low lumen light source within the VR lighting simulation. Natural cracks to the left of this depiction appear to be intentionally incorporated into the form of the horse. Image A: Blanca Ochoa. Image B: Author.*

Low luminosity, however, appears to not be necessary for certain areas of cave wall to trigger a pareidolic response. Depiction 13 is placed on a relatively flat section cave wall that appears hidden from view and is situated approximately 1.8m above modern ground level (Ochoa 2017). Under a low lumen light source, this area of cave wall is well-illuminated (RLV range between 17.2% and 3.4%), and its unique position may have meant this area was deliberately sought out and selected for depiction. However, the light source also casts shadows and emphasises natural features that appear to have been mimicked and incorporated in the form of the horse depiction (Figure 6.14): a suggestive right-angled crack is mimicked in the shape of the ventral line of the horse's neck and head; the dorsal line follows the upper edge of this area of cave wall; and the rear leg follows parallel to a raised convexity. A similar pattern is seen for depiction 33, where the edges of the rock

surface appear to have inspired the depiction of a horse. The rear and dorsal line of the depiction run parallel to the upper edge of the surface, suggesting this may have been recognised as an evocative form that inspired the horse depiction. In each example, suggestive forms may have been recognised by the artist(s) who, primed by their cultural familiarity with horses, had a pareidolic response of seeing these natural features as being evocative of a horse.



*Figure 6.14. Depiction 13 viewed under a low lumen light source within the VR simulation. Note the light source emphasises natural features that appear to have influenced aspects of the form of depiction 13. Image: Author.*

The initial psychological response to visual stimuli within the cave may have also been influenced by conceptual associations between certain cave wall morphologies and animals, likely shaped by particular socio-cultural understandings of these animals. For example, whilst there appears to be no direct use of natural features to represent or influence the particular form or theme of a depiction, depictions 28 and 29 appear to reflect a particular conceptual relationship occurring between diagonal cracks and the depiction of ibex. Depiction 28 appears to reflect a depiction that was abandoned, with only the head and neck represented. The identical style and proximity of depiction 29 suggests this was a re-attempt of depiction 28. For depiction 29, a diagonal crack is intentionally incorporated appearing to replace or represent the front leg of the ibex. A similar crack is observed below depiction 28, and it appears as though this depiction may have been abandoned as it was drawn too far forward to appropriately incorporate this crack. Although the diagonal crack is not particularly salient of any anatomical feature of an ibex, the crack itself may have triggered a conceptual association with the climbing nature of ibex (Figure 6.15); ibex both climb with their body at a diagonal angle, but also tend to select diagonal ledges and faces as they ascend. Darkness encourages creativity and abstract conceptual linkages of this kind

(Steidle *et al.* 2011; Steidle and Werth 2013), and the low RLV for this area of cave wall (11.3% to 1.1% with a light source positioned to the right, 4.8% to 0.8% with a light source to the left) perhaps triggered this psychological response.

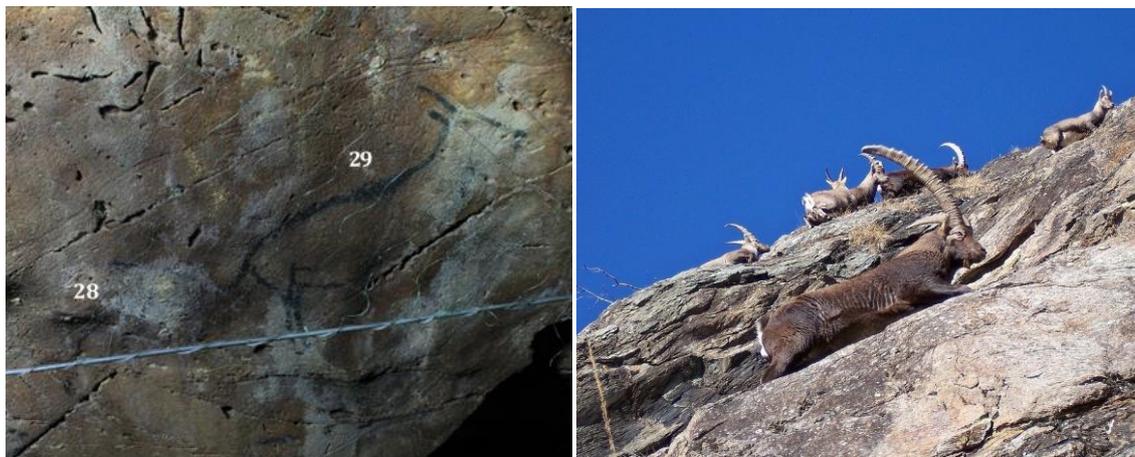


Figure 6.15. Depictions 28 (underlying heavy calcite deposits) and 29, compared to an image of ibexes climbing a rock surface (right). Note the presence of a diagonal crack under each, which may have been conceptually associated to the behaviour of ibex climbing and intentionally selected for to incorporate into the ibex depiction. Image (left) after: Blanca Ochoa. Image (right): Public domain image available at: [pxhere.com/ko/photo/835320](https://pxhere.com/ko/photo/835320)

For certain depictions, it appears the perceptual effects of specific cave wall topographies were recognised and selected for in the depiction of certain animals. Three depictions of reindeer (depictions 2, 3, and 14) appear to intentionally make use of an undulating topography, where the body of the reindeer is placed on a convex area and the shoulders and head are placed on a concave area (Figure 6.16). For all three depictions, a low lumen light source brightly illuminates the convex area, with RLV around 15% – 20%, but casts the concave region close to darkness, with RLV in these areas being around >1% – 3%. If the light source is shifted to illuminate the concave area, the reverse effect occurs with the convex area being cast in darkness. This appears to reflect a particular cultural penchant to make use of this visual effect for depicting reindeer; this pattern is not observed for other depictions in Las Monedas, but has been observed in other Cantabrian sites (Sakamoto *et al.* 2020). The initial visual and perceptual response in these cases appears to not be one that recognised zoomorphic forms. Instead, the perceptual effects of light and the undulating topography commingling appear to have been consciously recognised and selected for the depiction of a particular animal. This pattern extends somewhat for the cervid (likely reindeer) depiction 26; whilst only the head is represented, there is a concave section behind the neck which gives the impression that the cervid head is emerging from the darkness. This alludes to a deeper interaction occurring within this stage of art making in Las Monedas, with the artist(s) being consciously aware and deliberately engaging with the perceptual and visual effects of a low lumen dynamic light source within a cave environment.

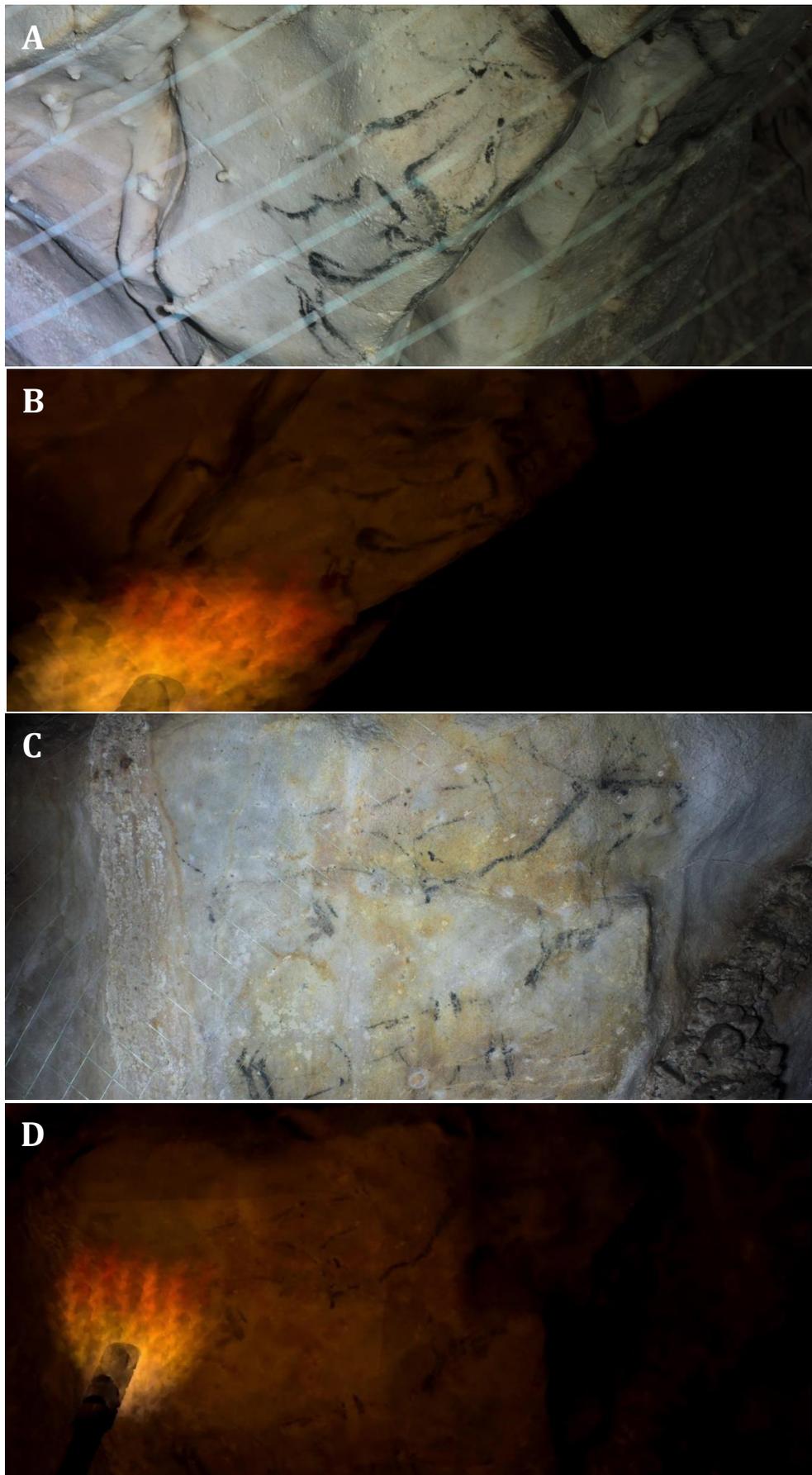


Figure 6.16. A) Image of depiction 2 and B) under the VR lighting simulation. C) Image of depiction 14 and D) viewed within the VR lighting simulation. Note for each depiction, the head appears to be placed on a concave area of the wall, where shadow falls - truncating the depiction. Image (A and C): Blanca Ochoa Images (B and D): Author.

This biographical stage emphasises a spectrum of visual and perceptual psychological responses that appear to be occurring within the making of cave art, from potent hyper-images in a limited number of cases, through to the deliberate play of perceptual effects of undulating topographies. Within this stage, it is clear that the artist(s) were consciously aware of visual perceptual effects caused by low lumen light sources within caves and utilised these effects to influence and add drama to their depictions.

### *6.5.3. Stage 3: Initial material engagement*

Once the artist(s) experienced a visual and perceptual psychological response to the cave wall this may have informed the initial material engagement which concerns the placement, form and orientation of the first line drawn in a depiction. It must be noted that the initial line depicted could not be discerned for all depictions, and aspects of this stage may be speculative. Where overlapping lines cannot clearly indicate the line that may have first been depicted, two assumptions have been made: 1) the cervico-dorsal line preceded the depiction of other lines; and 2) that lines were continued in the same direction, i.e. if a series of lines in the same orientation all indicate a direction left-to-right, it is assumed the leftmost line was depicted first. As with the initial psychological response, there appears to be a breadth of different material engagements that occurred. For a number of depictions in Las Monedas, the initial material engagement superficially appears to correspond to the perceived visual and perceptual phenomena. The first lines that appear to have been drawn for depiction 5, for example, originate from the suggestive contour edge of the rock surface with the line beginning at the end point of the edge. Depiction 8 has a similar pattern, with the dorsal line of the horse originating from a suggestive crack in the cave wall. For depiction 12, the line order and direction suggest the rear was completed first, with these lines originating from the suggestive cracks that appear to represent the rear leg of the horse (Figure 6.18). This type of pattern, where the initial lines drawn in a depiction appear to respond to perceived visual imagery, thus appears to be common for the art at Las Monedas.



Figure 6.18. Digital tracing of depiction 12, with the probable initial lines and their direction highlighted with arrows. The natural cracks evocative of a zoomorphic leg have been traced with a dashed grey line. Image: Author.

However, whilst these depictions certainly represent the initial material engagement being informed by visual and perceptual phenomena, it does not seem to be the case that this action was intending to directly trace or capture a perceived visual image. Instead, the initial material engagement often appears to be first concerned with extending natural forms, before the addition of more salient features of a particular animal. A closer look at depictions 5 and 8 highlights this. The depicted lines in each case appear to initially be drawing out from features of the cave wall, with a break in the line flow before it was then continued to represent the dorsal line of the animal (Figure 6.17). Depictions 30 and 33 exhibit a similar pattern. Whilst line direction was difficult to determine for both depictions, the dorsal line in each appears to intentionally emphasise the natural curvature of the rock, tracing and extending the natural form offered by the cave wall, before these lines were then incorporated to represent a salient feature of the animal (Figure 6.19).

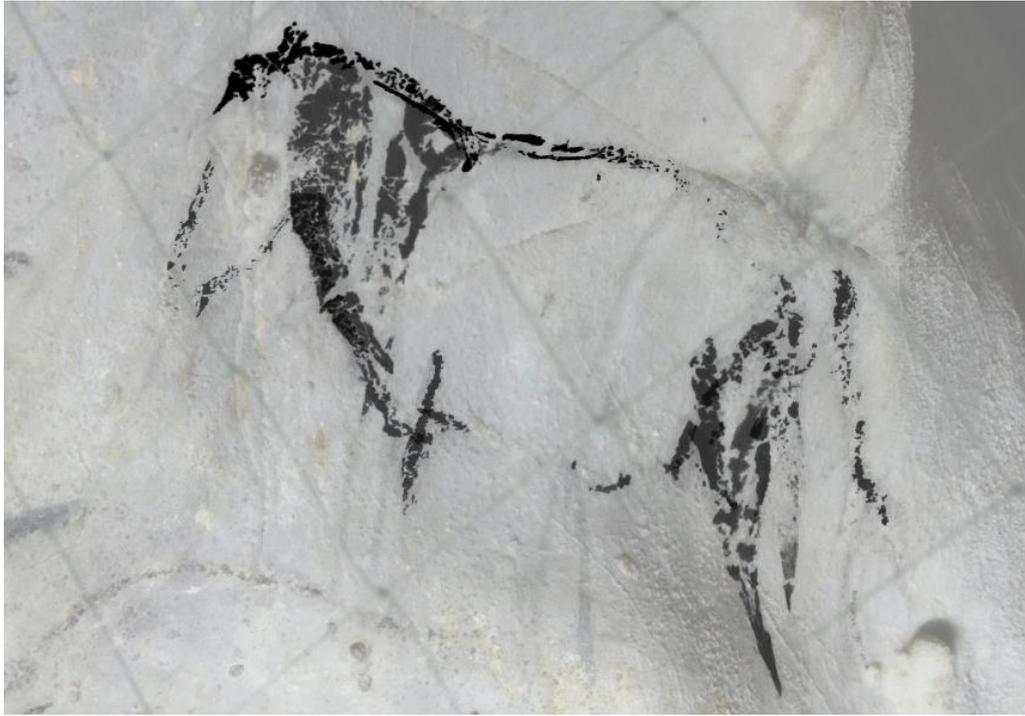


Figure 6.17. Digital tracing of depictions 5 (left) and 8 (right) with the probable initial lines depicted and their direction highlighted by arrows. Images: Author.



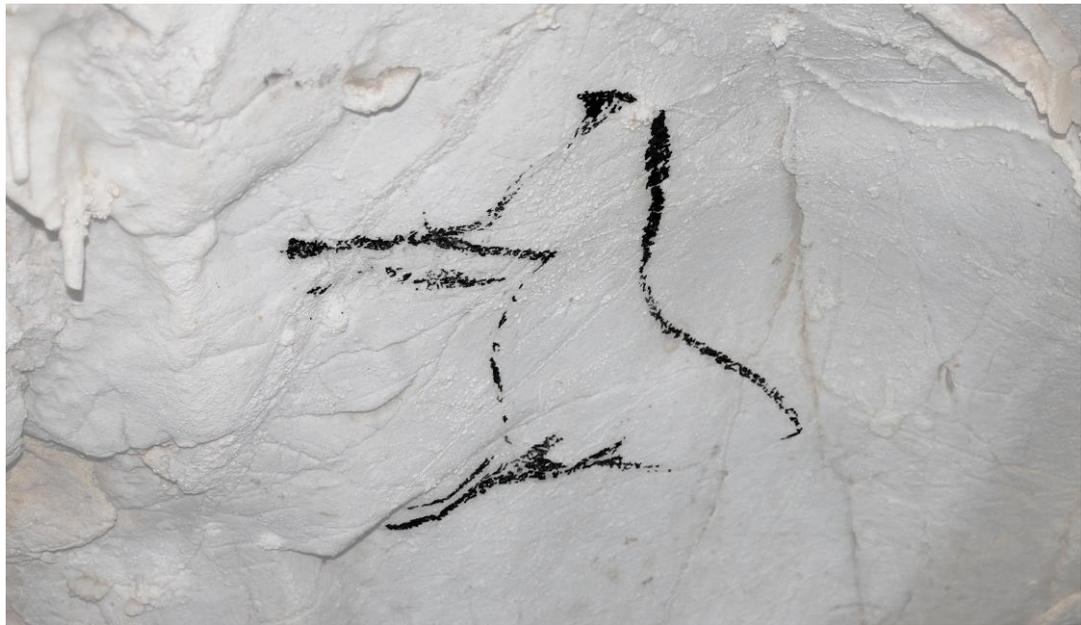
*Figure 6.19. Digital tracings of depiction 30 (left) and depiction 33 (right). The rear dorsal line of both depictions appears to trace and extend the natural curvature of the rock. Image: Author.*

This pattern alludes to a more dialogical relationship occurring between the initial material engagement and the visual and perceptual response triggered by low lighting conditions. Whilst the perceptual response may have been visceral, with the artist(s) perceiving animal forms in the rock, the initial material engagement suggests a more explorative and perhaps playful dimension to the art making. The dialogical aspect of this initial material engagement, and how it may relate to visual perception, is perhaps best characterised in depiction 6 (Figure 6.20). The dorsal line and tail of this horse depiction continues a suggestive crack in the cave wall, with the low light categorically blurring the anthropogenic marks with this natural feature. Whilst one might expect a similar drawing out from natural form as exhibited in depictions 5 and 8, the dorsal line of this depiction appears to have been repeatedly redrawn. The repetitive action of retracing the dorsal line may have been an attempt to clarify the form offered by the natural feature, with a dialogue occurring between the cave wall and the artist's perception. As the line was repeatedly redrawn, it may have gradually been recognised as evocative of a horse's dorsal line, allowing for the rest of the depiction to be completed.



*Figure 6.20. Digital tracing of depiction 6. The dorsal line appears to have been redrawn three times, suggesting a repetitive action that may have helped to clarify ambiguous visual stimuli. Image: Author.*

Whilst the relationship between perceptual effects and the initial material engagement is evocative, it is important to note that in a limited number of cases, the initial material engagement does not clearly correspond to a potential perceptual response to natural features of the cave wall. For depiction 11, the initial material engagement appears to be the depiction of the rear of the horse with the incorporation of a natural crack for the front leg appearing to occur either incidentally, or after the initial material engagement had occurred (Figure 6.21). This is perhaps surprising; one might expect the unusual orientation, placement and style of this depiction would mean this depiction was heavily influenced by psychological phenomena occurring in response to ambiguous visual stimuli. Instead, the placement appears to have been predetermined with the height of this depiction alluding to its making requiring some coordination and pre-planning, with the artist likely being lifted by another individual. It appears, therefore, that whilst the visual system may have influenced the initial lines drawn for a number of depictions, it was not always the sole impetus for depicting animals in Las Monedas. The decision to depict certain forms may have been culturally determined, alluding to the layering of a rich cultural meaning onto this artistic behaviour.



*Figure 6.21. Digital tracing of depiction 11. The front leg appears to correspond to a natural crack in the cave wall, but this may not have been the initial feature drawn. Image: Author.*

When taken together, this biographical stage reveals complexities in the initial stages of making art at Las Monedas, with the psychological phenomena experienced being an influencing, but not the only, factor that determined the initial material engagement. A scenario where the artist(s) experiences visual imagery of a complete animal form and subsequently depicts this form, as proposed by previous neurological and psychological approaches to cave art (e.g. Hodgson 2006; 2008; Hodgson and Pettitt 2018), appears to be unlikely in Las Monedas. Even in cases where the visual and perceptual response to natural features seems to have directly motivated the artist(s) to apply pigment to the cave wall, the relationship between these two stages appears to be more fluid and dialogical than it first appears. The initial material engagement may help to clarify ambiguous stimuli or serve to extend natural features in the cave wall, rather than directly trace a perceived visual image.

#### *6.5.4. Stage 4: Drawing out animal form*

As the artist continued adding pigment to the cave wall, an animal form would have gradually emerged from the rock surface. As established by the previous stage, whilst this form may originate in places from the cave wall, this does not necessarily mean the final form of the depiction was determined from the offset or entirely determined by the cave wall morphology.

In some examples, it appears as though once certain features of an animal were depicted the artist was faced with a decision: either leave the depiction as is; complete the anatomical form; clarify features of the animal further through adding detail; or, and perhaps most intriguingly, re-ambiguate the form of the animal. The majority of depictions (61%) in Las Monedas are incomplete. Not all basic anatomical features are represented with 18% (n=5) missing heads, 14% (n=4) mostly complete but missing limbs, and 25% (n=7) represented by only the head and dorsal line. For these incomplete depictions, particularly those represented without heads, DStretch imaging demonstrates that this was deliberate, rather than a result of poor preservation or calcite deposits obscuring these anatomical features of the animal depiction (Figure 6.22). It appears, therefore, that once certain aspects of the animal form had been adequately captured, the artist(s) deemed it not necessarily to complete the anatomical form of the animal nor embellish it further with the additional of facial features or pelage. Perhaps paradoxically, a number of depictions (e.g. depictions 3, 14, 21) were depicted as anatomically incomplete but were represented with facial features and/or pelage. Additionally, whilst the dorsal line is almost always depicted, suggesting this is a particularly salient feature of depicting animals, the presence of headless depictions perhaps contrasts with the idea that the cervico-dorsal line or *protomos* (head and forequarters) were always the most salient, and thus the features most likely to be represented in Upper Palaeolithic art (Hodgson 2003; Meyering *et al.* 2021). Additionally, the incomplete and often simplified nature of the animal form alludes to potential tensions in the drawing out of animal form. A balance appears to have been negotiated between capturing the form of an animal, but ensuring it still retained elements of the natural features of the cave wall. The depictions were perhaps not intended to be fully animal, therefore, but instead a commingling of animal, pigment, rock, and shadow/light.

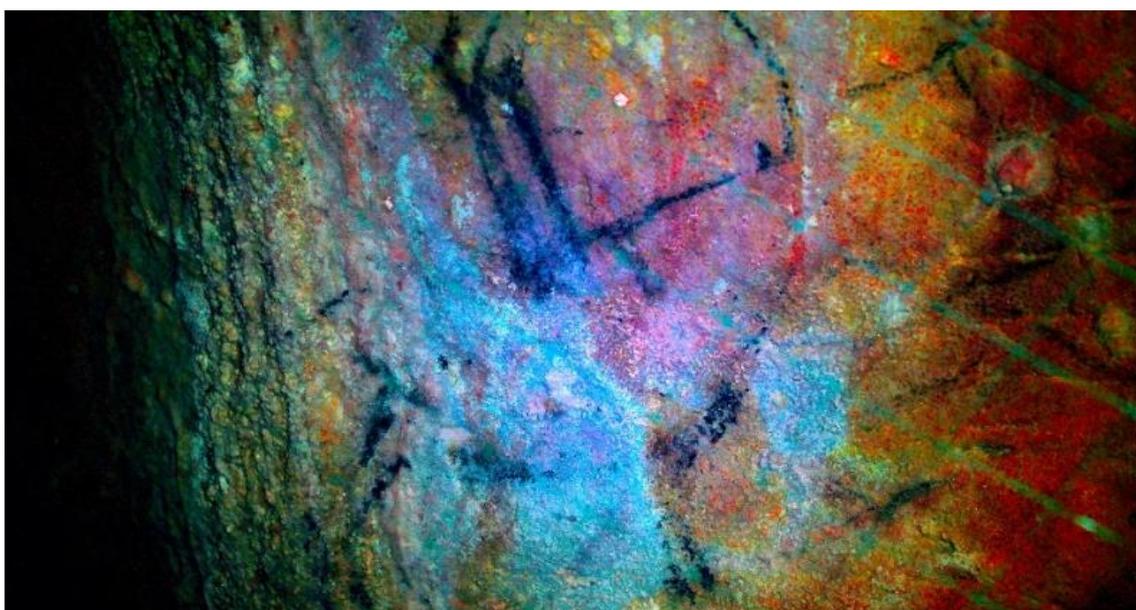


Figure 6.22. DStretch image of depiction 16, manipulated using the LAB colour-space, indicating there is no pigment in the head area and that this depiction was drawn headless Image: Author.

Depiction 5 perhaps captures the most intriguing dialogue occurring in the decisions made when drawing out the animal form. The basic outline of the bison in this depiction appears to have been re-ambiguous, so that it blurs back into shadows cast across the cave wall. The line order suggests that once the exterior lines had been completed to capture the general form of a bison, the artist decided to heavily apply pigment to infill the head. In the VR lighting simulation, it becomes clear that the head is close to a naturally concave area of cave wall; the application of charcoal pigment, therefore, appears to intentionally extend the area of shadow that falls across this concavity, blurring the bison depiction back into the wall (Figure 6.23).



*Figure 6.23. Depiction 5 viewed within the VR lighting simulation. Note how the infilled area of pigment corresponds to an area where shadow naturally falls on the wall and appears to extend it, ambiguating the animal form. Image: Author.*

The opposite pattern occurs for other depictions, that are perhaps perceived as more characteristic of a naturalistic style expected within a stylistic chronology for the late Magdalenian. Depictions 20 and 21, for example, are highly naturalistic and detailed. Given psychological perspectives on the need for relatively bright light to both allow the fovea to focus on detail and for the depiction itself to be conceptually perceived as psychologically proximal (i.e., lower construal level; see Chapter 4), one would expect the cave wall used for these depictions would receive high RLV. However, RLV is low, ranging between 8.8% to 0.2% for depiction 20 and 11.5% to 0.9% for depiction 21 when a low lumen light source is positioned to the left of the depictions (Figure 6.24). The use of detail in these depictions is intriguing, therefore, and may be serving to better clarify the depictions under low lighting conditions, increasing the salient features of the depiction. Whilst relatively well-illuminated areas of cave wall are suitable for “incomplete” outline style depictions, with the form of these depictions being unambiguous under the relatively bright lighting conditions, areas with poor illumination may have required more detailed depictions. A depiction that has a relatively simple, incomplete form would still appear ambiguous to the

observer when viewed under low RLV. Adding detail, therefore, may have served to ensure the form was salient to the viewer, despite the low luminescence of this area.

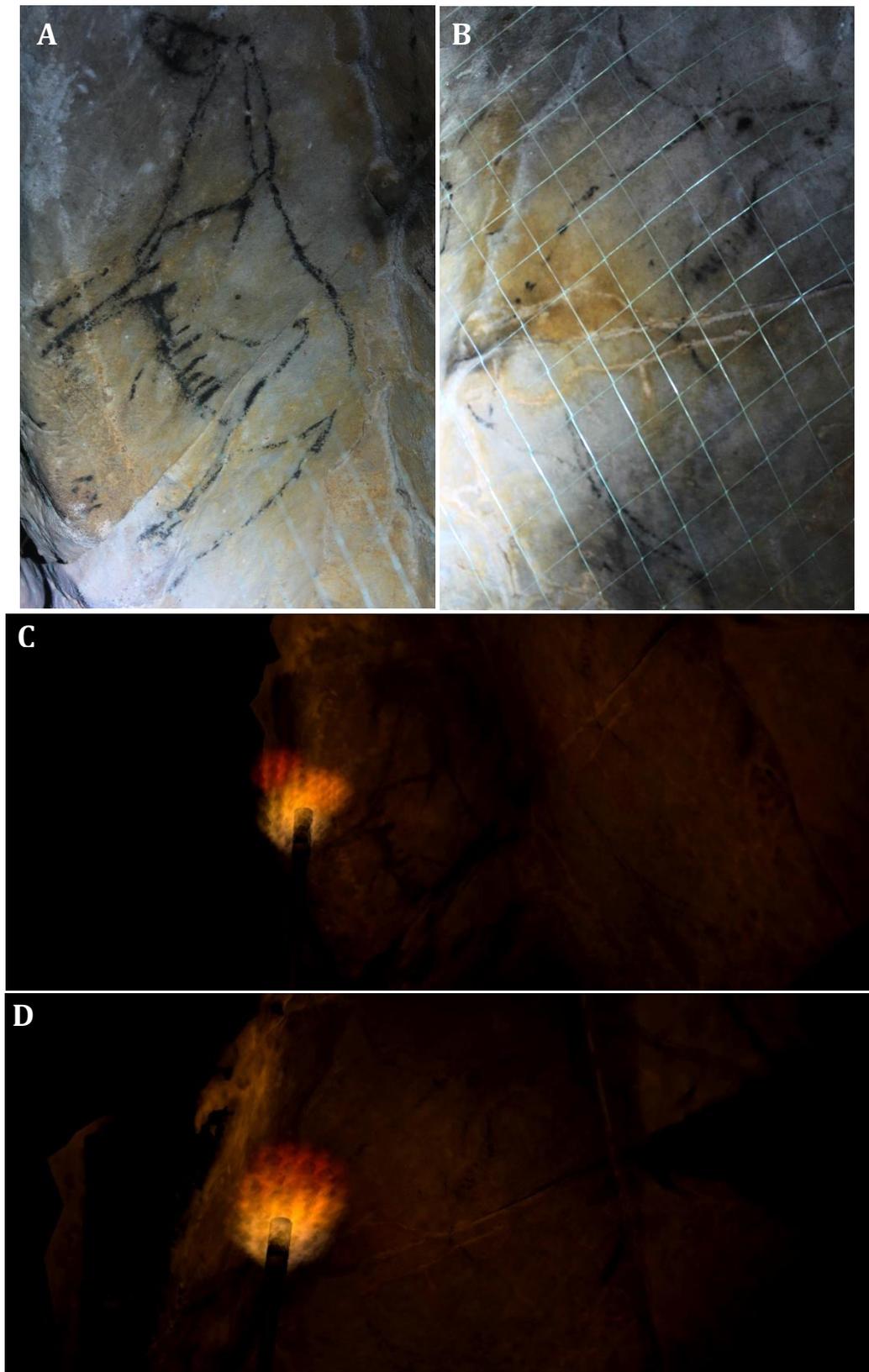


Figure 6.24. Images of depictions 20 (A) and 21 (B), and viewed under a low lumen light source in VR (C: depiction 20, D: depiction 21). Images (A and B): Blanca Ochoa. Images (C and D): Author.

There appears to be another dimension to this addition of detail too. For depiction 20, the m-shaped pelage and unusual ventral stripes appear to intentionally give the depiction depth when viewed under a low lumen light source (Figure 6.25). This detail may be attempting to artificially create shadow, as seen with depiction 5, to give the depiction a sense of depth. This effect is particularly prominent as the light source is shifted across the depiction, creating a visual illusion where the presence of a light source to the right and artificial areas of shading to the left deceives the mind into thinking the depiction must be emerging out of the rock in order to cast shadow. Shadows are essential visual information for the visual system to tease out depth, and it is possible the artist(s) of Las Monedas were aware of this, using it to breathe life into their depictions.

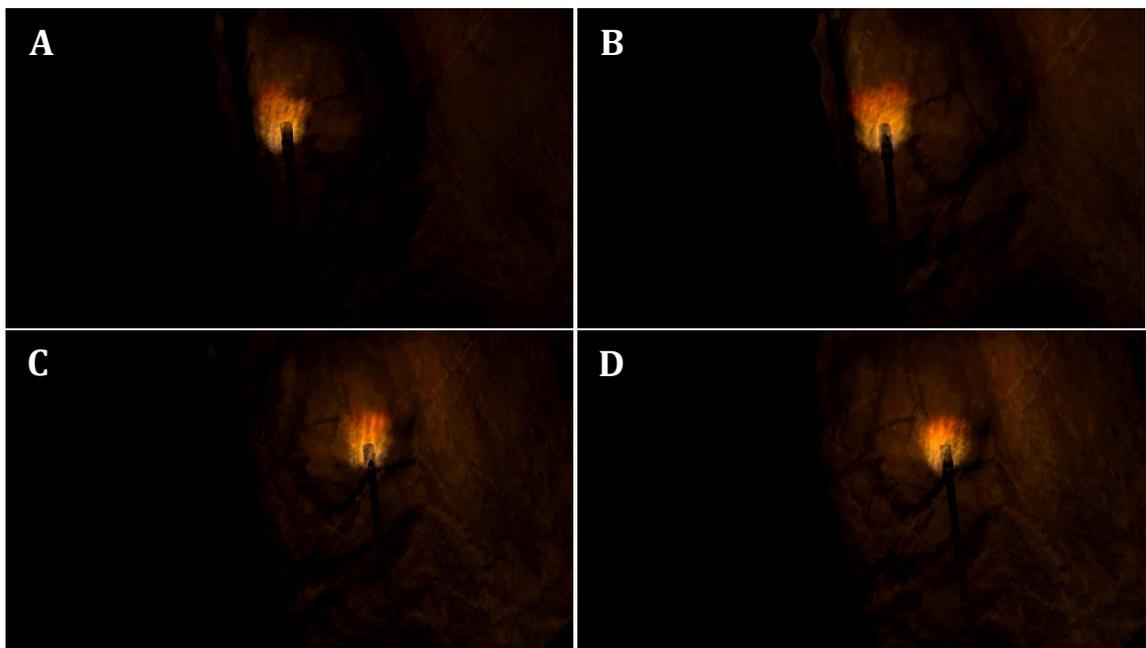


Figure 6.25. Different lighting positions for depiction 20, demonstrating this depiction is poorly illuminated regardless of light position. A) Light source to the left and 10cm away from cave wall. B) Light source to the left and 20cm away from cave wall. C) Light source to the right and 10cm away from cave wall. D) Light source to the right and 20cm away from cave wall. NB: Light sources are all at the same height, 1m. Images: Author.

Tensions between the artist, the materiality of the cave wall, and perceptual effects of a dynamic light source, during the depiction of certain forms are also evident in the Las Monedas art. The disproportionate and elongated form of certain depictions (e.g. 7, 10, 15, 18 and 36), may be the consequence of difficulties with appropriately visualising depth and distance in the dark. For these examples the cave morphology is often concave, casting shadow across this area of the cave wall, and the surfaces are textured, resulting in large disparities in RLV and unpredictable shadows. RLV for depiction 15, for example, ranges between 22.1% to 2.4%, with a significant drop off in luminance at the approximate midpoint of the depiction (Figure 6.26). The perceptual effects of these lighting conditions likely caused difficulties in identifying depth and dimension; in particular, uneven and movement

in shadows make these attributes difficult to discern (Kersten *et al.* 1997; Mamassian *et al.* 1998, 288; Snowden *et al.* 2006, 213 – 221; Imura *et al.* 2008; Katsuyuma *et al.* 2011, 485). It is likely, therefore, that the highly disproportionate features of these depictions may be a direct result of the artist(s) unable to appropriately measure depth in the darkness.

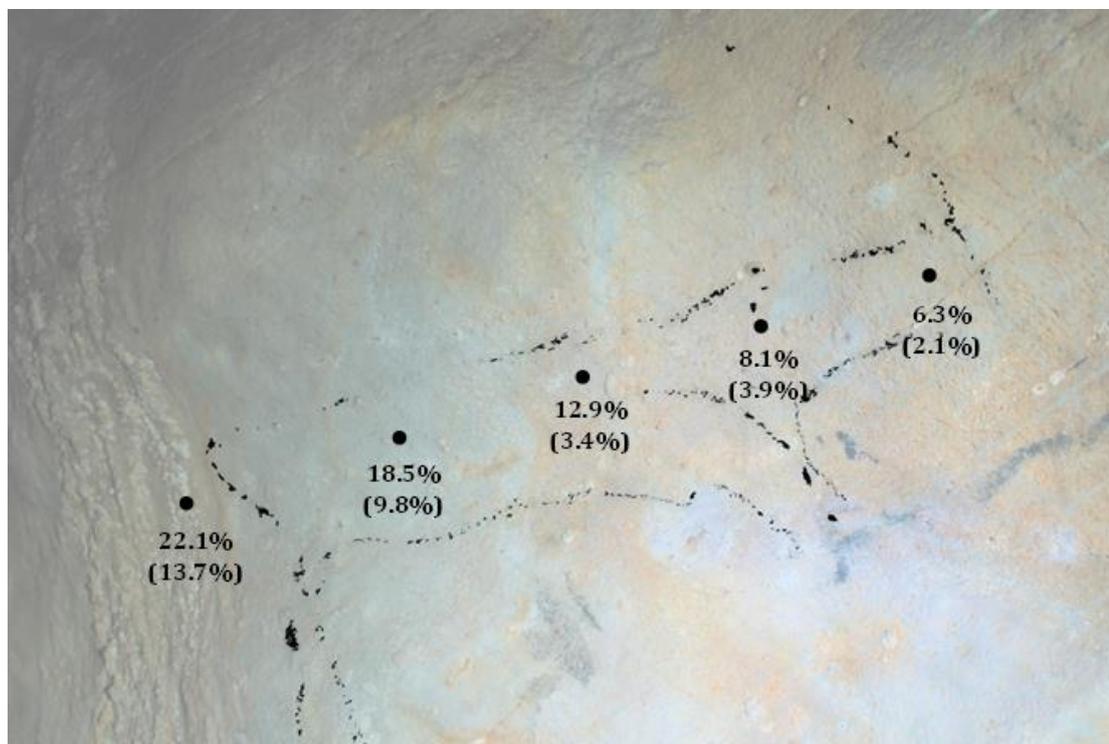


Figure 6.26. Digital tracing of depiction 15, with RLV at the brightest point and dimmest point (in brackets). The drop in RLV may be the cause for the elongation of the ibex's body in this depiction. Image: Author.

Simply put, the form of these depictions seems to highlight the difficulties with drawing in the dark under a low lumen light source. Yet they also provide a deeper insight into the art making at Las Monedas. Despite the illumination of these areas being low and uneven, causing difficulties for the visual system, and the presence of areas of cave wall with flatter topographies that received more homogenous illumination nearby, the artist(s) still decided to depict animals on these morphologically complex and poorly lit areas. This alludes to the play of light across undulating, textured surfaces and the ambiguity in visual stimuli this caused being a key component of making art within Las Monedas. The artist(s) appear to have been less concerned with depicting naturalistic forms, and instead were interested in the negotiation that occurred between light, darkness, cave formations and surface, and pigment, through their own anthropogenic action.

The drawing out of form in the art of Las Monedas, therefore, is rarely as straightforward as depicting all anatomical or salient elements of the animal. Instead, it appears to negotiate several sensitive relationships between the artist, the cave wall, the perceptual effects of light and shadow, and the overall visual effect of the depiction. This

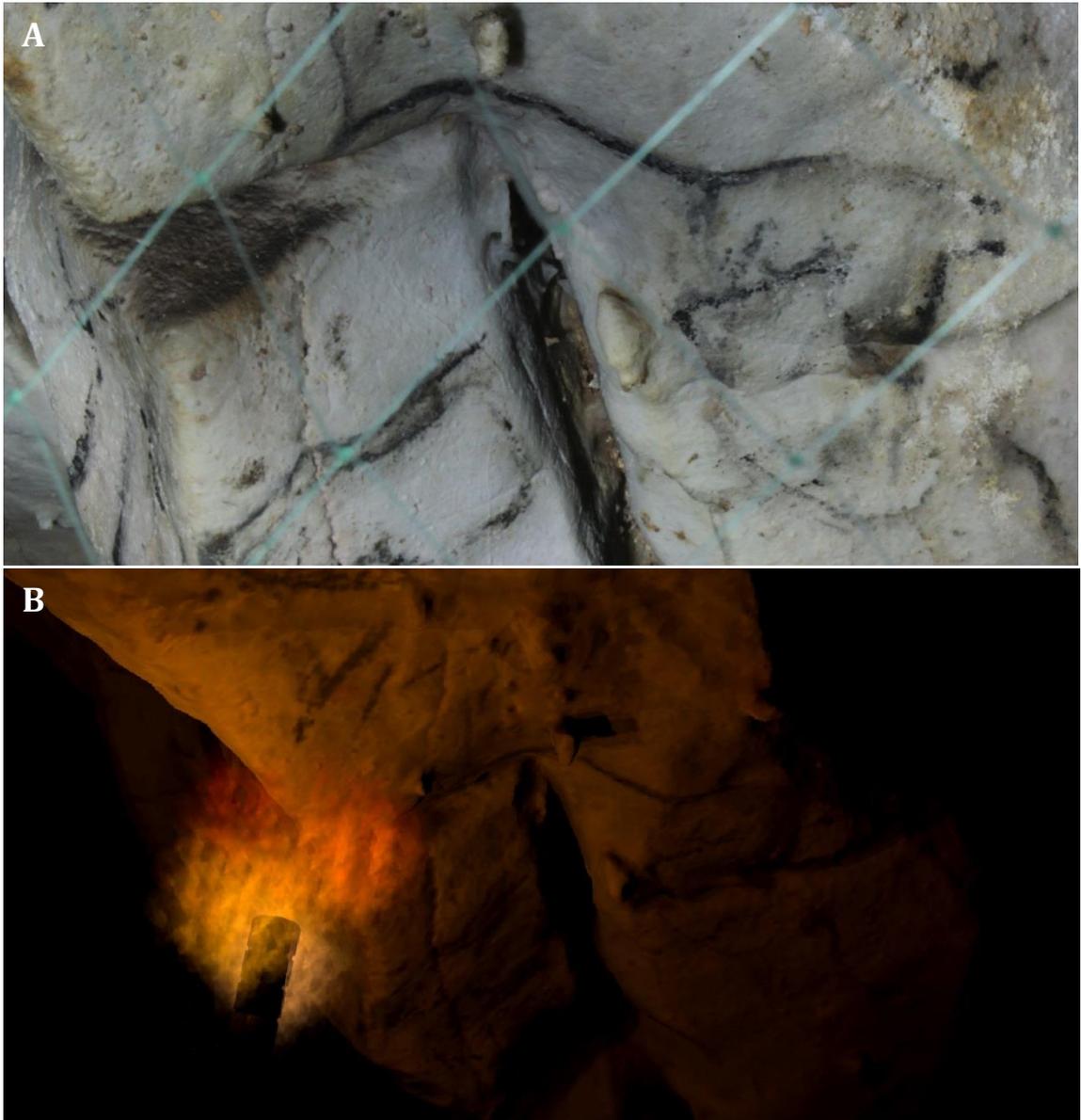
alludes to an awareness of the reception of the depictions by an audience, suggesting these depictions may have been interacted with repeatedly once complete.

### *6.5.5. Stage 5: Enduring relations*

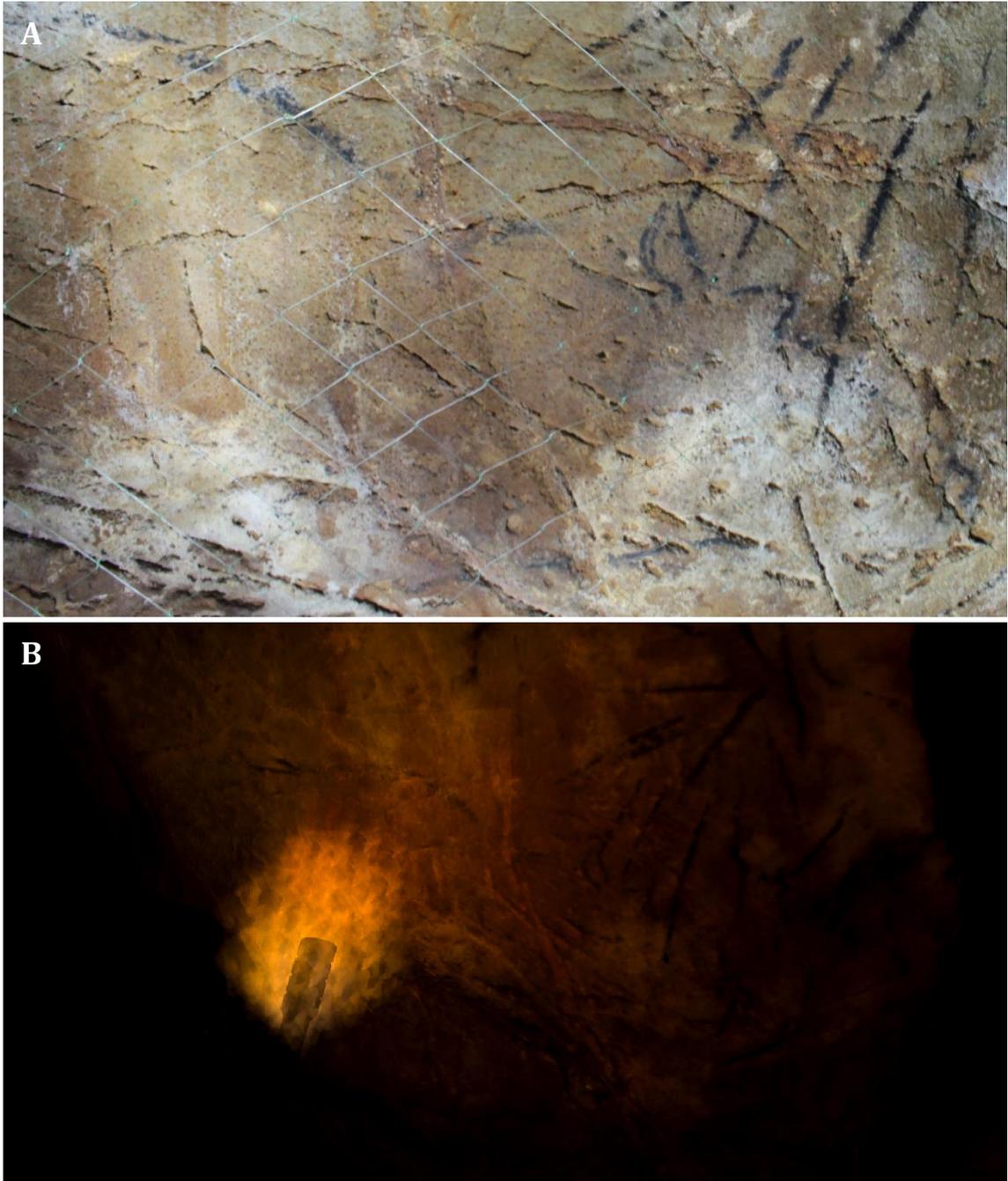
The completion of form does not necessarily mean the depiction itself was complete; relations endure, and the depiction may have been interacted with repeatedly, shaping both its physical attributes and the way it may have been understood within past societies. For the art in Las Monedas, there is little evidence to suggest the depictions were repeatedly engaged with once they had been drawn. No depictions have been redrawn, and the few instances of superimposition appear to be representative of a small composition, due to the position and stylistic similarities of the depictions (e.g. depictions 14 – 16), rather than incidentally drawing a depiction on top of an older, faded depiction. However, the lack of archaeologically visible engagement with the depictions after completing the form does not necessarily mean the depictions were forgotten or abandoned shortly after they were drawn. In fact, the deliberate interplay of perceptual effects of light on the cave topographies selected for depicting animals alludes to the artist(s) being conscious of how the depictions may be received and perceived by an audience further suggesting the depictions were intended to be interacted with for some duration of time. Observations made by Ochoa (2017) further support this; the vast majority of depictions in Las Monedas are positioned in areas that would accommodate a small audience of approximately 4 people, with a few notable exceptions where depictions appear intentionally hidden from view (e.g. depiction 13).

The positioning of depictions within Las Monedas to make use of the perceptual effects triggered by a dynamic light source appears to represent the artist(s) intending to imbue the depictions with narrative, with the relationship between the animal depictions and the cave wall creating visceral images of animate beings. Depictions 8, 25, and 26 appear to be clear examples where the animal depictions are deliberately positioned to appear as though they were emerging from the darkness. Depiction 8 is a notable example of this; it appears to creep out of a fissure and dive back into another crack in the cave wall creating an evocative image when viewed under a low lumen light source (Figure 6.27). For depiction 25, the placement of the dorsal line and head of the bear appears to intentionally make use of the darkness cast by a concave area behind the depiction, giving the impression the bear is stalking out of the shadows with its head low (Figure 6.28). In addition, the perceptual effects noted for the reindeer depictions (2, 3, and 14) in Las Monedas alludes to an intentional awareness and manipulation of the audience's perception. The lack of visibility of parts of the reindeer from certain positions appears to deliberately encourage the viewer to move and shift their light source across the depiction to reveal different

features of the animal. These attributes collectively appear to represent the artist(s) embedding the visual and perceptual effects of a dynamic, low lumen light source within the depictions, consciously utilising these effects to add drama and perhaps elements of narrative and storytelling to the art as has been suggested for other forms of prehistoric parietal art more generally (e.g. Kristiansen 2010; Aubert *et al.* 2019; Azéma 2021; Nyland and Stebergløkken 2021). It is possible, therefore, that the art in Las Monedas was intended to be revisited and actively engaged with, creating lasting relations with this cave, and the animal depictions within it.



*Figure 6.27. Depiction 8 (A) and viewed under a low lumen light source in VR (B). The depiction appears to emerge from and return to a fissure in the cave wall. Image: Author.*



*Figure 6.28. Depiction 25 viewed under a low lumen light source in the VR lighting simulation. The curvature of the wall casts shadow across the rear of the depiction, giving the impression that the bear is emerging from the darkness. Image: Author.*

## 6.6. Summary

The integration of different digital methods within this chapter has demonstrated the tangible effects of a low lumen light source on the topographical surface of cave walls selected for depiction in Las Monedas. When explored through a biographical framework, the results suggest that the visual effects caused by these lighting conditions triggered specific visual and perceptual psychological phenomena, which in turn informed specific attributes of the animal representations. The visual effects experienced appear to have been

consciously recognised and deliberately manipulated by the artist(s) of Las Monedas, with some examples suggesting the artist(s) may have been intentionally utilising specific cave wall topographies and artificially creating shadow in their depictions to create specific visual effects. Whilst the most prominent visual effects, such as pareidolia and the truncating of form through shadow, may have been consciously recognised by the artist(s), psychological effects such as shifts in construal levels perhaps may have been subconscious, causing subtle shifts in the mental psyche of the artist. This is perhaps reflected in the abstract and loose form of many of the depictions; high construal levels encourage abstract, general thinking. The results generated for the art of Las Monedas suggest that by the mid-late Magdalenian, Cro Magnon artists were keenly aware of the visual and perceptual psychological effects of cave environments and deliberately manipulated these effects to enhance their art. This is perhaps not surprising; the long tradition of art making within the sites of Monte Castillo suggest the inhabitants had expertise and temporally deep knowledge of making art within caves.

It must be noted that there are limitations in the approach utilised to understand the art of Las Monedas here, which pertain to its desk-based nature. Observations made from the 3D models and VR lighting simulations, particularly with regard to the relationship between depictions and natural topographic features of the cave walls cannot be validated against the archaeological record from this approach alone. Further, the limitations of creating photogrammetric models from images in pre-existing digital repositories likely has resulted in distortions in the models, which in turn will impact the way light disperses across these surfaces in the VR simulations. Nevertheless, new insights have been generated through this approach, demonstrating the inherent value of the integration of visual psychology and digital techniques for understanding the making of cave art. This approach also holds vast potential for distributing datasets, allowing for aspects of lighting and relationships between depictions and the cave wall to be explored from a desk-based study and importantly encouraging reproducibility in further testing the results presented here. The following chapter will integrate primary observations from fieldwork to elevate the interpretations generated through this approach, to understand the making of depictions within the cave art site of La Pasiega.

## Chapter 7.

# Phase 2: Integrating Primary Observations to Understand the Cave Art of La Pasiega

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### 7.1. Introduction

This chapter builds on the desk-based approach developed in Chapter 6, by integrating primary observations from fieldwork conducted during October 2021 in the cave art site of La Pasiega. Chapter 6 demonstrated the efficacy of an approach that utilised digital techniques within a biographical framework to understand the visual system's role within the making of cave art at Las Monedas. This second phase of the approach provides higher resolution to this method, facilitated through in-person observations. This enabled aspects such as the spatial positioning of the art and experiential components, such as tactility, to be considered in the biography of making these depictions. Through this approach, the depictions within Gallery A of La Pasiega are reinvigorated, and revealed to have emerged through the coalescing of haptic and visual stimuli that, in turn, were responsible for specific perceptual responses. The variety in the form and detail of depictions appears to have emerged through these discrete and nuanced interactions between the artist and the cave wall under low lumen conditions. Further, the placement of depictions to manipulate the lighting effects caused by the complex topography of the cave wall alludes to a dramatic component of the art; it was intended to be viewed and experienced after its making.

### 7.2. Methodology: Integrating Primary Observations

#### 7.2.1. *Preliminary evaluation*

The preliminary evaluation undertaken for La Pasiega was conducted in two stages. The first stage used available published information to produce an initial assessment of the distribution of the art within each gallery of the cave, and to provide a preliminary insight into the general spatial context of the art. Due to the volume of depictions at La Pasiega, this consisted of a coarse evaluation to determine the quantity, variety, and distribution of depictions within each gallery by recording the following: number of depictions; animals depicted; general style of depictions; date/stylistic attribution; notes regarding gallery size and accessibility; and any additional comments. This allowed for the research to subsequently focus attention on a specific gallery, which was deemed suitable for accessing during in-person fieldwork and for containing a representative variety of depictions.

As there is currently no comprehensive monograph for the art in La Pasiega, the desk-based portion of the preliminary evaluation was limited to recording the general

characteristics aforementioned for each gallery. The second stage of the preliminary evaluation therefore integrated observations recorded during fieldwork (outlined in the following section) to enable an appropriate assessment of the relationship between depictions and the cave wall and the stylistic features of depictions in the selected gallery. This used the database generated from the fieldwork, and served to identify interesting characteristics of the art which were subsequently explored further through the biographical framework.

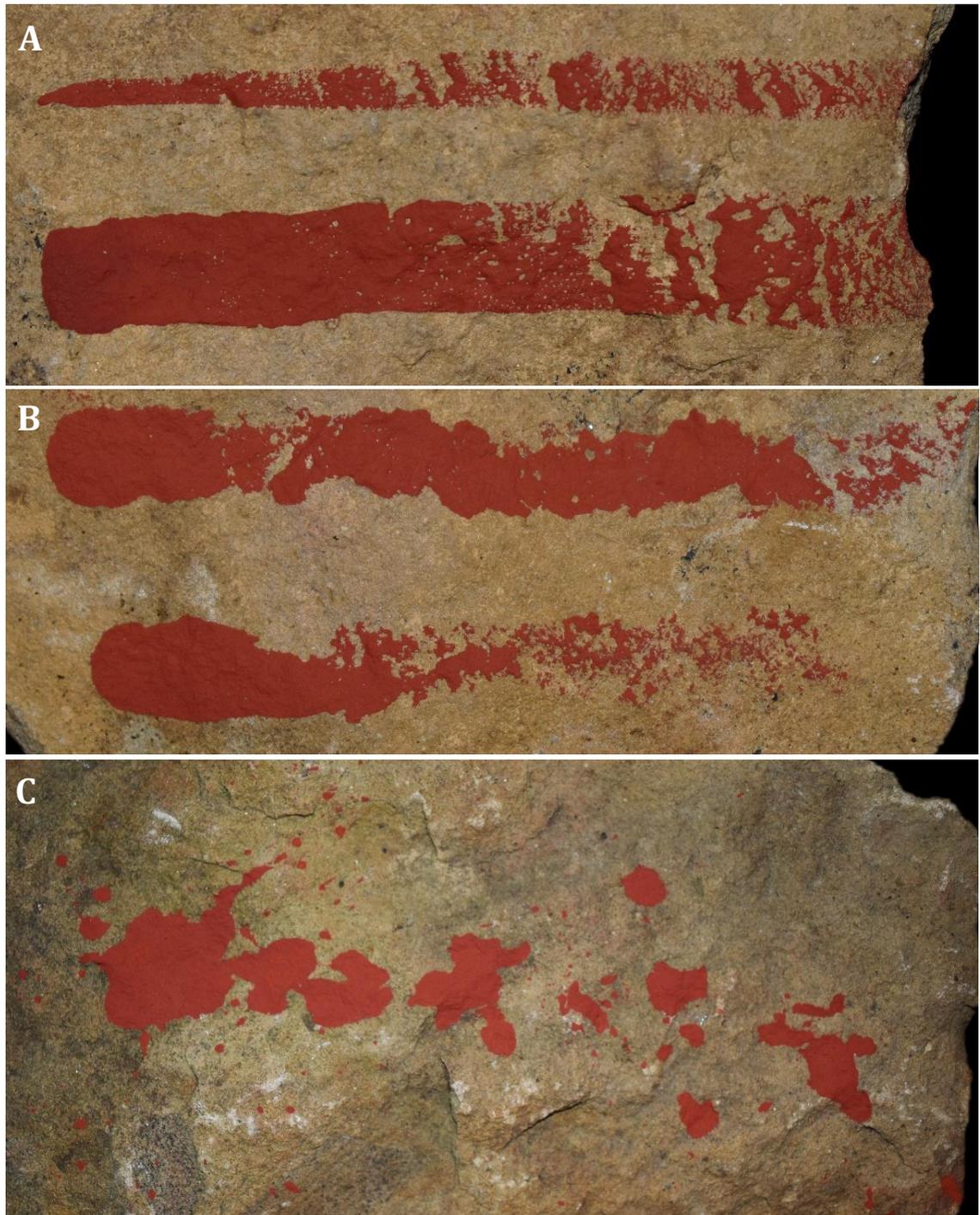
### *7.2.2. Fieldwork: Recording the art*

During in-person fieldwork, the depictions within the gallery selected by the first stage of the preliminary evaluation were recorded, detailing the following attributes: position within the cave/gallery; panel number; depiction number; animal depicted; orientation; features depicted; overall style; other notable stylistic features; main pigment used (approx. %); additional pigments used (approx. %); main technique used; additional techniques used; comments on techniques; max. height of depiction; max. length of depiction; approx. % of depiction represented by natural features; height of depiction from approximate Palaeolithic floor level; relationship to other depictions; approximate angle of viewing; visibility; association to cave wall; detailed comments on cave wall association; description of natural features associated; measurement of distance between natural features and depiction; and additional comments. A tape measure was used for approximate measurements of the depiction and its height from the ground level. Where possible, the height of depictions was measured from the approximate Palaeolithic floor level, indicated by preserved areas of the original calcite floor that were not affected by the excavations and floor modifications undertaken in the 1950's. All other attributes were visually observed and recorded in a notebook. These notes were subsequently inputted into a spreadsheet. This intended to provide a detailed record of each depiction selected in this study which could be referenced later, and to ensure appropriate measurements were recorded to scale the 3D models of the panels within the VR lighting simulations. Information regarding the spatial context and angle of viewing provided useful information to determine the spatial constraints on making and subsequently viewing the depictions, which were again considered in the lighting simulations.

### *7.2.3. Fieldwork: High resolution photography*

In addition to recording the above features of the depiction, high-resolution photographs were taken of each individual depiction and the surrounding spatial context (where possible) using a Nikon D3500 DSLR camera with an 18-55mm AF-P VR lens. This provided not only a detailed record of each depiction, but the resolution enabled the technical processes involved in the making of the depictions to be determined. Where

possible, photographs of intersecting lines or close-range photographs of the pigment were also taken to aid in evaluating how the pigment was applied to the cave wall, and the line order of the depiction. Additionally, experimental references were produced by applying an ochre paint mix onto sandstone using different techniques (i.e. brush, finger, oral projection). This allowed for comparisons between the diagnostic features of these paint application methods to high-resolution images from La Pasiega (Figure 7.1).



*Figure 7.1. Experimental examples of a red ochre paint mix (1:1 ratio of dry ochre powder with water) applied with A) a brush, B) a finger, with the upper line produced by repeatedly refreshing the pigment on the finger, and C) projected from the mouth. Note the flat vs. rounded edge between the brush and finger application, and splatter marks produced by oral projection. Images: Author.*

High-resolution images of intersecting lines allowed for the determination of line order, where lines intersected, and direction of the lines. Whilst this relied solely on digital tracings and DStretch images for Las Monedas in Chapter 6, integrating primary observations and high-resolution images of the lines provides greater precision in reconstructing the biography for each depiction. In Chapter 6, reconstructing line order through digital tracings alone was time-consuming and involved a degree of assumption. The use of primary observations for La Pasiega allowed for an assessment of line order primarily through in-person observations and the high-resolution images, with digital tracings only used to visualise the line order. These digital tracings were produced by following the same workflow presented in Chapter 6, section 6.2.3.

#### 7.2.4. Fieldwork: Photogrammetry

To appropriately record and evaluate the relationship between natural features of the cave wall and depictions, it was necessary to produce 3D models of the art that captured the topography of the cave art. 2D images are insufficient for fully capturing the dimensions of the art, significantly distorting depictions and flattening the undulating topography of the art. Consequently, Upper Palaeolithic cave art research, like many areas in archaeology, has increasingly incorporated 2.5D or 3D modelling techniques into traditional recording methodologies, to the extent that recording art in this way is now an established approach for the analysis and preservation of the art. There are numerous methods in which to create 3D models, the three most common of which are summarised in Table 7.1.

Table 7.1. Summary of common 2.5D/3D modelling methods used in recording Upper Palaeolithic cave art.

Method	Summary	Advantages	Disadvantages	Reference(s)
Terrestrial laser-scanning (TLS)	Device uses lasers to map an object or space, either through shining a pattern onto the surface, using pulsating lasers and measuring time difference of returned laser pulses, or using a laser beam and measuring phase difference of returning laser waveforms	<ul style="list-style-type: none"> <li>Creates a highly detailed model consisting of millions of points</li> <li>Accurately records the texture of the subject's surface</li> <li>Conducted within a relatively short time span</li> </ul>	<ul style="list-style-type: none"> <li>Requires expensive, bulky equipment and extensive training.</li> <li>RGB colour values have to be added by additional cameras</li> </ul>	González-Aguilera <i>et al.</i> 2009; Lerma <i>et al.</i> 2010; González-Aguilera <i>et al.</i> 2011

Reflectance Transformation Imaging (RTI)	2.5D models generated from a series of images that have been illuminated from different angles.	<ul style="list-style-type: none"> <li>• Relatively inexpensive</li> <li>• Creates high resolution model with detail not immediately visible to the human eye</li> <li>• Accurately simulates the reflective properties of a textured surface, allowing lighting to be manipulated</li> </ul>	<ul style="list-style-type: none"> <li>• Requires specialist set-up that may not always be suitable for a cave environment</li> <li>• Requires different light sources, which may be restricted by conservation conditions of fieldwork in cave art sites</li> <li>• Does not render 3D models</li> </ul>	Mudge <i>et al.</i> 2006; Díaz-Guardamino and Wheatley 2013; Porter <i>et al.</i> 2016; Strasser <i>et al.</i> 2018, 103
Photogrammetry	Multiple images are taken of the subject from different angles, and compiled in software to produce a textured model	<ul style="list-style-type: none"> <li>• Inexpensive</li> <li>• Requires only basic equipment</li> <li>• Easy to use</li> <li>• Can be deployed in small, restricted spaces</li> </ul>	<ul style="list-style-type: none"> <li>• Model quality limited to image quality</li> <li>• Missing areas of the subject results in holes in the model</li> <li>• Cannot be used on translucent materials</li> </ul>	González-Aguilera <i>et al.</i> 2009; Fritz <i>et al.</i> 2016

For producing 3D models of the art within La Pasiega, photogrammetry was selected. The benefits of photogrammetry have previously been outlined in Chapter 6, but there are additional considerations for using this method during in-person fieldwork. Unlike TLS or RTI, photogrammetry does not require the use of specialist equipment that may require additional training or may be difficult to deploy within spatially restricted areas of the cave. The production of photogrammetry models is also relatively quick, and therefore models can be produced during fieldwork and corrected in the field if necessary. Furthermore, the texture represented in photogrammetry models, despite not being as detailed as the texture captured by RTI or TLS, is a good proxy for the texture recognised by the human eye and therefore is appropriate for discussing the visual psychology that may have contributed to the making of the depictions. Models created by TLS or RTI arguably record more detail than is necessary for the research conducted here, and these methods

tend to be primarily used for high-resolution recording of cave art for conservation purposes or to record finely engraved shallow motifs that are difficult to identify by the human eye (Earl *et al.* 2010; Gonzalez-Aguilera *et al.* 2011, 120; Díaz-Guardamino and Wheatley 2013).

### 7.2.5. *Virtual reality: Lighting simulations*

As with Chapter 6, lighting simulations were used to determine the interaction of a warm, low lumen light source on the surface topography of walls selected for cave art depiction in La Pasiega. A similar portable light source was used in these lighting simulations that emulated the light cast from a small torch produced from juniper wood. This light source was scaled to cast a warm light of approximately 1850K over a diameter of 2.5m, and had a light intensity of 0.5, consistent with experimental observations of a torch made from juniper based on experimental observations (Medina-Alcaide *et al.* 2021). Similar to the Older Dryas conditions within which the art of Las Monedas was produced, the cold conditions of the late Solutrean to early Magdalenian that contextualise the art of Gallery A in La Pasiega would have limited the availability of woody resources, with only suitable species like juniper and pine being present in the immediate landscape.

The position of the light source near a panel was again indicated by the line direction of the depiction, with the same assumption that a depiction that generally had lines produced from left-to-right in a clockwise order were made using the right hand, and thus the light source would have been held in the left hand. However, primary observations regarding the spatial context of the art were also integrated to allow for more accuracy in the positioning of this light source. The distance of the light source from the cave wall generally aimed to conform to approximate lower arm's length (40cm), except for cases where the spatial context would have likely constrained the movement and position of the artist. In these instances, observations noted from in-person fieldwork were utilised to appropriately position the light source in relation to the cave wall. Similarly, the height of the light source – where possible – was measured from the height of the original Palaeolithic floor and aimed to be consistent with either approximate hip height (1m), shoulder height (1.5m) or above head height (1.9m). Again, there were exceptions to these three heights for cases where the spatial context likely constrained the position of the artist, particularly if it was unlikely the artist was standing upright.

The higher confidence and resolution of the photogrammetry models, compared to those produced in Chapter 6, also enabled for additional measurements to be taken from the lighting simulation to provide a more accurate light profile for the topographic surface. Relative Luminance Values (RLV) were therefore calculated at the following known distances from the centre of the light source across the area of the wall used for depiction:

0cm; 5cm; 10cm; 20cm; 30cm; 40cm; 50cm, and 60cm. The known distances enabled for a light profile to be generated for each topographic surface, to determine the distance at which light significantly diminished when compared to a light profile produced for a flat surface under the same conditions. The light profiles for each depiction/panel were compared to the light profile of a flat, white wall viewed under the same light conditions, to determine the extent to which these profiles deviated. This was evaluated to determine whether areas that received much lower RLV than expected corresponded with particular features of the depiction.

### 7.3. Preliminary evaluation

#### 7.3.1. General art summary

La Pasiega has a high density of cave art depictions throughout the cave complex that were likely produced during multiple phases of artistic activity in the site (González Sainz *et al.* 2013, 106). Different areas of the cave complex may have been accessible during different periods of the Upper Palaeolithic, with two likely entrances: one leading into Gallery B; and one leading into Gallery C. It is possible that the west (Gallery C and part of Gallery D) and the east (Gallery B and Gallery A) may have functioned as separate caves due to these two entrances (González Sainz *et al.* 2013, 106; Ochoa 2017, 168). Further, it is clear different galleries were interacted with in distinct ways, with Gallery B used as an occupation zone and deeper galleries, such as Gallery A, likely being infrequently traversed by a small number of individuals due to its low ceilings and narrow space (Ochoa 2017). There is also a variation in the number of depictions and their general style and technique between each gallery, summarised in Table 7.2, suggesting these were distinct spaces within the cave.

Based on the preliminary evaluation of depictions within each gallery in La Pasiega, Gallery A was selected as the focus for this research. The high number of figurative depictions that appear homogenous in style and a representative sample of the art within La Pasiega in terms of the animals depicted, in combination with the unusual morphology of this area of the cave means it is likely an interesting case study for understanding the psychological mechanisms that may have informed the making of the art in this area. It is anticipated the constrained nature of this gallery may have resulted in unusual lighting effects that may have been manipulated or responded to in specific ways.

Table 7.2. Summary of the depictions within each gallery of La Pasiega.

Gallery	Total number of depictions	Animals depicted	General style	Date/ stylistic attribution	Notes and additional comments	References
A	219 (100 figurative, 119 non-figurative)	Hind (34), Horse (30), Stag (14), Indeterminate quadruped (7), Aurochs (5), Bison (4), Ibex (3), Reindeer (2), Deer (1)	Simple outlines made mostly in red ochre, using finger dots	Solutrean to Early Magdalenian based on stylistic features of depictions	Narrow gallery deep within the cave. Accessed through Gallery B. High density of depictions.	Balbín-Behrmann and González-Sainz 1993
B	251 (91 figurative, 160 non-figurative)	Horse (24), Ibex (20), Indeterminate quadruped (16), Hind (11), Stag (9), Aurochs (3), Bison (2), Bovid (1), Deer (1), Carnivore (1), Bird (1), Fish (1) Anthropomorph (1)	Engraved depictions and depictions made with simple outlines in red, using finger dots	Solutrean based on stylistic features of depictions and date of occupation layers.	Large chamber. Original Palaeolithic entrance to the cave. Evidence of occupation within this area of the cave. Would have received daylight.	Balbín-Behrmann and González-Sainz 1993
C	316 (79 figurative, 237 non-figurative)	Hind (21), Horse (16), Indeterminate quadruped (13), Bison (9) Ibex (9), Aurochs (4), Stag (3) Chamois (1) Deer (1) Mammoth (1), Anthropomorph (1)	Variety of styles including the use of engraving, red, yellow, and brown ochres and charcoal.	Solutrean to Early Magdalenian based on stylistic features of depictions.	Complex chamber with both open and narrow areas. High density of non-figurative motifs. Has a separate Palaeolithic entrance.	Balbín-Behrmann and González-Sainz 1993
D	97 (27 figurative, 70 non-figurative)	Horse (7), Hind (5), Aurochs (3), Indeterminate quadruped (3), Stag (3), Bison (3), Bovid (1), Deer (1), Ibex (1)	Engraved, with some depictions in red.	Solutrean to Early Magdalenian based on stylistic features of depictions.	Narrow zone that connects Gallery C to Gallery A. Few depictions that are distributed sparsely in this area.	Balbín-Behrmann and González-Sainz 1993

### 7.3.2. Art summary: Gallery A

Gallery A is characterised by its low ceilings and narrow spaces (Figure 7.2), which likely restricted the number of individuals that interacted with this space. The high frequency of depictions in this small gallery has led to the term *horror vacui* being coined for Gallery A (García-Diez *et al.* 2018) – a phrase meaning “fear of empty space”, which is used in contemporary art studies to refer to art that occupies all available space. The art is present on almost all of the cave walls within this gallery, and is generally homogenous in style; the majority of depictions are produced using a red ochre paint mixture, and tend to be “simple” (i.e., no internal detail) outline representations of animals. Superimpositions of depictions are rare, further supporting the relative homogeneity of the art and implying the depictions may have been produced over a relatively short time span. Depictions instead appear to be consciously related to one another, for example a stag deliberately placed behind a hind to perhaps represent mating behaviours or animals of different species, but depicted as similar sizes, appearing to confront each other (Figure 7.3). As outlined in Table 7.2, hinds are the most frequently depicted animal accounting for 34% of the depictions. This is followed by horses (30%), stags (14%), aurochs (5%), bison (4%), ibex (3%) and reindeer (2%); indeterminate animals account for the remaining 8%.



Figure 7.2. General view of Gallery A, showing the low ceilings and narrow spaces that characterise this gallery. Image: Author.



Figure 7.3. Depiction PA6.1 representing a horse (left) confronting depiction PA6.2 (right) representing a hind, depicted as a similar size to the horse. Image: Author.

During fieldwork, 65 figurative depictions were identified and recorded (Table 7.3). The discrepancy between the number of depictions recorded during fieldwork and those previously reported by Balbín-Behrmann and González-Sainz (1993) for Gallery A may be due to a couple of factors. Firstly, some of the figurative depictions previously reported may have been engraved. This study focused only on painted depictions, due to the practical limitations of recording engraved motifs and ensuring these would be visible in the VR simulations. Secondly, there are several areas of Gallery A that are spatially constrained which were unable to be recorded during fieldwork. These may have featured additional depictions that were obscured from view and could only be observed by manoeuvring into the constrained areas. Thirdly, the area where Gallery A begins, and Galleries B and D end, is ambiguous and features a few isolated depictions. These may have been included as part of Gallery A in previous reports, but not deemed part of Gallery A in this study.

Table 7.3. Summary of the figurative depictions recorded in Gallery A.

Animal depicted	Frequency	Percentage
Horse	23	35%
Hind	20	31%
Stag	7	11%
Aurochs	7	11%
Ibex	3	5%
Indeterminate	3	5%
Bison	1	1%
Deer	1	1%

These depictions were grouped into 12 panels, based on their relationship to other depictions and their spatial position. Each panel was recorded individually using photogrammetry, thus producing a total of 12 photogrammetry models. For a number of panels, the spatial position and relationship of the depictions clearly delineated individual panels. However, for some panels, the grouping of depictions was somewhat arbitrary to ease the making of photogrammetry models; for example, where the wall topography caused difficulty in either taking images or relating sections of wall to one another, the depictions were grouped into separate panels. Each panel was given its own reference (e.g. PA1; “PA” refers to Pasiega A, and the number indicates the panel number) and each depiction within a panel was given an individual reference (e.g. PA1.1; the number after the decimal point indicates the depiction number). The panels and the depictions within each panel are summarised in Table 7.4 and the distribution of panels within the gallery is presented in Figure 7.4.

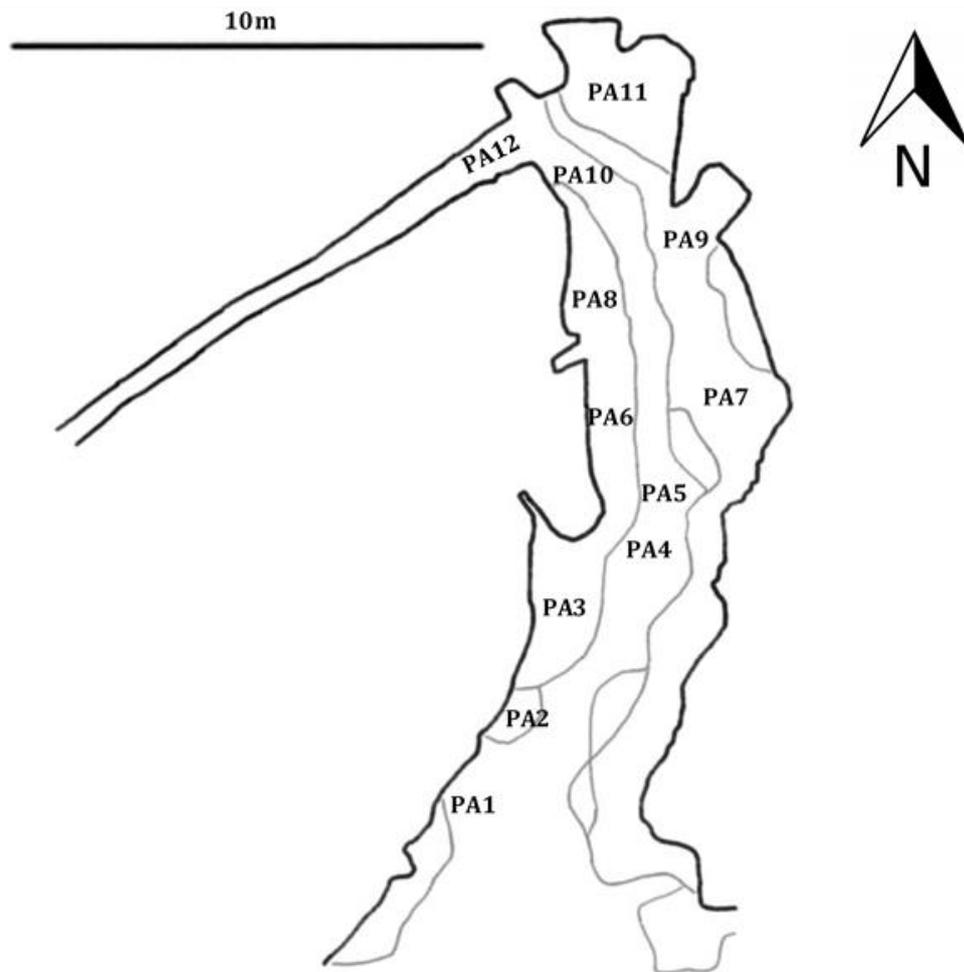


Figure 7.4. Approximate position of each panel within Gallery A. Panels positioned towards the centre feature depictions on the ceiling and/or both walls of the gallery. Map digitally retraced and modified after Ochoa 2017, 211.

Table 7.4. Summary of the panels and depictions in Gallery A, recorded during fieldwork.

Panel	Reference	Animal	Relationship to other depictions	Features represented	General style	Relationship to cave wall	Comments
PA1	PA1.1	Hind	Isolated	Cervico-dorsal line	Simple dotted outline	Direct	Dorsal line appears to continue a natural crack in the wall
PA2	PA2.1	Hind	Isolated	Head and dorsal line	Partial infill on head, simple dotted outline	Direct/ parallel	Horns run parallel to a natural crack
	PA2.2	Bison	Isolated	Mostly complete (no ventral line)	Simple dotted outline	Direct	Horns are mapped onto a natural feature. Ventral line appears to be represented by the natural shape of the rock
	PA2.3	Horse	Tiered under 2.4	Mostly complete (missing head)	Simple outline	Direct	Head is suggested by natural feature
	PA2.4	Horse	Tiered above 2.3	Mostly complete (missing ventral line)	Simple outline	Direct	Rear leg mapped onto a crack
	PA2.5	Stag	Stacked under 2.4	Head	Simple outline	Direct?	Dorsal line appears to follow natural crack
PA3	PA3.1	Horse	Row with 3.2	Head	Simple outline	Direct	Dorsal line mapped onto natural crack
	PA3.2	Hind	Row in front of 3.2, tiered above 3.3	Dorsal line	Very simple outline	Direct	Dorsal line partially mapped onto natural crack
	PA3.3	Stag	Tiered under 3.2	Head and dorsal line	Simple outline	Direct	Antlers and ventral line mapped onto natural crack
PA4	PA4.1	Stag	Confronting 4.2	Head and dorsal line	Simple outline	Direct	Antlers mapped onto natural crack
	PA4.2	Horse	Confronting 4.1, tiered above 4.3	Mostly complete	Simple outline	Limited	Depiction may follow natural cracks, but association is unclear
	PA4.3	Horse	Tiered under 4.2	Head	Detailed outline	Limited/ none	No clear association with natural features
PA5	PA5.1	Hind	Tiered under 5.2	Cervico-dorsal line	Simple outline	Limited	May run parallel to crack, but association is unclear
	PA5.2	Hind	Tiered above 5.1, row with 5.3	Cervico-dorsal line	Simple outline	Direct/ parallel	Part of the head is represented by a contour. Rear of depictions runs parallel to a natural crack
	PA5.3	Horse	Row with 5.2, tiered under 5.4	Mostly complete	Detailed outline	Direct?	Rear leg may be represented by natural feature
	PA5.4	Horse?	Tiered above 5.1, 5.2, and 5.3	Rear leg and tail	Simple outline	Direct?	Rear leg appears to be mapped onto a contoured surface

	PA5.5	Horse	Isolated	Mostly complete	Simple outline	Limited/ none	Positioned on a ledge, but no clear association to natural features
<b>PA6</b>	PA6.1	Horse	Confronting 6.2	Complete	Simple outline	Limited/ none	No clear association to natural features
	PA6.2	Hind	Confronting 6.1	Complete	Simple outline	Direct	Front legs are represented by natural cracks
<b>PA7</b>	PA7.1	Hind	Row in front of 7.3	Cervico-dorsal line	Simple outline	Limited/ none	No clear association to natural features
	PA7.2	Horse	Tiered under 7.3, confronting 7.5	Head and dorsal line	Simple outline	Limited	Appears to intentionally wrap around rock surface
	PA7.3	Aurochs	Row behind 7.1 and in front of 7.4. Tiered above 7.3	Complete	Simple outline	Direct	Head and rear mapped onto natural cracks
	PA7.4	Hind	Row behind 7.3, tiered above 7.2, 7.5, and 7.6	Complete	Simple outline	Direct	Ventral line mapped onto a natural crack
	PA7.5	Hind	Confronting 7.2, tiered under 7.3 and 7.4	Head	Simple outline	Limited?	May be mapped onto a suggestive contoured surface
	PA7.6	Hind	Tiered under 7.4, row with 7.7, 7.8 and 7.9	Head, dorsal line, front leg	Simple outline	Direct? /Limited	Wraps around a contoured surface
	PA7.7	Hind	Tiered above 7.8	Head	Simple outline	Limited/none	No clear association to natural features
	PA7.8	Hind	Tiered under 7.7, above 7.9	Complete	Infilled and engraved	Limited/none	Outline of depiction is engraved. No clear association with natural features
	PA7.9	Hind	Tiered under 7.8, stacked under 7.10	Mostly complete	Simple outline	Limited/ none	No clear association to natural features. The head may be positioned in a twisted position
	PA7.10	Indeterminate	Stacked above 7.9	Eye/front of head	Simple outline	Limited/ none	No clear association to natural features
	PA7.11	Stag	Isolated	Complete	Infilled	Limited/ none	Wraps around a contoured surface
<b>PA8</b>	PA8.1	Stag	Tiered above 8.2	Antlers	Simple outline	Limited/ none	No clear association to natural features
	PA8.2	Hind	Row in front of 8.3	Complete	Detailed outline	Parallel	Front leg follows a natural crack
	PA8.3	Stag	Row behind 8.2	Head and dorsal line	Simple outline	Direct? /Limited	Eye represented by a crack, but no other clear associations with natural features
<b>PA9</b>	PA9.1	Hind	Isolated	Forequarters	Infill head, simple outline	Direct	Front legs are mapped onto natural cracks. Rear may be represented by a contoured surface

	PA9.2	Hind	Row/confronting 9.3 and 9.4	Complete	Simple outline	Direct and parallel	Rear mapped onto a natural crack, and the head runs parallel to another natural crack
	PA9.3	Horse	Row confronting 9.2	Complete	Simple outline (head infilled?)	Direct and parallel	Head is mapped between two cracks, rear runs parallel to a crack
	PA9.4	Horse	Tiered under 9.3, confronting 9.2	Complete	Infilled head, simple outline	Direct	Mapped onto a suggestive contour, and the tail extends into a crack
	PA9.5	Aurochs	Tiered above 9.6	Forequarters	Detailed outline	Direct?	Ventral line appears to be represented by a crack
	PA9.6	Hind	Tiered below 9.5, row behind 9.4	Complete	Simple outline	Parallel	Dorsal line of the head runs parallel to a natural crack
	PA9.7	Horse	Tiered under 9.8, row behind 9.5/9.6	Mostly complete	Detailed outline	Limited/ none	No clear association to natural features
	PA9.8	Horse	Tiered above 9.7	Head	Detailed outline	Direct	Dorsal line represented by a natural crack. Nostril represented by a natural crack
	PA9.9	Aurochs?	Stacked under 9.7 and 9.8	Mostly complete	Simple outline	Direct?	Faded depiction. Dorsal line may continue a natural crack
<b>PA10</b>	PA10.1	Aurochs	Isolated	Complete	Simple outline	Direct and parallel	Ventral line follows the edge of the rock surface
	PA10.2	Horse?	Tiered above 10.2	Neck and front leg?	Simple outline	Limited/ none	No clear association to natural features
	PA10.3	Stag	Tiered above 10.4	Cervico-dorsal line	Simple outline	Parallel	Head runs parallel to a natural crack
	PA10.4	Aurochs	Tiered under 10.3, row behind 10.5	Complete	Infilled, detailed outline	Direct?	Legs may be intentionally mapped onto natural cracks
	PA10.5	Deer	Row in front of 10.4	Head	Simple outline	Direct?	Depiction may intentionally use natural cracks to suggest antlers
<b>PA11</b>	PA11.1	Ibex	Tiered above PA11.2	Mostly complete	Detailed outline	Limited?	Difficult to assess the relationship with the cave wall
	PA11.2	Ibex	Tiered under 11.2	Mostly complete	Detailed outline	Direct	Dorsal line is mapped onto a natural crack
	PA11.3	Horse	Isolated	Mostly complete	Simple outline	Parallel	Rear and front leg both run parallel to natural cracks
	PA11.4	Indeterminate	-	Mostly complete?	Simple outline	Limited/ none	Difficult to assess the relationship with the cave wall
<b>PA12</b>	PA12.1	Horse	Confronting PA12.2	Complete	Detailed outline	Parallel	Rear runs parallel to a suggestive contour; front leg runs parallel to a natural crack

	PA12.2	Aurochs	Confronting PA12.1	Mostly complete	Simple outline	Limited	Appears to be a loose relationship between natural cracks and the depiction, but difficult to assess
	PA12.3	Ibex?	Tiered under PA12.1 and PA12.2.	Forequarters	Simple outline	Limited/ none	No clear association to natural features
	PA12.4	Horse	Tiered under PA12.1 and PA12.2.	Mostly complete	Stylised	Direct	Front and rear legs are mapped onto a suggestive contour
	PA12.5	Horse	Tiered under PA12.4	Head	Simple outline	Direct	May follow natural cracks, but the association is unclear
	PA12.6	Horse	Row in front of PA12.4	Head	Simple outline	Direct	Mapped onto a suggestive contour
	PA12.7	Aurochs	Row in front of PA12.5	Forequarters	Simple outline	Direct	Mapped onto a suggestive contour, horns are mapped onto natural cracks
	PA12.8	Hind	Tiered under PA12.7?	Mostly complete	Simple outline	Limited/ none	No clear association to natural features
	PA12.9	Indeterminate	Isolated	Rear and dorsal line	Simple outline	Direct	Appears to follow suggestive contour, with the ventral line suggested by edge of rock surface
	PA12.10	Horse	Row with PA12.11	Forequarters	Simple outline	Limited/ none	No clear association to natural features
	PA12.11	Hind	Row with PA12.12	Forequarters	Simple outline	Direct	Head mapped onto a suggestive contour and cracks represent the neck
	PA12.12	Hind	Confronting PA12.11, tiered above PA12.13 and PA12.14	Forequarters	Simple outline	Limited	May be intentionally mapped onto a concavity, but difficult to assess
	PA12.13	Horse	Tiered under PA12.12	Forequarters	Simple outline	Limited	No clear association to natural features
	PA12.14	Horse	Tiered under PA12.13	Head	Detailed outline	Limited	No clear association to natural features

### 7.3.3. Relationship to the cave wall: Gallery A

The depictions within gallery A express a variety of relationships to the cave wall, with the slight majority (58%, n=38) having a direct or parallel relationship to natural features that appear to have been intentionally integrated into the form, but the remainder (42%, n=27) appeared to have a limited or no relationship to the cave wall. Where natural features are integrated into the depiction, these are rarely used to directly represent aspects

of the animal form; with notable exceptions, such as depiction PA2.3 (Figure 7.5). Instead, lines appear to be mapped directly on top of the natural forms. The use of finger dots or smears within some of these depictions alludes to the importance of tactile interaction in the initial perceptual response to natural forms and invites a deeper consideration of this facet of the



Figure 7.5. Depiction PA2.3 which appears to make use of a natural features to represent the head and front leg of the horse. Image: Author.

depictions' biographies. This may imply that whilst the initial visual response was perhaps less potent than those observed for depictions in Las Monedas (see Chapter 6), tactile interaction played a larger role in informing the perception of natural features and perhaps helped to visually resolve ambiguous stimuli. Direct relationships to natural features also appear to take the form of extending natural features, such as cracks, with a depicted line that then forms part of the depiction.

Although there are a number of depictions that appear to not have an immediate relationship to topographical features of the cave wall, this does not necessarily mean they are placed on flat, amorphous areas of the cave wall. For the majority of depictions in Gallery A, the surrounding spatial context alludes to some deliberate placement of the depictions to manipulate the perspective of the observer, either through influencing the position a person needs to be in order to view depictions that may be otherwise hidden from view or by the unusual placement of depictions in constrained spaces, that allow for only one or two individuals to observe the motifs at any one time. The selection of these spaces may provide important insights into aspects of the biographical making of the depictions, both the visual psychological responses to areas of the gallery, and the subsequent reception and interaction with these depictions. The constrained spatial context of these depictions may also have resulted in unusual lighting effects that affected the visual and perceptual response to the cave wall; this is an important consideration for the VR lighting simulations.

#### 7.3.4. Stylistic analysis: Gallery A

As with Chapter 6, the stylistic analysis attempted to understand the variation in depicting animals in Gallery A to determine which features of an animal might vary between depictions and whether this might be the result of specific visual perceptual responses and/or material engagements with the cave wall. For the depictions in gallery A, the unique style of depictions that uses a combination of finger dots, smearing pigment with the hand, and brush techniques in depicting the outline of an animal alludes to distinct phases in producing a depiction, which may correspond to shifting engagements occurring in the dialogical making.

Horse depictions in gallery A share features characteristic of securely dated Solutrean to early Magdalenian horse depictions in northern Spain, further supporting this stylistic attribution. The majority of these horse depictions have no distinct mane (i.e., no parallel line is drawn external to the dorsal line to indicate a mane) but feature a vertical line between the anterior end of the dorsal line and the head. This is often referred to as a “stepped mane” and is a common feature of Solutrean horse depictions (Bicho *et al.* 2007,103). The horse depictions at La Pasiega also share stylistic features with examples dating between the Solutrean to early Magdalenian in Cantabria from cave art sites such as La Haza, Covalanas, and Ekain (Figure 7.6), including detailed manes, raised tails, and the use of only a vertical line between the head and dorsal line to suggest a mane. The position of the tail as anatomically too low and slightly raised in a number of the depiction in La Pasiega is also shared with Solutrean and early Magdalenian horse depictions elsewhere in northern Spain, referred to as the “Pyrenean style” by Ochoa and García Díez (2015) who attribute this to the early Magdalenian. The use of finger dots to represent the outline of the animal is also a common feature of Solutrean depictions more generally.

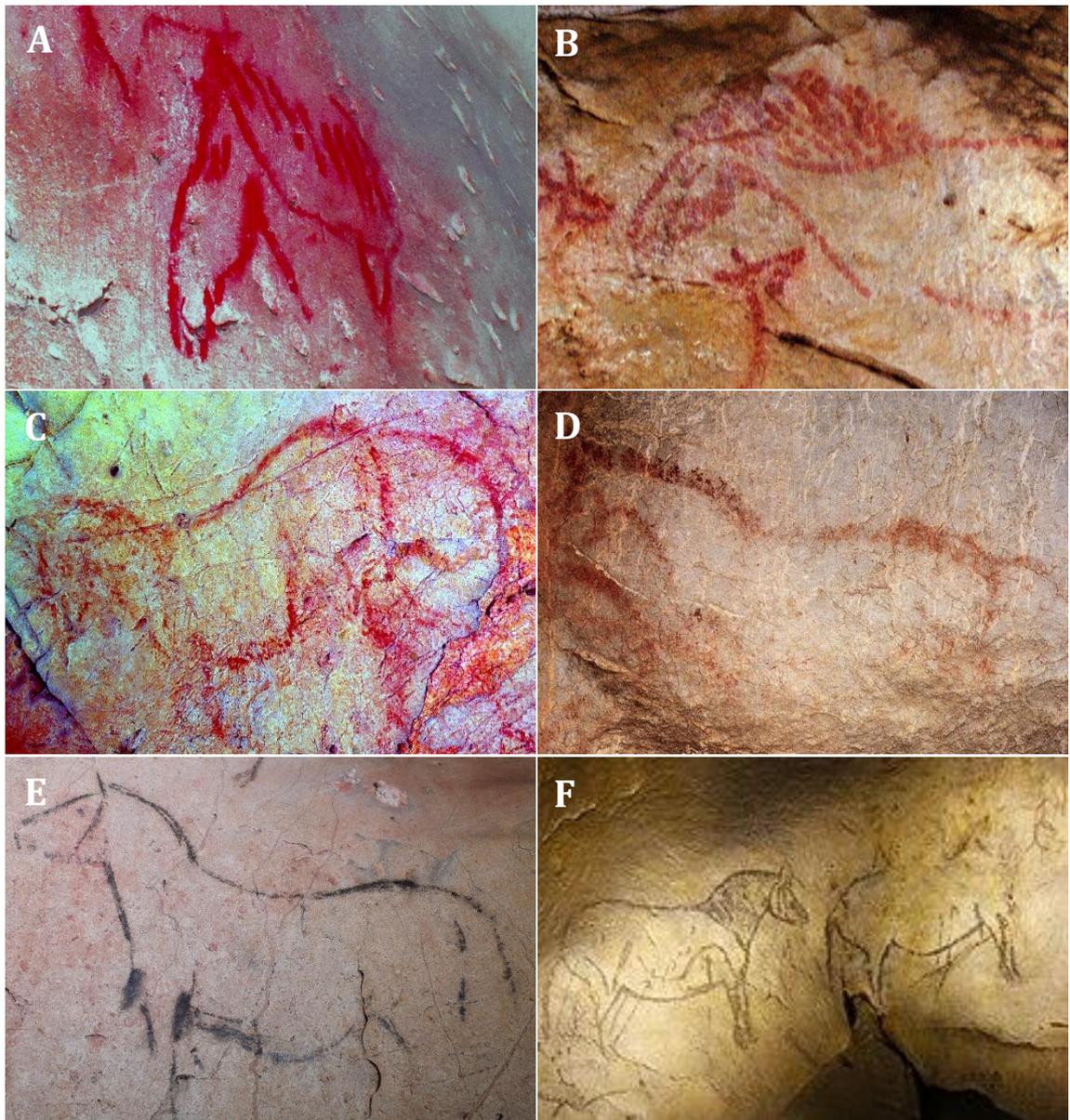


Figure 7.6. Horse depictions PA12.14 (A), PA9.3 (C), and PA9.7 (E) compared to contemporary examples from Covalanas (B), La Haza (D), and Ekain (F). Images (A, C, E): Author. Image (B): <https://latitude65.ca/covalanas-cave>. Image (D): García Díez and Equizabal Torre (2007). Image (F): Wikimedia commons.

Whilst the horse depictions in gallery A appear to conform to the typical cultural style of the late Solutrean-early Magdalenian, there are a few features that invite further evaluation. Although most horse depictions are represented in static positions, with rigid legs and heads placed in a neutral position, some deviate away from this to capture more dynamic behaviours. Depiction PA5.3, for example, is represented with its front legs extended forward in a position evocative of galloping or falling, akin to the “falling cow” from Lascaux (Figure 7.7). This position of limbs on horse depiction is also seen in other depictions from the late Solutrean-early Magdalenian, most notably at Lascaux, but also elsewhere such as Depictions PA5.5, PA6.1, PA9.4, and PA12.1 also have unusual leg positions, with the front and/or rear legs placed in a twisted positioned i.e., side-by-side. This may be an attempt to capture the walking movement of horses, rather than difficulty

with drawing multiple limbs. Depiction PA6.1, for example, has its front legs positioned as parallel to one another, but rear legs in a twisted position.



Figure 7.7. DStretch image of depiction PA5.3 with its front legs extended out, to give the impression of galloping. Image: Author.

In addition, the inconsistency in the level of detail used to represent a horse varies significantly within Gallery A – sometimes within the same panel - with some horses suggested by only the rear and tail or a simplified head, and others depicted as complete with detailed manes or partial infill to represent pelage (Table 7.5). This encourages a deeper evaluation of the factors that may have influenced the particular style of the depictions, and whether this might relate to the visual perceptual response during the making of the art.

Table 7.5. Stylistic features of horse depictions in Gallery A, La Pasiega. \* Indicates stylistic trait is shared by over 50% of the depictions.

Stylistic trait	Depiction no.
No distinct mane*	PA2.3; PA2.4; PA3.1; PA4.2; PA4.3; PA9.3; PA9.4; PA9.7; PA10.2; PA11.3; PA12.5; PA12.6; PA12.10; PA12.13
Stepped mane (vertical line)*	PA2.4; PA3.1; PA4.2; PA4.3; PA5.3; PA6.1; PA7.2; PA9.7; PA9.8; PA12.5; PA12.10; PA12.13
Bun-shaped mane (curved line)	PA9.4
Internal line defining mane	PA12.1; PA12.14
External line defining mane	PA5.5; PA7.2; PA9.8; PA12.4
Vertical lines detailing mane	PA5.3; PA6.1; PA9.8; PA12.1; PA12.14
Infilled head	PA9.3; PA9.4
No head	PA2.3; PA10.2

Triangular shaped head	PA2.4; PA4.2; PA9.3; PA9.4; PA9.7; PA12.5; PA12.6; PA12.10
Globular shaped head	PA7.2; PA12.4; PA12.13
Naturalistic shaped head (curved/defined jaw and nose)	PA3.1; PA4.3; PA5.3; PA6.1; PA9.8; PA11.3; PA12.1; PA12.14
Eye represented	PA3.1; PA5.3; PA9.7; PA9.8; PA12.14
Nostril represented	PA4.3
Pelage on head represented	PA4.3; PA9.3; PA9.7; PA9.8
Pelage on body represented	PA12.4; PA12.14
Y-shaped front legs	PA9.7; PA12.4; PA12.10; PA12.13
Single line front legs	PA5.3; PA5.5; PA6.1; PA9.3; PA9.4; PA10.2; PA11.3; PA12.1
Y-shaped rear legs	PA2.3; PA5.4; PA9.4; PA9.7; PA11.3; PA12.4
Single line rear legs	PA6.1; PA12.1
Finger dot outline	PA2.4; PA3.1; PA6.1; PA9.4; PA12.1
Flat ventral line	PA5.5; PA9.4; PA12.1; PA12.4; PA12.10
M-shaped ventral line	PA2.3; PA4.2; PA5.3; PA9.3; PA9.7; PA11.3
Long tail (extending to length of legs)	PA5.4; PA6.1; PA9.3; PA9.4; PA9.7; PA12.1
Short tail (stopping before legs begin)	PA2.3; PA4.2; PA5.3; PA5.5; PA7.2
Raised tail	PA2.3; PA4.2; PA9.3; PA9.7
Tail continues from dorsal line	PA2.3; PA5.4; PA5.5; PA6.1; PA9.7
Tail positioned low	PA2.4; PA4.2; PA5.3; PA6.1; PA7.2; PA9.3; PA9.4

Hind depictions are the second most common motif in Gallery A, and express remarkable homogeneity in style (Table 7.6). Almost all hind depictions are depicted with a triangular shaped head, diverging lines above the head representing ears, with a relatively flat dorsal line, and are often incomplete (Figure 7.8) Some depictions (e.g. PA1.1, PA5.1) are reduced to just represent the cervico-dorsal line, but are still identifiable as representing hinds. This reduction of form to the most basic, salient features is common throughout the Upper Palaeolithic and is particularly characteristic of Solutrean and early Magdalenian art. There are, however, notable exceptions that diverge from the standard stylistic form of hinds in this gallery and again, this appears to be an attempt to capture behaviours and movement of the animals (Figure 7.9). Depiction PA7.9 is depicted with its head in a twisted position as if it is looking back on itself, depiction PA7.8 is represented with its head raised high and neck extended, depiction PA7.10 appears to be represented with its head raised and ears pricked, as if in an alerted state, and depiction PA12.8 also seems to be depicted with an extended neck. This attention to representing different behaviours clearly indicates the familiarity the artists had with these animals, but invites a consideration of why certain hinds are represented as dynamic and detailed, and others are

represented only by the most basic salient form; this will be explored further through the biographical framework in section 7.4.



Figure 7.8. DStretch image of depiction PA5.1 and PA5.2, which represent two incomplete hinds reduced to just the cervico-dorsal line. Image: Author, courtesy of the Gobierno de Cantabria.

Figure 7.9. DStretch images of (A) depiction 7.8 (B) depiction 7.9 (C) depiction 7.10 and (D) depiction 12.8. Image: Author.

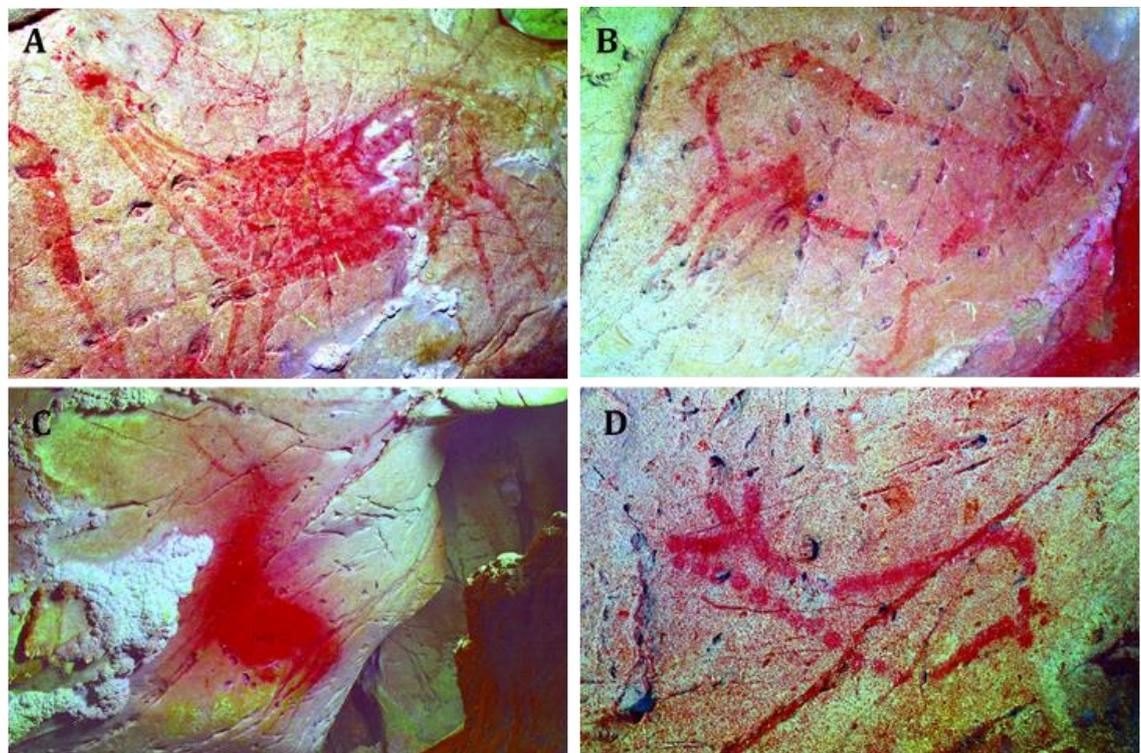


Table 7.6. Stylistic features of hind depictions in Gallery A, La Pasiega. \* Indicates stylistic trait is shared by over 50% of the depictions.

<b>Stylistic trait</b>	<b>Depiction no.</b>
Head represented by single line	PA1.1; PA5.1
Triangular head*	PA2.1; PA5.2; PA6.1; PA7.1; PA7.4; PA7.5; PA7.6; PA7.7; PA7.8; PA7.9; PA7.10; PA8.2; PA9.1; PA9.2; PA9.6; PA10.5; PA12.8; PA12.11; PA12.12
Infilled head	PA2.1; PA7.8; PA7.9; PA7.10
Detailed head	PA8.2
Twisted head	PA7.9
Diverging lines representing ears*	PA1.1; PA2.1; PA5.1; PA5.2; PA6.1; PA7.1; PA7.4; PA7.5; PA7.6; PA7.7; PA7.9; PA8.2; PA9.1; PA9.2; PA9.6; PA10.5; PA12.8; PA12.11; PA12.12
Finger dot dorsal line	PA1.1; PA2.1; PA5.1; PA12.8
Y-shaped front legs	PA7.8; PA8.2; PA9.1
Single line front legs	PA6.1; PA7.6; PA7.9; PA7.10; PA9.2; PA9.6; PA12.12
Y-shaped rear legs	PA6.1; PA7.9; PA8.2; PA9.6; PA12.8
Single line rear legs	PA7.4; PA7.8; PA7.10; PA9.2
Infilled body	PA7.8; PA7.10
Tail represented	PA7.4; PA7.9; PA8.2; PA9.1
No tail*	PA5.2; PA6.1; PA7.6; PA7.8; PA7.10; PA9.2; PA9.6; PA10.5; PA12.8; PA12.12

Stag depictions are also relatively homogenous in this gallery, with very few variations between each depiction (Table 7.7). All stag depictions feature a triangular head, with large, detailed antlers and are often depicted with an eye and the mouth open, perhaps to capture roaring vocalisations that are made during rutting season. The large antlers depicted on the stags could also correspond to an attempt to capture stags during the rutting season, where antlers reach their full maturity (Elliott 2012, 212; Langley and Wisler 2019). In addition, the placement of stag depictions PA8.1 and PA8.3, either side of a hind (PA8.2) may further be an attempt to encapsulate rutting behaviours, perhaps intending to capture the interaction of stags and hinds before mating. Whilst the stylistic features of stag depictions are relatively homogenous, the depictions do vary in both the use of different colourants – with reds, yellow-browns, and blacks used – and in their degree of completeness; three depictions (PA3.2; PA8.1; PA10.3) are reduced to a cervico-dorsal line; two depictions represent the complete head and dorsal line; one depiction is represented by the head only; and only one depiction (PA8.3) is complete. It is interesting to note that whilst all stag depictions have a direct relationship with natural features in the cave wall, the complete depiction (PA8.3) has no apparent relationship with natural features and is

placed on a relatively amorphous area of the wall. This may suggest that the visual response and subsequent material interaction with natural features may be the reason behind the incompleteness of the majority of stag depictions, and potentially that the natural topography of the cave wall suggests the rest of the stag form.

*Table 7.7. Stylistic features of stag depictions in Gallery A, La Pasiega. \* Indicates stylistic trait is shared by over 50% of the depictions.*

<b>Stylistic traits</b>	<b>Depiction no.</b>
Head represented by a single line	PA3.2; PA8.1; PA10.3
Triangular head*	PA2.5; PA3.3; PA4.1; PA8.3
Mouth depicted open	PA2.5; PA3.3; PA8.3
Eye depicted	PA2.5; PA8.1; PA10.3
Antlers branch up and back	PA3.2; PA8.1; PA8.3
Antlers branch forwards and back*	PA2.5; PA3.3; PA4.1; PA10.3
Tines depicted only on rear antler	PA2.5; PA3.3
Tines depicted on both antlers*	PA4.1; PA8.1; PA8.3; PA10.3
Tines not depicted	PA3.2
Tail depicted	PA8.3

Aurochsen are similarly depicted with a degree of homogeneity in their general style, albeit with subtle stylistic variations in certain features, such as horns and the shape of the head (Table 7.8). There is an approximate even split between the use of S and C-shaped horns, and C-shaped horns only; this may be a consequence of preference by an artist in representing the perspective of horns, rather than a significant stylistic variation. A number of aurochs depictions are infilled with details in the form of vertical lines used to presumably depict pelage for depictions PA7.3, PA9.5, PA9.9, and PA10.4 (Figure 7.10). This represents a significant departure from the typical style of depictions in Gallery A, which generally tends to conform to simplistic outlines that represent only the basic anatomical features of animals.

*Table 7.8. Stylistic features of aurochs depictions in Gallery A, La Pasiega. \* Indicates stylistic trait is shared by over 50% of the depictions.*

<b>Stylistic traits</b>	<b>Depiction no.</b>
S and C shaped horns	PA12.2; PA12.7; PA7.3
C shaped horns only	PA9.5; PA10.1; PA10.4
Rectangular shaped head*	PA7.3; PA9.9; PA10.1; PA12.2; PA12.7
Triangular shaped head	PA9.5; PA10.4
Eye depicted*	PA7.3; PA10.1; PA12.2; PA12.7
Mouth depicted open	PA9.9; PA12.2
Infilled head/neck	PA7.3; PA9.5; PA9.9

Infilled body	PA10.4
Dorsal hump*	PA7.3; PA9.9; PA10.1; PA12.2; PA12.7
Finger dot outline	PA9.9; PA12.2
Y-shaped front legs	PA9.9; PA10.1
Single line front legs	PA7.3; PA10.4; PA12.7
Y-shaped rear legs	PA7.3; PA10.1; PA10.4
Tail depicted raised	PA7.3; PA10.1; PA10.4
No tail depicted	PA10.4; PA12.2

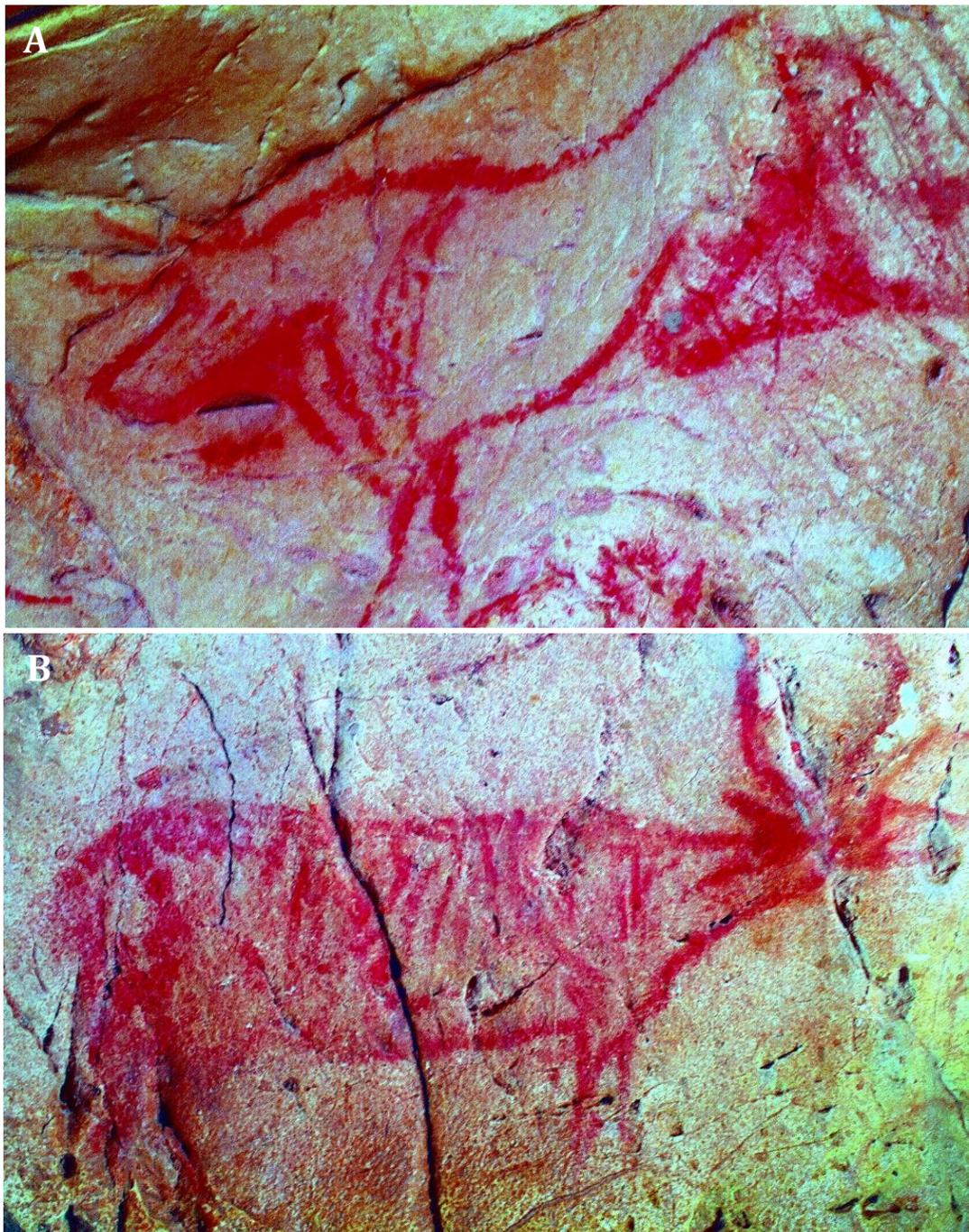


Figure 7.10. DStretch images of A) depiction PA7.3 with infilling on the head and shoulder and B) depiction PA10.4 with infilling across the body. Both appear to have infilling produced with finger smears. Images: Author.

However, whilst all depictions are attributed as representing aurochs by virtue of their narrow, elongated heads (in comparison to the shorter, squarer heads of bison), the presence of a dorsal hump in some depictions and a flat dorsal line in others may represent different species, or subspecies, being represented. Depictions with a flat dorsal line, such as depictions PA9.5 and PA10.4, tend to have a narrow, more triangular shaped head. The depictions that exhibit a dorsal hump, and have elongated, rectangular heads may possibly be intending to represent wisent; a species closely related to bison that is often overlooked in classifications of Palaeolithic depictions. Spassov and Stoytchev (2003) identify depictions in Palaeolithic cave art sites such as Carriot and Pair-non-Pair that have similar features, such as a dorsal hump and extended, rectangular face, as perhaps representing wisent (Figure 7.11). However, in Gallery A, the presence of similar patterns of infilled details across examples of “aurochs” and “wisent” appears to blur this category. Consequently, they are treated within the same category of “aurochs” here to reflect the artist(s) treatment of these depictions as similar, even if this is likely an inaccurate classification for some of these depictions.

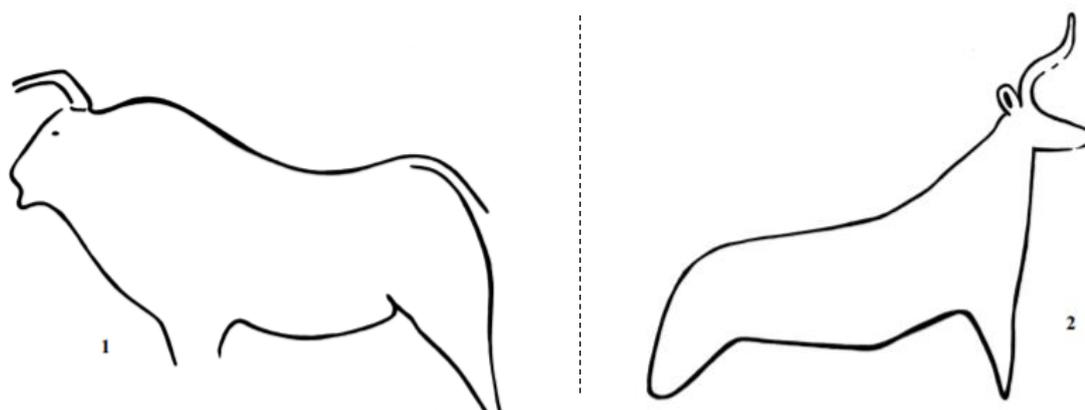


Figure 7.11. Example of the differences between a wisent (left) depiction from Pair-non-Pair cave and an aurochs (right) depiction from Ebou cave. Note the similarities between the wisent depiction and PA7.3, and the aurochs depiction and PA10.4 (see Figure 7.33). Image after: Spassov and Stoytchev 2003, 127.

## 7.4. Results and Discussion

### 7.4.1. Stage 1: Before entering the cave

Before entering La Pasiega to produce depictions, the particular cultural and ecological conditions of the late Solutrean-early Magdalenian (c. 22,000 – 19,000 cal. B.P.) would have informed aspects of the art making in Gallery A, particularly the visual expertise of the artists and cultural “norms” in the depiction of certain animals. During this period, climatic conditions would have been arid and cold, yet gradually warming as the climatic conditions of MIS2 began to ease. The ameliorating environment would have likely structured the relationships between Cro Magnons at La Pasiega and certain animal species,

in turn informing the visual expertise of these Upper Palaeolithic people. The gradually declining presence of cold-adapted species such as reindeer, megaloceros, and bison was likely recognised and perhaps accounts for the rarity of these species within La Pasiega. By contrast, the continual presence of species such as horse and possibly red deer, with the latter species likely expanding in population, may have increased their importance to Cro Magnon groups. At the onset of the Magdalenian period, Cro Magnons were specialised in hunting horse and red deer, and undoubtedly had visual expertise in recognising the characteristics and behaviours of these species. In particular, they would have been attuned to the seasonal rhythms of these species, from migration patterns to mating, and identified how these rhythms affected the herd dynamics. The possible new, or at least increasing, presence of species adapted to warmer climates, such as aurochs, perhaps would have necessitated a process of learning in these groups, to become accustomed to these new species' behaviours. Attention may have been particularly paid to salient features of these animals, to hone the ability to visually distinguish these species whilst observing, tracking, and hunting. For aurochs, this may concern the cervico-dorsal line and the features that differentiate this species from other animals with similar features, like bison or wisent. The blurring of stylistic features between depictions that may represent aurochs and wisent in Gallery A, therefore, may reflect the artists beginning to develop visual familiarity with these species, but perhaps still finding difficulty in distinguishing the two.

The ameliorating conditions would have not only supported the increasing presence of warmer-adapted flora and fauna, but also a population increase from approximately 5,885 people during the LGM to over 28,800 at the onset of the Magdalenian (Bouquet-Appel and Demars 2000, 568; Bouquet-Appel 2005, 1664; Maier 2017, 91). This increasing population likely resulted in more extensive, interconnected social networks, which may have shared social and cultural values. Indeed, the shared stylistic features of depictions within Gallery A to sites elsewhere in northern Spain, as discussed in the stylistic evaluation, appears to reflect this increasing interconnectedness of the late Solutrean-early Magdalenian world. The rich culture of artistic making that proliferates across Europe in the late Solutrean and certainly Magdalenian periods is important contextual information for understanding the art within La Pasiega. The extensive preparation of pigments evidenced by the presence of a "paint palette" – a limestone plaque that is heavily ochred on one surface (Figure 7.12) - in the cave clearly indicates the artistic expertise of the inhabitants of La Pasiega.



*Figure 7.12. The "paint palette" within Gallery A of La Pasiega, with a heavy deposit of a red ochre paint mixture on the upper surface. The palette was likely moved from its original location in the cave during work in the 1950's. Image: Author.*

This, particularly when taken with the presence of cave art depictions in the occupation areas of the cave that would have received daylight, alludes to art making being a deeply layered cultural behaviour. This may have been one means of Upper Palaeolithic people to structure and negotiate relationships with animals, and was certainly situated within a broader repertoire of artistic behaviour. Whilst the specific meaning of the art is lost, aspects of meaning embedded within the making – the way the artist(s) negotiated tensions in agency between animal subject, visual phenomena caused by light dispersing across undulating surfaces, and material engagements – may be revealed through the biographical framework. This ecological and cultural milieu within which the art of Gallery A in La Pasiega is situated suggests that the artist(s) not only intended to produce art within this area of the cave, but extensively prepared for this venture. The intentionality behind this behaviour serves to elevate the insights revealed through the framework, particularly with regard to the visual and perceptual response. The artist(s) may not have been beholden to the psychological phenomena they may have experienced in this environment, but perhaps anticipated this experience, deliberately engaging with and “listening” to their visual and perceptual response during the art making process.

#### *7.4.2. Stage 2: Visual and perceptual response*

As the artist(s) in La Pasiega ventured deeper into the cave and away from their habitation area in Gallery B, the familiar rhythms and vistas of their daily life would have

faded, replaced by an encompassing darkness. Stimuli from a heightened sensory awareness would have coalesced, enriching their perception within this unfamiliar environment and allowing them to navigate through the narrow cave system under the dim light cast from their torch. To determine how the immediate visual and perceptual psychological responses to the commingling of undulating cave wall topographies and dynamic light informed the subsequent making of depictions, three hypotheses were formulated. These were based on the conceptual understanding of visual responses to a low light source in dark ambient conditions discussed in Chapter 4 and insights generated for Las Monedas in Chapter 6.

**Hypothesis 1)** Cave wall models that experience high variations in RLV should feature depictions that have a direct relationship to natural features. Fluctuating RLV may have been conducive to triggering pareidolic or hyper-imagery responses due to the resulting visual ambiguity, and consequently depictions may have been scaffolded on the features responsible for this visual imagery.

**Hypothesis 2)** Cave wall models that receive lower-than-average RLV should feature depictions that have tactile elements embedded into their form (i.e. finger dots or smears). Haptic stimuli have been demonstrated to be important to enriching visual information, with the perceptual system integrating visual and haptic information to form an understanding of ambiguous stimuli (Ernst and Banks 2002; Helbig and Ernst 2007; Gaissert and Wallraven 2011; Jansson-Boyd 2011; Björkman *et al.* 2013) and perception may even be distorted if haptic stimuli does not match visual inputs (Ide and Hidaka 2013). Therefore, in areas of the cave wall that received low RLV, the chance of tactile interaction should be higher.

**Hypothesis 3)** As predicted by construal level effect, where lower light conditions result in more abstract, generalised thinking and brighter conditions allow for detailed thinking, there should be a relationship between areas that receive the highest RLV and detailed depictions, and areas that receive the lowest RLV and simplistic depictions.

Table 7.9. Summary of the RLV results, identifying whether this supports each of the proposed hypotheses. For hypothesis 1, a result was considered as supporting this hypothesis if a depiction with a direct relationship had a average RLV variation higher than 18.3% (the average across all depictions) or a depiction with a limited relationship had a variation lower than 18.3%. For hypothesis 2, a result was considered as supporting the hypothesis if a depiction had tactile marks and an overall average RLV lower than 11.4% (overall average RLV for all depictions) and equally if a non-tactile depiction had an average RLV higher than 11.4%. For hypothesis 3, a depiction was considered to support the hypothesis if it was detailed and had a higher-than-average overall (11.4%) and average bright RLV (higher than 14.2%), or was simple and had a lower-than-average overall RLV or lower average dim RLV (lower than 9%).

Depiction	Animal depicted	Relationship to cave wall	Complete/incomplete	Detailed/simple	Tactile marks?	RLV max. variation	RLV average (overall)	RLV bright average	RLV dim average	RLV profile	RLV profile comments	Supports hypotheses?
PA01.1	Hind	Direct	Incomplete	Simple	Y	10.4%	12.39%	15.06%	9.73%	Steady	Flat until 20cm, then steady drop off to 60cm	1: N 2: N 3: N
PA02.1	Hind	Direct	Incomplete	Simple	Y	10.9%	5.77%	7.33%	4.20%	Flat	Slight fluctuations	1: N 2: Y 3: Y
PA02.1 (right)	Hind	Direct	Incomplete	Simple	Y	20.4%	10.32%	12.71%	7.93%	Steady	Steady drop off	1: Y 2: Y 3: Y
PA02.2	Bison	Direct	Incomplete	Simple	Y	23.6%	9.41%	11.86%	6.95%	Complex	Steep drop to 5cm, increase at 20cm, steep drop at 30cm, increase at 40cm, then steady drop to 60cm	1: Y 2: Y 3: Y
PA02.2 (right)	Bison	Direct	Incomplete	Simple	Y	21.0%	13.81%	17.80%	9.82%	Steady	Slight increase at 5cm and 60cm, but steady drop off	1: Y 2: N 3: N
PA02.3 - PA2.5	Horse and stag	Direct (PA2.3)	Complete	Simple	N	28.3%	12.37%	16.38%	8.37%	Steep	Steep drop to 20cm, then steady drop 30-60cm	1: Y 2: Y 3: N
PA02.3 - PA2.5	Horse and stag	Direct (PA2.3)	Complete	Simple	N	19.2%	13.58%	16.40%	10.75%	Steady	Slight drop at 20cm	1: Y 2: Y 3: N

<b>PA03.1</b>	Horse	Direct	Incomplete	Simple	Y	16.2%	11.15%	14.76%	7.55%	Steady	Slight increase to 10cm, but steady drop to 60cm	1: N 2: Y 3: N
<b>PA03.1 (right)</b>	Horse	Direct	Incomplete	Simple	Y	16.0%	12.15%	15.93%	8.37%	Complex	Increase 5-20cm, drop at 30cm, increase to 50cm, drop at 60cm	1: N 2: N 3: N
<b>PA03.3</b>	Stag	Direct	Incomplete	Simple	N	35.1%	12.85%	15.90%	9.80%	Steep	Steep drop to 40cm, slight increase 40-60cm	1: Y 2: Y 3: N
<b>PA03.3 (right)</b>	Stag	Direct	Incomplete	Simple	N	27.5%	10.83%	13.72%	7.95%	Steep	Slight increase at 30cm, but steep drop 0-20, 30-50	1: Y 2: N 3: Y
<b>PA04.1</b>	Stag	Direct	Incomplete	Detailed	Y	15.5%	11.60%	14.58%	8.62%	Complex	Increase until 10cm, then steady drop to 60cm	1: N 2: N 3: Y
<b>PA04.1 (right)</b>	Stag	Direct	Incomplete	Detailed	Y	17.9%	10.26%	13.00%	7.53%	Steady	Slight increase at 20cm	1: N 2: Y 3: N
<b>PA04.2</b>	Horse	Limited	Complete	Simple	N	17.3%	12.94%	16.99%	8.89%	Complex	Slight increase 5-30cm, then steady decrease to 60cm	1: Y 2: Y 3: N
<b>PA04.2 (right)</b>	Horse	Limited	Complete	Simple	N	27.9%	12.57%	15.41%	9.74%	Steep	Steep decrease 0-5cm, slight increase at 10cm, but steep decrease to 60cm	1: N 2: Y 3: N
<b>PA04.3</b>	Horse	Limited	Incomplete	Simple	N	11.2%	6.47%	8.56%	4.37%	Flat	Steep decrease 0-10cm bright value only	1: Y 2: N 3: Y

<b>PA05.1 and PA5.2</b>	Hind	Direct	Incomplete	Simple	Y	15.6%	11.70%	14.52%	8.87%	Steady	Slight increase 20-30cm, but steady	1: N 2: N 3: N
<b>PA05.3</b>	Horse	Direct	Complete	Detailed	N	23.1%	14.79%	19.50%	10.09%	Steep	Steady until 10-20cm, then steep drop to 60cm	1: Y 2: Y 3: Y
<b>PA05.3 (right)</b>	Horse	Direct	Complete	Detailed	N	10.6%	11.46%	14.11%	8.81%	Steady	Very steady drop	1: N 2: Y 3: N
<b>PA05.4</b>	Horse	Direct	Incomplete	Simple	N	20.4%	9.98%	13.23%	6.74%	Steady	Steep drop between 5cm-20cm, increase at 30cm, then steady	1: Y 2: N 3: Y
<b>PA05.5</b>	Horse	Limited	Complete	Simple	N	5.5%	7.16%	9.04%	5.29%	Flat	Level RLV	1: Y 2: N 3: Y
<b>PA06.1</b>	Horse	Limited	Complete	Simple	Y	15.7%	12.94%	16.09%	9.79%	Complex	Flat until 20cm, then increase to 30cm, steep drop to 50cm, increase at 60cm	1: Y 2: N 3: N
<b>PA06.2</b>	Hind	Direct	Complete	Simple	N	15.3%	12.25%	13.83%	10.67%	Complex	Fluctuates between 10-40cm	1: N 2: Y 3: N
<b>PA06.2</b>	Hind	Direct	Complete	Simple	N	11.3%	12.51%	15.25%	9.77%	Flat	Fairly level RLV	1: N 2: Y 3: N
<b>PA07.01</b>	Hind	Limited	Incomplete	Simple	N	31.1%	14.68%	17.82%	11.54%	Steep	Slight increase at 20cm, but steep drop to 60cm	1: N 2: Y 3: N
<b>PA07.01</b>	Hind	Limited	Incomplete	Simple	N	26.2%	11.71%	14.91%	8.51%	Steep	Slight increase to 5-10cm, then steep drop to 50cm	1: N 2: Y 3: N

<b>PA07.02</b>	Horse	Limited	Incomplete	Simple	N	18.2%	12.46%	14.37%	10.54%	Steep	Increase to 10cm, then steep drop to 40cm	1: Y 2: Y 3: N
<b>PA07.03</b>	Auroch	Direct	Complete	Detailed	N	17.3%	11.04%	13.83%	8.26%	Steady	n/a	1: N 2: N 3: N
<b>PA07.03</b>	Auroch	Direct	Complete	Detailed	N	13.6%	10.48%	13.82%	7.14%	Steep	Steep drop-off after 40cm	1: N 2: N 3: N
<b>PA07.04</b>	Hind	Direct	Complete	Simple	N	27.7%	12.18%	15.56%	8.80%	Steep	Steep drop-off from 0cm-20cm	1: Y 2: Y 3: N
<b>PA07.04</b>	Hind	Direct	Complete	Simple	N	16.8%	10.71%	13.34%	8.09%	Complex	Increase at 10cm, steady drop from 20cm	1: N 2: N 3: Y
<b>PA07.05</b>	Hind	Limited	Incomplete	Simple	N	18.0%	12.79%	16.30%	9.28%	Steady	n/a	1: Y 2: Y 3: N
<b>PA07.06</b>	Hind	Direct?	Incomplete	Simple	N	19.3%	12.70%	16.16%	9.24%	Steep	Steep drop-off 0cm-20cm, then increase to 40cm before steady drop	1: Y 2: Y 3: N
<b>PA07.06</b>	Hind	Direct	Incomplete	Simple	N	18.0%	12.88%	15.97%	9.80%	Steep	Steep drop-off 10cm-40cm, then flat	1: N 2: Y 3: N
<b>PA07.07</b>	Hind	Limited	Incomplete	Simple	N	16.5%	17.05%	19.91%	14.20%	Steady	Steady drop off	1: Y 2: Y 3: N
<b>PA07.08</b>	Hind	Limited	Complete	Detailed	N	21.9%	14.87%	18.33%	11.40%	Steady	Steady drop off	1: N 2: Y 3: Y
<b>PA07.08</b>	Hind	Limited	Complete	Detailed	N	10.5%	10.76%	14.03%	7.49%	Flat	Some fluctuation 5cm-20cm, but mostly flat	1: Y 2: N 3: N

<b>PA07.09</b>	Hind	Limited	Complete	Detailed	N	22.4%	16.25%	19.18%	13.31%	Complex	Steep drop 10cm-20cm, then increase at 30cm, steep drop 30cm-50cm	1: N 2: Y 3: Y
<b>PA07.09</b>	Hind	Limited	Complete	Detailed	N	20.4%	16.26%	20.65%	11.87%	Steady	Flat until 20cm, then steady drop	1: N 2: Y 3: Y
<b>PA07.11</b>	Hind	Limited	Complete	Detailed	N	12.4%	10.99%	14.15%	7.82%	Flat	Some fluctuation 30cm-50cm	1: Y 2: N 3: N
<b>PA07.11</b>	Hind	Limited	Complete	Detailed	N	9.9%	12.07%	15.35%	8.79%	Flat	Some fluctuation 30cm-50cm	1: Y 2: Y 3: N
<b>PA08.1</b>	Stag	Limited	Incomplete	Simple	N	36.3%	20.87%	23.80%	17.94%	Steep	Steep drop off 0cm - 50cm	1: N 2: Y 3: N
<b>PA08.1 (right)</b>	Stag	Limited	Incomplete	Simple	N	17.6%	11.68%	14.74%	8.61%	Steady	Steady drop off	1: Y 2: Y 3: N
<b>PA08.2</b>	Hind	Parallel?	Complete	Detailed	N	24.7%	11.86%	14.29%	9.43%	Steady	Steady drop off	1: Y 2: Y 3: Y
<b>PA08.2 (right)</b>	Hind	Parallel?	Complete	Simple	N	18.3%	10.77%	14.16%	7.37%	Steady	Steady drop off	1: N 2: N 3: Y
<b>PA09.4</b>	Horse	Direct	Complete	Detailed	Y	19.9%	10.74%	14.01%	7.47%	Steady	Steep drop 0-5cm, but steady from 5-60cm	1: Y 2: Y 3: N
<b>PA09.4 (right)</b>	Horse	Direct	Complete	Detailed	Y	9.3%	8.52%	11.75%	5.29%	complex	Flat profile, gradually increase to 60cm	1: N 2: Y 3: N
<b>PA09.5</b>	Auroch	Direct?	Incomplete	Detailed	N	29.7%	15.25%	18.53%	11.97%	Steep	Steep drop until 50cm	1: Y 2: Y 3: Y

<b>PA09.5 (right)</b>	Auroch	Direct?	Incomplete	Detailed	N	19.8%	12.47%	15.17%	9.77%	Steep	Steep drop 0-5cm, , 10cm-20cm	1: Y 2: Y 3: Y
<b>PA09.6</b>	Hind	Parallel?	Complete	Simple	Y	22.3%	10.95%	13.89%	8.00%	Steady	Steady drop off until 30cm, slightly steeper 30-60cm	1: Y 2: Y 3: Y
<b>PA09.7</b>	Horse	Limited	Complete	Detailed	N	14.5%	11.05%	12.69%	9.41%	Steady	Steady drop off	1: Y 2: N 3: N
<b>PA09.7 (right)</b>	Horse	Limited	Complete	Detailed	N	11.0%	9.92%	12.32%	7.52%	Flat	Fluctuates slightly 10-30cm	1: Y 2: N 3: N
<b>PA10.1</b>	Auroch	Direct	Complete	Simple	N	17.0%	11.50%	14.09%	8.91%	Steady	Steep drop off 0-5cm, but steady 0-60cm	1: N 2: Y 3: N
<b>PA10.1 (right)</b>	Auroch	Direct	Complete	Simple	N	14.0%	10.95%	13.36%	8.54%	Steady	Steady drop off	1: N 2: N 3: Y
<b>PA10.3</b>	Stag	Parallel?	Incomplete	Simple	N	15.7%	9.36%	11.34%	7.38%	Steady	Steady drop off	1: N 2: N 3: Y
<b>PA10.3 (right)</b>	Stag	Parallel?	Incomplete	Simple	N	11.2%	8.98%	10.95%	7.00%	Steady	Steady drop off	1: N 2: N 3: Y
<b>PA10.4</b>	Auroch	Direct?	Complete	Detailed	N	15.1%	8.28%	10.30%	6.25%	Steady	Steady drop off	1: N 2: N 3: N
<b>PA10.4 (right)</b>	Auroch	Direct?	Complete	Detailed	N	11.3%	8.61%	10.75%	6.46%	Steady	Steady drop off	1: N 2: N 3: N
<b>PA12.01</b>	Horse	Direct and parallel	Complete	Detailed	Y	14.3%	8.35%	10.80%	5.89%	Steady	Steep drop 5-10cm, but then steady 10-60cm	1: N 2: Y 3: N
<b>PA12.01</b>	Horse	Direct and parallel	Complete	Detailed	Y	10.3%	7.43%	9.72%	5.14%	Steady	Steady drop off	1: N 2: Y 3: N

<b>PA12.02</b>	Auroch	Limited	Incomplete	Detailed	Y	15.8%	11.03%	12.73%	9.34%	Steep	Flat/steady drop until 40cm, then steep drop to 60cm	1: Y 2: Y 3:N
<b>PA12.04</b>	Horse	Direct	Complete	Detailed	N	13.8%	7.24%	9.63%	4.84%	Steady	Steep drop 30-40cm	1: N 2: N 3:N
<b>PA12.04</b>	Horse	Direct	Complete	Detailed	N	13.9%	8.72%	11.29%	6.15%	Steady	Steep drop 20-30cm	1: N 2: N 3:N
<b>PA12.06</b>	Horse	Direct	Incomplete	Simple	Y	17.31%	8.50%	10.87%	6.14%	Steep	Steady until 10cm, then steep drop off to 40cm	1: N 2: Y 3:Y
<b>PA12.10</b>	Horse	Limited	Complete	Simple	N	22.1%	12.71%	16.60%	8.82%	Steady	Fluctuates at 5cm and 40cm	1: N 2: Y 3: N
<b>PA12.11</b>	Hind	Direct	Incomplete	Simple	Y	24.2%	10.56%	12.90%	8.22%	Steep	Steep drop 0-30cm, slight increase at 40cm, then steep drop to 60cm	1: Y 2: Y 3:Y
<b>PA12.12</b>	Hind	Limited	Incomplete	Simple	Y	23.1%	7.84%	10.09%	5.60%	Steep	Steep drop to 50cm	1: N 2: Y 3: Y
<b>PA12.13</b>	Horse	Limited	Incomplete	Simple	N	19.8%	11.24%	13.58%	8.90%	Steep	Slight increase to 10cm, then steep drop to 60cm	1: N 2: N 3:N
<b>PA12.14</b>	Horse	Limited	Incomplete	Detailed	Y	22.1%	9.26%	11.84%	6.68%	Steep	Slight increase to 10cm, then steep drop to 40cm	1: N 2: Y 3:N

The VR lighting simulations (Table 7.9) indicated that the majority of depictions with a direct relationship to topographic features (59%, n = 13) had a variation of RLV above 18.3% - the average value for RLV variation across all depictions modelled (i.e., including depictions with parallel or limited relationships). Superficially, this appears to support hypothesis 1. The extreme variation in RLV caused by a fluctuating light source dispersing across an undulating surface would prevent the eye from fully adjusting to dark conditions. Dark-adapted rods in peripheral vision would have been partially bleached by higher light intensities and bright-adapted cones in central vision would have been activated in one instance in brightness, but inactive in lower light intensities. This may have been conducive to triggering pareidolic or hyper-imagery responses for certain depictions, as the visual system attempts to resolve the contradictory and ambiguous visual information from these cells.

However, whilst the majority of depictions with a direct relationship to the cave wall experienced highly fluctuating RLV, so too did depictions with limited relationships to topographic features. The variation of RLV does not appear to be statistically distinct between depictions that have a direct relationship to the cave wall, those that have a parallel relationship, and depictions that have limited/no relationship (Figure 7.13). This hypothesis is further challenged by the highest recorded value for RLV variation (36.3%) being recorded for depiction PA8.1, which appears to not integrate or directly relate to the cave wall's topography. Additionally, not *all* depictions that directly integrate natural forms are placed on areas that receive highly fluctuating RLV; RLV variation is perhaps not necessary for pareidolic responses. This alludes to a more nuanced relationship occurring between the interaction of light diffusing across the cave wall surface, its influence on the visual response of the artist, and the subsequent integration of these effects into the making of a depiction.

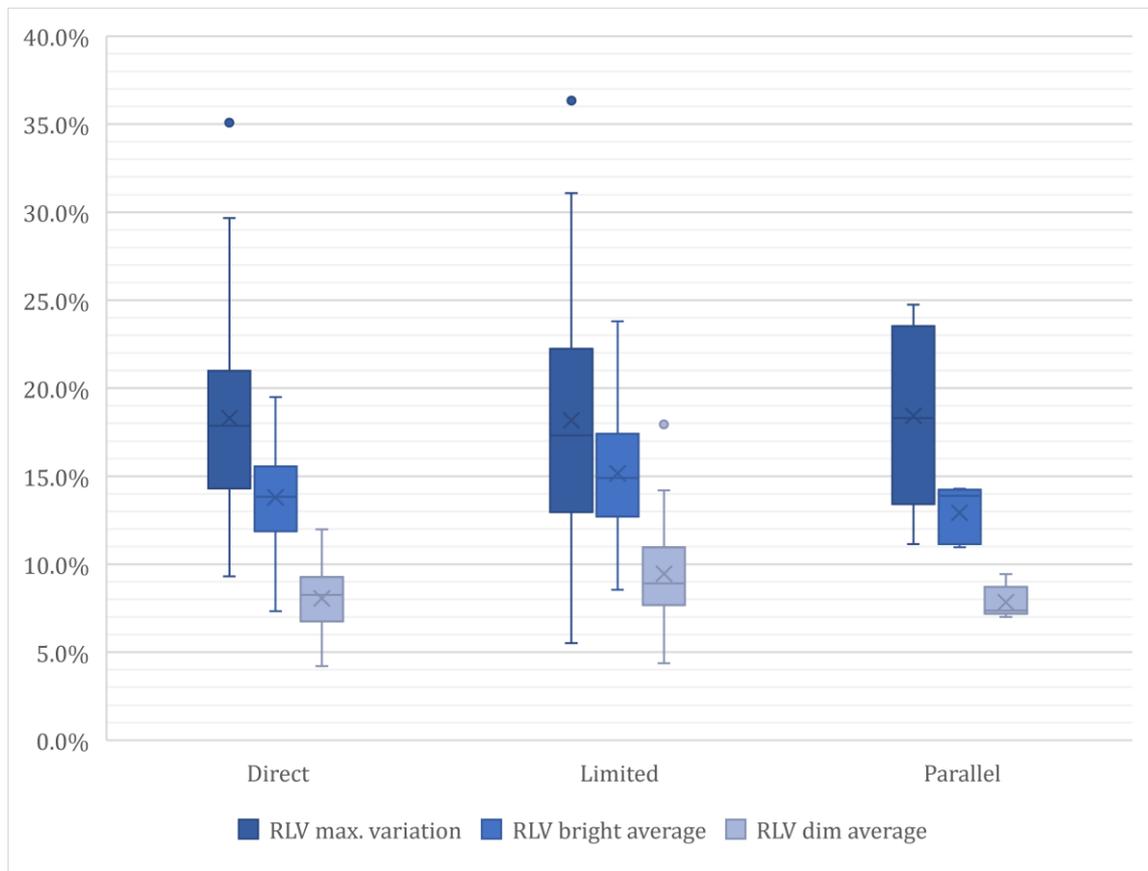


Figure 7.13. Box and whisker plot comparing the maximum variation in relative luminance values (RLV) and the average RLV for brightest and dimmest points of flicker for depictions that have a direct relationship to the cave wall, depictions that have a limited relationship, and depictions that have a parallel relationship. Please note, the sample size for parallel relationships is much smaller than direct or limited categories, hence the closer grouping for these results.

The high variation in RLV tends to manifest as a steep drop-off in RLV across the area of a wall used for depiction, and occasionally this drop-off corresponds to a specific feature of the depiction. For example, across the surface used for PA12.6 – a depiction of a horse head mapped onto a suggestive contour – RLV steeply drops between 10cm (RLV: 14.8% bright; 9.3% dim) and 30cm (RLV: 4.7% bright; 1.7% dim) (Figure 7.14); the exact area where the depiction has been placed (Figure 7.15). This likely reflects the artist experiencing potent visual imagery within this peripheral area where RLV significantly drops. The suggestive form of the contoured surface here may have been literally perceived as representing a horse head, with the artist capturing this intangible image. The simplicity of the depiction, its unusual orientation and incomplete nature, particularly when compared to other horse depictions on the same panel, further supports the influence of the visual and perceptual response and suggests an immediacy to producing this depiction.

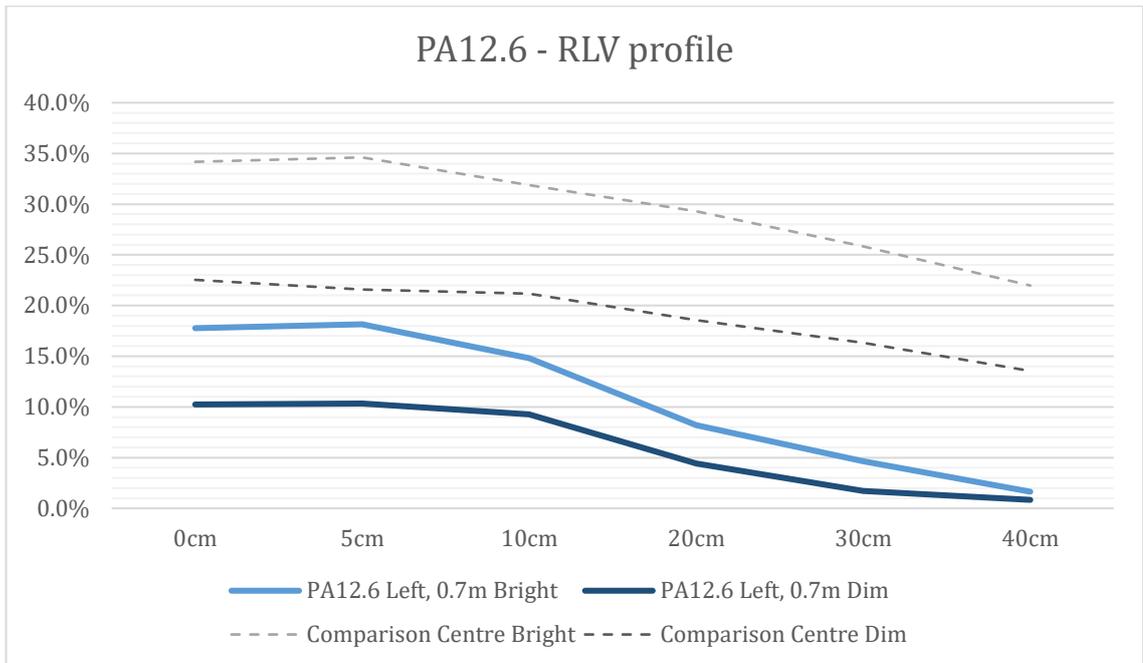


Figure 7.14. Light profile of the RLV for depiction 12.6. Distance was measured vertically across the depiction, from the brightest point.



Figure 7.15. A) Image of depiction PA12.6. B) PA12.6 viewed within the VR lighting simulation, at the point of brightest flicker. Images: Author.

Similarly, depiction PA2.2 – a bison in right profile – is mapped onto several suggestive features, with a crack influencing the placement of the horns and a natural feature suggesting the ventral line of the bison. This depiction also experiences a high variation in RLV, with a sharp drop at 30cm corresponding to an area of shadow cast by the natural feature used to represent the ventral line (Figure 7.16; Figure 7.17). Another drop in RLV between 40-50cm also relates to the area where the horns are mapped onto a natural crack. When taken together, these low, fluctuating values likely resulted in unclear visual stimuli, that may have been resolved by the visual system as being evocative of salient features of a bison. Depiction PA2.3 also expresses this pattern, with a steep drop-off in luminance occurring between 0-30cm, the same area utilised for this depiction (Figure 7.18; Figure 7.19). The use of a natural crack to suggest the head of the horse may be a consequence of a pareidolic response caused by this sharp decline in relative luminance.

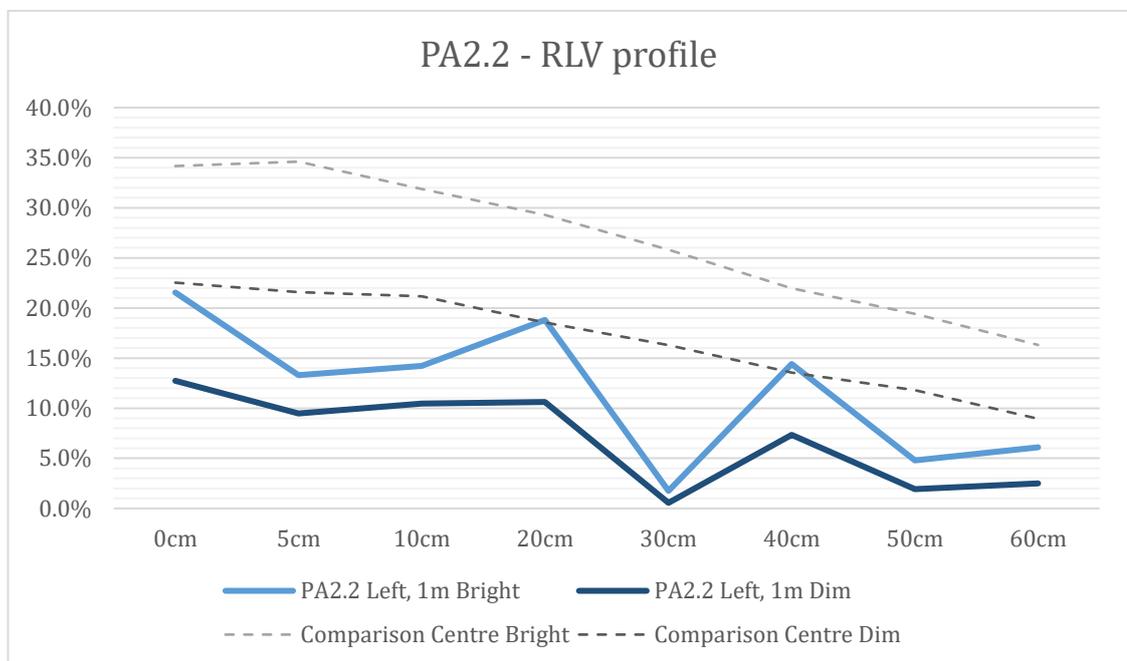


Figure 7.16. RLV profile for PA2.2. Note the steep drop in RLV at 30cm and 50cm.



Figure 7.17. A) Image of depiction PA2.2. B) PA2.2 within the VR lighting simulation. The scale bar is approximate, based on the measurements for the depiction. Images: Author.

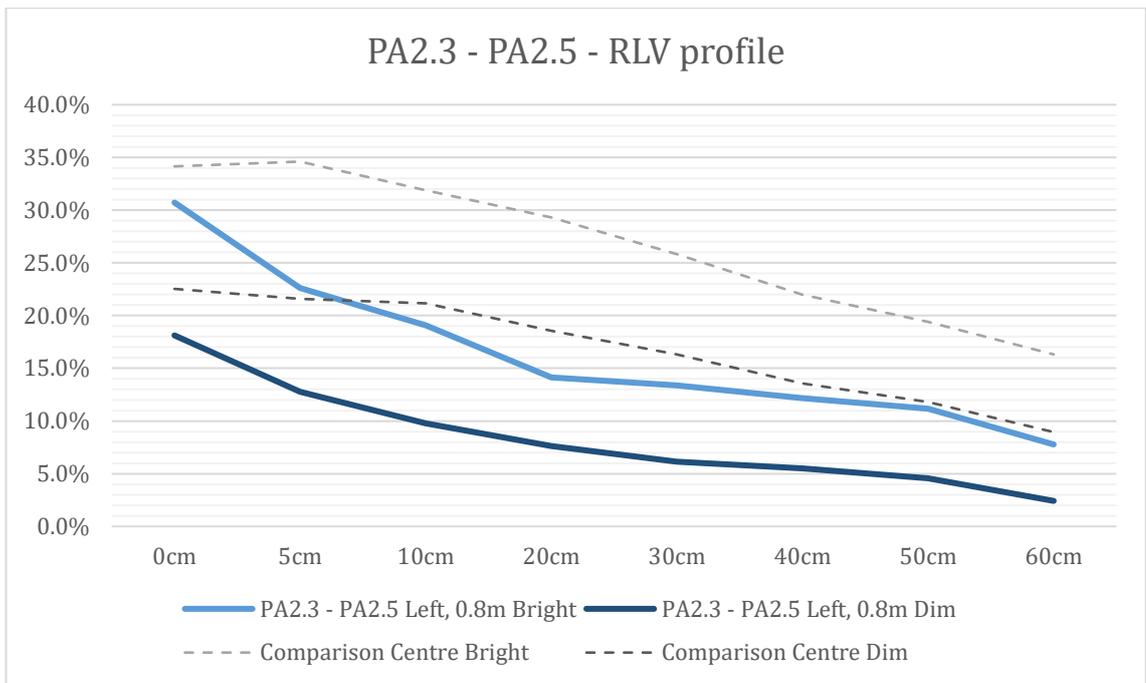


Figure 7.18. RLV profile for the area of cave wall used for depictions PA2.3 - PA2.5. There is a steep drop between 0-30cm, which corresponds to the area used for depiction PA2.3.



Figure 7.19. A) Image of depiction PA2.3. B) PA2.3 within the VR lighting simulation. The scale bar is approximate, based on the measurements of the depiction. Image: Author.

Some depictions that directly integrate natural features and receive high variations in RLV may not have been influenced by a potent pareidolic or hyper-imagery response. Instead, there appears to be a more nuanced interplay with the fluctuation in luminance and the intentional placement of the depiction. For example, depiction PA7.4 – a hind in left profile that has a natural edge representing the ventral line – appears to be deliberately placed to associate this depiction with darkness (Figure 7.22). The lighting profile reflects a steep drop-off in RLV across the depiction, but this does not seem to specifically correlate with the integrated natural features. Additionally, ventral lines are not particularly salient features of animals; salient features tend to correspond to the head and dorsal line. The placement of this depiction may have been to intentionally make use of the particular lighting effects on this area of the wall, rather than due to a pareidolic response, to perhaps make it appear as if the animal was emerging out of the darkness. A similar relationship is observed for two other hind depictions, PA7.4 and PA9.6. For PA7.6, the ventral line is similarly suggested by the edge of the cave wall and for PA9.6, the rear of the depiction is placed on an area with a significant drop-off in RLV (Figure 7.22). This may reflect the deliberate selection of areas of wall that have a high contrast in RLV to evoke a sense of narrative to the depictions: animals emerging out of the shadows.

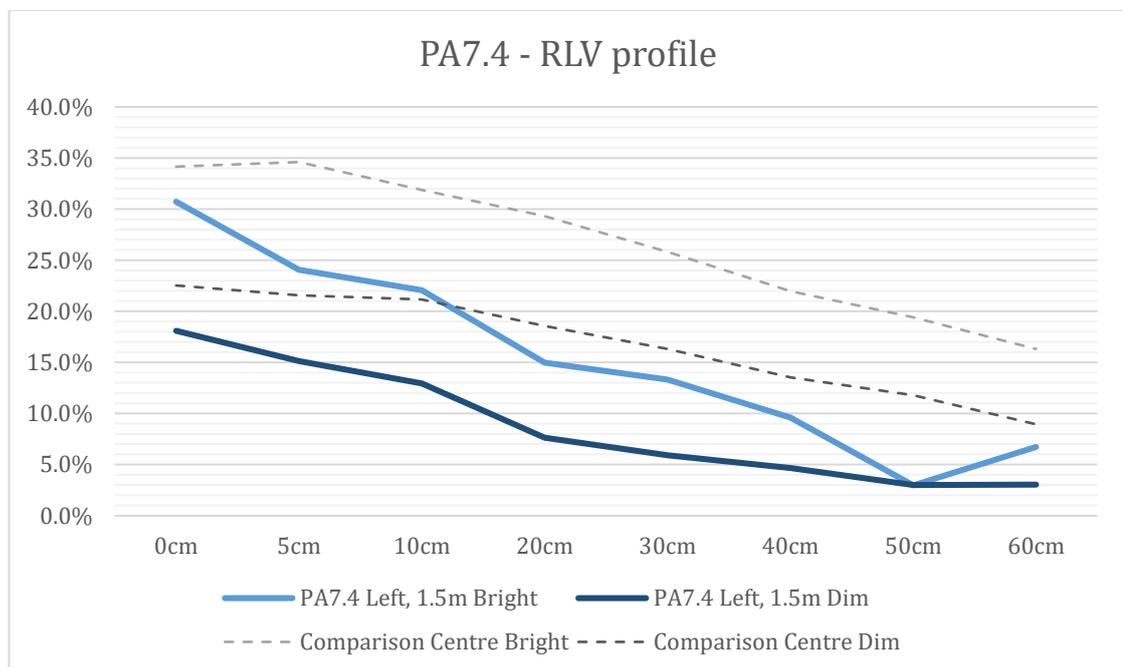


Figure 7.20. RLV profile for depiction PA7.4. Note the steep decline in RLV across the depiction.

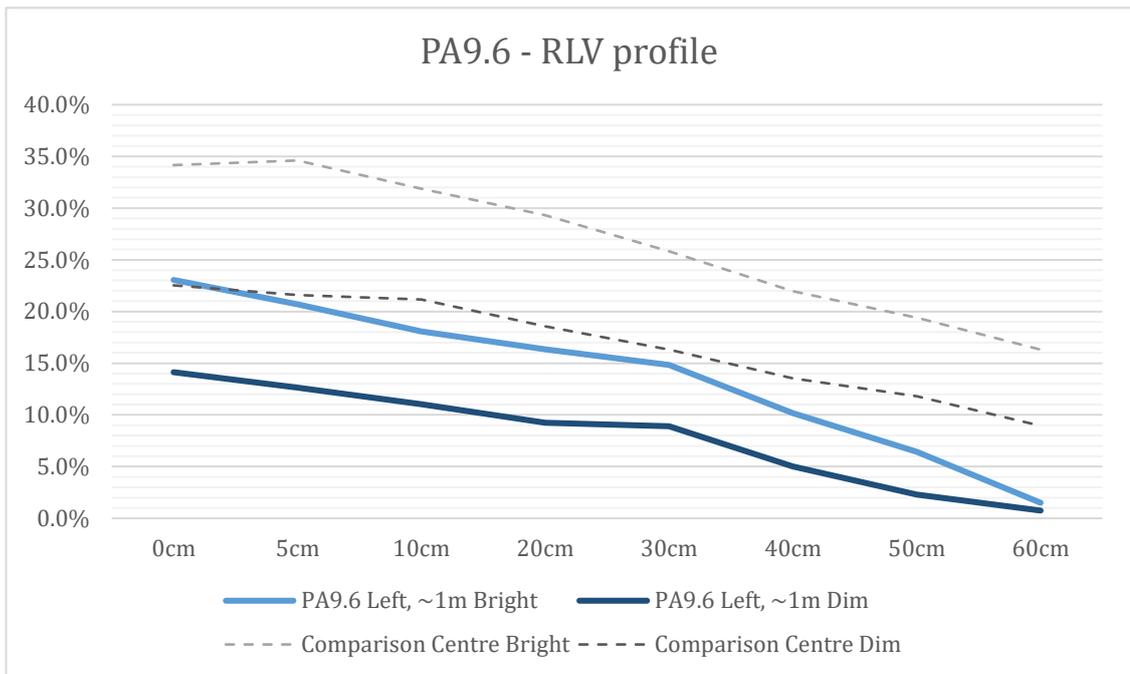


Figure 7.21. RLV profile for depiction PA9.6. Note the steep drop-off in RLV after 30cm, corresponding to the curvature of the cave wall morphology. Image: Author.

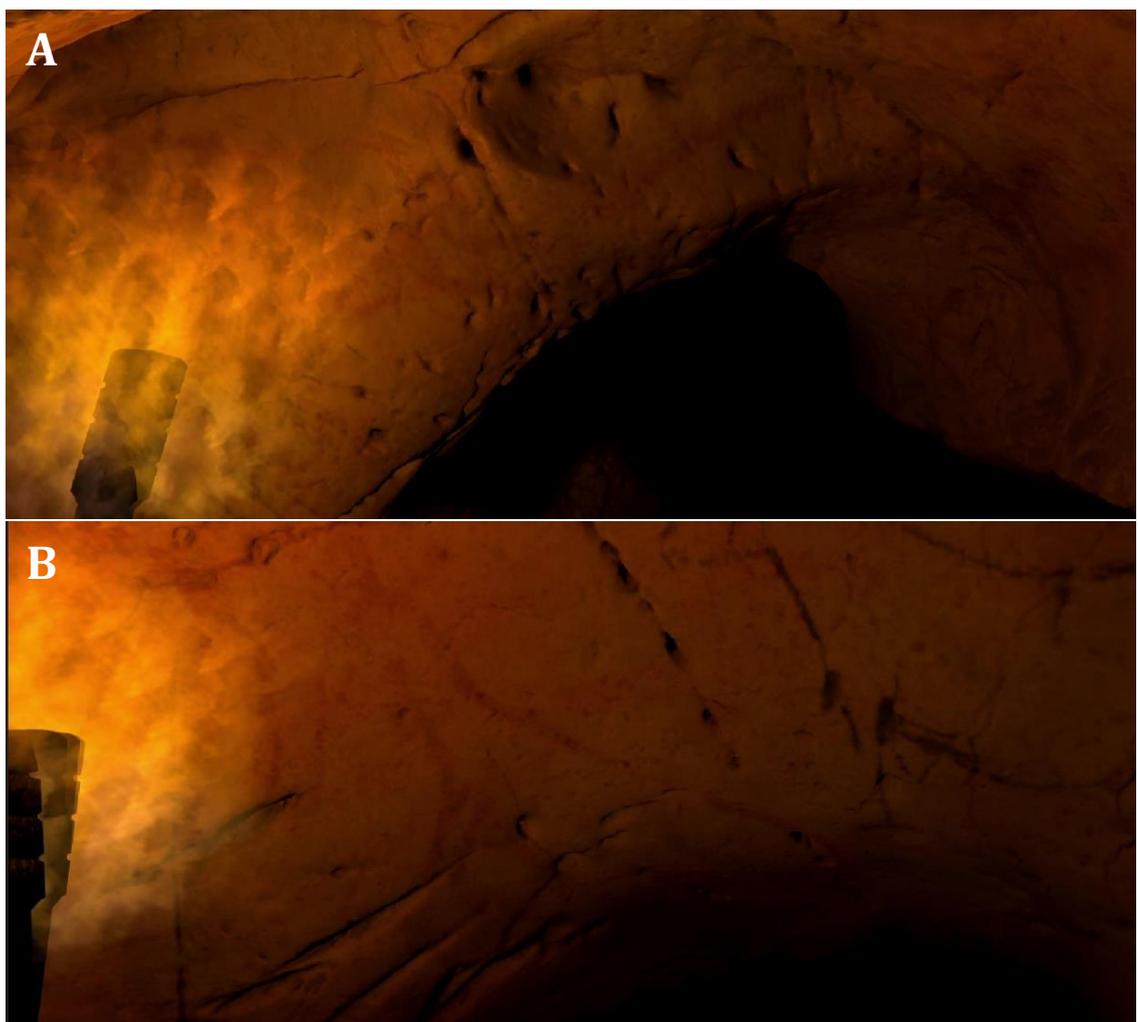


Figure 7.22. Depiction PA7.4 (A) and depiction PA9.6 (B) within the VR simulation, at the brightest point of flicker. Note the association of these depictions to edges of the cave wall surface, which form natural areas of darkness. Image: Author.

There are also examples of depictions that have a direct relationship to natural features of the cave wall, but do not appear to experience this high variation in RLV or a steep drop in the RLV profile. In some of these cases, it appears the form of the depiction may have still been influenced by a pareidolic response. Depiction PA7.3 – an aurochs in left profile - clearly reflects this phenomenon. The depiction is shaped by natural features, with the head and horns mapped onto natural suggestive cracks in the wall (Figure 7.23). Whilst the RLV is relatively stable across the surface, the RLV variation between the brightest and dimmest points of flicker is significant for the head area of the depiction which integrates these natural features (Figure 7.24). The pareidolic response for this surface may have been discrete, corresponding to only the head of the animal, with the artist then deciding to complete the rest of the depiction.

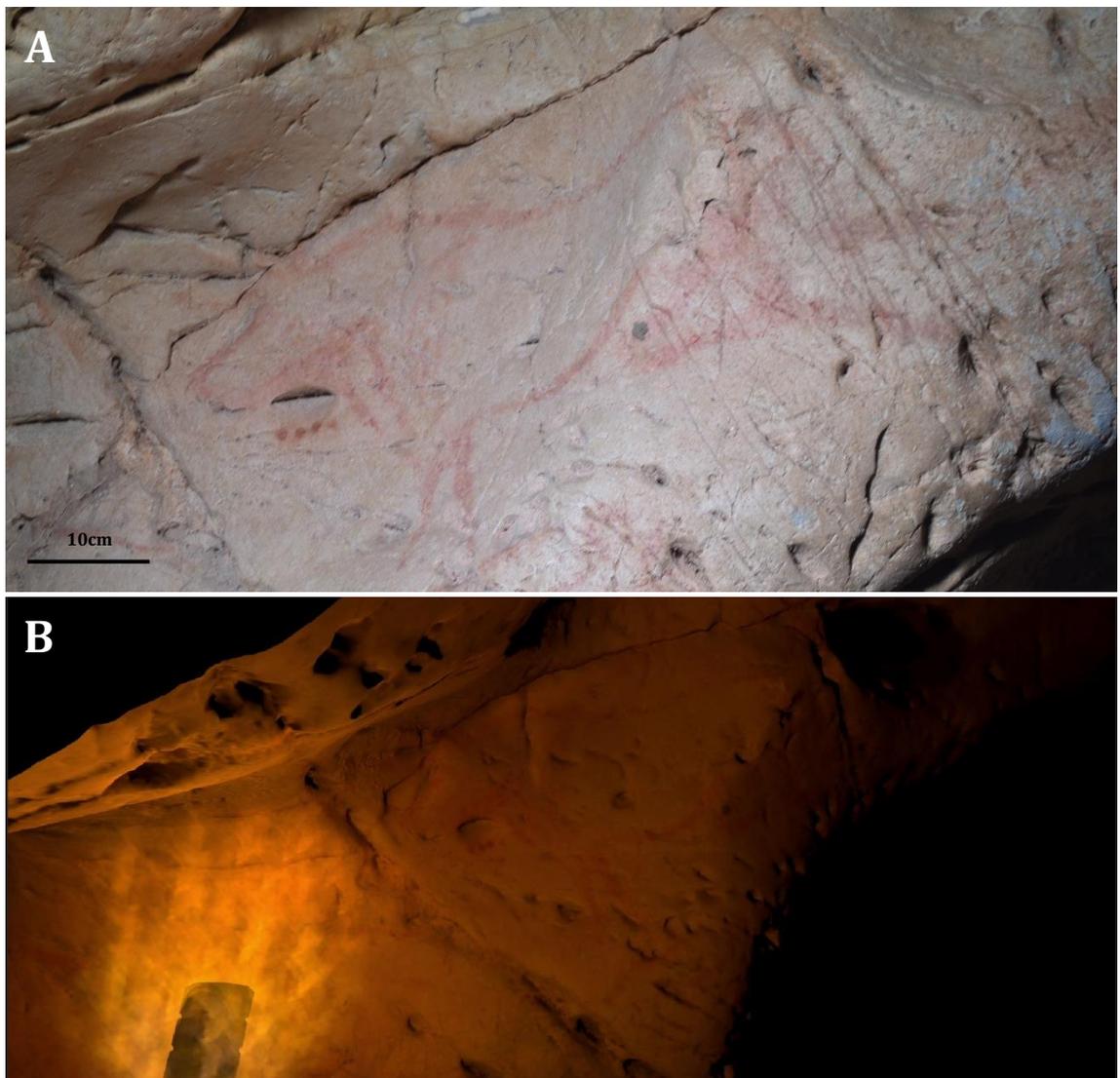


Figure 7.23. A) Image of depiction PA7.3. B) Depiction PA7.3 viewed within the VR lighting simulation. Images: Author.

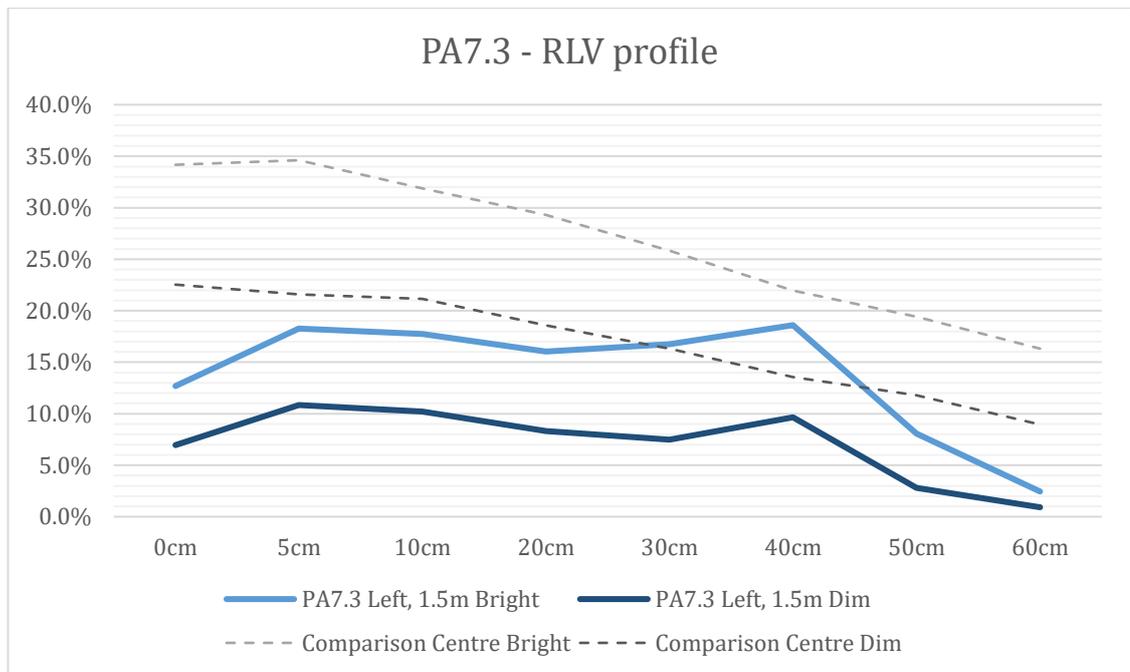


Figure 7.24. RLV profile for depiction PA7.3. Note that RLV is low and varies between the brightest and dimmest points of flicker for the area of the cave wall used for the head of the depiction.

Similarly, depictions PA6.2 and PA10.4 integrate natural cracks to represent the legs of the animals (Figure 7.25) and depiction PA4.1 appears to have used natural cracks to influence the placement of antlers and to suggest the ventral line. The subtlety of the relationship between the depiction and natural forms may suggest a quieter dialogue between the wall and artist here, with the artist being inspired, rather than overtly directed, by the suggestive natural forms. This still alludes to a pareidolic response, but one that perhaps was encouraged by the artist seeking out suggestive forms: the visual imagery was less potent.



Figure 7.25. Depiction PA10.4 which represents an aurochs in right profile. The rear legs appear to be intentionally mapped onto natural cracks. The scale bar is approximate, based on the depiction's dimensions. Image: Author.

It thus appears that hypothesis 1 cannot account for the relationship between all depictions in Gallery A and the cave wall. Whilst some depictions that have a direct relationship with the cave wall are placed on areas of the wall that experienced high variations in RLV which may have triggered, perhaps involuntary, visual imagery responses to natural features, other depictions that integrate natural features appear to be placed on areas of the cave wall that had relatively stable RLV. This may reflect a gradating scale of visual responses, from involuntary visual imagery triggered by fluctuating light to the artist actively seeking out suggestive forms in the surface. The relationship between visual response, lighting, and the form of depictions thus is more complex than fluctuating light caused visual imagery of an animal which was subsequently depicted. Additionally, the presence of RLV profiles that express a steep drop-off for areas of the wall where depictions appear to have no apparent relationship to natural features further suggests a more complex relationship between the visual response caused by particular lighting effects and the placement and form of depictions, which will be explored in subsequent stages.

Exploring the second hypothesis provides some deeper insight into this relationship between the initial visual response, lighting effects, and the form of depictions elucidated by the testing of hypothesis 1. The presence of tactile marks in certain depictions that integrate natural features appears to reflect the use of haptic stimuli to clarify ambiguous visual information. Finger dots and smears are a common stylistic feature of Solutrean art, but their use is not consistent across all depictions in Gallery A of La Pasiega: some depictions are completely represented by tactile marks; others appear to feature a combination of both tactile and brush marks; and a number have no tactile marks at all. This encouraged a deeper consideration of the use of tactile marks in these depictions, particularly with regard to the use of haptic information in informing perception. On average, depictions that had features depicted through the tactile application of pigment experienced lower RLV at both the brightest and dimmest point of flicker compared to depictions that were not produced using tactile marks (Figure 7.26). This suggests the low RLV experienced necessitated the use of haptic information to help clarify ambiguous stimuli and simultaneously influence the making of the depiction. For example, the dorsal line of depiction PA1.1 has been created through finger dots, that seem to follow contours and cracks in the cave wall (Figure 7.27). This area of the depiction received low RLV in the lighting simulation (16.3-10.5% brightest point of flicker; 10.5-5.9% dimmest), which may mean the features of the wall were indistinct and difficult to discriminate by the artist. The tactile interaction would have helped to clarify this visual information, but simultaneously informed the form of the depiction.

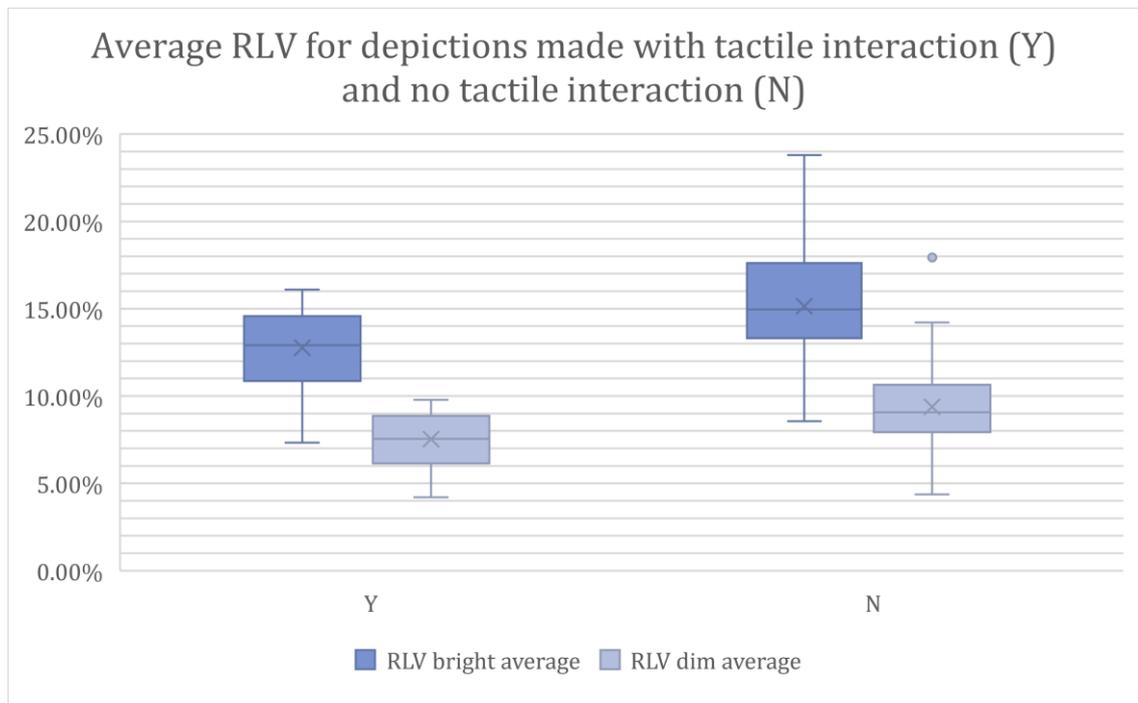


Figure 7.26. Average RLV at the brightest and dimmest points of flicker for depictions with tactile interaction (Y) and non-tactile interactions (N).

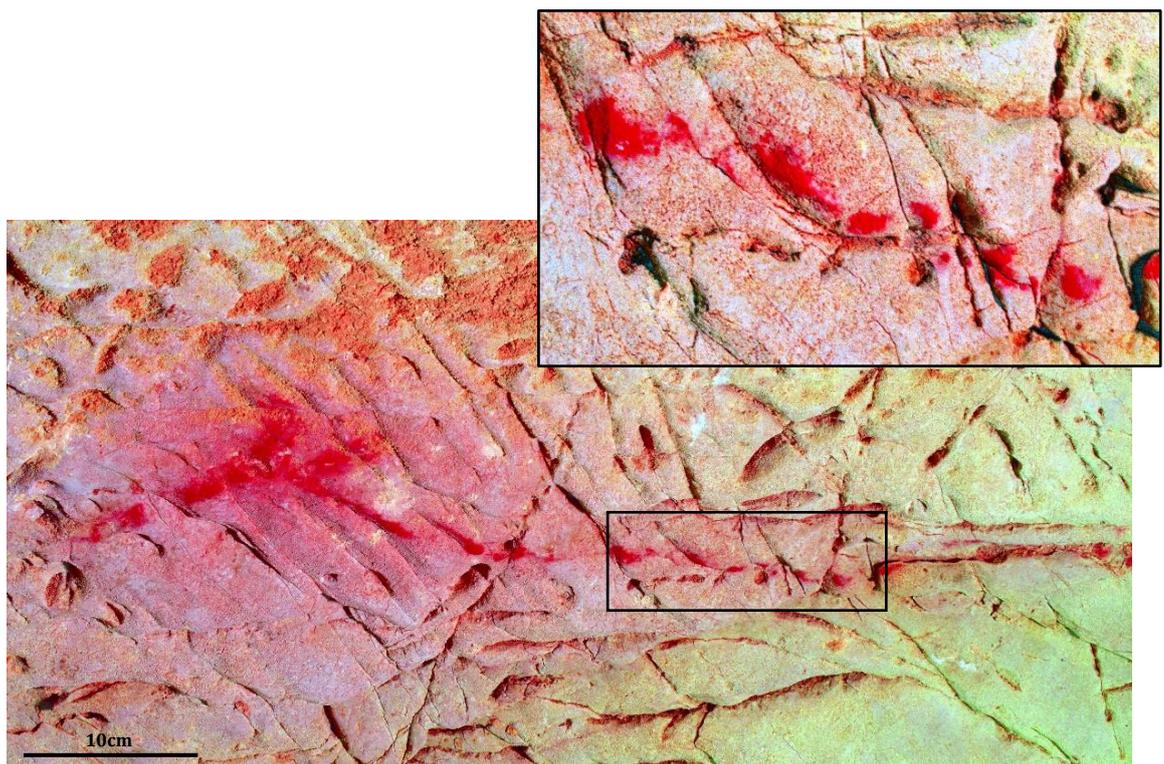


Figure 7.27. DStretch manipulated image of PA1.1, highlighting an area of finger dotted marks along natural cracks and contours of the surface. The scale bar is approximate, based on measurements for the depiction. Image: Author.

Depiction PA12.1 – a horse in right profile depicted using tactile marks - also clearly reflects the use of tactile engagement to enrich perception within a dim environment (Figure 7.30). Regardless of the position of the light source, either offset to the left or right,

this area of the wall receives very low RLV (Figure 7.28; Figure 7.29). The exclusive use of finger dots and smears to complete this depiction therefore indicates the necessity of the haptic stimuli to help inform visual information. The integration of natural features in this depiction may similarly reflect the use of this tactile information to direct its form. Whilst these stimuli may not have elicited a pareidolic response, the coalescing of ambiguous visual stimuli and haptic information may have resulted in the perception of natural features as evocative of a horse form. A similar scenario may have occurred in depicting PA12.14 (Figure 7.32); a horse head in left profile, again depicted with finger smears and dots. This depiction experiences a prominent drop-off in RLV between 10cm and 40cm, exhibiting a similar pattern to depiction PA12.1 (Figure 7.31; Figure 7.33). It is interesting to note these two depictions share a similar style and are positioned on opposite walls to each other in a narrow passage, suggesting they may have been produced by the same artist.

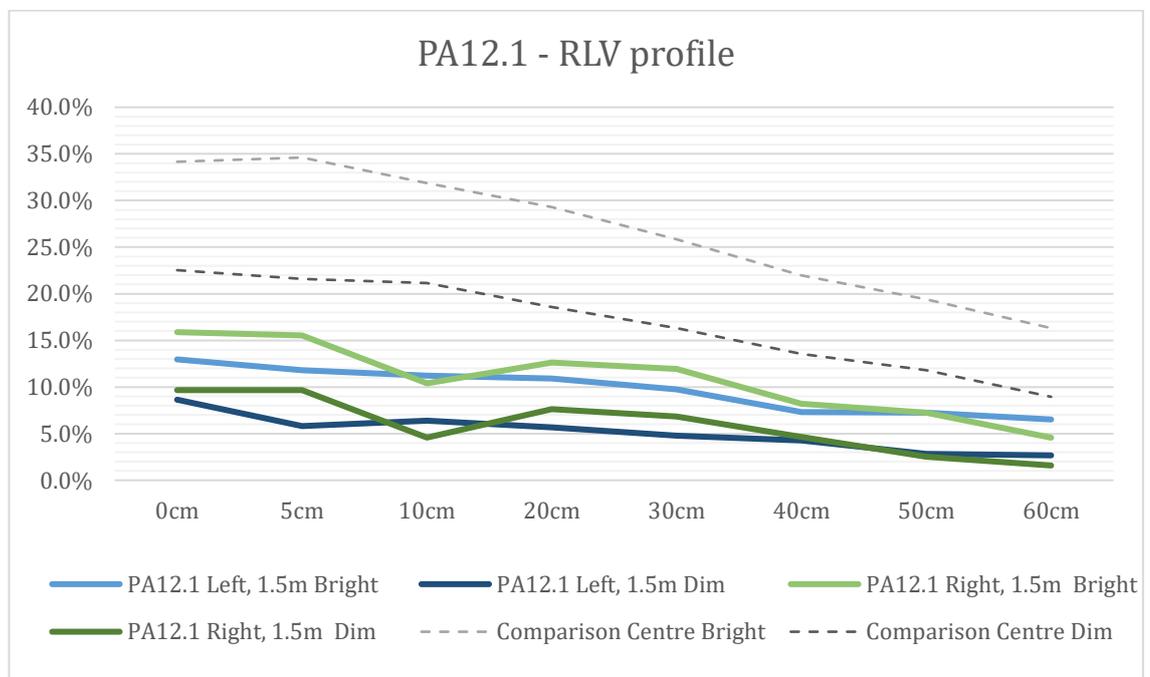


Figure 7.28. RLV profile for depiction PA12.1. The profiles for both illuminating the depiction from the left or right are represented, indicating little difference in the profile between the two.



Figure 7.30. Image of depiction PA12.1. Image: Author.

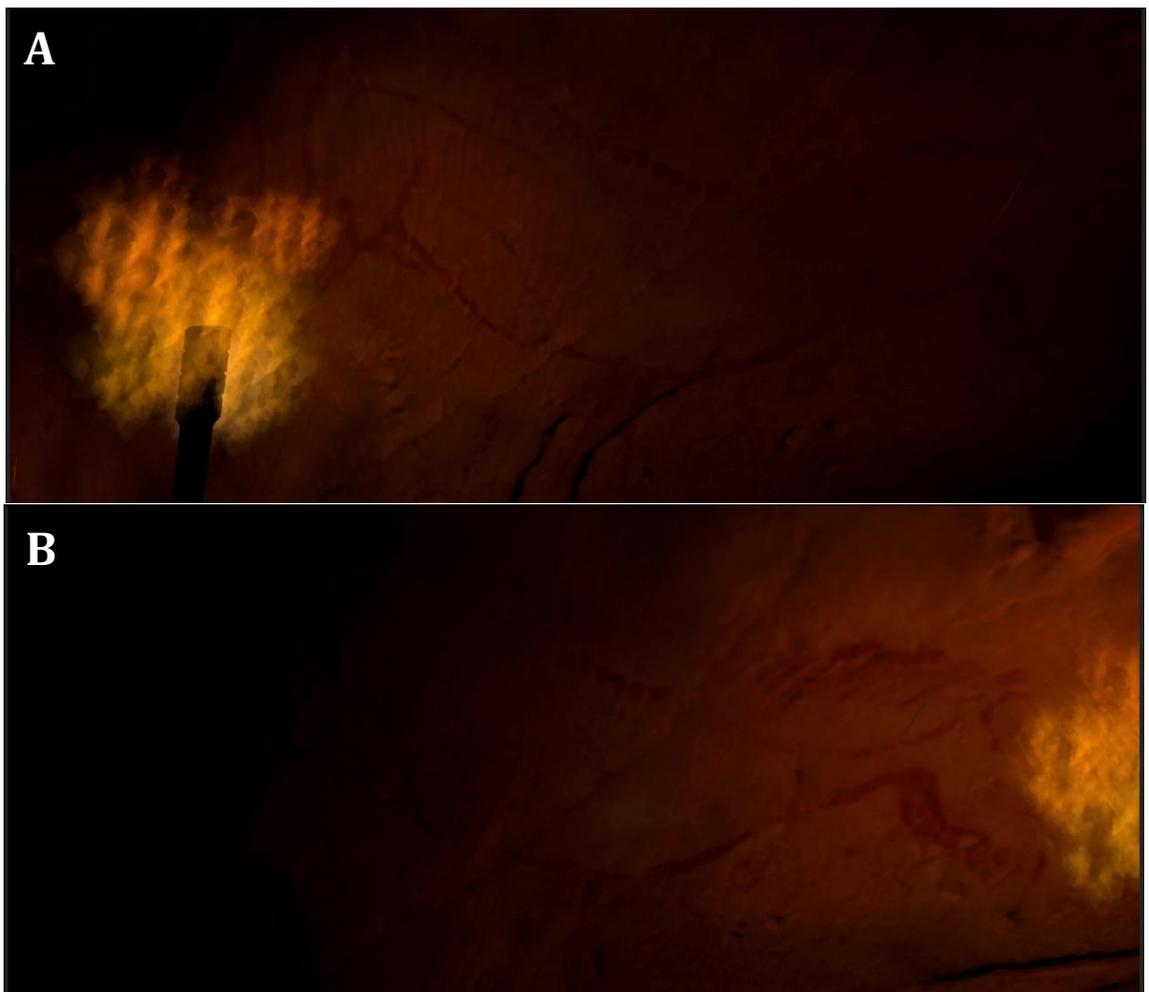


Figure 7.29. Depiction PA12.1 in the VR simulation illuminated from the left (A) and right (B). Image: Author.

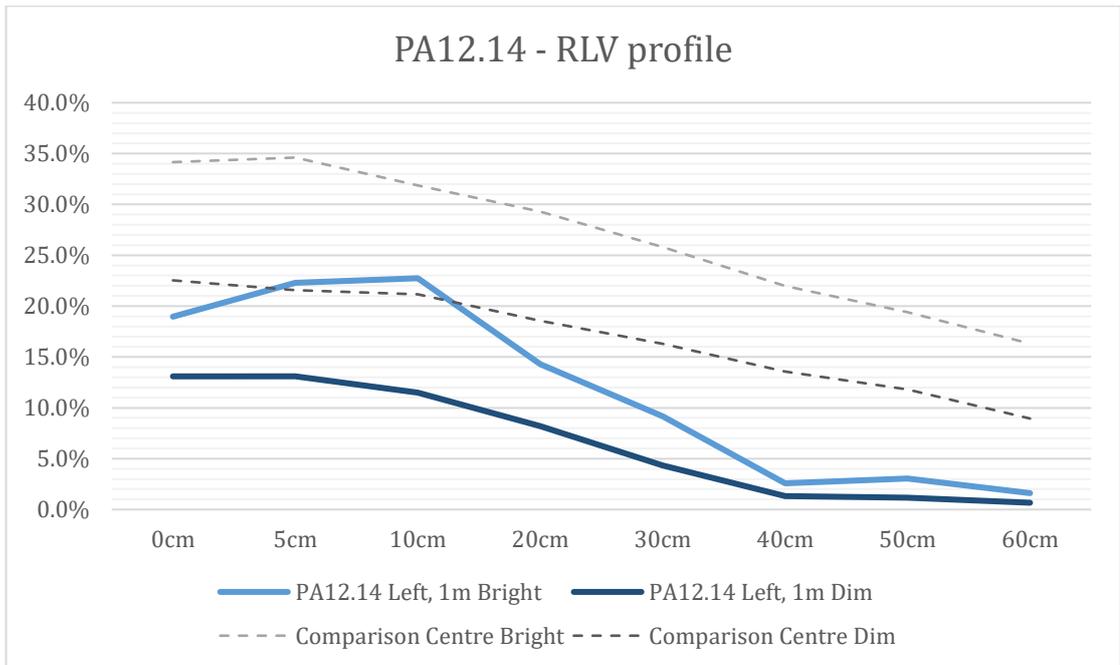


Figure 7.31. RLV profile for depiction PA12.14. Note the steep drop-off in RLV that occurs between 10-40cm.



Figure 7.32. Image of depiction PA12.14. Image: Author.



Figure 7.33. Depiction PA12.14 within the VR lighting simulation. Image: Author.

The results from the lighting simulations therefore appear to validate hypothesis 2, demonstrating that the presence of tactile marks in depictions may reflect the need to clarify indistinct visual information. The support for this hypothesis blurs the categorical divide between the visual and perceptual response and material engagement involved in the art making. It is clear that the material engagement directly informed visual perception, helping to clarify stimuli that were poorly lit and visually ambiguous. This serves to stress the point that the biographical framework here is *relative*, and likely does not capture the full complexity of the relationship between the discrete stages outlined here.

By contrast, the construal level effects of the lighting conditions appear to have had no influence over the completeness or detail of the depictions in Gallery A, discounting hypothesis 3. As demonstrated in Figure 7.34, there is no distinct pattern between the average RLV for the brightest and dimmest points of flicker and these features of the depiction, and certain data points actively challenge the hypothesis, for example the highest value for RLV at the brightest point of flicker corresponds to an incomplete, simplistic depiction (PA8.1). Not only does this suggest that construal level effects had a negligible influence on the form of the depictions in Gallery A, but it serves to emphasise the importance of considering the autonomy of the artist within the biographical framework. The extensive preparation of pigments in La Pasiega, and the presence of depictions within areas of the cave illuminated by daylight indicates that there was a degree of premeditation behind producing the depictions in Gallery A. There are tensions in agency between the influence of the visual perceptual responses, the artist(s) intention, and other participants (cave wall, pigments, light) in the making of this art. Whilst the visual psychological responses to natural features in low light conditions may have been the impetus behind the placement and form of certain depictions, it appears that the completeness and detail of the

final form may have been determined by the artist. This will be further explored in the subsequent stages of the biographical framework.

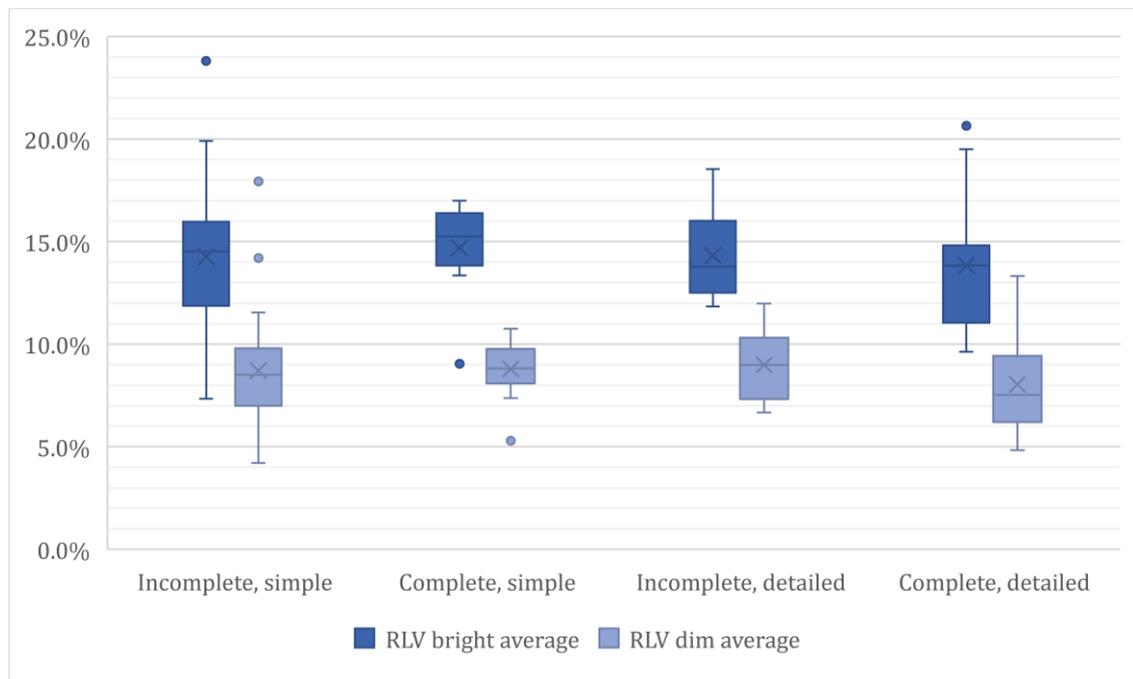


Figure 7.34. Box and whisker plot summarising the average RLV at the brightest and dimmest point of flicker for depictions that are incomplete and simple, complete and simple, incomplete and detailed, and complete and detailed. Image: Author.

The lighting simulations indicate that whilst there is no statistical difference in the RLV between depictions that have direct or limited/no relationship to topographic features of the cave wall, there are still clear examples that appear to be underpinned by the experience of visual imagery, either pareidolic or hyper-imagery. Instead, this stage of the dialogical making of the art is varied between depictions in this gallery, and this variety is observed even between depictions on the same panel. The potency of the visual response is diverse, with some depictions appearing to be directly informed by the artist experiencing a visceral response to perceiving suggestive features of the cave wall under fluctuating light, but others suggesting the artist either deliberately sought out forms that triggered a pareidolic response or was not influenced by any form of visual imagery. Further, aspects of this stage suggest that there is complexity within the visual response; it did not only concern the initial perception of unusual forms under low light conditions, but also the tactility of the surface and the manipulation of visual effects of the light source to enrich depictions. These facets of the depictions will be further explored in the subsequent stages of the art making. In summary, the visual and perceptual response was not the only factor that determined the placement and theme of figurative depictions in Gallery A; the degree of premeditation by the artist and their autonomy in this process must be considered. Within the dialogue of making, artists may have listened to other participants (light, natural

features, pigment), allowing them to shape the form of the depiction, but in other instances the artist may have taken the lead, with the other participants having a quieter influence.

#### *7.4.3. Stage 3: Initial material engagement*

After experiencing visual and perceptual phenomena to features illuminated under the dynamic light of their torch, the artist began applying pigment to produce an animal depiction. In some cases, this may have been to capture the intangible visual imagery they were experiencing, in others the material engagement may have been integrated with the perceptual response, with haptic modalities helping to clarify visual information. The initial material engagement therefore reflects the way the artist(s) negotiated art making under uncertain visual conditions, with the relationship between the first lines depicted and natural features, and the technique used for these initial lines, providing insight into this process.

For certain depictions that express a direct relationship with topographic features of the cave wall, the initial material engagement reflects the intentional integration of these features into the animal form. Depiction PA2.3 provides a clear example; the initial lines in the sequence for this depiction move out from the suggestive natural cracks used to represent the head (Figure 7.35). The addition of small finger dots to represent the eye and emphasise the ear of the horse further demonstrate the intentional integration of this feature into the form of the animal. The visual and perceptual response triggered by fluctuating RLV in this area of the cave wall appear to have manifested as pareidolic imagery, which subsequently influenced the theme and placement of this depiction. The initial lines thus reflect the artist's response to this visual imagery, drawing out from the form embedded in the features of the cave wall and "completing" it. The application of pigment to represent an eye and highlight the ear is also evocative of a bird depiction the in the intersection between Gallery A and B (not included in this study). The form is entirely natural, with pigment applied to represent eyes and legs, reflecting a clear pareidolic response to topographic forms in La Pasiéga (Figure 7.36).

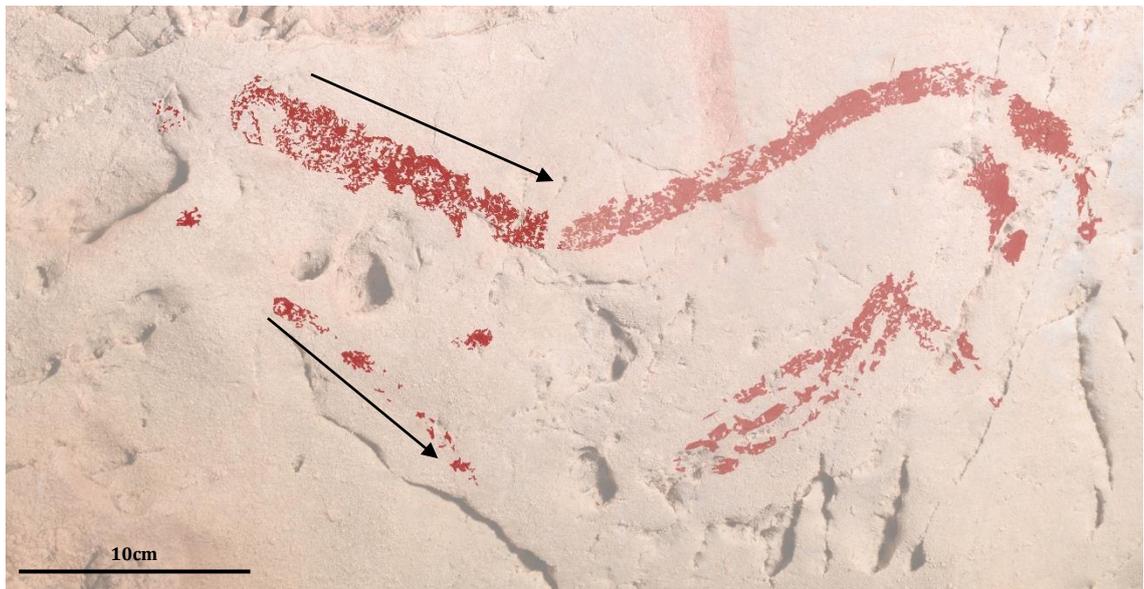


Figure 7.35. Digital tracing of depiction PA2.3, with the lines likely initially drawn in the sequence highlighted. Based on the left-to-right directionality of lines in this depiction, it is proposed the initial lines drawn were the leftmost. The scale bar is approximate, based on measurements for the depiction. Image: Author.



Figure 7.36. Depiction of a bird from La Pasiega. The rock shape is natural, with pigment applied to represent the eye and legs, "completing" the form. Image: Author.

This integration of natural features to directly represent aspects of the animal's form, whilst clearly demonstrating the influence of the visual response on the theme and placement of depictions, is a rare occurrence in Gallery A. Instead, the mapping of depicted lines onto suggestive features is more common (35% of the depictions recorded from

Gallery A, n=23) and in a number of cases (48%, n=11), this concerns the tactile application of pigment over the natural feature. For depiction PA12.6, for example, the initial lines appear to have been created through finger smears that follow the edges of a contoured surface which may have been perceived as evocative of a horse's head (Figure 7.37). The lines move from the area of the wall that received highest RLV, into dimmer areas that may have been imperceptible to the artist. The initial material engagement therefore appears to not only represent the artist capturing the visual imagery they experienced by applying pigment onto the natural feature responsible, but also perhaps a coalescing of haptic and visual stimuli to aid the artist in distinguishing the edges of the natural surface.



*Figure 7.37. Digital tracing of depiction PA12.6, with the initial lines highlighted. Whilst the line on the right of the depiction underlies subsequent lines, the direction is difficult to determine. The scale bar is approximate – the depiction was unable to be measured during fieldwork, so dimensions were approximated from the 3D model. Image: Author.*

Depiction PA3.1 – a horse head in right profile – appears to reflect a similar engagement, albeit perhaps with a less overt relationship between the natural features and the form of the depiction. The initial lines depicted here are the ventral and dorsal lines of the head, which appear to continue and be mapped onto natural cracks in the cave wall (Figure 7.38). The dorsal line is formed through the application of pigment by finger dots and smears, indicated by the disjointed nature of this line. As with depiction PA12.6, this may be a response to uncertain visual stimuli with tactile engagement aiding perception; the RLV for this depiction falls steeply after 10cm, particularly for the dimmest point of flicker (Figure 7.39; Figure 7.40). However, the ventral line deviates from this tactile

engagement. The homogeneity of this line indicates the use of a tool (i.e., a brush) that could hold and apply more pigment to produce a fluid line, in comparison to the application of pigment with fingers. The shift in technique during the initial material engagement may reflect tensions in agency; whilst the artist engages with natural features through tactile interaction in one instance, they opt to expediently produce a line in another and perhaps suppress the agency of natural features in the process.

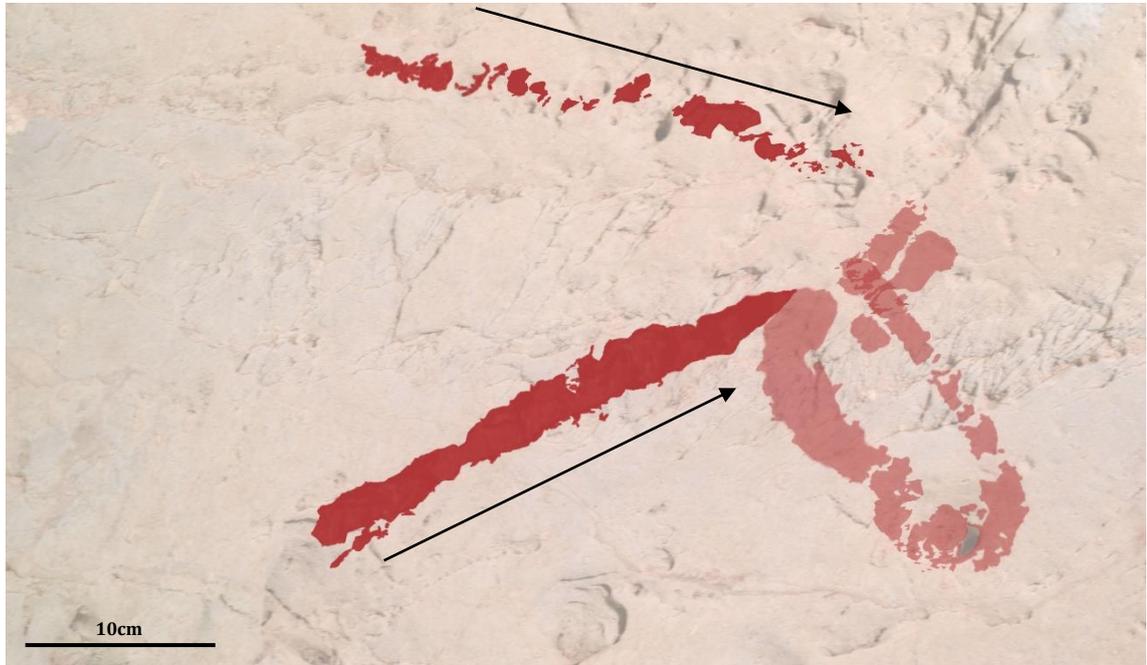


Figure 7.38. Digital tracing of PA3.1, with the initial lines highlighted. The dorsal line is depicted using finger dots and smears, whereas the ventral line appears to be depicted using a brush. The scale bar is approximate, based on measurements for the depiction. Image: Author.

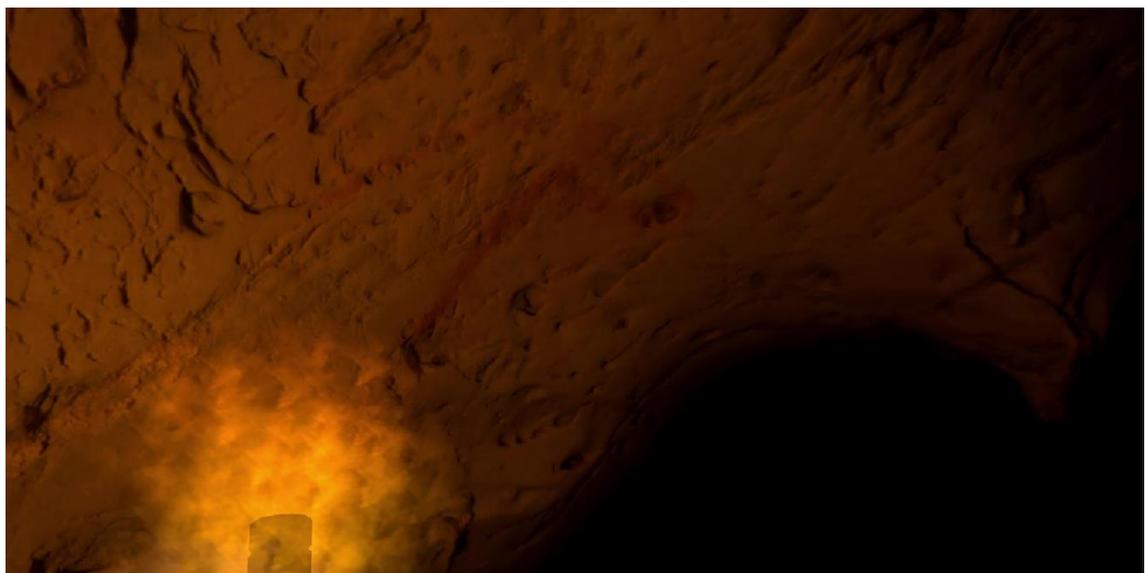


Figure 7.39. Depiction PA3.1 within the VR lighting simulation, at the point of brightest flicker. Image: Author.

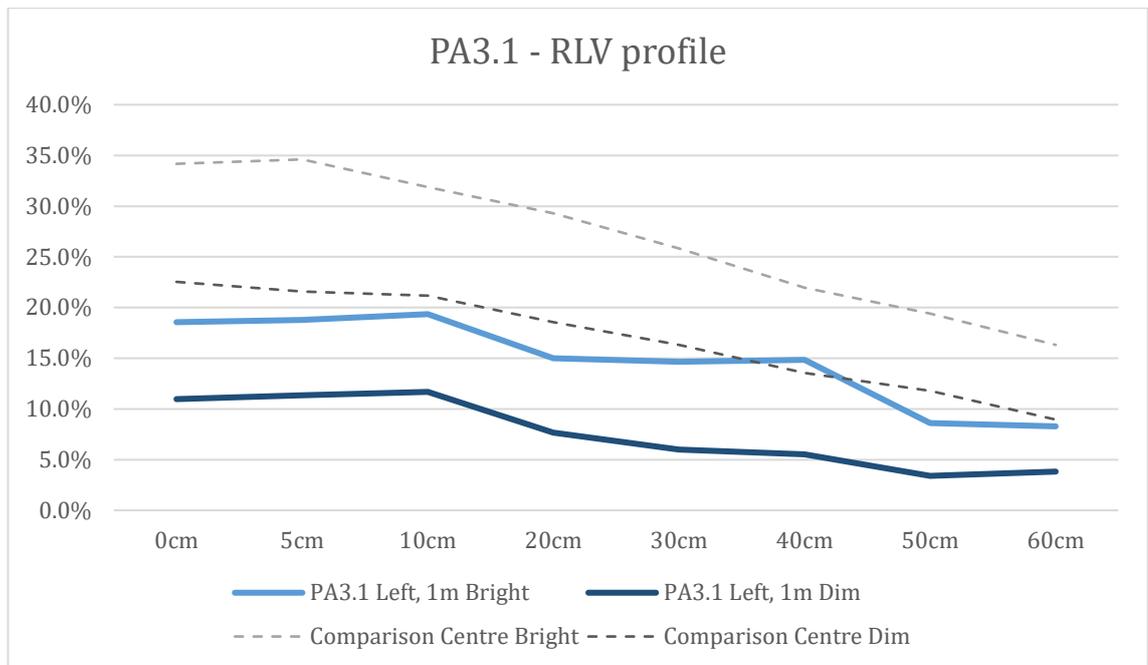


Figure 7.40. RLV profile for depiction PA3.1.

The use of tactile marks as the initial lines for a depiction that experiences areas of low RLV is reflected in several other depictions. For example, PA1.1, PA2.1, PA12.11 and PA12.12 use the initial tactile material engagement, as with PA12.6, to trace topographic features in areas that receive low RLV. The initial material engagement for PA1.1 and PA2.1 manifests as a finger dotted dorsal line, which traces cracks and contours in the cave wall. Similarly, the initial lines depicted for PA12.11 appear to be those forming the ears and head, and were produced by using the finger to smear the pigment mix onto the surface (Figure 7.41). These lines correspond to a suggestive natural feature, which may have been ambiguous under the low, flickering light received on this area of the cave wall, shifting in and out of the artist's perception (Figure 7.42; Figure 7.43).

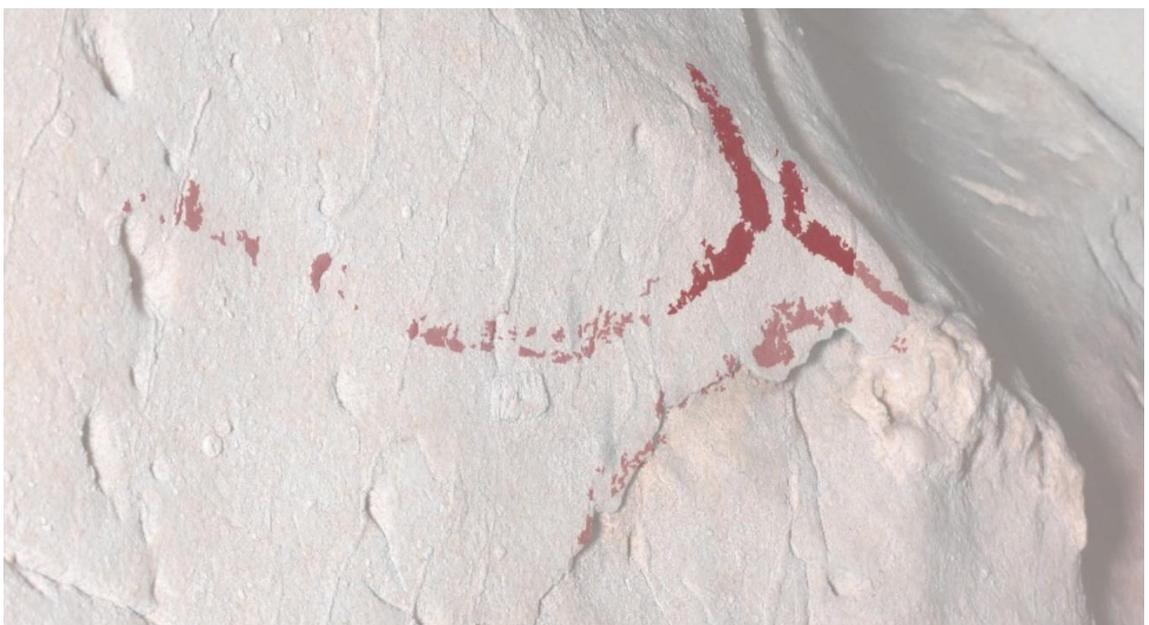


Figure 7.41. Digital tracing of PA12.11 with the initial lines highlighted. Image: Author.



Figure 7.42. Depiction PA12.11 within the VR lighting simulation, at the point of brightest flicker. Image: Author

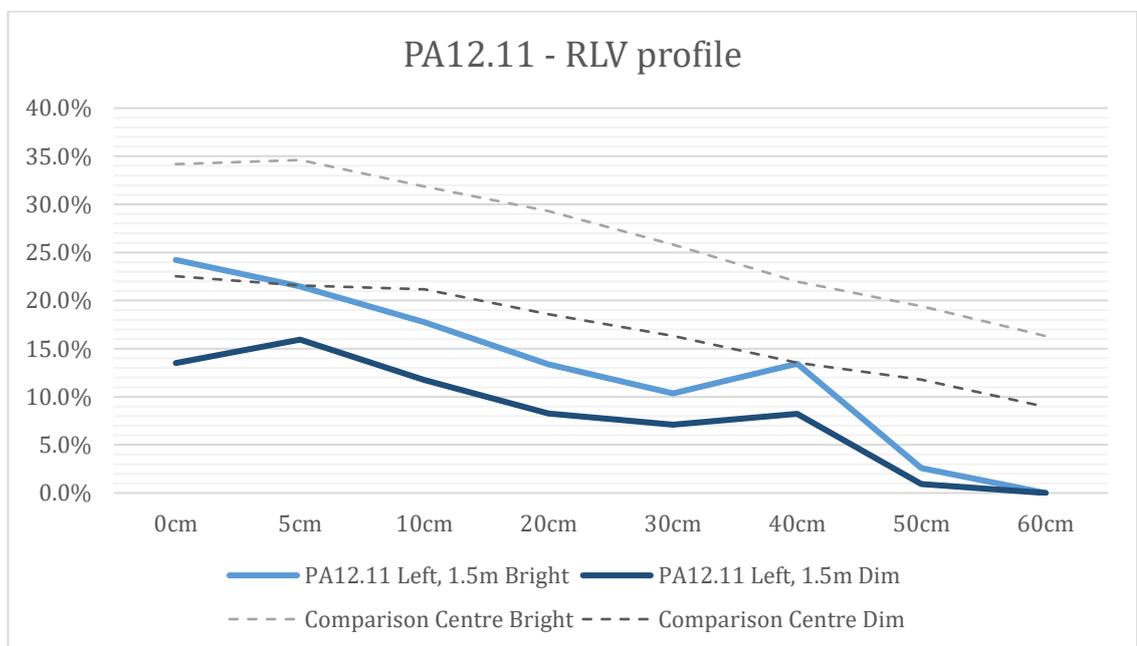


Figure 7.43. RLV profile for PA12.11. The increase at 40cm corresponds to the area of the wall that juts out, where the head of the hind has been placed.

The relationship between the tactile initial engagement and topographic features of the cave wall for PA12.12 is more subtle, but reflects a similar phenomenon. The initial lines in the sequence for PA12.12 again appears to be those that form the head, which follow the edge of a concave area of the wall (Figure 7.44). The RLV profile for this depiction reflects a steep drop off, but this corresponds to the body, rather than the head, and may indicate the importance of a continual tactile engagement in drawing out the animal form (Figure 7.45; Figure 7.46). These depictions further reinforce the importance of the integration of haptic stimuli in the perceptual response to help the artist distinguish natural features, and influence the form of the depiction.



*Figure 7.44. Digital tracing of depiction PA12.12 with the initial lines highlighted. Image: Author.*



*Figure 7.45. Depiction PA12.12 viewed under the VR lighting simulation. The concave and undulating nature of the cave wall causes a steep drop off in RLV for this depiction. Image: Author.*

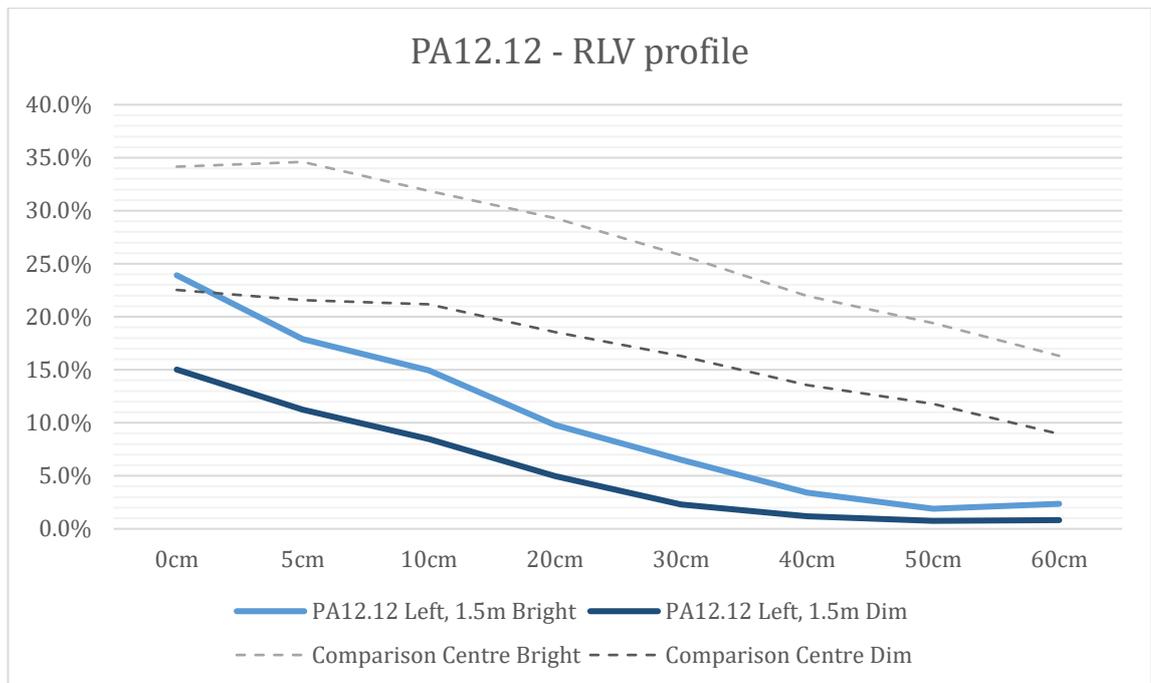


Figure 7.46. RLV profile for depiction PA12.12. Note the steep drop off in RLV across this area of the cave wall.

The following of natural forms through the tactile application of pigment provides insight into the dialogical aspects of the making of these depictions. This stage of the biography therefore reflects the artists not only responding to visual imagery triggered by suggestive forms under a flickering, dim light, but “listening” by physically tracing the natural forms responsible for the visual imagery and allowing the natural features to have agency in shaping the form of the depiction. The use of tactile engagement to facilitate this process of “listening” and engaging with natural features of the cave wall, even when these may have been visually imperceptible, further emphasises the importance of the interaction with the cave wall in the making of these depictions.

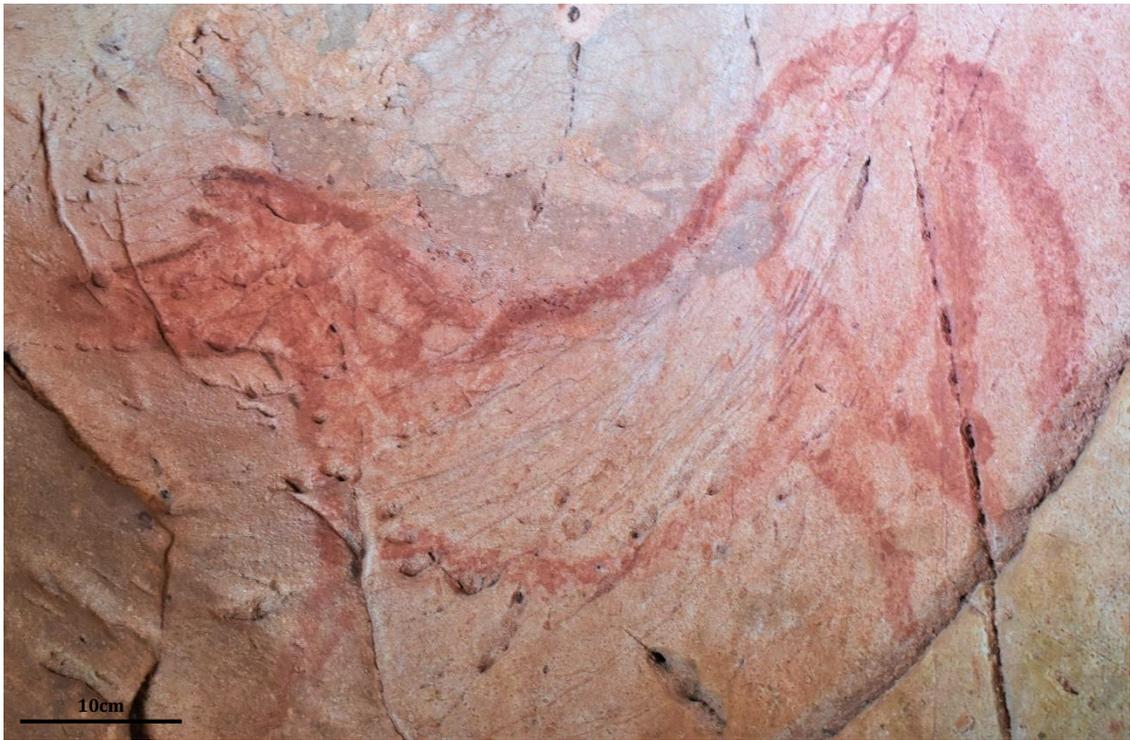
#### 7.4.4. Stage 4: Drawing out animal form

As the artist continued to add pigment to wall, the form of an animal began to emerge. There appear to be several different processes related to the drawing out of animal form, which implicitly relate to the previous states of the visual perceptual response and initial material engagement. For certain depictions, this concerned the sustained tactile engagement after the initial material engagement, as the artist continued their sensory exploration of the cave wall. The sensitivity to topographic features as the animal form is drawn out is evident in depictions PA2.2 and PA9.4. Depiction PA2.2 shows a close relationship between the application of pigment and forms in the cave wall, with the dorsal line following cracks in the wall, the horns mapped onto a suggestive calcite formation, and the ventral line of the head drawing out from a natural feature (Figure 7.47).



*Figure 7.47. DStretch image of the head of depiction PA2.2, showing how finger dots and smears directly trace natural features in the cave wall. Image: Author.*

PA9.4 also reflects this continual tactile engagement in the completion of animal form, with the entire form completed through a combination of finger dots and smears (Figure 7.48). The line forming the chest of the horse follows a vertical crack in the wall, the ventral line partially follows a horizontal crack, the rear leg is mapped onto another vertical crack, and the tail appears to intentionally extend into a curved crack. These features are not particularly salient of a horse, and their integration into the form through tactile engagement may allude to a more playful exploration of the cave wall. Rather than natural features directly informing the theme of the depiction through potent visual imagery, the haptic perception and interaction with these features may have gently guided the artist as they completed the horse depiction. This subtle, and perhaps playful, integration of natural features that do not appear to be salient of animal forms manifests in other depictions: PA6.2 integrates vertical cracks to suggest the front legs of the hind; PA9.8 uses a small crack to represent the nostril of the horse depiction; and the tail and rear legs of PA10.4 are mapped onto three vertical cracks.



*Figure 7.48. Depiction PA9.4. Note how the tactile application of pigment follows natural cracks in the cave wall. The scale bar is approximate, based on the measurements of the depiction. Image: Author.*

For other depictions, the completion of animal form appears to reflect a nuanced relationship between the depiction and areas of darkness, reflected in both the relationship between tactile marks and areas of low light, and the truncating of animal form to associate the depictions with edges, and thus darkness. Depiction PA12.1, for example, reflects the use of tactile marks that appear to have a right-to-left directionality, moving from an area of brightness into darkness (Figure 7.49). The tactile lines do not appear to correspond to topographic features, but instead appears to reflect the importance of the combination of tactility and gradating light in the process of making these depictions. This is particularly emphasised for PA12.1, where the size of the depiction and available space of the cave wall demonstrates this depiction could have been produced at a smaller scale within an area that was fully illuminated by the light source.



*Figure 7.49. Depiction PA12.1 viewed in the VR lighting simulation at the point of brightest flicker, illuminated from the right hand-side. The tactile marks appear to move from the area of brightness into darkness. Image: Author.*

In a similar vein, depictions PA7.4, PA9.6, PA9.7 and PA10.1 seem to be intentionally placed near an edge of the cave wall, or a concave feature that casts shadow over a large area of the depiction. This association truncates the form, and appears to be deliberate; PA9.7 and PA10.1, for example, are depicted without legs as shadow and darkness intersects the animal form in this area (Figure 7.50; Figure 7.51). Salient features are preserved, however, which may suggest the association to darkness may not be intended to ambiguate the animal forms. Instead, the deliberate use of the topography of the cave wall to truncate forms may be an intentional attempt to evoke the sense of animals moving out of darkness, perhaps intended to capture the experience of perceiving pareidolic or hyper imagery within cave environments. Drawing animals “in the dark”, particularly where the pigmented lines overlap onto natural features – blurring the two – may further reflect an attempt to manipulate this element; under low light conditions, it may have been difficult to distinguish depictions from natural forms, further evoking (and perhaps implicitly triggering) the experience of perceptual imagery.



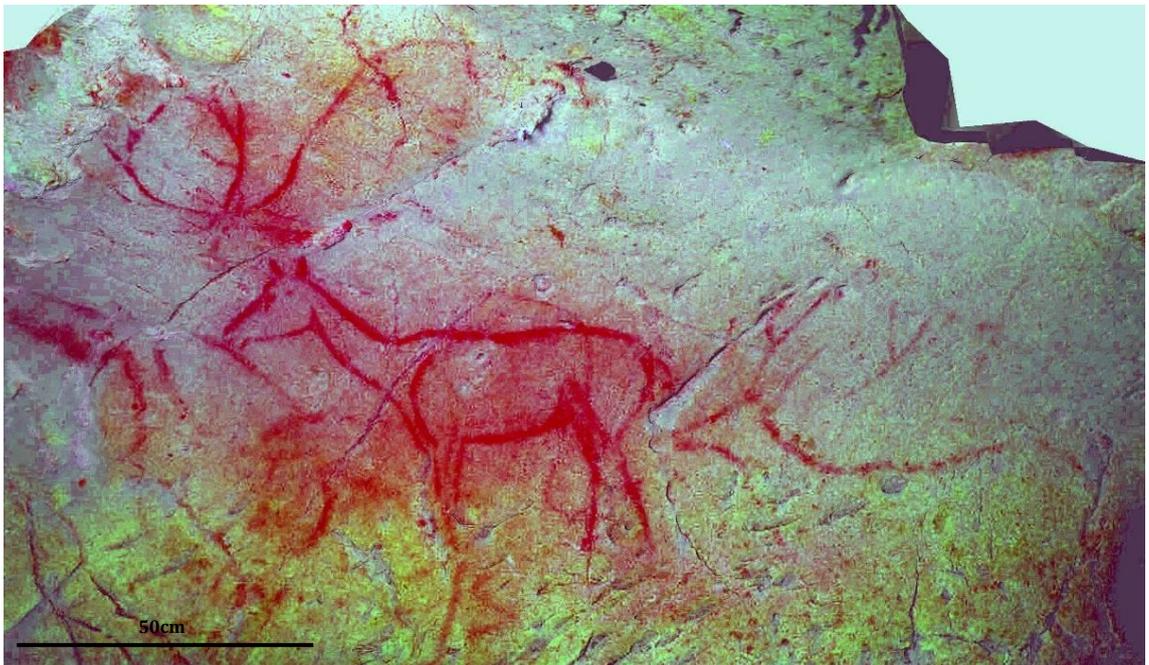
Figure 7.50. Image of depiction PA10.1. It is mostly anatomically complete, but the legs have not been depicted. The scale bar is approximate, based on the measurements for the depiction. Image: Author.



Figure 7.51. Depiction PA10.1 viewed in the VR lighting simulation at the brightest point of flicker. The natural edge of the rock surface appears to truncate the depiction with darkness. Image: Author.

The degree to which animal forms were completed also provides some insight into the way the artist(s) decided to draw out animal form. The variety in the final form of hind depictions, for example, provides a good example of the certain decisions made by artists in this process. The reduced form of hinds to the cervico-dorsal line is a common motif in Upper Palaeolithic art; the ability of artists to produce this *synecdoche* of hinds reflects their visual expertise of this animal. Yet, despite the ability of artists to expediently produce these salient hind depictions, only 25% (n=5) of hind depictions are represented in this manner, and some of the most detailed depictions in Gallery A are of hinds. The additional level of detail in hind depictions PA7.8, PA7.9, PA7.10 and PA8.2 may intend to capture aspects of the animal's characteristics or behaviours. Depiction PA8.2 appears to be framed in a scene

with a partial stag depiction in front of the hind, and a faded stag depiction placed behind the hind (Figure 7.52). The interaction between these animals may be an attempt to capture seasonal rutting behaviours; hinds and stags live in separate herds throughout the year, only coming together in late autumn for the rut. The slightly raised tail of the hind and the close presence of the stag behind with its mouth partially open further suggests this may be depicting this particular seasonal behaviour. Depiction PA7.8 also portrays red deer behaviour, with the extended neck and raised head perhaps intending to capture deer grazing on the low foliage of trees (Figure 7.53). The increasing presence of deciduous flora as the climate ameliorated may have seen an increase in this behaviour, and reflects the visual expertise and intimate knowledge artists had of red deer. Whilst certain depictions in Gallery A may have been influenced by the experience of visual imagery, it is clear that others – as with these detailed depictions of red deer – may instead be primarily be determined by the artist, reaffirming the artist’s knowledge of particular species and their behaviours.



*Figure 7.52. DStretch manipulated image of the photogrammetry model for Panel PA8. Note the hind (PA8.2) in the centre of the panel appears to be flanked either side by stags to the left (PA8.1), indicated by antlers alone, and right (PA8.3). The scale bar is approximate, based on the measurements for depiction PA8.2. Image: Author.*



Figure 7.53. Left: DStretch image of depiction PA7.8. Image: Author. Right: Image of a red deer eating low foliage from a tree, © Getty Images.

#### 7.4.5. Stage 5: Enduring relations

Despite the density and salience of the depictions in Gallery A, the constrained spatial conditions would have prevented the art from being experienced by a large audience. The low ceilings and narrow width of the gallery alludes to the art representing more intimate interactions between the artist, the cave wall, and the animal subject. This appears to be true for at least some depictions within Gallery A, where the tactile interaction, small size, and simplicity of the animal form indicates the art was formed through a discrete interaction between the artist and the cave wall. Yet several depictions subvert this expectation for Gallery A, and appear to deliberately manipulate different conditions to breathe drama into the depictions. The movement captured within the detailed hind depictions PA7.8 (Figure 7.54; Figure 7.55) and PA7.9 (Figure 7.56; Figure 7.57), for example, may have become further animated under the flickering light cast from a torch. The engraved lines of PA7.8 may have enhanced this effect, adding dimensionality to the depiction which may have been accentuated under the lighting conditions. The RLV profiles for the area of the cave wall used for these two depictions appears to support this; low and unpredictable fluctuating RLV likely augmented the dynamic movement captured in these depictions.

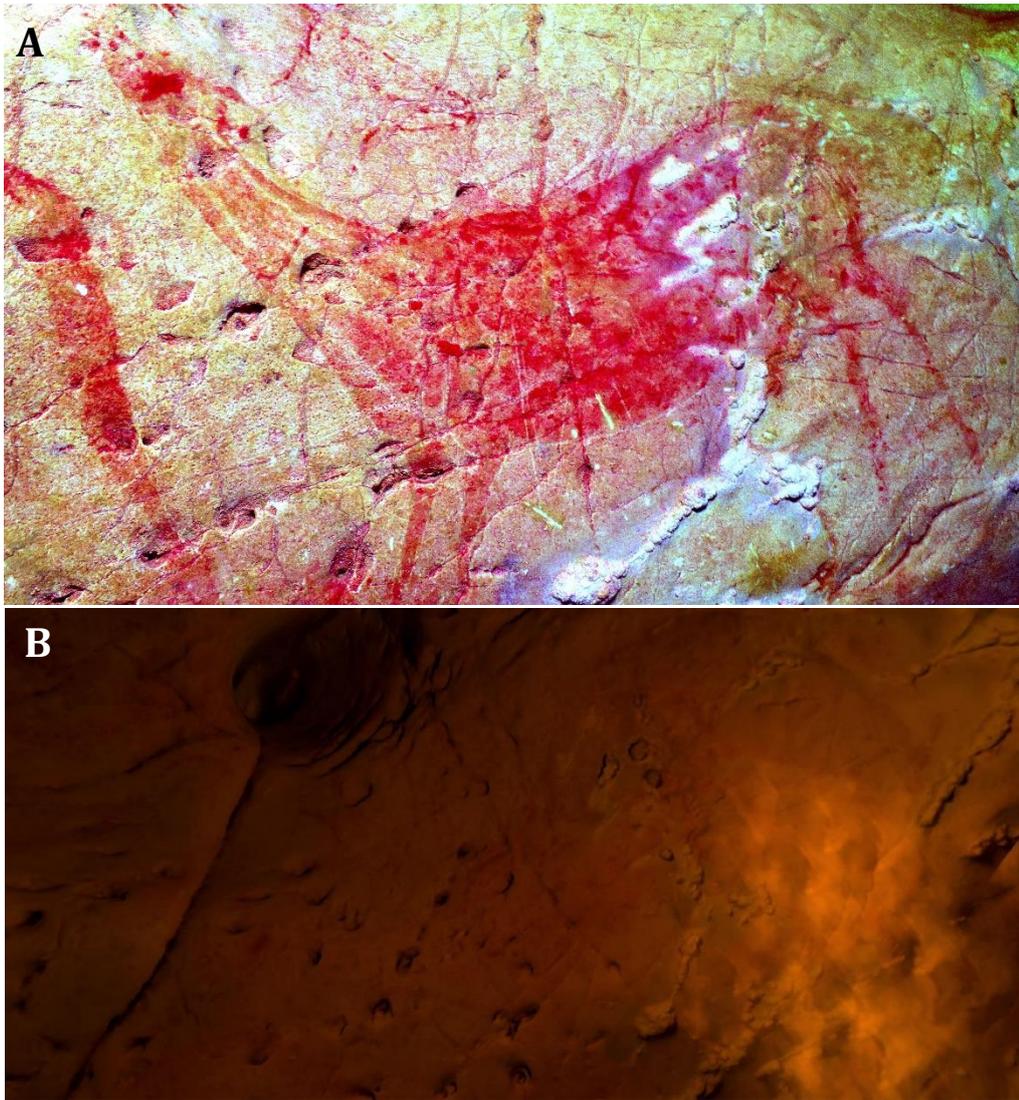


Figure 7.54. A) DStretch image of depiction PA7.8 and B) PA7.8 viewed in the VR lighting simulation at the point of brightest flicker. As this depiction is faded, it is difficult to distinguish in the VR image. Images: Author.

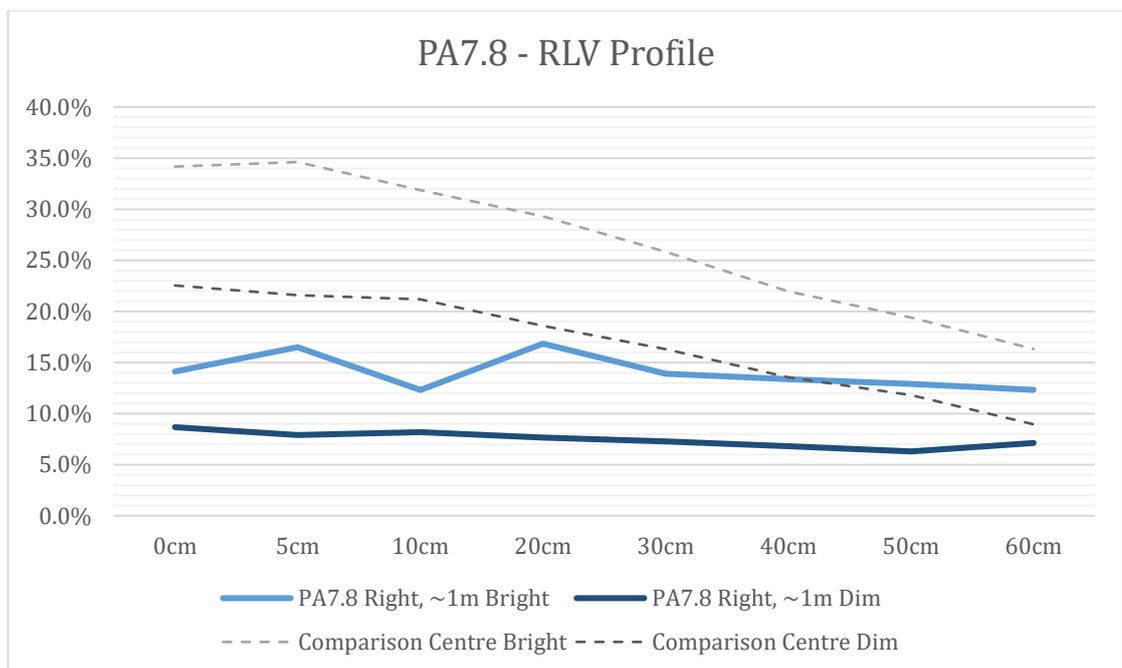


Figure 7.55. RLV profile for PA7.8. Note the fluctuating and low values for this area of the cave wall.

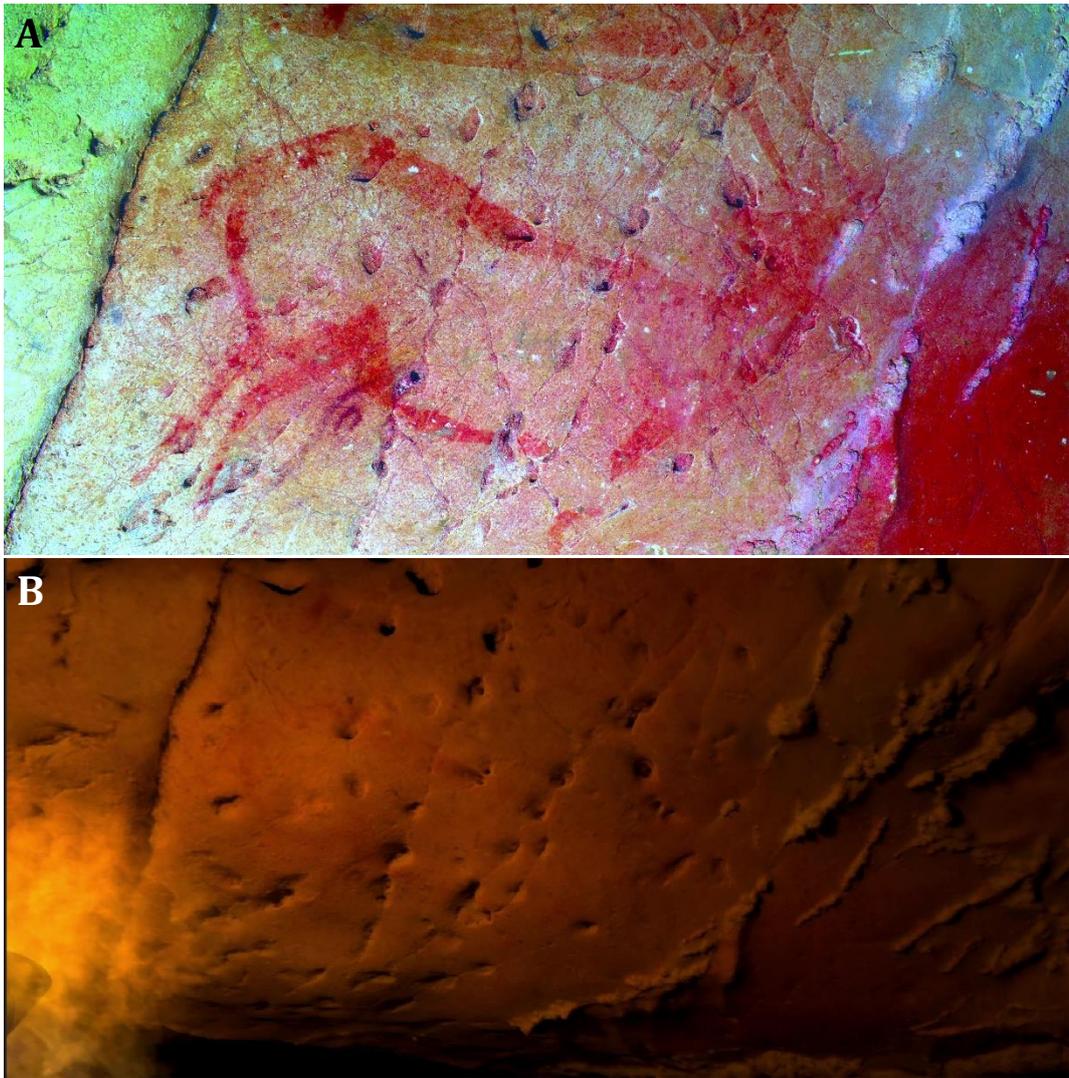


Figure 7.56. A) DStretch image of depiction PA7.9 and B) PA7.9 viewed in the VR lighting simulation at the brightest point of flicker. Due to the faded nature of this depiction, it is difficult to distinguish in the VR image. Images: Author.

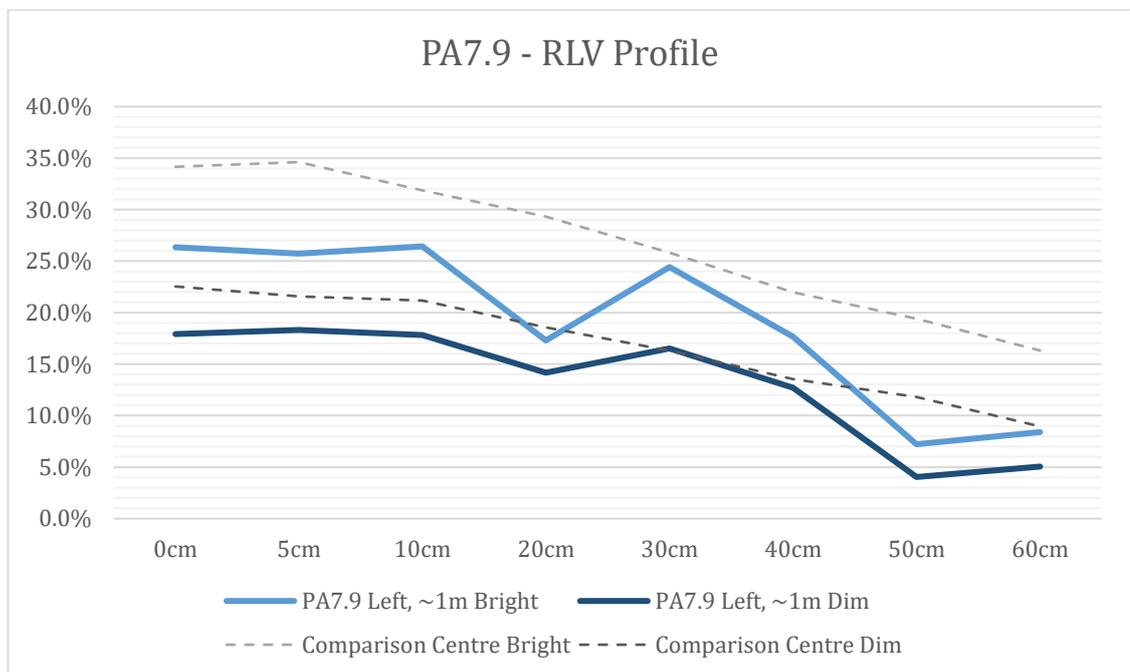


Figure 7.57. RLV profile for PA7.9. Note how the values fluctuate and steeply decline after 30cm.

The spatial placement of depictions within Gallery A further implies that they were intended to be viewed and engaged with after their making. As one moves through the gallery, the density and detail of depictions increases, culminating with the two confronting depictions – PA12.1 and PA12.2 – that are disproportionately larger than other depictions within the gallery. The immersive experience is evocative of other well-known and highly decorated caves from the Magdalenian, such as Altamira and Lascaux. The density of depictions within two domed features of the gallery, panels PA7 and PA9, further appears to reflect this intention for the depictions to be viewed and engaged with after their making. The morphology of these cave features and the concentration of animals immerses the viewer; animals swirl overhead, emerge from shadows and darkness, and appear animated. The reception of these depictions was likely visceral, deepening the relationships between observer, the cave, and the animal subjects. This immersion alludes to an element of artist autonomy in the placement of depictions, particularly within these two areas. However, the agency of the artist in determining the placement and theme of depictions does not necessarily diminish the effects of the visual response or material engagement. The artist(s) may have deemed areas of the wall suitable to depict on, based on the haptic stimuli and visual imagery triggered by cracks, undulations, and calcite formations; each “participant” influenced the creative, art-making process.

Although rare, the superimposition of forms that appear to be a distinct style to underlying depictions further suggests relations endured, through repeated visits and engagements with the art in this area of the cave. For example, depictions PA9.7 and PA9.8 overlie depiction PA9.9 and are produced using a charcoal crayon: a distinct technique to the use of ochre paint mix applied with the hands or a brush on this panel. Whilst modifications to the cave in the 1950’s limits the stratigraphic information available, the presence of archaeological levels attributed to the Mousterian, the Solutrean and Magdalenian and the recovery of lithic tools, deer tooth beads, and portable art from the Solutrean and Magdalenian levels (Ochoa 2017, 173 – 174) suggests La Pasiega may have been occupied for a prolonged period of time. This further entices the possibility of repeated engagements with the art in this gallery, and may even suggest the art was produced over several iterations, albeit likely during the same cultural period, rather than a single burst of artistic activity.

## 7.5. Summary

This chapter demonstrates the potential resolution that can be achieved through integrating primary observations within the methodology developed in Chapter 6. Through this approach, the depictions are understood to have emerged through a coalescing of haptic and visual responses which reflect intimate interactions between the artist, cave wall,

pigment, and animal subject. This chapter also further emphasises the discrete nature of the making of these depictions; no two depictions were produced in precisely the same way. General statistical trends thus do not capture the nuanced interactions that occurred for each depiction, nor the variation in the role of visual perceptual responses within their making. Where some depictions in Gallery A may have been rooted in visceral perceptual responses, grafted onto the pareidolic imagery perceived by the artist, others instead reflect a deliberate manipulation of lighting elements to breathe life into depictions whose form may have been premeditated by the artist. Similarly, where some depictions reflect the artist listening and responding to natural features through intimate tactile interactions, others are placed on amorphous areas of the wall with little or no relation to the wall's topography. This crucially emphasises that even within the same area of a cave art site, no singular explanation can be applied to explain the making of all depictions; drawing out general trends suppresses the nuance of behaviours that can be understood. The approach developed in this chapter allowed for these subtle variations in the biography of depictions in Gallery A of La Pasiega to be teased out. In the following chapter, this approach is built upon further to explore whether aspects of this biographical making, and in particular the visual and perceptual response, can be more fully understood through psychological experimentation.

## Chapter 8.

### Phase 3: Piloting VR Psychology Experiments to Understand the Cave Art of El Castillo

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#### 8.1. Introduction

Chapters 6 and 7 presented results from VR lighting simulations on photogrammetry models of art panels from Las Monedas and La Pasiega to understand the biographical making of depictions in these sites. Chapter 6 utilised available digital repositories and literature to produce these simulations for Las Monedas, demonstrating the potential of novel digital techniques for sites that may have limited access or instances where primary fieldwork is not possible. The approach utilised in Chapter 6 was revised and developed for La Pasiega, where in person fieldwork and primary observations enabled for greater precision in the VR simulations, and provided more detailed insights into the making of the depictions. Through these novel approaches, both chapters suggested that the commingling of a dynamic, low lumen light source and the complex morphology of cave walls may have triggered specific visual and perceptual responses. Through a biographical framework, the psychological responses were integrated into an understanding of the making of the art, proposing that these responses directly informed the theme, style, and placement of depictions within these caves. This approach also elucidated nuances in the production and engagement with the art both between the two cave art sites, and between different depictions within a site. Notably, this emphasised both playful and creative attributes to the making of the art, but also discrete and visceral experiences.

This chapter builds on the approach developed in the previous two chapters, to provide in-depth insights into the psychological foundations of making cave art by integrating primary observations with psychology experiments. These experiments aimed to determine the responses of modern participants when viewing cave walls under a dynamic, low lumen light source. This intended to test the hypotheses proposed in the previous two chapters regarding the role of the visual system in cave art production. VR was utilised to produce immersive cave environments that integrated photogrammetry models of cave art panels from El Castillo. These cave environments enabled participants to observe the cave art panels under lighting conditions analogous to those likely experienced by Upper Palaeolithic artists. The results demonstrate that specific visual and perceptual psychological phenomena were experienced by participants, often in response to suggestive, undulating topographies of the cave wall. As suggested by the previous chapters, these responses tended to be most potent in particularly low lumen regions, towards the peripheral boundaries of the light cast by a virtual torch. The phenomena experienced, in

turn, directly informed the participant's description of the depictions they would produce on the wall. Whilst participant's visual attention often corresponded to natural features of the cave wall that were used in the depictions at El Castillo, responses to these natural features varied and rarely corresponded with the exact species featured in the Palaeolithic art. This suggests that whilst the natural features integrated into the depictions at El Castillo were visually interesting and conducive to triggering pareidolic responses, these responses may be culturally determined – informed by both people's familiarity with particular animals and the cultural importance of certain species.

## 8.2. Methodology: Piloting VR Psychology Experiments

### 8.2.1. *Preliminary evaluation*

As with previous chapters, a preliminary evaluation was conducted to provide an initial evaluation of the art in El Castillo and to focus the fieldwork on recording specific panels in the site. This utilised images available within available publications and the online digital repository of the NESPOS database (available at [nespos.org](http://nespos.org)). The following information was recorded for depictions available through these media: gallery; panel; animal depicted; technique; pigment; general style; orientation; relationship to other depictions; features depicted; detailed style of features; association to cave wall; and visibility. Although the data obtained through this preliminary evaluation was limited, both by distortion of the art inevitable in 2D images and by the available information itself, it enabled three panels to be selected for study. Each panel reflects a diverse range of ways the depictions relate to the cave wall, including depictions that appear to have no association to natural features, and therefore were deemed a suitable sample of the art in El Castillo. A fourth panel was identified during fieldwork, due to its interesting morphology and artistic techniques. These panels collectively, despite being a small sample, represent the diverse stylistic nature of the art in El Castillo across several phases of figurative art production in the cave from the Gravettian, Solutrean, and Magdalenian periods.

### 8.2.2. *Fieldwork: Recording the art*

During fieldwork, additional features of the art were recorded to provide an accurate record for each depiction pre-selected by the preliminary evaluation. This included: panel; reference number; animal depicted; orientation; profile; features depicted; general style; relationship to other depictions; main technique used; main technique (approx. %); other techniques; other techniques (approx. %); pigment; height (cm); length (cm); distance from modern floor (cm); angle of viewing; visibility; association to cave wall; features represented by cave wall; additional comments. A tape measure was used for approximate measurements of the depictions and their height from the modern ground level. For all panels, the height from the modern ground level is likely the same as the height

from the original Palaeolithic floor. Whilst there have been extensive modifications within El Castillo to level the floor and install stairs, these modifications do not impose on the immediate area of the panels selected for this research. Panels 2 and 3, in particular, are in areas of the cave that are not visited by tourists and thus are even less likely to have been affected by modern modifications.

### *8.2.3. Fieldwork: Photography and photogrammetry*

During fieldwork in May 2019, selected panels were photographed with a Canon EOS-1Ds Mark II to record each individual depiction and a view of the general panel. Low-resolution photogrammetry models were produced using images taken with a phone camera (12 MP) that were subsequently imported into Agisoft Metashape. Despite the low resolution of the images, the photogrammetry models captured all relevant topographic and visual information about the cave panels and thus were considered suitable to use in the VR experiments. Further, the lower resolution of these models meant they did not need to be decimated before importing into the VR environments. Due to the need to frequently refresh information during a VR experience, particularly when a mobile light source requires the rapid generation of accurate light and shadows on a 3D object, high-resolution models would result in slow refresh times and glitching during the VR experience. The lower resolution of the photogrammetry models was thus favourable for this purpose. Additional images of the panels were also produced during fieldwork in October 2021 using a Nikon D3500 DSLR camera with an 18-55mm AF-P VR lens. This produced high-resolution images and captured additional macroscopic detail of the depictions that was not recorded during previous fieldwork. This high-resolution photography aided in determining the line order for each depiction.

### *8.2.4. VR environments*

Four VR cave environments were constructed for the psychology experiments in the open-source gaming software, Unity (Figure 8.1); the same software utilised for VR lighting simulations in previous chapters. A VR toolkit was imported into each environment to enable the environment to be explored and interacted with via a HTC Vive headset and controllers. Participants were able to freely move around the environment to allow for more realistic visual responses; the visual system is embodied and responsive to active movement (Snowden *et al.* 2006, 248 – 249). To ensure participants would respond to visual stimuli in the VR environments as they would in real life, the virtual caves were designed to be immersive and to ensure the participants felt present. Psychological research into virtual reality draws a distinction between immersion and presence, with the former concerning the level of detail of a VR environment and the latter defined as how embodied a participant feels in an environment, influenced by emotional responses and sensory

information (Wilson and Soranzo 2015). High resolution models of the cave walls, but also boulders, rocks, and speleothems were integrated into the virtual caves to create an immersive environment. These assets were occasionally placed to deliberately obstruct the participant as they navigated through the space causing the participant to move around these assets, to encourage a feeling of presence as they actively responded to stimuli within the environment.



*Figure 8.1. Example of a VR cave environment in Unity under artificial lighting, which features boulders, rocks and speleothems to create an immersive environment. Each large square on the light grey grid visible represents 10m. Image: Author.*

Each cave had a similar layout measuring approximately 40m by 30m, with ambient lighting set to an intensity of 0.2 to create lighting conditions of near complete darkness. Absolute darkness (intensity = 0) was not selected for these experiments, as this may have made the environment too difficult for participants to navigate and would have increased the likelihood of participants feeling disorientated or uneasy during the experiments. The darkness intended to simulate the conditions experienced by Upper Palaeolithic people in deep caves, and to enhance the immersion of the environment. Each cave featured three photogrammetry models of cave walls from El Castillo, either manipulated to remove the depictions or with the depictions visible. Small virtual hearths which cast a warm light over a radius of 2m were placed either side of a photogrammetry model to help guide the participant, but were positioned to ensure the light from the hearth did not illuminate the photogrammetry model (Figure 8.3). As such, the photogrammetry models were only illuminated by the virtual torch held by the participant, allowing the participant to have full control over lighting the wall. A torch, rather than a stone lamp, was selected as the mobile light source used by participant due to the absence of lamp technologies from El Castillo and the presence of torch swipes observed during fieldwork on the cave walls.

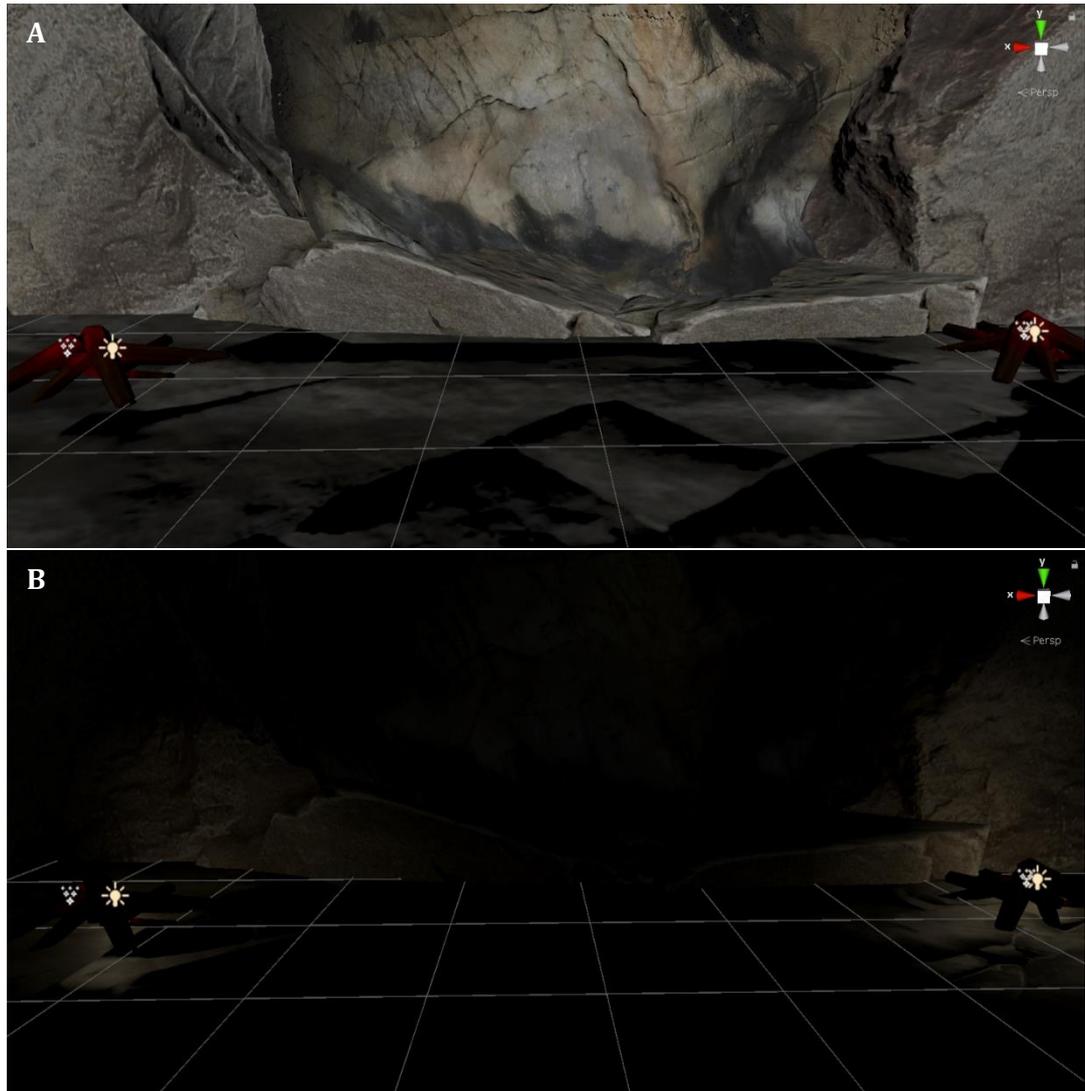


Figure 8.2. Example of Panel EC3 with art removed as viewed from the editor view of the VR environment. Each square represents 1m. The virtual hearths either side of the panel help to guide the participant to the panel, but are positioned so that the panel is not illuminated by the light cast from these hearths. A) shows the panel under homogenous artificial lighting, and B) shows the panel as it appears in the VR environment lighting conditions. Images: Author.

Whilst in Chapters 6 and 7, the virtual torch used was modelled to produce an accurate simulation of the light cast from woody sources that may have been available during the Upper Palaeolithic, this was not the case for the VR experiments. As lighting was limited in the VR environments, available primarily from the torch held by participants, the torch was modified to ensure the limited lighting did not cause too much disorientation for participants, but still simulated some characteristics of a Palaeolithic torch or lamp (Figure 8.3). As such, it was scaled to cast a flickering light over a radius of 2m (diameter of 4m) consistent with estimates and experimental observations for the light cast from torch technologies available in the Upper Palaeolithic (Rouzaud 1997, 261; Pastoors and Weniger 2011; Medina-Alcaide *et al.* 2021). The intensity was set at 1, a higher value than the light simulations of the previous chapters, to allow the participants to navigate the environment

with ease. The colour of the light was neutral-warm, again to provide participants with slightly more clarity in the VR environment. Whilst these mitigations undoubtedly reduced the extent participants experienced visual and perceptual ambiguity or disorientation within the VR environments, factors likely experienced by Palaeolithic artists, these were necessary adjustments for the comfort of the participants. These mitigations additionally emphasise that the experience of participants in the VR environments cannot be equated to the experience of Palaeolithic artists in caves. Instead, it only serves to provide an insight into the possible visual responses of these artists.



*Figure 8.3. Example of the light range cast by the virtual handheld torch. Participant is viewing panel 3 with the art removed, standing at a distance of approximately 1m away from the wall. Image: Author.*

The photogrammetry models featured in each virtual cave were configured to ensure participants did not encounter a panel with the art visible before they encountered the same panel with the art removed. The exception to this was Panel EC1, which was mitigated by the model of this panel with the art removed being the final wall encountered by the participants. A breakdown of the photogrammetry models within each cave is below:

- Cave 1: 1) Control wall, 2) Panel EC1 (art visible), 3) Panel EC2 (art removed)
- Cave 2: 1) Control wall, 2) Panel EC2 (art visible), 3) Panel EC3 (art removed)
- Cave 3: 1) Control wall, 2) Panel EC3 (art visible), 3) Panel EC4 (art removed)
- Cave 4: 1) Control wall, 2) Panel EC4 (art visible), 3) Panel EC1 (art removed).

Within each cave, the order in which participants encountered each wall occasionally varied between participants. This was usually due to ease, with participants directed towards the walls most proximate to them in the VR environment or walls which they were orientated towards first.

### *8.2.5. Experimental protocols and procedures: Ethics*

The psychology experiments were granted ethical approval by the Department of Archaeology ethics subcommittee. A full risk assessment was completed to mitigate risks related to the Covid-19 pandemic, and any additional minor risks involved for the experiment. All participants completed a consent form before undertaking the experiments, confirming that they had read and understood the briefing sheet and provided their informed consent for the recording of audio responses, recording of responses via typed notes, and tracked eye movements. The consent form also confirmed that participants understood that their data would be anonymised, in compliance with GDPR, and that they were able to withdraw from the study at any time. In addition, during a verbal briefing the participants were reminded that they were welcome to take a break at any point during the experiment and if they wanted to pause or stop the study, they were welcome to do so. The risks associated with feeling disorientated or uneasy within virtual reality were emphasised during this verbal briefing, and participants were encouraged to inform the researcher if they experienced any feelings of discomfort during the experiment. Participants were also given the opportunity to ask any questions about the study during this verbal briefing. To mitigate the disorientation that can occasionally be caused by virtual reality environments, participants were also offered the opportunity to run through the in-built SteamVR tutorial to help familiarise themselves with VR. All participants had little to no prior experience with VR, and consequently all opted to do this tutorial.

### *8.2.6. Experimental protocols and procedures: Participant recruitment*

14 participants were recruited for the study: 12 with no or limited prior knowledge of Palaeolithic art; and 2 Palaeolithic art experts. Uninformed participants were recruited through an open email call to all members of the Department of Archaeology, Durham University. These participants consisted of predominately undergraduate students and some postgraduate students. Some of the uninformed participants indicated they had an interest in Palaeolithic art but in each case, this was either an informal interest or they had taken no more than one undergraduate module that had included lectures on the subject. None of these participants therefore had any familiarity or expertise in Palaeolithic art.

The two expert participants (EP9 and EP14) were recruited through direct personal invitations. These participants were considered to have an expertise in Palaeolithic art due to their current active research in the field. While they had some general knowledge of the research project, they had not seen materials directly relating to the psychology experiments nor were aware of the specific research questions and hypotheses being tested in these experiments. This small sub-group provided an interesting comparison to the uninformed groups of participants, serving to represent a group that may closer resemble

the responses from Upper Palaeolithic artists with regard to the participant's knowledge of cultural rules, themes, or styles related to the making of Palaeolithic art. The small size of this sub-group does, however, mean any potential interpretations of their responses being influenced by a familiarity with Palaeolithic art are tentative. Future study with additional expert participants will enable these tentative interpretations to be better supported.

All participants were provided with a briefing sheet that stated the general activities that would be involved in the experiment (see appendix 6), i.e., they were informed that they would be within a virtual reality cave environment and would be asked to observe cave walls, and that the research was exploring Upper Palaeolithic cave art. For uninformed participants, this likely meant they were unaware that the experiment intended to explore whether participants had pareidolic responses to cave walls. However, this general information may have meant the two expert participants were aware that the experiment intended to explore this aspect of Upper Palaeolithic cave art, even if this was not explicitly stated. This is important to mitigate aspects of the expert participant responses; they may have, intentionally or not, sought out suggestive features to give the "right" answer they felt was being sought in the experiment. However, this does not invalidate the results of the expert participants – even if they were more likely to give pareidolic responses, they did not have any familiarity with El Castillo cave nor the particular panels shown within the experiment, and thus they had no way to "predict" what features were used in the Palaeolithic art of El Castillo or the particular animals represented by this art.

### *8.2.7. Experimental protocols and procedures: Priming*

The priming stage aimed to familiarise participants with certain species of Pleistocene animals and prime participants with the salient features of these species. The Pleistocene species shown to the participants were the most dominant species present in Upper Palaeolithic faunal assemblages from sites in northern Spain, using the contextual information provided in Chapter 5, and therefore likely the species that Upper Palaeolithic hunter-gatherers had visual expertise in. This intended to mitigate some of the issues with using modern participants in this experiment. This priming stage therefore intentionally cued the participants to have certain animal species in mind during the experiments, but invariably does not resolve the stark cultural differences in relationships to animals between modern Westerners and Upper Palaeolithic hunter-gatherers.

The priming stage consisted of presenting participants with a series of images of different Pleistocene animals that gradually increased in visual ambiguity. Participants were asked to identify the animals, and their responses (Correct = Y, Incorrect = N) were recorded. The first stage displayed animals that were visually clear and prominent in the image, to first familiarise the participant with the different names of Pleistocene animals.

The order in which the animals appeared within each stage varied, to ensure participants could not use this to anticipate the animal shown. Some flexibility was allowed in these responses, for example “goat” or “wild goat” was accepted as a correct response to an ibex, “pony”, “wild horse” or “horse” was accepted as correct for a Prezwalski horse, and “antelope” was accepted for chamois (where participants unfamiliar with the species had been informed that a chamois was like an antelope). As each stage progressed, the animals became increasingly visually ambiguous through images that placed the animals in the background, images that were visually distorted and/or partially obscured, and by using black and white images so participants could not guess the animal based on colour information (Figure 8.4). This therefore gradually encouraged the participants to visually discriminate particular animals based on their salient features. The responses to the priming stage also served to identify which participants may have had more familiarity with one particular species over another, indicated by consistency in correctly identifying that species.

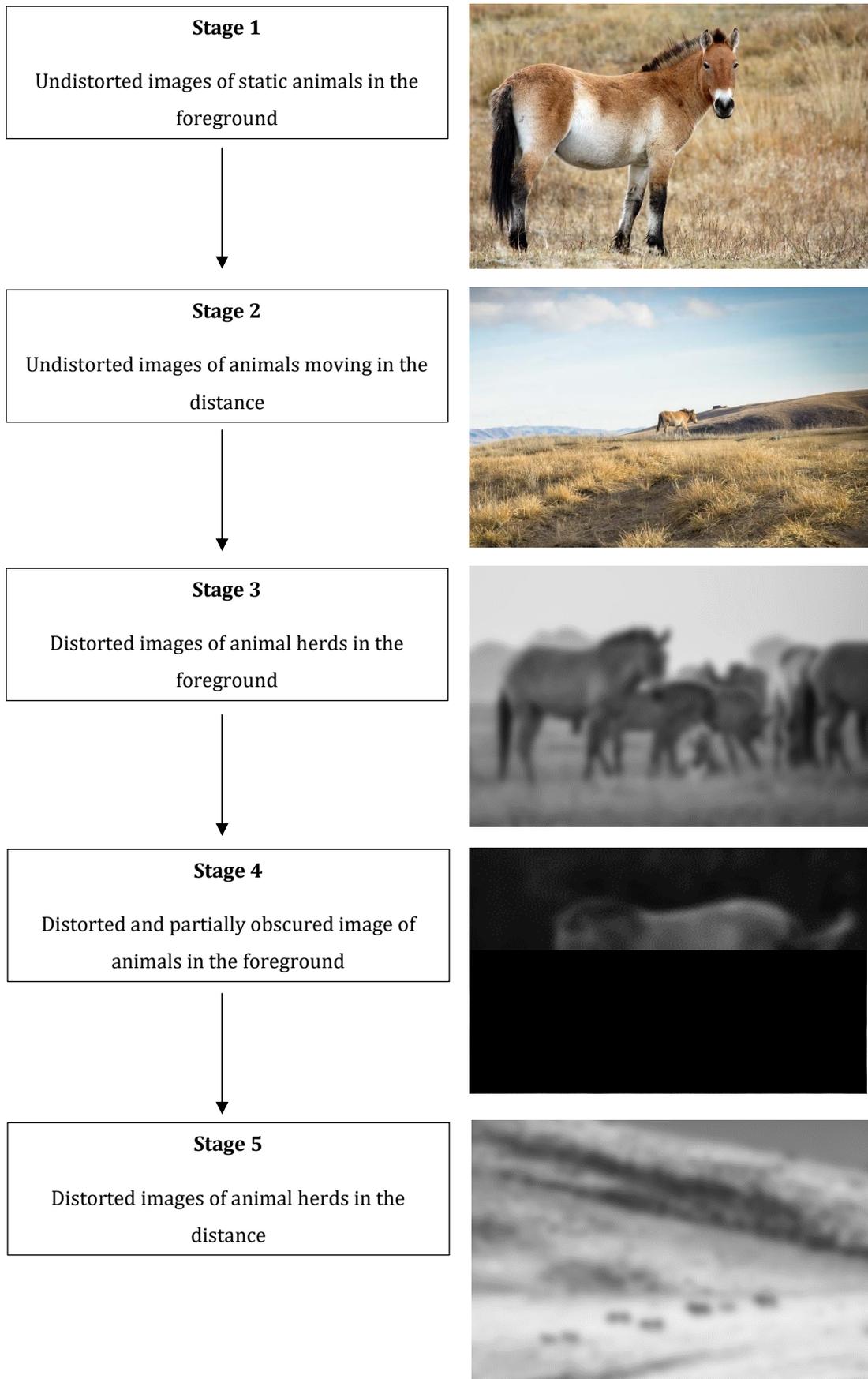


Figure 8.4. The different stages of priming the participants, with example images shown for horse on the right. Images became increasingly visually distorted to "train" the participants to rapidly identify visually ambiguous animals.

### *8.2.8. Experimental protocols and procedures: Eye tracking*

Eye tracking was used to determine which natural features drew the visual attention of the participants, both identifying the features which were cumulatively paid the most visual attention by a participant and the saccade of visual attention across a wall. This also allowed for a comparison between both the idle and active observation of a participant, and between participants that had strong pareidolic responses to a wall and those that had no pareidolic response to the same wall. To achieve this, a bespoke calibration code was produced by Prof. Bob Kentridge which served to reduce the errors in the in-built HTC Vive headset eye tracking system to an acceptable level.

Participants were first asked to complete the in-built HTC Vive eye tracking calibration, which aided in ensuring the headset was correctly positioned on the participant's head and that the distance between the headset lenses was adjusted to match the interocular distance of the participants. Once the cave environment was loaded, they were then asked to complete the eye tracking calibration. This consisted of clicking a button on the HTC Vive remote to bring up a red circle, then focusing their gaze on the circle until it disappeared. Participants were asked to do this between 6-10 times at different positions (i.e. looking up, to the left and right). Once the calibration was complete, participant's eye movements were visualised by a small pink dot. Participants were informed of this, and were asked to do another calibration if they felt at any point that the pink dot did not reflect their eye movements. Whilst the eye tracking successfully worked for the majority of participants, in a small number of instances there were some issues which prevented this. This consisted of inaccuracies in the eye tracking with the tracked dot disappearing off screen, perhaps due to the participant accidentally adjusting the headset to an incorrect position during the experiment, and rare instances where the eye tracking calibration did not work due to issues with either the code or the HTC Vive headset. These issues were subsequently addressed, but resulted in some missing eye tracking data for two participants: P1 (all caves) and P7 (Cave 1). The tracked eye movements were recorded through a screen captured video of the participant's view in VR. Tracked eye movements were recorded at a rate of 30 times per second, corresponding to the frame rate of the screen captured video.

### *8.2.9 Experimental protocols and procedures: Audio responses*

Questions were designed to collect qualitative responses from the participants, and to encourage participants to gradually interrogate walls with the art removed (Figure 8.5). For walls with the art visible, participants were only asked to observe the wall and comment on any animals they could see depicted. Responses were recorded both through typed notes and audio responses for all participants that consented to both. One participant did not

consent to audio recording, and consequently their responses were recorded by typed notes alone. The tone was kept conversational and friendly throughout, to ensure the participants felt comfortable in freely describing their subjective experience of the cave walls. Whilst no verbal confirmation was provided if participants asked a question about what they were seeing, verbal encouragement (e.g., “Mh-hmm”, “Okay.”, “Great.”) was provided where appropriate to maintain a conversational tone.

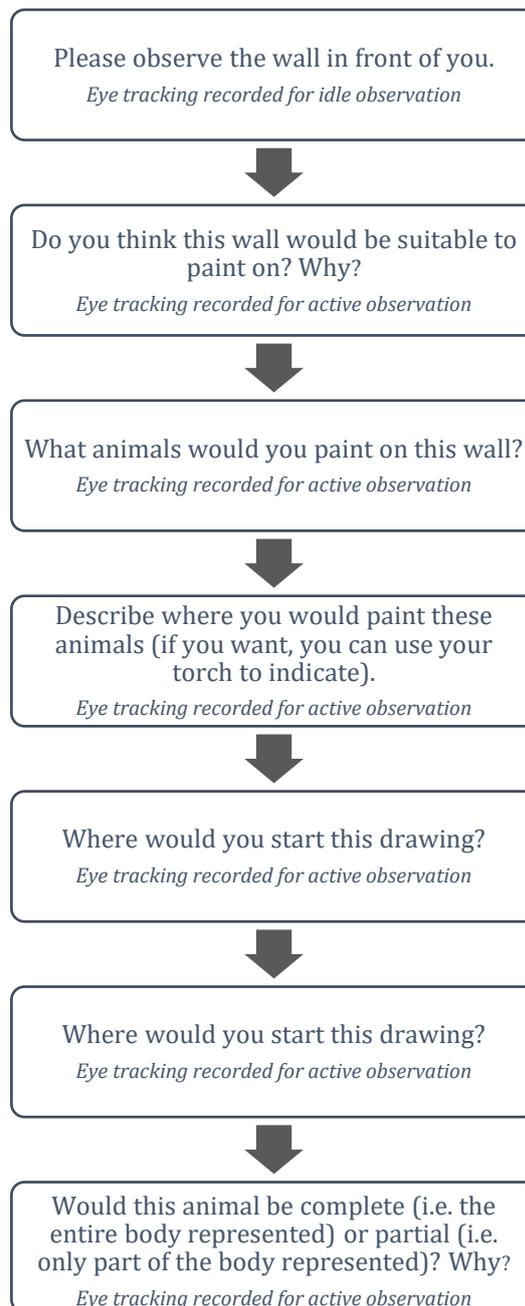


Figure 8.5. Summary of the questions asked to participants as they observed either panels with the art removed or the control wall. Questions were designed to encourage the participants to interrogate the wall in increasing detail.

This series of questions asked to participants for undecorated walls encouraged them to gradually interrogate the wall at increasing levels of specificity. Once guided to the wall, participants were first asked to observe the wall for approximately a minute, allowing

for eye movements to be recorded for this idle observation period. This intended to both allow the participant to visually explore the wall, and to determine which natural features initially attracted the participants' visual attention. Once the idle observation period was over, participants were first asked whether they thought the wall was suitable to paint on. This provided insight into the features participant's thought were important to allow them to depict on the wall (e.g. texture, colour, accessibility, suggestive forms). They were then asked what animals they would depict on this wall, and where they would place these depictions: participants were allowed to indicate with their torch or controller for the latter. This directed question intended to indirectly elicit pareidolic responses to the wall, encouraging participants to consider whether any areas of the wall may already be suggestive of animal forms. Participants were then asked where they would begin their depictions, and in cases where the participant asked for more clarity, this was elaborated to explain that this could be either what area of the cave wall or what area of the animal they would start drawing first. This intended to determine whether participants would start the drawing to directly correlate with a natural feature, or end the drawing to intersect with a natural feature. Finally, participants were asked whether their animal depiction would be complete or partial. This intended to both provide clarity regarding the depiction the participants had in mind, and again to determine whether the form of the depiction would relate to natural features in the cave wall, for example with part of the animal represented by or obscured by natural features.

#### *8.2.10. Data processing*

The innovative use of eye tracking in VR within this research meant there was no pre-established method for processing the data. As the VR experiments allowed participants to experience 6 degrees of freedom (6-DoF, i.e. participants were able to rotate their head, rotate and move their body, and navigate through the VR space: Figure 8.6) to increase immersion, this caused some degree of difficulty for processing the tracked eye movements. Although VR is being increasingly used in psychological research (Wilson and Soranzo 2015), eye tracking in VR is a relatively new technological development (Garbin *et al.* 2020) and has only recently been pioneered in visual psychology studies (Clay *et al.* 2019). These tend to restrict participants to viewing an image in virtual reality with only 3-DoF (Figure 8.6) i.e., participants' movements were limited to only moving and rotating their head (e.g., Anderson and Bischof 2019; Anderson *et al.* 2020; Sipatchin *et al.* 2021). This enables accuracy and ease in processing eye movements for these studies, but reduces immersion for the participants, limiting their ability to actively engage with the VR environment. Whilst this is undoubtedly beneficial for certain kinds of research in visual psychology, the lack of participant immersion would have been a significant limitation for this research. However, to develop an automated program that could process tracked eye movements with 6-DoF,

it would need to recognise the same point from multiple different angles; this would have necessitated a lengthy process of machine-learning. Some creative, albeit complex, solutions for tracking eye movements in a 3D VR environment with 6-DoF do exist (Clay *et al.* 2019), but there is currently no standard for processing this kind of data.

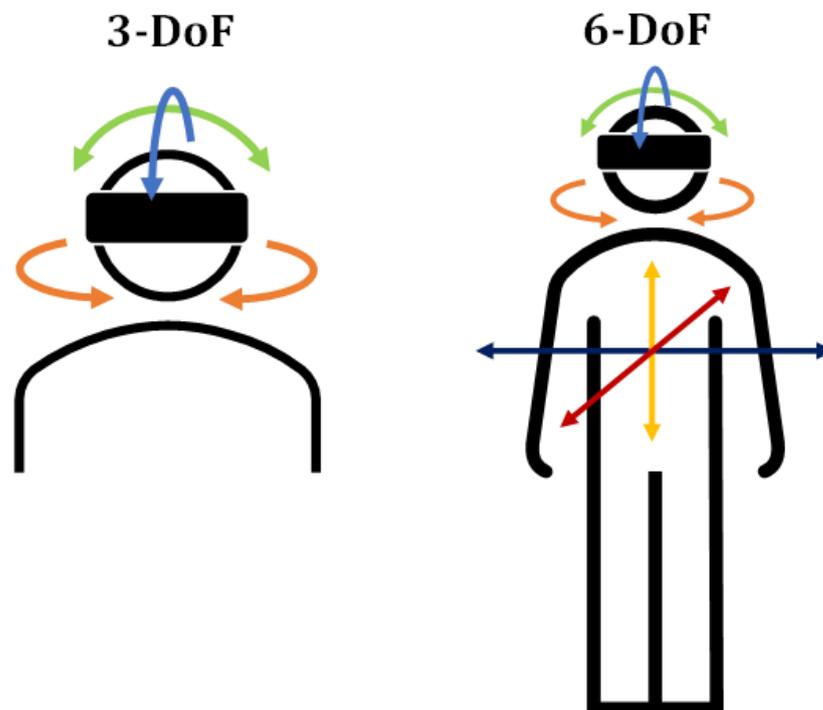


Figure 8.6. Difference in movement within VR between 3-DoF (left) and 6-DoF (right). Image: Author.

Tracked eye movements were thus manually processed and plotted onto a 2D static image of the photogrammetry model of a wall, using the open-source image editing software, Krita. The 2D image aimed to capture a neutral perspective i.e., from the perspective of a participant looking at the wall from an upright, central position. This was saved as a base image layer. The tracked eye position, represented by a pink dot within the screen-captured video, were analysed frame-by-frame and a small dot was placed in a separate layer for eye position per frame. Each layer represented one second of eye movements, allowing for the generation of dynamic heatmaps that visualised the general shifts in the participant's visual attention. Due to the nature of mapping eye movements in a 3D environment onto a 2D image, it is expected some distortion occurred during this process. However, care was taken to ensure the plotted eye position closely corresponded to the tracked eye position from the screen-captured video. Due to the high rate of recorded eye movements (30 times per second), the time intervals selected for plotting eye movements was restricted to between 30-45 seconds. Although this resulted in figures which provided only a snapshot of the eye movements of a participant observing a wall, it enabled each eye tracking figure to correspond to a specific response of a participant or the idle observation period before the participant was asked questions. Once the eye movements had been plotted onto a 2D image, static and dynamic heatmaps were generated

in MatLab. The static heatmap provided a cumulative visualisation of the areas which were paid the most visual attention by a participant. The dynamic heatmap visualised the shifting areas of visual attention of participants over time as a short video.

Invariably, the process of manually plotting tracked eye movements resulted in some limitations to the data analysis. Heatmaps were only able to be produced for three out of the four cave art panels. For panel EC4, its complex morphology caused difficulty in creating 2D heatmaps; participants would explore all three dimensions of this cave wall, which meant eye movements could not be plotted onto a 2D neutral image of the cave wall. Additionally, as the tracked eye position was plotted manually, the number of heatmaps that could feasibly be produced was limited. Manually plotting eye movements is time-consuming, and consequently only 22 heatmaps were produced in total.

Audio responses were manually transcribed into a Word document (see Appendix 6 for all transcribed responses). The transcription only recorded responses for the periods of time participants were looking at one of the three cave walls; responses during the period of time where participants were being guided to a wall were not transcribed. Additionally, any audio that may have affected the anonymity of the participant were omitted from the transcription. The transcriptions were then analysed to highlight any references made by the participant to natural features of the cave wall, and any pareidolic or hyper-imagery responses experienced by the participant. Pareidolic responses were indicated by participants stating phrases such as “this feature looks like a horse” or otherwise referencing natural features as suggestive of or looking like a specific animal. Hyper-imagery responses were indicated by participants stating phrases such as “I see a horse”, “this is a horse”, or otherwise directly referring to them perceiving an animal in the natural features of the cave wall.

## 8.3. Preliminary Evaluation

### 8.3.1. *Art summary*

The preliminary evaluation summarised available information about figurative depictions within El Castillo (Table 8.1), reflecting the breadth of stylistic features exhibited at this site. Based on stylistic comparisons between securely dated portable art from the Gravettian (Ochoa *et al.* 2019), it appears figurative depictions may have been produced in El Castillo as early as this period. These motifs are simplistic in form, depicting animals in static, canonical profile, and appear to be depicted exclusively in red or yellow ochres. Depictions that have stylistic features consistent with Solutrean depictions, such as stepped manes, are also present within the cave, and appear to reflect a mix of pigment use. Direct AMS radiocarbon dates from several depictions within the cave also confirms the presence

of a Magdalenian phase of art production, which generally appears to conform to naturalistic depictions of animals produced using charcoal or a combination of pigments and techniques. From this initial evaluation of figurative depictions in the site, 3 panels were selected as representative of the variety of styles and periods exhibited in the art of El Castillo. These also intended to capture the breadth of relationships to the natural topographic features, from the direct integration of natural forms to represent parts of the animal to the apparent placement of depictions on amorphous areas of the cave wall. An additional panel (EC4) was selected during fieldwork, which further captures some of the variety expressed in the art. The panels included in this study are summarised in Table 8.2, the position of each panel within the cave is detailed in Figure 8.7, and the stylistic features and relationship to the cave wall are detailed in the following sections.

*Table 8.1. Summary of the preliminary evaluation, that utilised available published images of the art in EL Castillo..*  
*\* indicates panels that were selected from the preliminary evaluation for further study during fieldwork.*

<b>Gallery</b>	<b>Panel</b>	<b>Animal(s) depicted</b>	<b>Technique</b>	<b>General style</b>
A	Panel of engravings	Horse (1), indeterminate (1), ibex (1), aurochs (1)	Engraved	Detailed engraved outline
	Panel of engraved deer	Deer (6)	Engraved	Simple engraved outline
	Polychrome panel *	Bison (5), hinds (4), horse (2)	Painted	Red naturalistic outline depictions, and infilled naturalistic depictions in black
	Panel of the hands	Bison (7), indeterminate (2), aurochs (1)	Painted and engraved	Naturalistic outline in red and yellow
B	Stalagmite	Bison-man (1)	Painted and carved	Stylised infilled depiction in black
	[isolated depiction]	Ibex (1)	Drawn	Simple outline in black
	[isolated depiction]	Horse (1)	Drawn	Simple outline in red
	[Unnamed panel]	Bison (2)	Drawn	-
C	[Unnamed panel] *	Horse (1), aurochs (2), deer (1)	Drawn	Simple outline in black
	[isolated depiction]	Ibex (1)	Drawn	Simple outline in black
	[Unnamed panel] *	Bison (3)	Drawn	Naturalistic and stylised outline depictions in black pigment
Galeria de los discos	[isolated depiction]	Mammoth (1)	Painted	Simple outline in red
	[isolated depiction]	Deer (1)	Painted	Simple outline in red

Table 8.2. Summary of the panels and depictions selected from the preliminary evaluation and evaluated in this research.

Panel	Reference	Animal depicted	Relationship to other depictions	Features represented	General style	Relationship to cave wall	Comments
EC1	EC1.1	Bison	Stacked under EC1.2	Head	Naturalistic head in red ochre	Direct	Dorsal and ventral lines continue natural cracks, head may mimic the shape of the rock immediately below
	EC1.2	Hind	Stacked over EC1.2	Cervico-dorsal line	Simple outline in red ochre	Limited	No apparent relationship between natural features and depiction
	EC1.3	Horse	Tiered above EC1.2	Partial head	Simple outline in red ochre	Limited/none	No apparent relationship between natural features and depiction
	EC1.4	Horse	Tiered above EC1.11	Ventral line, rear leg, tail	Simple outline in red ochre	Limited/none	No apparent relationship between natural features and depiction
	EC1.5	Bison	Stacked over non-figurative sign, tiered under EC1.7	Mostly complete	Naturalistic outline in charcoal	Direct	Dorsal line follows edge of the concave surface, legs mapped onto undulating contours
	EC1.6	Bison	Isolated	Complete	Naturalistic and infilled depiction in charcoal and brown ochre	Direct	Dorsal line is mapped onto the edge of the rock surface
	EC1.7	Bison	Stacked over hand-stencils, EC1.8 and EC1.9	Complete	Naturalistic, infilled depiction in charcoal with engraved detail	Direct	Head mapped onto suggestive cracks, legs mapped onto undulating contours
	EC1.8	Hind	Stacked under EC1.7, row behind EC1.9	Mostly complete	Simple outline in red ochre	Limited	No apparent relationship between natural features and depiction
	EC1.9	Hind	Stacked under EC1.7, row behind EC1.9	Mostly complete	Simple outline originally in red ochre, redrawn in charcoal	Limited	No apparent relationship between natural features and depiction
	EC1.10	Bison	Isolated	Complete	Simple outline on charcoal	Direct	Dorsal line represented by natural contour
	EC1.11	Hind	Tiered under EC1.4	Dorsal line and antlers	Simple outline in red ochre	Limited/none	No apparent relationship between natural features and depiction

EC2	EC2.1	Horse	Tiered above other depictions	Head	Simple outline in black pigment with stepped mane	Mimic?	Depiction may be influenced by the natural shape of the rock surface, but unclear if association is intentional
	EC2.2	Aurochs	Tiered under EC2.1	Dorsal line and horns	Simple outline in black pigment	Direct?	Front leg may be suggested by a natural crack, but unclear if the association is intentional
	EC2.3	Hind	Row behind EC2.4	Forequarters	Simple outline in black pigment	Limited/none	No apparent relationship between natural features and depiction
	EC2.4	Aurochs	Row in front of EC2.3	Forequarters	Simple outline in black pigment	Limited/none	No apparent relationship between natural features and depiction
EC3	EC3.1	Bison	Row behind EC3.2	Complete	Naturalistic outline in black pigment	Direct	Horns represented by natural crack
	EC3.2	Bison	Row in front of EC3.1, stacked on top of EC3.3	Complete	Stylised outline in black pigment	Direct	Dorsal line represented by natural crack, rear leg mapped onto contour, head mapped onto contour
	EC3.3	Bison	Stacked under/inside EC3.2	Head	Simple outline in black pigment	Direct	Horns represented by natural crack
EC4	EC4.1	Horse	Isolated, but visually below EC4.2 and EC4.3	Complete	Naturalistic outline in red and yellow ochre	Parallel	Dorsal line appears to follow the edge of the concave surface
	EC4.2	Horse	Tiered below EC4.3	Forequarters	Simple outline in yellow ochre	Limited/none	No apparent relationship between natural features and depiction
	EC4.3	Hind	Tiered above EC4.2	Head	Simple outline in red ochre	Limited/none	No apparent relationship between natural features and depiction

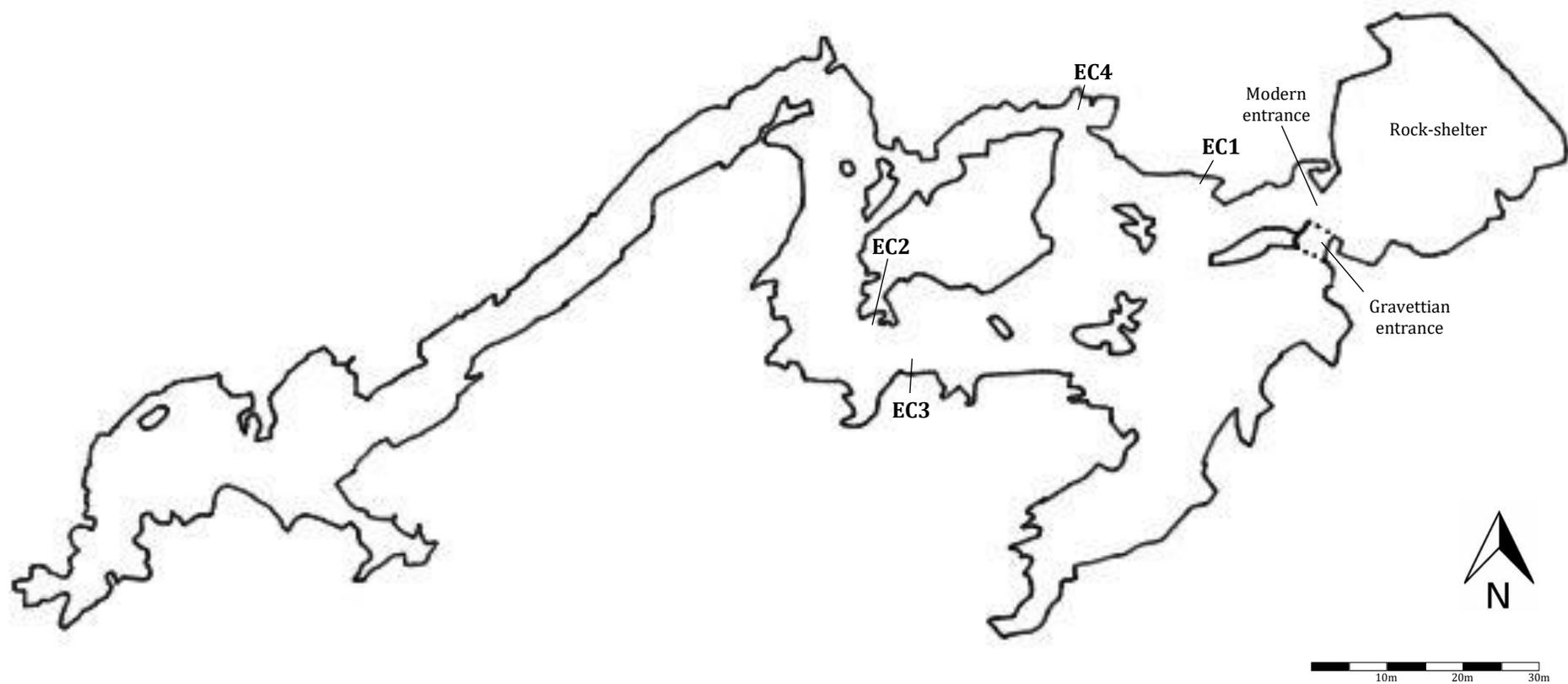
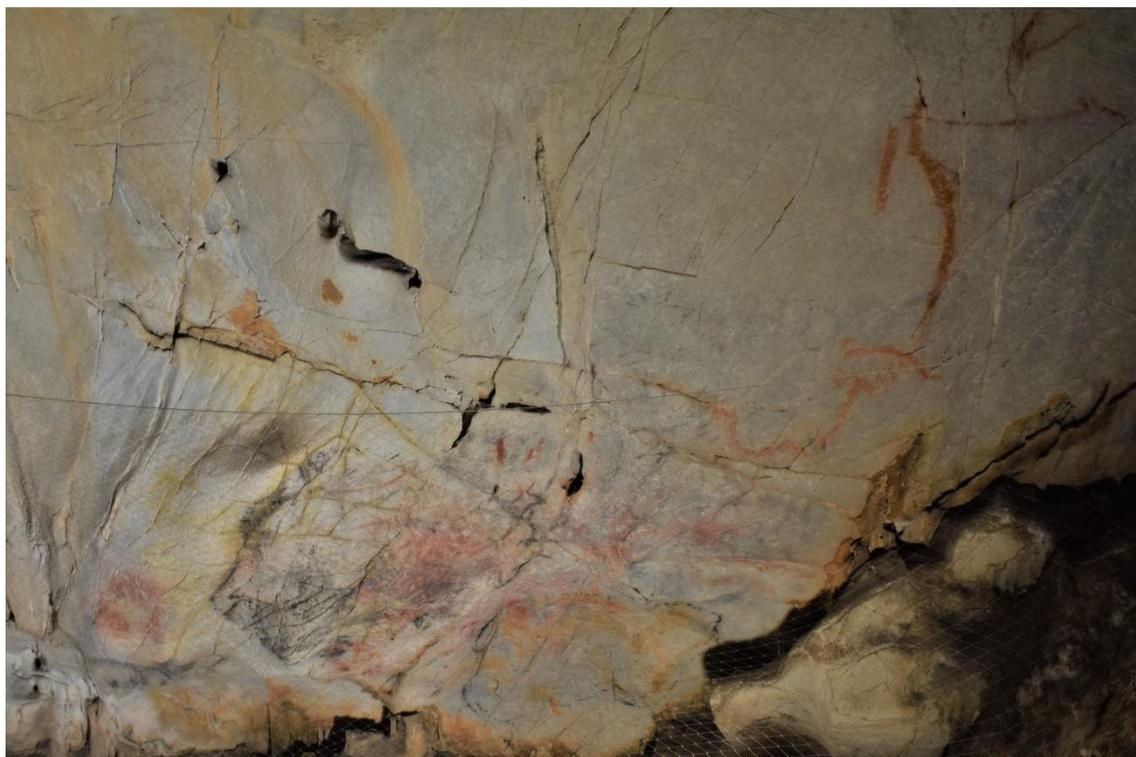


Figure 8.7. Simplified map of El Castillo, showing the position of each panel focused on in this study. Image: Author, digitally retraced after Groenen and Groenen 2017, 133.

### 8.3.2. Panel EC1



*Figure 8.8. Image of Panel EC1 which features 11 figurative depictions, produced with a range of pigment and techniques. Note, two depictions (EC1.4 and EC1.11) located towards the upper right of the panel are not visible in this image and depictions EC1.6 and EC1.10 are partially hidden from view. Image: Author.*

Panel EC1 (the polychrome panel) was the first panel selected for this research, and is situated towards the right of the cave in an area concentrated with both figurative and non-figurative depictions. It contains 11 figurative depictions, at least 4 hand-stencils and non-figurative depictions, and appears to exhibit different phases of depiction (Figure 8.8). Bison, deer, and horse are represented in the figurative depictions and exhibit a variety of styles, from simplistic outline depictions in red ochre to infilled, naturalistic depictions in charcoal. The name “polychrome panel” given for EC1 is a misnomer. The red ochre figurative depictions and hand-stencils underlying certain charcoal depictions appears as if two colours have intentionally used for these depictions, and the presence of natural yellow-orange stains further gives the impression that multiple pigments have been used for depictions, e.g. bison depiction EC1.5 appears to have been infilled with a yellow-orange pigment, but this is natural discolouration that underlies the depiction.

The panel is dominated by depictions of bison; both numerically, with bison accounting for 5 of the 11 depictions, and visually, with one of the bison depictions (EC1.1) being over 2 metres in height which appears to intentionally draw the eye of the observer. Despite this visual dominance of bison, this animal is also intentionally visually hidden in

two examples: EC1.6 and EC1.10. The variation in the position of bison depictions suggests this panel is less likely to be a composition, where one animal is intentionally dominating the composite depiction as part of a pre-imagined design, but more likely to be a palimpsest of discrete interactions between the artist and cave wall. The stylistic variation of these depictions also indicates several phases to this panel. The large red bison head (EC1.1) is an unusual style with no distinctive features that may allow for a stylistic attribution to a particular period: only one horn is depicted with a subtle s-shaped line, and the short, square nature of the head appears to be a feature of bison rather than a diagnostic stylistic feature. However, given its relative stylistic simplicity when compared to other bison depictions on this panel, it may pre-date these examples. The four other bison depictions have been dated using AMS radiocarbon dating (Table 8.3). Although there are internal inconsistencies in the dates derived from these depictions – none of which appear to have been refreshed, which might account for the variation in dates – these suggest the depictions date to the mid-late Magdalenian. The naturalistic form and attention to animal behaviour supports this attribution, particularly for depiction EC1.7 which shares stylistic features with the polychrome bison from Altamira (Figure 8.10).

*Table 8.3. AMS radiocarbon dates obtained by Valladas et al. (2001) for the four charcoal bison depictions from panel EC1.*

<b>Depiction</b>	<b>Age range in calibrated years B.P. (2 sigma)</b>
EC1.7	15,689 - 14,196 cal. B.P.
	16,351 - 14,448 cal. B.P.
	16,791 - 15,713 cal. B.P.
EC1.5	16,140 - 14,362 cal. B.P.
EC1.6	12,926 - 11,953 cal. B.P.
	13,772 - 13,010 cal. B.P.
	12,992 - 12,359 cal. B.P.
	13,000 - 12,373 cal. B.P.
EC1.10	16,779 - 15,726 cal. B.P.
	16,851 - 15,771 cal. B.P.
	17,031 - 15,917 cal. B.P.
	17,502 - 16,329 cal. B.P.

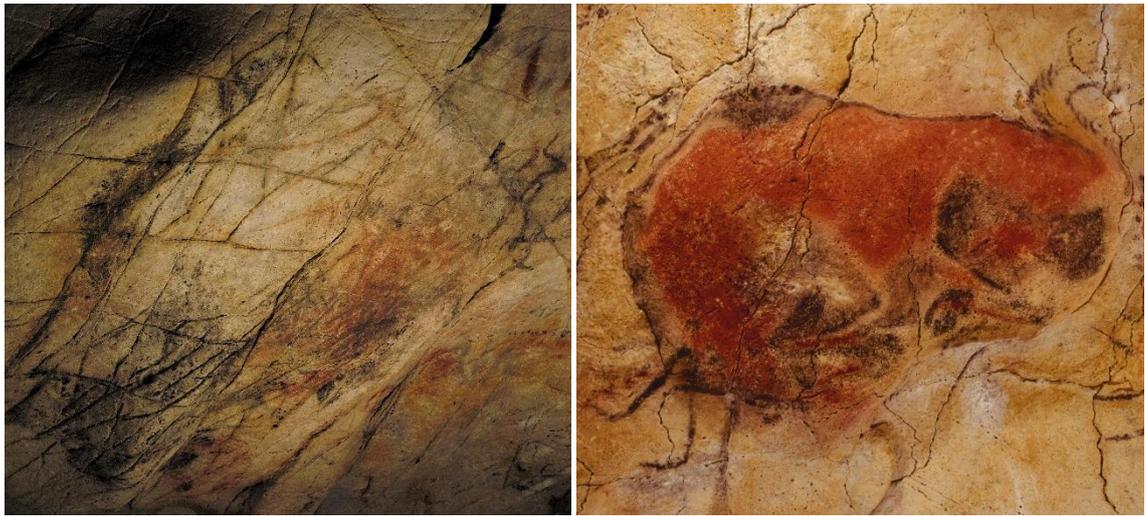


Figure 8.10. Comparison between depiction EC1.7 (left), a bison in right profile with its legs curled under its body, and a bison from Altamira cave in left profile again with legs curled underneath (right). Note the attention to naturalistic features and the similar position of the bison. Image (left): Author. Image (right): © Museo de Altamira.

Deer account for 4 of the depictions, but are visually much less prominent, either being hidden in a palimpsest of other depictions (EC1.8 and EC1.9), or only being depicted by a dorsal line towards the uppermost right corner of the panel (EC1.2 and EC1.11). Despite this, there still appears to be effort exerted to ensure these depictions are still recognisable; with depictions EC1.8 and EC1.9, the bison which overlies them is painted to ensure the deer are still visible, and EC1.9 is repainted in black to further ensure this. All depictions are simplistic in style, with the animals depicted by either the cervico-dorsal line or by a complete outline that represents the animals in a static position. These depictions share features with an engraved hind depiction from El Castillo that dates to the Gravettian (Figure 8.9). Given this stylistic comparison, and as all figurative motifs depicted in red ochre underlie the charcoal depictions, it is likely they pre-date the charcoal series and may have been produced as early as the Gravettian period.



Figure 8.9. Comparison between depiction EC1.9 (left) an engraved hind on portable art from the Gravettian period at El Castillo (right). Image (left): Author. Image (right): Ochoa et al. 2018.

The two horse depictions are both partial and situated towards the uppermost right corner of the panel. Depiction EC1.3 consists of only a head, and despite EC1.4 being one of the larger of the depictions, it does not visually dominate as EC1.1 does. Instead, EC1.4 has a faint, diffuse line which makes its identification difficult, and is partially hidden by its positioning in the panel whereby natural contours somewhat obscure it (Figure 8.11).



*Figure 8.11. Depiction EC1.3 representing a partial horse head (lower centre) and EC1.4 depicting the rear leg, tail, and ventral line of a horse (upper centre). Image: Author.*

Across the figurative depictions, there are a range of relationships to the cave wall topography, with five expressing a direct relationship to the cave wall, and six appearing to have no or a limited relationship. The bison depictions, in particular, appear to be closely associated to natural features. EC1.1 continues natural cracks in the cave wall and appears to partially mimic the shape of a small rock feature at the bottom of the panel. The dorsal line of EC1.5 follows the edge of the concave surface, the legs are placed on convex undulating features, and the head appears to be shaped around the shadow cast by the rock feature. The head of EC1.7 is mapped onto a suggestive crack, and similarly the legs are placed on convex undulations in the wall. EC1.6 is placed on the rock feature, with the dorsal line following the edge of the surface, and EC1.10 is intentionally hidden from view by cave wall topography. By contrast, the deer and horse depictions appear to have no apparent relationship to topographic features, and appear to be placed on relatively amorphous areas of the wall.

### 8.3.3. Panel EC2



*Figure 8.12. Image of Panel EC2, which features four figurative depictions produced with a black pigment. Image: Author, courtesy of the Gobierno de Cantabria.*

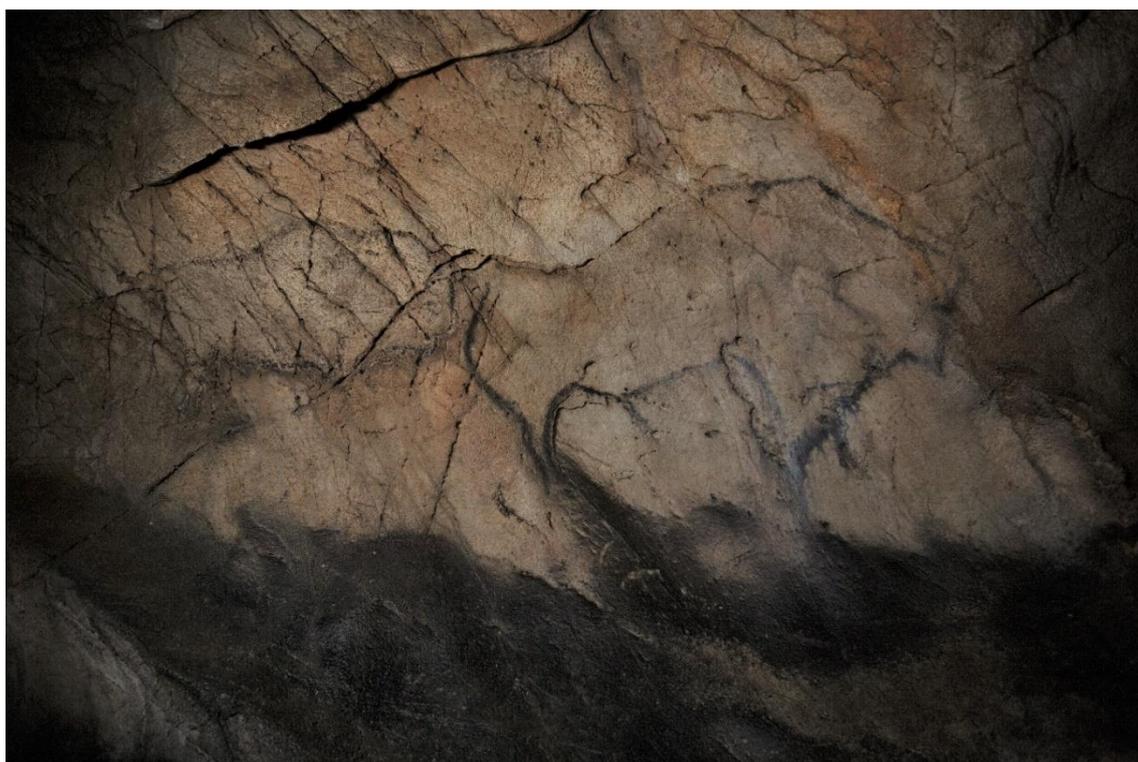
Panel EC2 (Figure 8.12) was selected for this research based on the depictions expressing different relationships with the cave wall, its intriguing location within the cave, and the relative stylistic simplicity of the depictions contrast with panel EC1. This panel only consists of depictions drawn with a charcoal crayon in a simplified outline style. Unlike the very visually apparent and striking panel EC1, panel EC2 is situated in a fairly difficult to access alcove, positioned in a higher locale of the cave. However, the panel can be viewed from a lower chamber (Sala de la Oveja). Depiction EC2.2 is the most visible and recognisable from the Sala de la Oveja, as the line of sight from the Sala de la Oveja is of the left-hand side of the panel. Whether the orientation of the majority of the animals towards the left is intentional to ensure their visibility from this chamber is difficult to ascertain; with modern lighting the panel is very visible, but with limited light from a torch or oil lamp, it is unknown how much of the panel would have been visible, and if it would have been intentionally lit to be visible from the Sala de la Oveja.

The panel has relatively few depictions, which consist of a horse head orientated facing right (depiction EC2.1), an aurochs dorsal line and horns facing left (depiction EC2.2),

a doe head facing left (depiction EC2.3), and another aurochs head facing left (depiction EC2.4). The depictions are all homogenous in style, depicted as simplistic outlines of animals produced with a black pigment, likely applied to the wall in the form of a crayon. The stepped mane of EC2.1 indicates these may date to the Solutrean, but no direct dates have been obtained from this panel to confirm this attribution. Two non-figurative marks are present on the panel: a curved black line and a small black circle.

Only two depictions on this panel appear to express a relationship with the cave wall, but these relationships are subtle and may be incidental. Depiction EC2.1 may have been informed by the suggestive shape of the rock surface, which appears to take the subtle form of a horse's head. Depiction EC2.2 appears to make use of a natural crack to suggest the front leg of the animal, but again it is unclear whether this association was intentional. EC2.3 and EC2.4 seem to be placed on relatively amorphous areas of the cave wall, and do not directly integrate or relate to any topographic features.

#### *8.3.4. Panel EC3*



*Figure 8.13. Image of Panel EC3. Note the long, horizontal crack in the centre of the panel, which has been used to both represent the horns of bison EC3.1 and the dorsal line of EC3.2. Image: Author.*

Panel EC3 (Figure 8.13) is located in a similar area of the cave as panel EC2, and was selected based on the strong relationship between depictions and natural features. Three bison are depicted on this panel, all in right profile and produced using black pigment that was likely applied in the form of a crayon. The panel is within a narrow area of the cave with restricted accessibility, requiring one to climb up a steep incline. Whilst the bison are

represented by silhouetted outlines, they are naturalistic in form which has led some to attribute these depictions to the Magdalenian (Clottes 2008; García-Diez *et al.* 2013). The smaller bison, EC3.1, shares comparable stylistic features with other securely dated Magdalenian bison depictions (Figure 8.14). The larger bison depiction, EC3.2., by comparison is an unusual style. The head is stylised, represented through geometric lines with no detail added to represent features such as the eyes or horns.

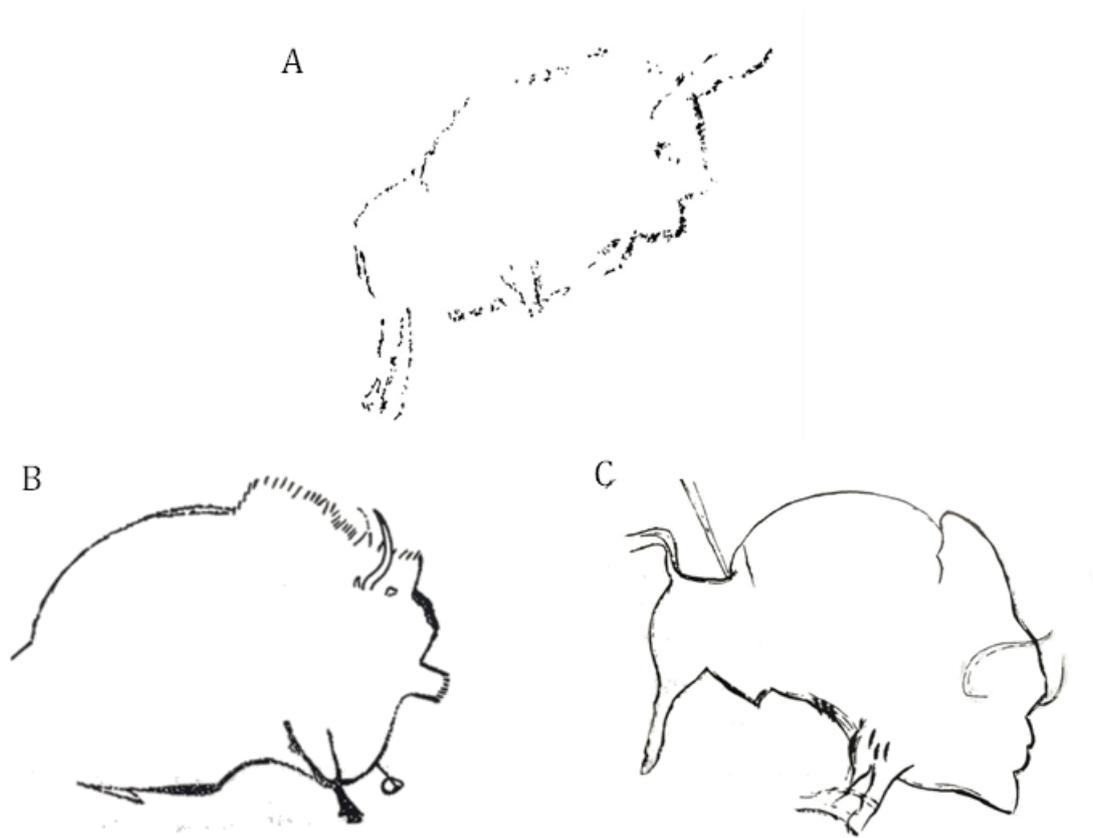


Figure 8.14. Depiction EC3.1 (A) compared to Magdalenian bison from Rouffignac cave (B) and La Mouthe (C). Image (A): Author. Image (B and C): Paillet 1999.

Depiction EC3.1 and EC3.2 express a direct relationship with the cave wall. A prominent, suggestive crack in the centre of the wall has been integrated into both depictions. Towards the left, this crack represents the two horns of the bison with one horn simultaneously representing the raised tail of EC3.2, and the crack continues to form the dorsal line of this depiction. EC3.2 integrates a number of additional natural features: the rear leg is mapped onto a convex contour of the wall; the front leg follows a shallow natural crack; and the head is placed on another convex feature, which juts out at an oblique angle to the area of the wall used to represent the body of the bison. The latter obscures the head of the bison, when the depiction is viewed from the right of the panel. Depiction EC3.3, placed within the outline of EC3.2, also appears to use a natural crack to represent the horn. The extensive association between the depictions on this panel and topographic features of

the cave wall implies natural features directly influenced the placement and form of these depictions.

### 8.3.5. Panel EC4



Figure 8.15. Image of panel EC4. Note how the depictions on the overhang feature relate to the back wall.

Panel EC4 was selected during fieldwork in May 2019 within El Castillo and is situated at the end of the *Techo de los Manos*, which is characterised by low ceilings, and to the left of a small concavity that have been used for depicting a number of non-figurative signs: the *Rincon de Tectiformes*. Three figurative depictions feature on this panel, which are positioned across a small overhang feature and the rear wall (Figure 8.15), giving the impression of an intentional association between these three depictions. A combination of ochres was used for these depictions, with EC4.1 depicted in both red and yellow ochre pigment, EC4.2 depicted in yellow ochre, and EC4.3 depicted in red ochre. For all depictions, the pigment appears to have been applied using the ochre in raw form i.e., as a crayon.

Depictions EC4.1 and EC4.2 both represent horses, with EC4.1 appearing to be depicted to give the impression of a horse either grazing or drinking with its head bent low. EC4.1 is anatomically complete, with all elements of the animal represented by just an outline and, with the exception of two internal lines on the body, no additional detail. EC4.2 is also represented by an outline, but represents only the forequarters of the animal. These depictions share stylistic characteristics, for example with the lack of a distinct mane depicted, the narrow, elongated head, and short lines protruding forward to depict the ears. The shared stylistic features further support the association of the two distinct areas of the

panel; the remarkable similarity of EC4.1 and EC4.2 indicates they may have been produced at the same time. The stylistic features of these horse depictions are akin to depictions from La Pasiega, and consequently may be late Solutrean in age. EC4.3 is very simple in style, representing just the head of a hind with a narrow triangular head and short lines used for the ears.

Despite the interesting location selected for these depictions, with the depictions on the overhang appearing to frame EC4.1 on the rear wall, there appears to be a limited relationship between the depictions and topographic features of the wall. Depictions EC4.2 and EC4.3 do not appear to have not been influenced by any immediate topographic features, nor have any features been directly integrated into the depictions. Depiction EC4.1 is placed on a subtle concave feature of the cave wall, with the arch of the neck and dorsal line appearing to follow the edge of this concavity. However, no other features of the cave wall appear to have influenced the form of this depiction.

## 8.4. Results and Discussion

The results and discussion presented through the biographical framework takes a different approach to previous chapters. The experience and responses of modern participants are interwoven with the archaeological evidence, with the psychological results providing deeper insight into the visual system's role within the art making. It must be emphasised that the responses of modern participants are only indicative, providing deeper insights into psychological elements related to the art but not seen as equivalent to the responses of Upper Palaeolithic people. Although these are presented side-by-side in this section, this is intended to present two narratives in tandem with one (the experience of modern participants) complementing and providing glimpses into the other (the experience of Upper Palaeolithic people).

### *8.4.1. Stage 1: Before entering the cave*

The selected art of El Castillo spans multiple periods of the Upper Palaeolithic, with the earliest figurative depictions perhaps dating to the Gravettian period and the latest dating to the mid-late Magdalenian. Throughout this time span, northern Spain experienced climatic fluctuations, which affected the presence of certain animal species within the immediate environment. The faunal assemblage from the stratigraphic sequence at El Castillo reflects some of these changes. During the Gravettian period, represented by levels 12 and 14 at El Castillo, species such as red deer, horse, and chamois dominate the assemblage with a high presence of bison and ibex, and some cold-adapted species such as reindeer, megaloceros and woolly rhinoceros represented (Pike-Tay *et al.* 1999, 294; Bernaldo de Quirós *et al.* 2015a, 465). The dominance of red deer and the presence of these cold-adapted species continued as climatic conditions further deteriorated towards the Last

Glacial Maximum (LGM), as represented in level 10 at El Castillo, corresponding to the Solutrean period (Bernaldo de Quirós *et al.* 2015b). As conditions gradually ameliorated after the LGM during the Magdalenian, El Castillo and sites across Cantabria demonstrate a continued dominance of red deer and horse, a decline of cold-adapted species, and an increase of mountainous species like chamois and ibex (Marín Arroyo 2013, 3).

Before participants entered the virtual cave, they were primed with the species that had a high presence throughout much of the Upper Palaeolithic: red deer; horse; bison; chamois; ibex; reindeer; megaloceros; and mammoth. The increasing visual ambiguity of the animal images displayed to the participants encouraged them to visually interrogate salient features of these species, loosely analogous to the visual expertise likely held by Upper Palaeolithic people in recognising animals in the landscape. The full responses of the priming stage for each participant are available in Volume 2, Appendix 6: several general trends can be drawn out (Figure 8.16). Participants were generally more familiar with species that are common today, particularly horse and red deer. Paradoxically, mammoth was the most correctly identified animal, which may be due to the frequent feature of mammoth in popular cultural representations of the Palaeolithic or “Ice Age”. This perhaps caused a conceptual association between the experiment and this animal, facilitating its recognition. They generally expressed less familiarity with species such as chamois and megaloceros. The priming appeared to increase recognition in these less familiar species, but challenged the identification of those initially familiar species; for the former, correct identification increased by stage 5, yet with the latter, recognition appeared to slightly fall.

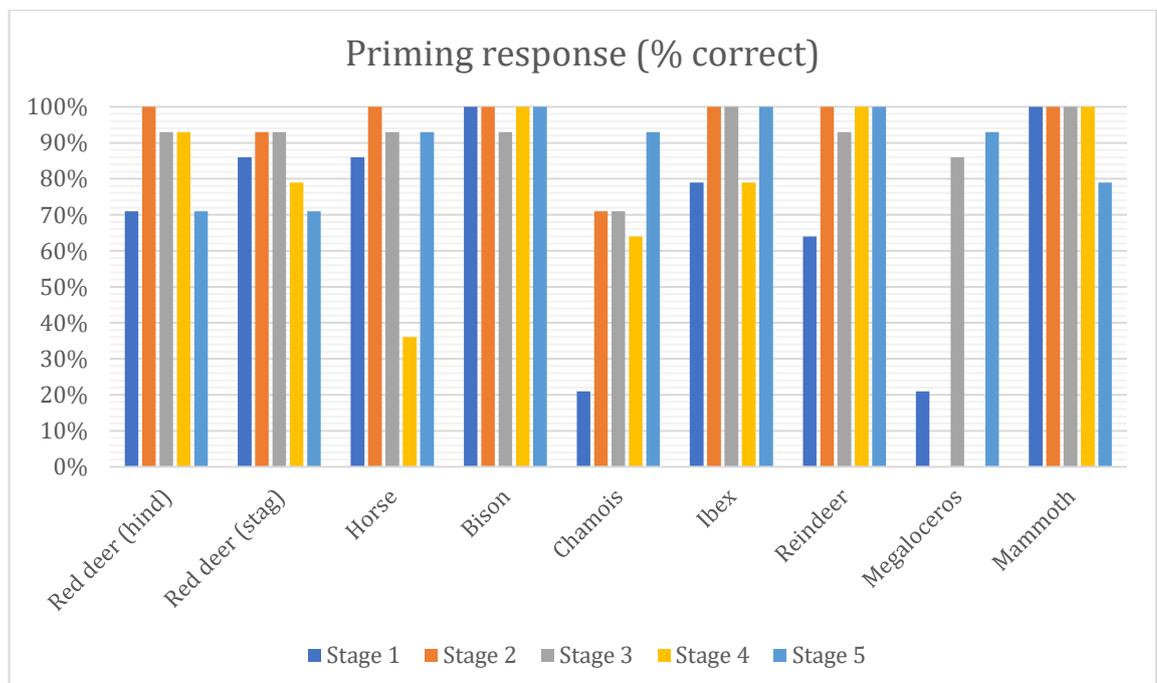


Figure 8.16. Summary of the frequency with which participants correctly identified Pleistocene animals across each priming stage. Due to limited image availability, stages 2 and 4 are missing for megaloceros. Image: Author.

The ecological milieu of the Upper Palaeolithic in northern Spain is not the only factor that may have contextualised and influenced the making of art within El Castillo. The near continuous occupation of this cave indicates this site was likely deeply embedded within Upper Palaeolithic cultures, perhaps with generations of the same populations returning to this site periodically to exploit the variety of local flora and fauna across the mixed terrains within which El Castillo is situated. The palimpsest of art on panel EC1 reflects this repeated interaction with the cave, and has pertinent implications for contextualising the engagement and the production of art within this cave. The presence of non-figurative art, hand-stencils, and figurative depictions that likely would have been encountered by those that made the particular art focused on within this study deepens the understanding of how people related to this cave. Their visual response may have been influenced by these relations, perhaps shaped by the presence of pre-existing marks and forms in the cave walls with a degree of expectation and understanding that animal forms are present in the surfaces.

The coarse contextual relations embedded within the art between people, animals, and place are also important for tempering the insights that can be provided by modern participants experiencing the art panels, far removed from this cultural context. The presence of portable art and a rich assemblage of material culture from across the Upper Palaeolithic at El Castillo (Breuil and Obermaier 1912; Bernaldo de Quirós *et al.* 2015a; Bernaldo de Quirós *et al.* 2015b), emphasises that the making of art in this cave did not occur in a cultural vacuum; it was situated within a breadth of behaviours that represented and related people to animals. Modern participants are unlikely to have this deep dependency and relationship to animals as Upper Palaeolithic people, and thus their responses will not capture the cultural meaning that was layered onto visual responses and the art making process. The responses of participants provide only a snapshot into the potential visual and perceptual responses of Upper Palaeolithic people and how, in turn, their psychology may have constrained or informed particular depictions.

#### *8.4.2. Stage 2: Visual and perceptual response*

Once entering the cave, Upper Palaeolithic people would have experienced vast, open chambers – the extent of which would have been difficult to determine under the dim light of their torch – but also more restricted areas with unusual calcite formations, which would have cast complex and shifting shadows. The modern participants experiencing the virtual cave environment similarly were entered into a vast, unusual space, one that was starkly different from the brightly-lit room they had initially entered to participate in the experiment. This adjustment of size, scale, and darkness would have likely induced similar feelings of disorientation in both Upper Palaeolithic people in El Castillo and modern

participants in the virtual caves, but perhaps also excitement and a desire to explore this new environment. The flickering of torch light, commingled with emotions of trepidation and a heightened sensory awareness, perhaps evoked visceral visual responses in Upper Palaeolithic people which, in turn, influenced the art made within these environments. The experience of modern participants viewing the same cave walls under similar lighting conditions in VR can perhaps provide some insight into the potential responses of these Upper Palaeolithic artists. To explore these effects on modern participants, five hypotheses were formulated to explore during the psychology experiments, based on the conceptual discussions of psychological experiences in Chapters 6 and 7 which primarily concerned the visual responses to a low lumen light source commingling with morphologically complex cave walls. These are presented below:

**Hypothesis 1** proposed that when idly observing cave art panels with the art removed participants would pay greater visual attention to areas of the cave wall that were used for Palaeolithic depictions. This would indicate the areas selected for depiction were visually interesting based on their topographic characteristics and/or the effect of light across the surface, as proposed for depictions in other cave art sites discussed in Chapters 6 and 7.

**Hypothesis 2** suggested that participants would experience visual imagery for areas of the cave wall that corresponded to the same areas used for depiction. This visual imagery may or may not take the form of the animal represented by Palaeolithic artists, but should relate to similar features that appear to have informed the depiction either by being directly integrated or the depiction running parallel to these features. This would indicate that specific features of the cave wall evoked visual responses that in turn influenced the form and placement of depictions.

**Hypothesis 3** suggested that where participants experience visual imagery should also correspond to the periphery of the light source, where the visual stimuli is most ambiguous. This was formulated based on understanding of the visual system discussed in Chapter 4, and observations made from the lighting simulations in Chapters 6 and 7, where depictions appear to be placed on areas of the cave wall that receive significant drop-offs in illumination i.e., placed towards the periphery of the light's boundary.

**Hypothesis 4** proposed that this visual imagery should take the form of animals visually familiar to participants i.e., those animals participants expressed greater familiarity with during the priming stage.

**Hypothesis 5** when presented with a cave wall from El Castillo that features no depictions, participants should have a less pronounced psychological response. This therefore suggests that the placement of depictions within the cave was primarily

guided by the visual imagery triggered by certain features of the cave wall, and thus walls with no depictions should not elicit the same responses.

During the initial idle observation of cave art panels with the art removed, participants were visually drawn to different areas of the wall which occasionally corresponded to the same areas that other participants found visually interesting and/or the areas used for depiction by Palaeolithic artists. Whilst this initial idle observation was exploratory, with participants familiarising themselves with the features of the cave wall, the heatmaps of eye movements for some participants reflect the repeated return of visual attention to the same features. For example, as participant P10 observed panel EC1, their attention was focused on three areas of the panel (Figure 8.17) with the dynamic heatmap indicating they returned to these features repeatedly during an observation period of 38 seconds. These areas broadly correspond with the areas used for depictions EC1.7, EC1.8, EC1.9 (left), depiction EC1.5 (centre), and depiction EC1.6 (rock outcrop). Participant P11 expressed a similar pattern when viewing the same panel with attention similarly focused towards the leftmost and lower centre of the panel, albeit with only fleeting attention paid to the small rock outcrop (Figure 8.17). Similarly, participants EP14 and P10 during idle observation of panel EC3 appear to be visually drawn to the horizontal crack across the centre of this panel which was used to represent both the dorsal line and horns of two depictions (Figure 8.17). However, other features of this panel also drew visual attention, particularly towards the top and right of the panel. This suggests a loose trend that provides some support for hypothesis 1, with areas of the wall selected for depiction appearing to repeatedly draw visual focus, but equally other areas not used for depictions received the same level of visual attention.

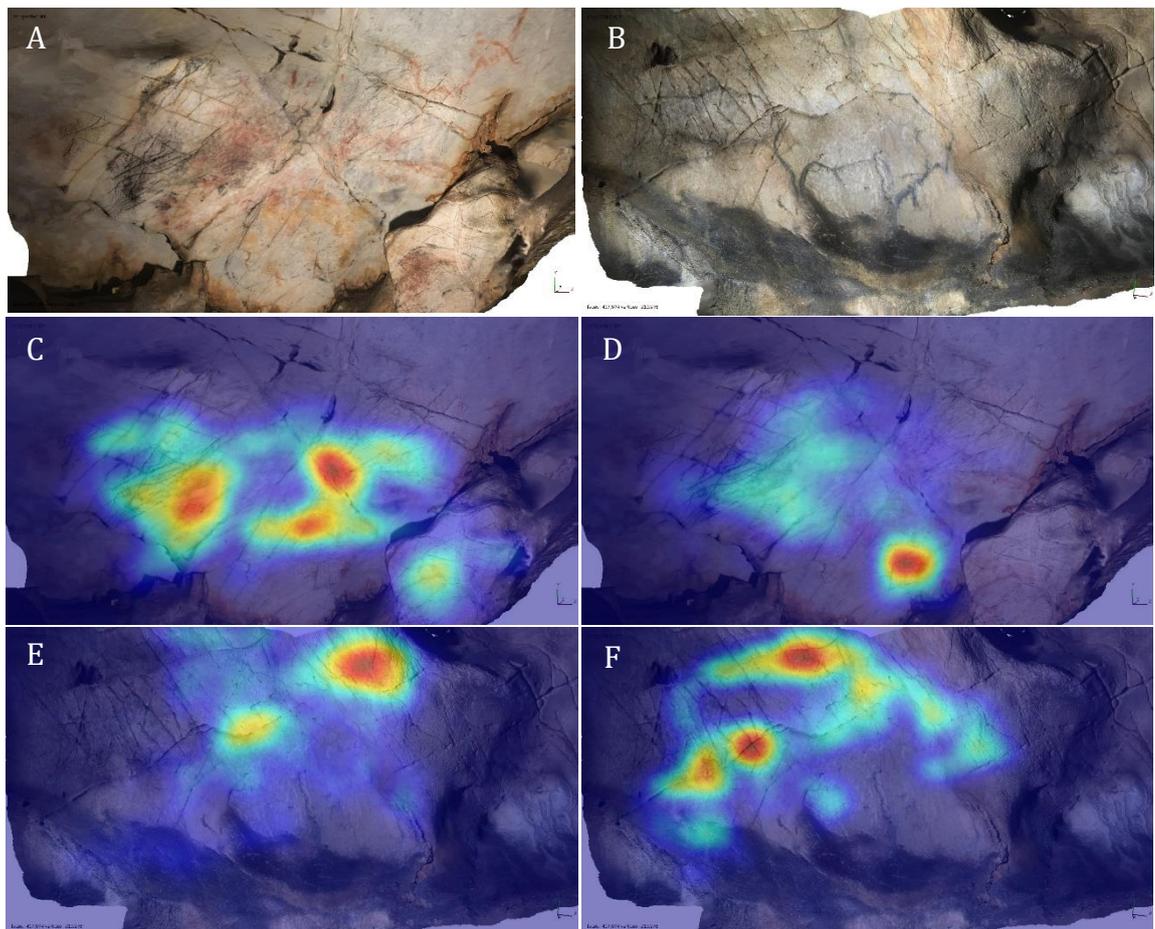


Figure 8.17. Panel EC1 (A) and Panel EC3 (B) and the heatmaps of the idle observation period for: C) participant P10 and D) participant P11 observing panel EC1 with the art removed; E) participant P10 and F) participant EP14 observing panel EC3 with the art removed. Images: Author

The indistinct pattern in visual attention suggests there may be further considerations, beyond visual interest, that determined the areas of a wall used for depictions; as has previously been conceptually discussed in Chapters 6 and 7. The random pattern of the idle observation of some participants, such as participant 6, further supports this (Figure 8.18). The dynamic heatmap indicates that during P6's observation of panel EC3, some attention is paid to the horizontal crack feature of the panel, but visual attention does not return to this feature suggesting it was not paid any greater attention than other features of the panel.

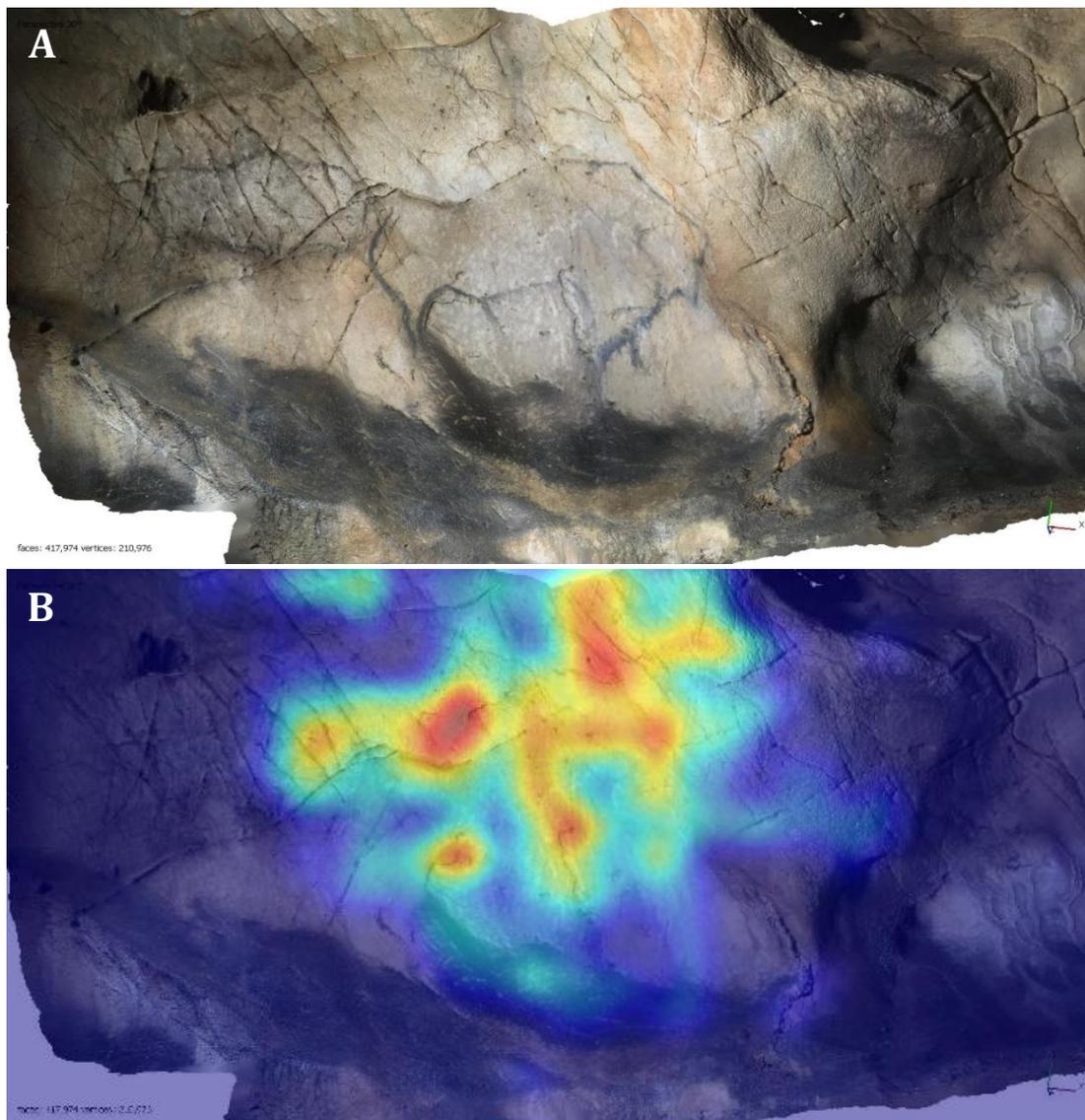


Figure 8.18. A) Panel EC3 and B) heatmap for the idle observation period of P6, between 00:04:40 – 00:05:17. Their eye movements appeared to be random, with some focus on the central crack but with other areas receiving equal visual attention. Image: Author.

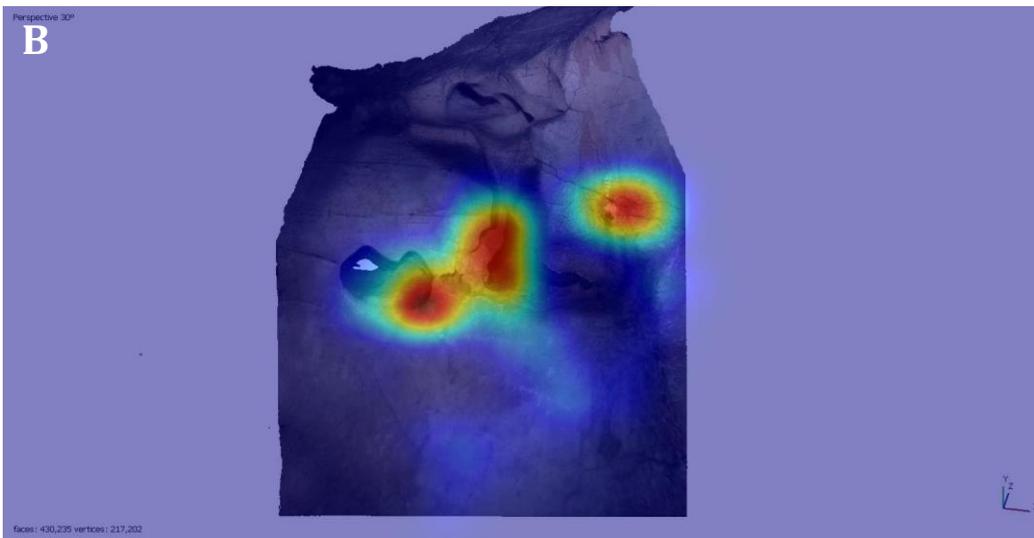
In one case (participant EP14), the areas that drew visual attention during this initial idle observation period did not correspond to any of the areas selected by Upper Palaeolithic people for depicting on. Participant EP14, when observing panel EC2, was visually drawn to the undulating topography to the top-centre and top-right of the panel (Figure 8.19). EP14 also perceived several pareidolic forms of animals within these features, commenting on the natural cracks and features of this area of the wall as evocative of animals: *“something like a bison or [...] a reindeer here, because you have this whiteish accumulation that projects upwards along this break in slope and I think if you have the head positioned out which follows this shape of the head you’d turn that whiteish projection into a series of antlers”*. However, for this panel, these areas did not feature any figurative depictions. This suggests that whilst complex, undulating surface topographies may have been visually interesting to Upper Palaeolithic artists, this may not have always been the sole impetus behind the placement of depictions.

Perspective 30°  
**A**



faces: 430,235 vertices: 217,202

Perspective 30°  
**B**



faces: 430,235 vertices: 217,202

Figure 8.19. A) Panel EC2 and B) Heatmap of eye movements during the idle observation period for participant EP14 between 00:37:29 – 00:38:15, reflecting how this participant's visual attention gravitated towards the upper section of the panel. Image: Author.

It is only once participants were invited to observe the wall in more detail after being asked “do you feel this wall is suitable to depict on?” and “what animals would you depict on the wall?” that attention became more focused on specific areas of the cave walls that corresponded to those used by Palaeolithic artists, with some participants simultaneously providing verbal indications that they were experiencing particular visual and perceptual responses. This, in turn, implies that participants only experienced visual imagery when directed to observe the wall in more detail, suggesting that the experience of this kind of imagery may be partially voluntary. The degree to which participants experienced visual imagery in response to topographic features of the panels varied, from some participants expressing visceral, potent visual responses to others appearing to have relatively normal visual responses that did not trigger any form of subjective imagery (Table 8.4). This variation appeared to be due to two factors: the way participants engaged with and moved around a panel; and the topographic features of the panel itself.

Table 8.4. Summary of the pareidolic responses each participant had to modified panels with the art removed, and whether these corresponded to the same area used for Palaeolithic art, or the same species represented.

Participant	Panel	Pareidolic response?	Location correct?	Species correct?	Additional comments
P1	EC1	Yes	No	No	Perceived a horse or an ibex towards the upper left area of the panel
P1	EC2	No	No	No	Used lower area of the panel to represent mammoths
P1	EC3	Yes	Yes	No	Perceived horses involuntarily in the natural horizontal crack used for the bison depictions EC3.1 and EC3.2
P1	EC4	No	Yes	No	Did not describe specific species, but mentioned using the overhang and the lower area of the rear wall which corresponded to the areas used for Palaeolithic depictions
P2	EC1	No	Yes	Yes	Did not appear to have a pareidolic response, but described depicting bison (and horse) in the same location as depiction EC1.5
P2	EC2	No	Yes	No	Described using the lower right area of the wall (same location used for EC2.3 and EC2.4) to depict ibex and chamois
P2	EC3	No	No	No	Described depicting horses, stags or deers, but did not correspond to the same location used for Palaeolithic depictions
P2	EC4	No	Yes	No	Used lower area of the rear wall and overhang to depict a scene of mammoths
P3	EC1	Yes	Yes	Yes	Perceived a bison in the lower, central area used for depiction EC1.6
P3	EC2	No	No	No	Described using the lower area of the wall to depict a large mammoth or multiple animals of horse and deer
P3	EC3	Yes	Yes	No	Perceived a mammoth in the horizontal crack used for bison EC3.2, but also described drawing ibex that did not relate to natural features
P3	EC4	Yes	No	No	Perceived an elk/reindeer in the morphology of the rear wall, but not corresponding to any areas used for Palaeolithic art. Participant also described depicting small animals on the overhang feature
P4	EC1	Yes	Yes	No	Perceived a horse head in natural cracks, in the same area used for bison depiction EC1.7
P4	EC2	No	No	No	Described several animals, including bison, horse, and mammoth but these did not correspond to areas used for Palaeolithic art
P4	EC3	Yes	Yes	No	Perceived the central crack as evocative of antlers, and described drawing a stag
P4	EC4	No	Yes	Yes	Did not have pareidolic responses, but described drawing a horse on the rear wall and a hind on the overhang feature.
P5	EC1	No	Partially	No	Uses the central lower section of the panel to draw a stag, but places different depictions of deer in locations not used for Palaeolithic art

<b>P5</b>	EC2	No	No	No	Used the lower left section of the panel to draw large animals (mammoth and elk)
<b>P5</b>	EC3	No	Yes	No	Used the central crack but to frame a scene of multiple antelope
<b>P5</b>	EC4	No	Partially	No	Used the overhang to depict female deer, but used a different area of the rear wall to depict reindeer
<b>P6</b>	EC1	No	Partially	No	Partially uses the central lower section to depict a rhinoceros
<b>P6</b>	EC2	No	No	No	Uses the lower section of the panel to depict deer or mammoth
<b>P6</b>	EC3	Yes	Yes	No	Pareidolic response pertains to seeing the central crack as looking like a mountain, and describes depicting ibex as a result
<b>P6</b>	EC4	No	No	No	Describes depicting mammoth on the rear wall, towards the left
<b>P7</b>	EC1	No	Partially	No	Describes different sections of the panel that are suitable to depict on, which broadly correspond to the areas used by Palaeolithic artists. However, discusses depicting herds of animals (no specific species mentioned)
<b>P7</b>	EC2	No	No	No	Describes depicting mammoth on the lower section of the panel
<b>P7</b>	EC3	No	Yes	Yes	Describes depicting bison using the central crack, and details how these would be in side profile and complete
<b>P7</b>	EC4	No	No	No	Describes depicting a hunting scene across the rear wall
<b>P8</b>	EC1	Yes	No	No	Perceived a fish in natural features of the cave wall, but this did not correspond to any areas used for Palaeolithic art
<b>P8</b>	EC2	Yes	Yes	No	Participant had pareidolic response to lower right section of the cave wall, used for depictions EC2.3 and EC2.4, but perceived the natural colour of the rock and texture as evocative of a bison
<b>P8</b>	EC3	Yes	Yes	No	Perceived a horse head in the central crack of the wall
<b>P8</b>	EC4	Yes	No	Yes	Perceived a horse on the rear wall, but not in the location where a horse (EC4.1) was depicted
<b>EP9</b>	EC1	Yes	Yes	Yes	Perceived lower central area as evocative of a bison (corresponding to EC1.6)
<b>EP9</b>	EC2	Yes	Yes	Partially	Perceived a horse heads in the upper left section of the panel (corresponding to EC2.1) but corrected their response to change it to a bison
<b>EP9</b>	EC3	Yes	Yes	Partially	Initially perceived the central crack as evocative of a mammoth, but changed their response to describe a bison
<b>EP9</b>	EC4	Yes	No	No	Perceived undulations in the rear wall as evocative of a bison, but this does not correspond to areas used for Palaeolithic art
<b>P10</b>	EC1	Yes	Yes	Yes	Perceived both a bison in the lower central area (EC1.6), and a horse or bison in the small rock used for depiction EC1.5
<b>P10</b>	EC2	No	No	No	Utilised natural undulations towards the upper section of the panel to depict antelope, but did not correspond to areas used for Palaeolithic art

<b>P10</b>	EC3	Yes	Yes	No	Perceived the central crack as evocative of a mammoth
<b>P10</b>	EC4	Yes	No	No	Perceived rear wall as evocative of a deer, but does not correspond to area used for Palaeolithic art
<b>P11</b>	EC1	No	No	No	Describes depicting a deer or ibex, but this does not correspond to any areas used for Palaeolithic art
<b>P11</b>	EC2	Yes	Partially	No	Initially described depicting a large mammoth on the lower area of the panel, but then discussed the upper edge as being evocative of a bison (corresponding to area used for EC2.2), and how they would use this to then depict a bison
<b>P11</b>	EC3	No	Yes	No	Describes depicting a hunting scene/heard of animals across the central crack
<b>P11</b>	EC4	No	No	No	Describes depicting multiple animals as a hunting scene across the rear wall
<b>P12</b>	EC2	No	No	No	Describes depicting a large animal on the lower section of the panel
<b>P12</b>	EC3	No	Yes	No	Uses the central crack as a horizon or landscape feature, and describes depicting multiple animals/herds on this feature
<b>P13</b>	EC1	Yes	Yes	Yes	Perceived the lower central area as evocative of a bison (corresponding to EC1.6), but also describes other representations (bear, a skull) that do not correspond to areas used for palaeolithic art
<b>P13</b>	EC2	No	No	No	Describes using the lower section to depict a scene of a mammoth herd or deer
<b>P13</b>	EC3	Yes	Yes	No	Perceives the central crack as initially evocative of a mammoth, but then describes using it as the dorsal line of a horse
<b>P13</b>	EC4	Yes	No	No	Perceived several animals in the rear wall, including an ibex, lion's head and otter, but these did not correspond to areas used for Palaeolithic art
<b>EP14</b>	EC1	Yes	Yes	No	Perceives the small rock used for EC1.5 as evocative of a horse, and describes perceiving other horse forms in the panel but these do not correspond to areas used for Palaeolithic art
<b>EP14</b>	EC2	Yes	No	No	Perceived multiple different animals in the upper section of the panel, including bison, reindeer, and horse, but these did not correspond to the areas used for Palaeolithic art
<b>EP14</b>	EC3	Yes	Yes	No	Perceived the central crack as evocative of several horse heads, and described utilising this feature to represent the dorsal line and head of two of these horses.
<b>EP14</b>	EC4	No	No	No	Described having difficulty with this panel, described depicting animals in general but no specific species and did not correspond to areas used for Palaeolithic art

The responses to panel EC1 capture the variety of responses that were elicited through different ways of engaging with the wall. Several participants (EP9, P1, P3, P4, P10, P13) had a pareidolic response to the central lowermost section of the panel which corresponded to the same area selected by Palaeolithic artists for depicting a bison. This area visualised some natural orange discolouration and had an undulating topography. Both EP9 and P3 noted that the undulating features of this area of the cave wall were evocative of the muscular features of a bison, with P3 directly referring to these undulating features as the bison's "*big, muscular forearms*". Both participants manipulated the lighting of this area from different distances and angles, which emphasised the undulating morphology and drew their visual attention to this feature. In initially describing the suitability of the wall to depict on, P3 subtly moved around the wall which resulted in low and variable relative luminance values for areas of wall corresponding to tracked eye movements, ranging from 12.9% - 4% during a period of >3 seconds<sup>7</sup>. Similarly, EP9 moved their light source to wash light over the surface from different angles, again resulting in RLV that ranged from 23.1% - 4.7% during a period of >3 seconds<sup>8</sup>. Relatively low and fluctuating luminance values for a cave wall were proposed in Chapters 6 and 7 to be conducive to triggering pareidolic responses, and has been suggested elsewhere by Hodgson (2008; 2012; 2021); this appears to have been the case for EP9 and P3. The regularity of the gentle, undulating topography in this case may have also contributed to this feature of the cave wall being visually resolved by the participants as looking like the proportionate limbs of a large animal.

For the same area of the panel, participants P1, P4, P10 and P13 had a pareidolic response to an area of natural discolouration, perceiving this as evocative of a bison form. In contrast to participants EP9 and P3, however, these participants did not tend to sweep the light source across the surface of the wall. Instead, the relative position of themselves and their light source remained fairly static as they observed the wall, but their eye movements were drawn to different regions of the illuminated area of time. For example, during the initial observation of the wall, P10's tracked eye movements tended to gravitate towards the periphery of the light source in areas that were poorly illuminated, with RLV between 12% - 7.7% for >2 seconds<sup>9</sup>. Yet when they began describing the animal they would depict on this area of the wall, their eye movements became focused towards the centre of the light source, with RLV for the immediate area of their tracked eye movements increasing to around 16.2% - 12.4%<sup>10</sup>. Similarly, P13's eye movements indicate they initially observed

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<sup>7</sup> Values obtained from 10 frames

<sup>8</sup> Values obtained from 9 frames

<sup>9</sup> Values obtained from 8 frames

<sup>10</sup> Values obtained from 8 frames

this area of the cave wall under the peripheral light of their torch, with RLV ranging between 19.4% - 4.3% during a period of 3 seconds<sup>11</sup>. As with P10, when P13 began describing the animal they would depict on this area of the cave wall, they moved closer to this area and raised their torch to brightly illuminate it, resulting in high RLV between 36.6% - 27%<sup>12</sup> (Figure 8.20). This may suggest that during idle observation participants were first drawn to the peripheral areas of the light as their visual system attempts to resolve these ambiguous stimuli. This may be where they first experienced pareidolic visual images, but as they begin to describe the image, they focus on areas of brighter illumination enabling them to tease out and communicate details of the visual image they are perceiving to an external person. This provides some support for hypothesis 3, indicating that visual imagery may initial occur in the periphery areas of illumination, as has been suggested for the lighting simulations of other depictions during Chapters 6 and 7.

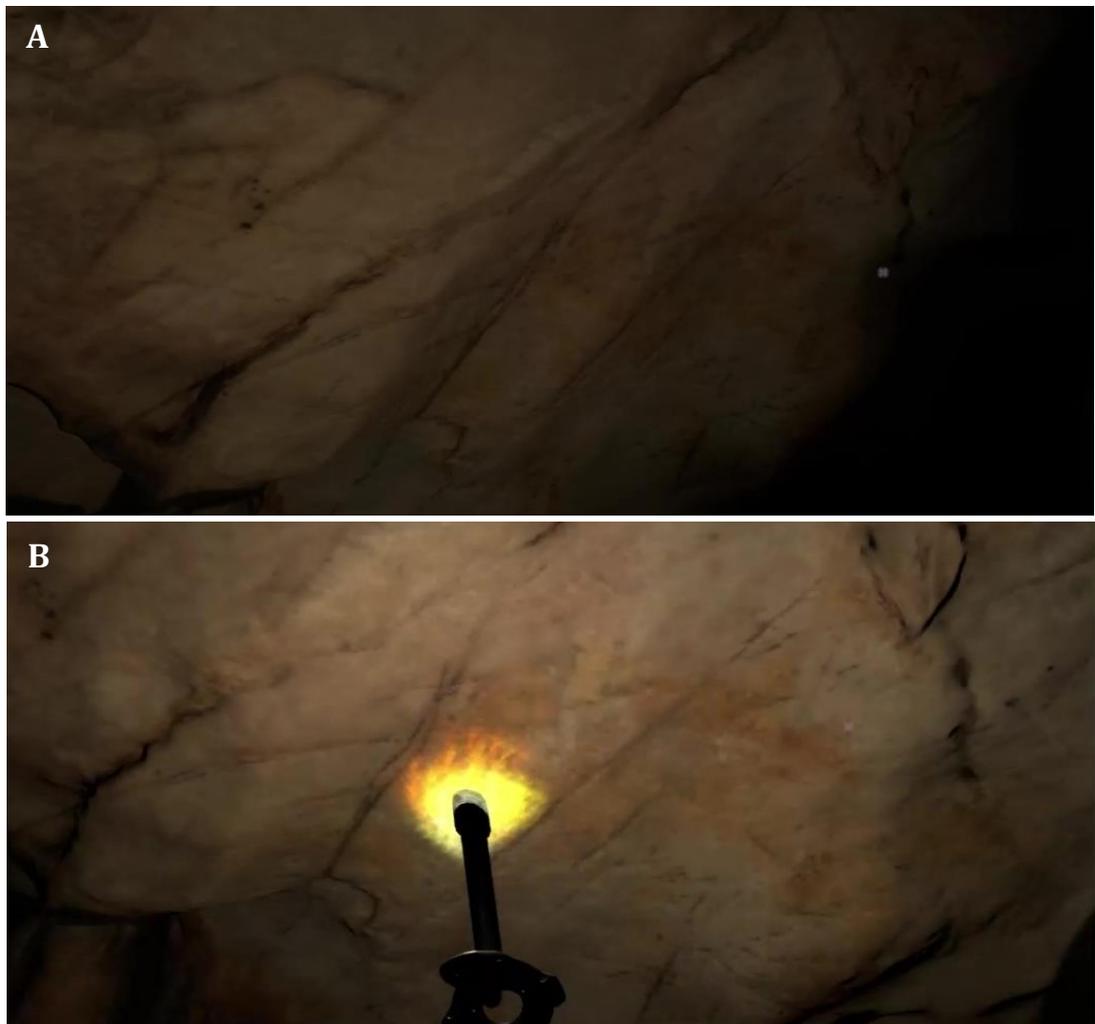


Figure 8.20. A) Initial observation of the wall by P13 at 00:13:20.35, where RLV for the immediate area surrounding the eye tracked position (represented by the lilac dot) is 3.4%. B) Active observation of the wall by P13 at 00:13:30.05 where they are describing depicting a bison on this area of the wall. RLV for the immediate area surrounding the eye tracked position is 33.4%. Images: Author.

<sup>11</sup> Values obtained from 10 frames

<sup>12</sup> Values obtained from 9 frames

Some participants when viewing EC1, however, either did not have a pareidolic response to the features of the wall, noting flat amorphous areas as suitable to depict animals on with no reference to natural features (participants P2, P5, and P7) or described the wall as unsuitable to depict on due to the undulating and cracked nature of the surface (participants P8 and P11). Although it is difficult to ascertain why there is stark disparity between the participants' responses, one contributing factor may be the position of the light source and movement of the participants that had relatively neutral responses to the wall compared to those that had more potent pareidolic responses. In general, these participants remained static when observing this wall, with their eye movements focused on areas that were brightly illuminated. For example, during the period of both idle observation and actively describing the animals they would depict on the wall, participant P2 remained fairly static with their eye movements constrained to areas of the wall that were brightly illuminated with little fluctuation in RLV. During idle observation, RLV for the areas visually focused on by P2 ranged between 17.8% and 24.4% for a period of 3 seconds<sup>13</sup>, and similarly during active observation, ranged between 19.6% and 26.6% for a period of 2 seconds<sup>14</sup>. This pattern was observed anecdotally for the other participants that did not express a pareidolic response, with both their limited movements noted during the VR experiment and the screen-captured video for their observation of panel EC1 reflecting a relatively static position in relation to the panel when compared to other participants.

This pattern of diverse engagements with a cave wall rousing different visual and perceptual responses amongst the participants was also observed for panel EC2. The responses varied for this panel, with a number of participants expressing little or no visual imagery to natural features and others experiencing prominent perceptual responses. This divide across the participants appeared to correlate to the areas of the panel that participants were visually drawn to. Participants (P1, P2, P3, P5, P6, P7, P12) that focused their visual attention on the lower, amorphous area of the cave wall expressed few pareidolic responses and this may be due to the relatively stable RLV. P5 experienced RLV between 26% - 16.7%<sup>15</sup> for a period of 4 seconds (with higher values corresponding to areas of white calcite) and P12 similarly experienced RLV between 15.4% and 7.1%<sup>16</sup>, (again with higher values corresponding to white calcite) during a period of 4 seconds as they were describing the wall. Most participants did not perceive any visual imagery in this area, but some expressed a slight pareidolic response, which appeared to be triggered by a subtle contrast in colour towards the lower right of the panel – corresponding to an area selected

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<sup>13</sup> Values obtained from 10 frames

<sup>14</sup> Values obtained from 7 frames

<sup>15</sup> Values obtained from 10 frames

<sup>16</sup> Values obtained from 10 frames

for depicting a hind and aurochs, that underlie calcite flowstone. P8 appeared to perceive a pareidolic image of a bison in the subtle colour contrast in this area (Figure 8.21):

*P8: "I can see the outline of a bison here in the differences of the colours of the rock. Its head, its legs and the uhm..."*

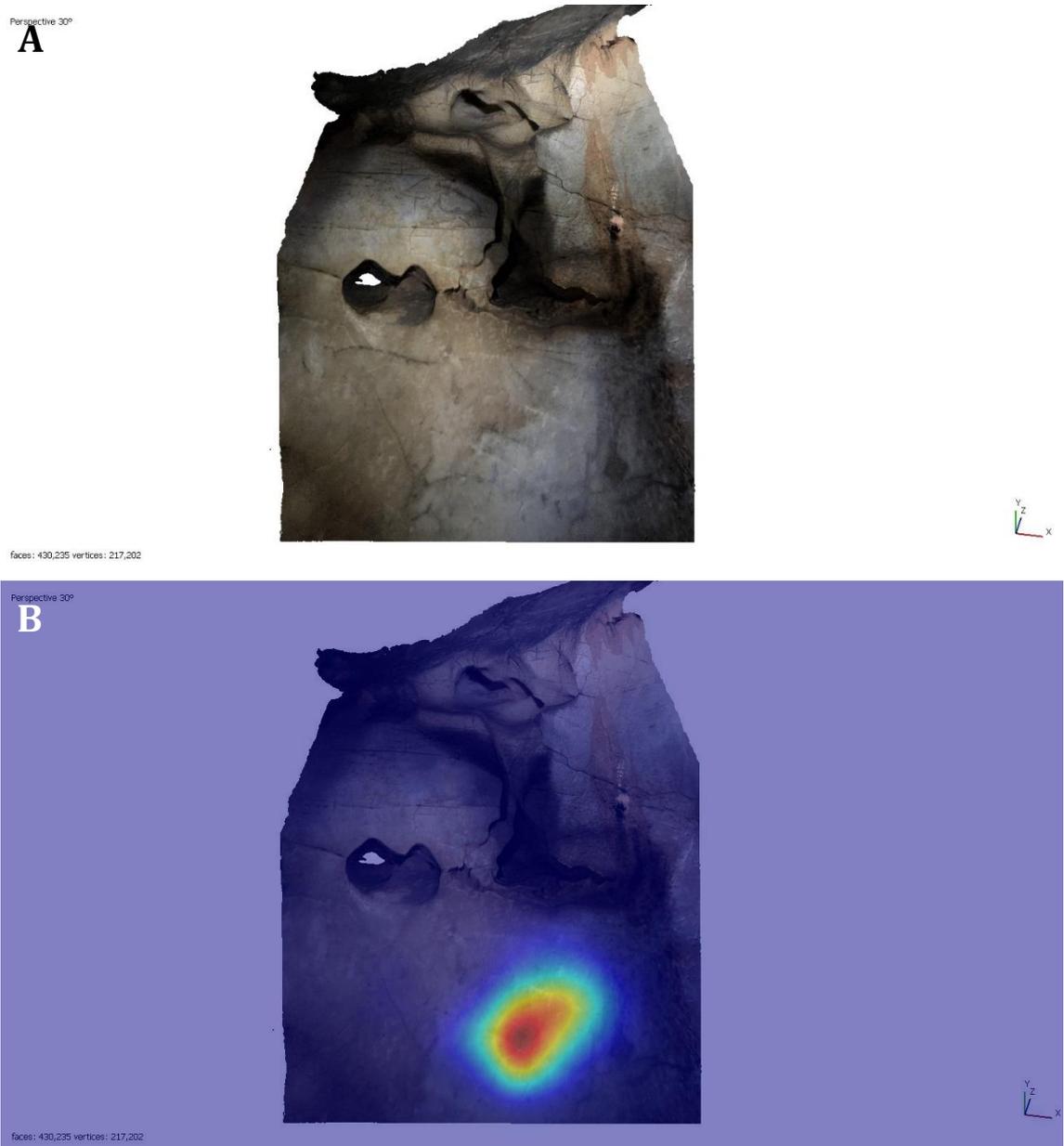


Figure 8.21. A) Panel EC2 and B) Heatmap of the tracked eye movements of P8 during active observation as the participant is describing depicting a bison, corresponding to 00:15:49 – 00:16:15. Image: Author.

For participants EP9, P10, P11, and EP14, however, the amorphous lower section of this panel was deemed not suitable to depict on and visual attention was instead focused on the upper portion of the panel. The undulating topography of this area of the panel under the low lumen light resulted in significant fluctuations of RLV. For example, for EP9, RLV fluctuated drastically between values of 30.5% and 6.12% during a period of >2 seconds<sup>17</sup>

<sup>17</sup> Values obtained from 7 frames

for the upper left region of the panel. Similarly, for EP14, RLV fluctuated between 20.5% and 1.7% during a period of 3 seconds<sup>18</sup> for the upper right region of the panel. This variation and contrast in RLV appear to have triggered pareidolic responses in these participants, centred around certain features of this upper section of the wall. For EP9 and P11, this focused around the upper left area of the wall – corresponding to an area utilised by Palaeolithic artists to depict a horse head – with each participant describing the perceived visual image in detail:

*EP9: “So, uh, I don’t know but I think this is definitely part of something, the fact that it’s got these deep undulations. So, I reckon that’s probably the belly of the bison, and the horns. The edge of this would [be] the horse with the ears here, and you can see with that shadow being made up.”*

*P11: “In fact it actually looks like a bison, that shape anyway. Maybe I’d draw a bison actually. Initially, I’d go up here because it’s got the hump of the back then the sloping- the shoulders and the sloping down back of an- almost filling that space, bison would fit quite well.”*

This region also drew the visual attention of EP14, who perceived multiple pareidolic forms in different areas of this surface. The undulating edge of a fissure towards the upper left of the region was interpreted as evocative of a mammoth cervico-dorsal line for EP14, and subsequently drew the visual attention of this participant for a prolonged period of time (Figure 8.22). Additionally, the upper right area of this panel was interpreted as evocative of multiple forms, with a longitudinal crack interpreted as a bison cervico-dorsal line and the orange discolouration interpreted as representing part of a horse head. This pronounced pareidolic response of EP14 may be a consequence of their expertise which perhaps encouraged them – consciously or not – to perceive forms in the natural features of the surface.

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<sup>18</sup> Values obtained from 9 frames

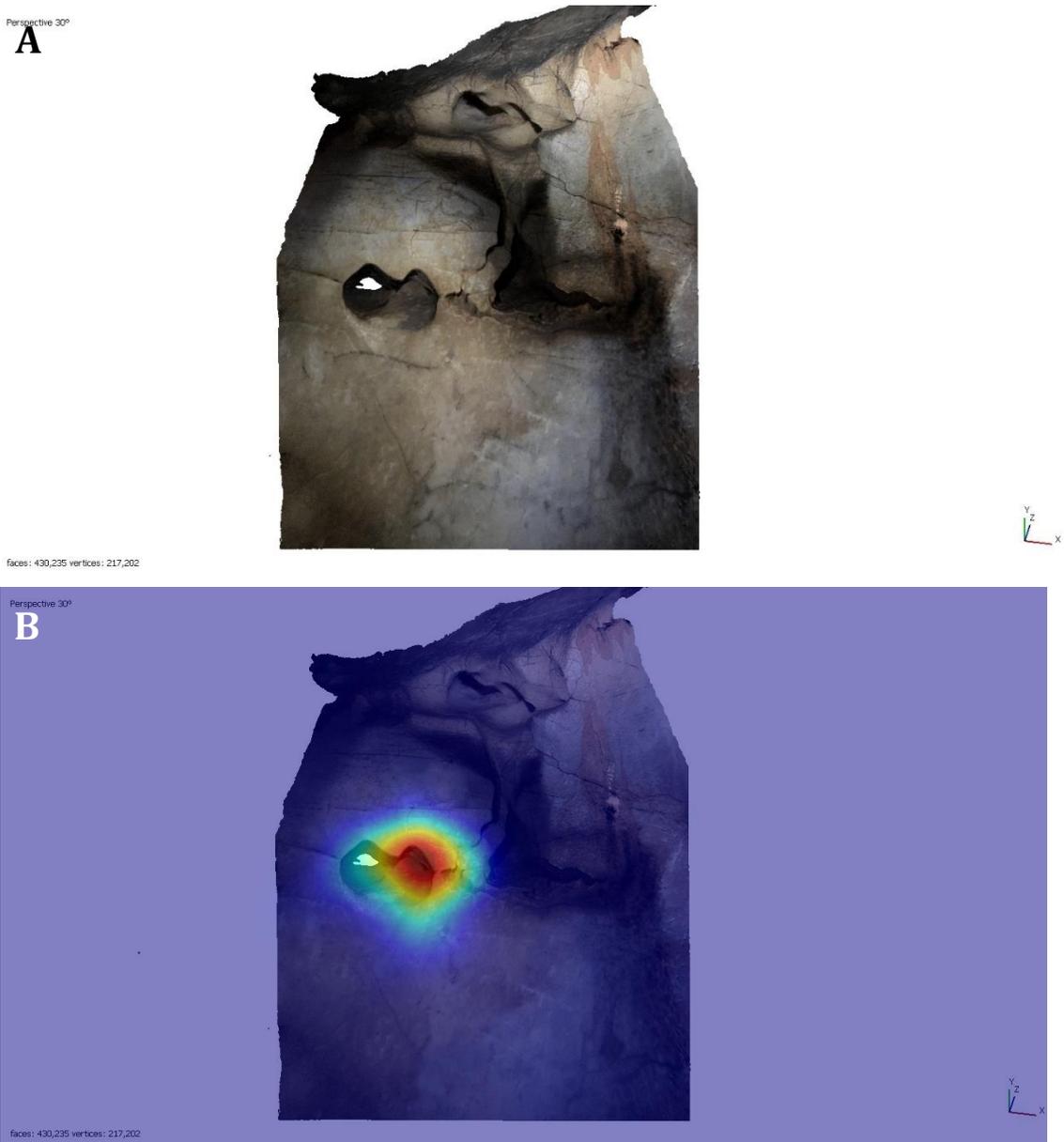


Figure 8.22. Static heatmap of the tracked eye movements of EP14 whilst perceiving a mammoth form in the surface between 00:42:05-00:42:25. Image: Author.

The different perceptual responses of participants to panels EC1 and EC2 provides some insight into hypotheses 2 and 3. It appears that the particular visual *engagement* with natural features may have played an important role in selecting certain areas for depiction, with both the movement of light across a surface and the receptiveness of participants to natural forms being important in their perceptual responses. Where participants both manipulated the light and appeared to actively seek suggestive forms, responses were potent and appeared to relate to similar areas used for depictions.

However, for panel EC3, it seems the natural topographic features evoked pareidolic responses in the majority of participants (8 out of 14) regardless of the way they engaged with the wall. These responses centred around the horizontal crack across the panel, which had been utilised for two depictions of bison. The pareidolic responses varied in form for

each participant: P3 and P10 perceived a mammoth; P1, P8, EP9, P13, EP14 perceived horse forms; EP9 also perceived a bison; and P6 perceiving the feature as evocative of a mountain, and conceptually associated this to depicting ibex. This resonated somewhat with the particular animals that participants appeared more familiar with during the priming stage.

Two participants, P1 and EP14, verbally indicated they experienced pareidolic responses during the initial observation of this wall, *before* being asked to visually interrogate the wall in more detail. For participant P1, this visual imagery appeared potent and involuntary. They perceived horse forms as pre-existing in the natural surface, commenting the following during the idle observation period:

*P1: "I can instantly see erm engravings of horse, I think? Kinda one here using this as the kinda back line and head around here. And then above it to its right, kind of heads looking down."*

After they had described the visual imagery that they were perceiving, P1 was deliberately told that this was a panel that was undecorated and expressed surprise at this, which further suggested the visual imagery they were experienced was compelling:

*P1: "Oh is it? [...] I don't know what was going on there with my eyes, but like I don't know it maybe looked very suggestive to me."*

Similarly, EP14 remarked on perceiving several horses in the natural features when initially observing the wall. They subsequently described these horses in detail after being asked "*what animals would you depict on the wall?*", directly relating their horse depictions to the natural features of the wall – particularly the central crack – and the pareidolic forms they had perceived in these suggestive features:

*EP14: "For example, there's a really obvious area here, this long deep crack running down here gives you the natural shape of the ear. You can position the head in two ways I think. You can position the head down and around, or you can position it out and forward [...] And I think you have uhm a wonderful area here that I think is a natural horse in opposite orientation, so that I was seeing in right profile. And a much larger animal here, smaller and more compact animal in left profile where the natural crack works really well as the ear, the back of the neck into the spine and then rolling around uhm as well. So, I see another horse there."*

The tracked eye movements of EP14 further demonstrate that they were visually attracted to the crack along the centre of this panel, with this natural form directly influencing the pareidolic imagery they were experiencing. Whilst their idle observation reflects some visual scanning of other regions of the panel (see D, Figure 8.17), once the participant began describing the forms they were perceiving in the surface, their eye movements are much more focused, gravitating almost exclusively towards the central

crack (Figure 8.23). Although this participant interpreted the natural features of this panel as being evocative of horse forms rather than a bison, the participant's visual attention correlates with the same natural features utilised by Palaeolithic artists in the depiction of bison on this panel.

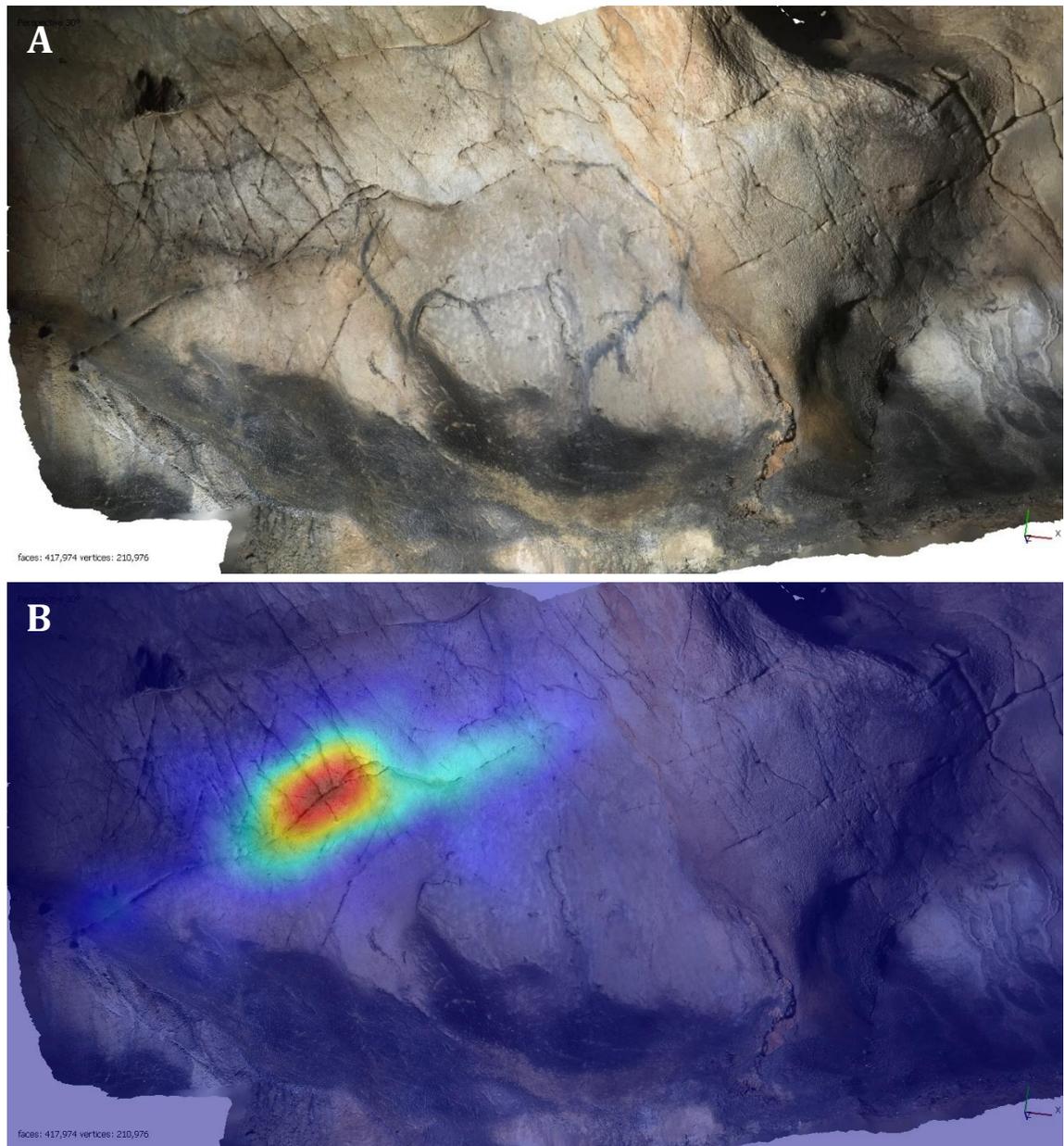


Figure 8.23. A) Panel EC3 and B) Static heatmap for the active observation of participant EP14 at 00:02:54 – 00:03:34, as the participant is describing depicting horse forms that utilise the central crack. Image: Author.

Participant P10 exhibited a similar pattern in their visual attention and their subjective perceptual interpretation of the natural topographic features. As with EP14, this participant's pareidolic response centred around the central horizontal crack and this, in turn, directly influenced the depictions they considered placing on this wall. In their response explaining why they felt the wall was suitable to depict on, P10 made direct reference to the visual imagery triggered by the natural features and low lumen conditions:

*P10: “Again because of the shapes that are already there are quite, uhm, what’s the word? Not influencing. Yeah, like kind of inspired shapes. Like there’s one here uhm which is kind of like comes out from here and comes up, and there’s a leg, and it kind of reminded me of an elephant or a mammoth with its trunk kind of in the air. So, I think it’s just the shapes that are already there look like something, especially using the light and you’ve just got to kind of adapt I think.”*

Their tracked eye movements during this explanation further emphasise the significance of the horizontal crack in informing the perceptual response of this participant, with their attention focused almost exclusively on this topographic feature ( Figure 8.24).

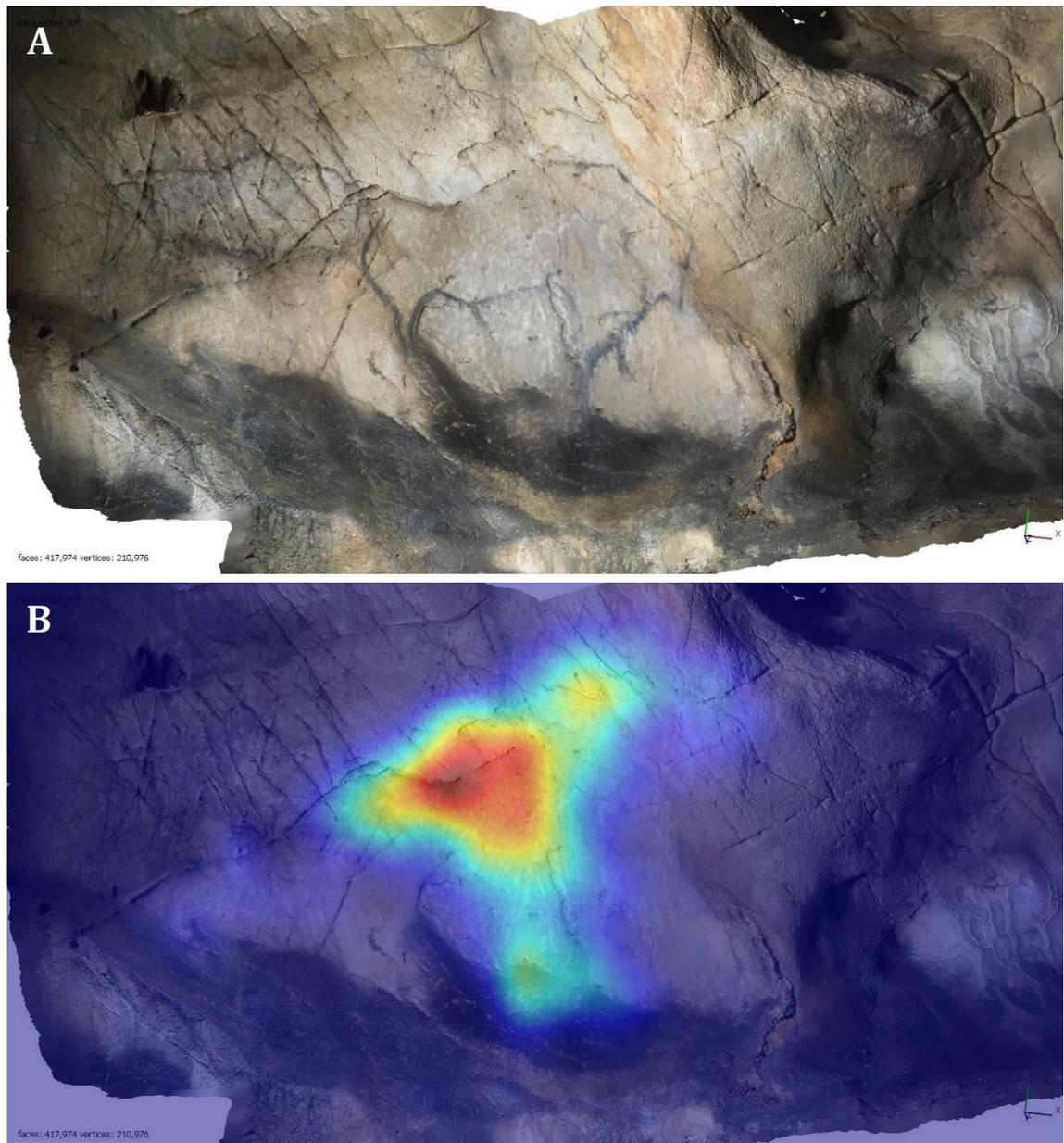


Figure 8.24. A) Panel EC3 and B) Static heatmap for participant P10 actively observing panel EC3 at 00:02:49-00:03:28, corresponding to their description of a mammoth form in the natural features. Image: Author.

The participant’s responses for panels EC1, EC2, and EC3 appear to indicate that for certain depictions, particularly those that integrate natural features, the topographic

characteristics of the wall were conducive to eliciting visual imagery responses, which subsequently informed the placement and theme of the depictions produced. This appears particularly compelling for panel EC3; the central horizontal crack on this panel when viewed under a dynamic, low lumen light may have been perceived as evocative of a bison form to the Palaeolithic artist(s). The responses also indicate the potential role of visual expertise in the perceptual responses to suggestive topographic features. A number of participants perceived horse forms in this panel, and this was likely due to their respective familiarity with horses over other species. However, for Upper Palaeolithic people, bison would have been visually familiar; bison would have peppered the immediate landscape surrounding Monte Castillo, with their immense form being a prominent, yet familiar, feature. Further, these responses highlight that the active engagement with the wall through manipulating light and seeking out suggestive forms may have been an important aspect of this initial visual response.

Although these results support the influence of visual imagery in determining the theme, form and placement of depictions, the participant's perceptual responses to the two other walls – panel EC4 and the control wall – encourages a deeper evaluation of the particular role of the visual system. The complex morphology of panel EC4 evoked different responses within the participants, but these were rarely pareidolic and often did not correspond to either the same areas of the wall or the same forms depicted by the Palaeolithic artist(s). A number of participants (P1, P3, P5, P6, EP9, P10, P11, EP14) expressed that they were having difficulty in both determining whether the wall was suitable to depict on and what animals they might depict on the wall. Several of these participants mentioned their difficulty was due to the lack of suitable or suggestive forms, as indicated by their responses to *“do you think this wall would be suitable to depict on?”*:

**P1:** *“Y’know actually there are natural protrusions across here that are not very suggestive really... so maybe the overhang would be a bad place.”*

**P3:** *“Erm, I guess maybe like a 3 or 4 out of 10. I wouldn’t go onto those parts [towards the right of the rear wall]. This bit comes out, it’s not the animal... erm... But then there’s these bits there, bits that stick out. You know [that] could get in the way.”*

**EP14:** *“Uh, I think I’m finding this one [a] slightly trickier panel. [...] Yeah, finding it a bit trickier. This feature is interesting, but I don’t necessarily have an animal in mind.”*

Two participants (P18 and P13) expressed a pareidolic response to certain features on the rear wall of the panel, but these did not correspond to the same area selected for depicting on by Palaeolithic artists. However, it is interesting to note that these took the form of horses to both participants:

**P8:** *“This back here. I can see the body of. It looks like, maybe. The body of a horse.”*

**P13:** *“Oh yeah that bit. There’s a bit that looks exactly like a horse’s snout and then it goes into a nice long thing. Okay, yeah so a big horse head here.”*

This may reflect the participant’s familiarity with horses, with P13 in particular informally noting they had a close familiarity with these animals. Although this corresponds to the same animal depicted on this wall, this may be incidental. In both pareidolic responses, the features that evoked these responses were towards the upper left of the rear wall; an area not used for the figurative depiction of a horse. Both the limited responses of participants to this panel, and the lack of integrating natural features into the form of depictions, indicates other factors – explored in subsequent stages – may have affected the placement and form of depictions, beyond a pareidolic response to suggestive natural forms.

In contrast to the limited visual perceptual responses to panel EC4, participants experienced prominent pareidolic responses to the control wall – a model of a blank area of wall within El Castillo - which was scaled and orientated in different ways within each cave to prevent participants from recognising it. This appeared potent for certain participants, with a number (P2, P3, P4, P8, EP9, P10, P11, P12, P13, EP14) interpreting features as evocative of animals, such as vertical cracks as the limbs of ibex and chamois, and some (P3, P4, P5, P6, P7) utilising large spaces of the wall to depict animals such as bison, with participant P3 notably stating *“it just feels like the shape of a bison”*. No participant described this wall as unsuitable to depict on, with the majority (9 out of 14 participants) expressing some form of pareidolic response to the features of this wall. Although this appears to discount hypothesis 5, there are key considerations that caveat these responses. The rescaling and manipulation of this model meant participants often did not encounter a “real” wall from El Castillo, with only one of the iterations of this wall within the four caves bearing some resemblance to the original wall. Consequently, it is difficult to assess whether this accurately provides an insight into the potential responses of Palaeolithic artists i.e., did Palaeolithic people similarly experience pareidolia in this but opted not to depict on the wall? Further, this encourages the consideration of other factors – such as accessibility – which may have influenced whether a wall was depicted on or not. The placement of this wall in El Castillo is high from the original cave floor, and thus may have not been depicted on merely due to its relative inaccessibility. Nevertheless, the pareidolic imagery perceived by participants within this wall serves to reinforce the point that the particular conditions of caves are conducive to eliciting potent visual and perceptual responses.

The psychology experiment results indicate that the initial visual and perceptual response to the cave walls in El Castillo appear to have had some influence over the subsequent production of animals. In certain cases where suggestive wall morphologies and

low, fluctuating light commingled, visual responses were visceral and often took forms familiar to the participants, supporting both hypotheses 2 and 4. The tracked eye movements for participants during their experience of pareidolic imagery suggests that this may have initially been experienced towards the periphery of the light source and in areas where RLV significantly fluctuated, providing some support for hypothesis 3. Together, the exploration of these hypotheses alludes to this stage of the art making process being discrete and intimate. The subjective experience and interaction with particular areas of the wall was pertinent to how participants responded to it, and subsequently discussed the animal depictions they would produce.

Crucially, the psychology results indicate that the experience of visual imagery in these environments appears to be, at least partially, voluntary; participants only expressed that they perceived forms in natural features after they had been invited to interrogate the wall in more detail. Only one panel – EC3 – appeared to elicit involuntary visual responses, as demonstrated by P1’s perception of the wall being decorated with horse forms. The results also suggest that the particular areas participants interrogate during this voluntary visual engagement with the wall may be culturally determined. A number of participants were visually drawn to flat areas of the wall, even if their initial idle observation showed some visual interest in more complex topographic regions. This suggests that participants may be seeking out areas that conform to the “blank canvas” ideal. Other participants, and in particular the expert participants, were drawn to complex areas within which they subsequently perceived evocative animal forms. This insight provides a new perspective on the role of the visual system in the art making process. Where visual stimuli are ambiguous, there appears to still be a requirement to consciously engage with the cave wall – the manipulation of light across the surface, the movement of the artist to observe the surface from different angles, and the *desire* to see certain forms – for the ambiguous stimuli to then be visually resolved as representing an animal. The particular way one reads the surface matters, and this may provide one explanation for the disparity both across different participant’s responses, and between the participant’s responses in general and the depictions that feature on the cave walls.

#### *8.4.3. Stage 3: Initial material engagement*

The agency of the artist in responding to ambiguous visual stimuli and engaging with the topographic features of the cave wall during this initial visual perception evokes the example of figurine making within the Aivilik discussed in Chapter 3. Listening to the material, manipulating it with light and the hands, tentatively exploring certain engagements, and subsequently interpreting what the material is saying, are important features of both the perceptual response and the initial material engagement. Indeed,

during the VR psychology experiments, participants that “listened” to the cave wall by responding to pareidolic imagery and the topographic features of the surface appeared to both select similar areas as the Palaeolithic artists to depict on, but also had greater ease in describing the forms they would depict. For participants that did not relate their animal depictions to natural features, their responses tended to be fairly general, particularly when asked further detail about where they might start their depiction of an animal, as captured by the audio response for P7 describing depicting animals on panel EC1:

**IW:** *“If you were going to draw animals on [this wall], what animals would you depict?”*

**P7:** *“Maybe some ponies across there or some goats or smaller animals. You don’t want something big with antlers, because there’s not enough space, but maybe some smaller ponies or goats or deer. Not goats, uh, antelope. It’s a tricky one. I guess you could kind of go up here and do a herd of them kind of far away.”*

By contrast, participants who actively related their forms to natural features appeared to easily describe in detail the features of their depiction, inspired by the forms existing in the rock surface (e.g., P11 in response to panel EC2: *“I’d [depict a bison] up here because it’s got the hump of the back then the sloping, the shoulders and the sloping down back”*). The response of EP14 when describing the suitability of this panel EC2 for depicting on perhaps best captures the ease in creating forms when one engages in a dialogue with the surface:

**EP14:** *“It’s got really suggestive inherent forms in the cracks, in the rock, but also in the shadows and how you can manipulate those shadows. So, in my mind I’ve already etched an entire array of animals, just with the potential I can see in the surface. So, does that make sense? In my mind this surface is already occupied. With an array of animals that would be really easy to finish off. So, I’m doing that mostly based on the correlation between inherent forms, whether they’re rendered by shadow or natural features in the rock, and for me [if] the entire surface is natural then it could really easily be turned into a series of animal depiction without too much hard work or imagination.”*

Participant EP9 expressed a similar sentiment when observing panel EC3 with the art removed:

**EP9:** *“Oh, and I was looking at this part actually thinking what animal would this [be]... but you know I’m thinking too big. So maybe I’d use this for another horse, you know the snout of the horse, that’s the nose, ventral line. It’s just easy, isn’t it? It’s just easy.”*

One therefore expects that the initial material engagement for depictions in El Castillo reflects this dialogue between artist and the cave wall, particularly for depictions that feature a direct relationship with the cave wall. This certainly appears to be the case

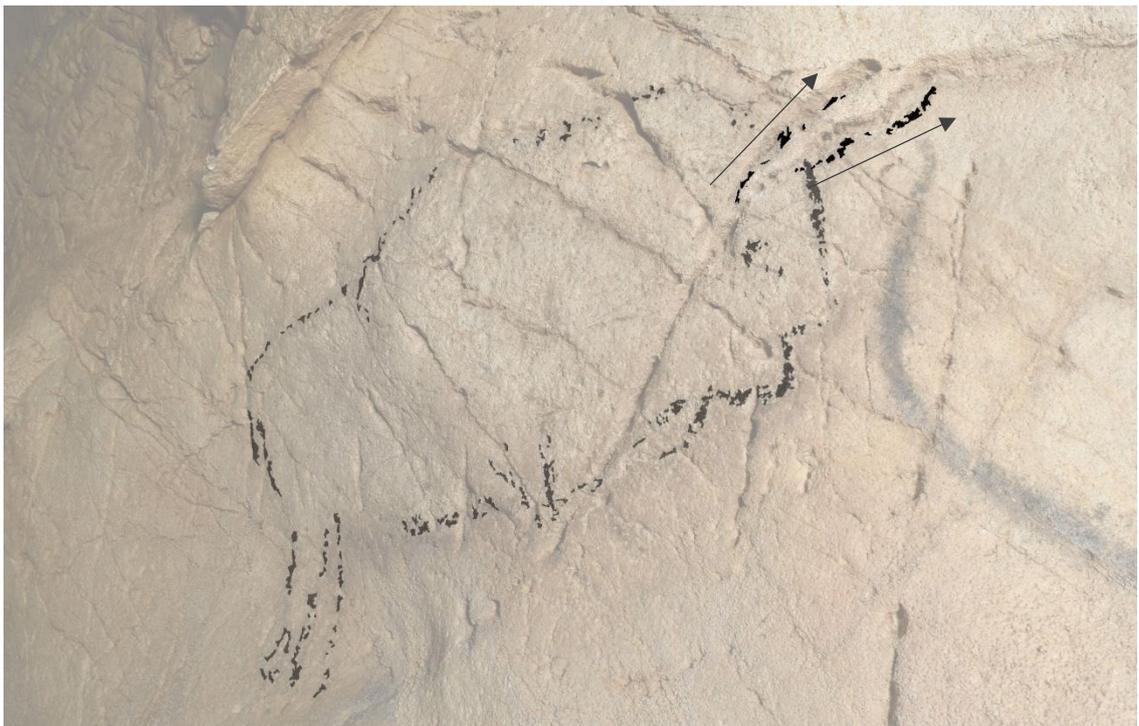
where line order can be determined for these depictions. The most prominent examples of the material engagement likely corresponding to the perceptual response of the artist viewing natural features under a low lumen light source are evident in panel EC3. The horizontal crack integrated to represent the dorsal line of depiction EC3.2 drew significant visual attention from participants, several of whom perceived pareidolic imagery of animals within this form. This visual response appears to be reflected within the depiction through the initial material engagement, with a faint line moving left-to-right mapped onto the crack towards the posterior of the depiction and an additional faint line towards the anterior that extends the natural crack to form the remainder of the bison's dorsal line (Figure 8.25). The lighter application of pigment during this initial engagement, compared to the heavier application used for completing the form of the animal, speculatively may represent a tentative initial engagement that served to clarify aspects of the visual imagery, enabling the complete form to fully emerge to the artist. For this example, the pareidolic response to this surface and the suggestive natural topographic features of it appears to have scaffolded the form of the depiction; a clear indication of the influence of visual and perceptual responses on the making of the art.



*Figure 8.25. Digital tracing of depiction EC3.2, with the direction of the likely initial lines depicted indicated with arrows. Image: Author*

A similar pattern is observed for depiction EC3.1. The initial material engagement of EC3.1 appears blurred with the drawing out of form for EC3.2; the line used to depict the tail of EC3.2 corresponds to one of the initial lines depicted for EC3.1, representing the horn of this depiction (Figure 8.26). This line draws upwards from left-to-right to meet and map

onto the natural crack, directly integrating this feature into the two depictions. The second horn of EC3.1 similarly is mapped onto a natural crack, moving from left to right to extend the length of the crack and forming the curvature of the horn. This deliberate integration of the cracks suggests, therefore, that topographic features were visually perceived as evocative of the salient features of a bison – its horns – and thus directly informed the nature of the depiction. The smaller size of this bison may allude to this representing a calf of the larger bison. However, given the position of this bison as “floating” in comparison to the larger bison, the presence of relatively sizeable curved horns and a hump which bison do not develop until the end of their first year, with horn curvature only occurring at 3 years old (Meagher 1986, 5), and this direct integration of natural features, it is perhaps more likely the bison was scaled to fit the suggestive features inherent in the surface of the cave wall. The initial material engagement as a response to the artist visually resolving the cracks as evocative of bison reflects this constraining of form, with the depiction being scaffolded on the pareidolic image. Space does not constrain the depiction, and it is entirely possible the artist could have produced a larger bison depiction.



*Figure 8.26. Digital tracing of depiction EC3.2, with the initial lines and their direction highlighted. Image: Author.*

A similar relationship occurs for other depictions that directly integrate natural features, but appears to be a more subtle interaction with the cave wall. These perhaps reflect instances where the artist that may not be implicitly related to a perceptual response triggered by these features, but was still guided by an interaction with the wall’s topography. For depiction EC1.1, the likely initial line depicted draws out from a natural crack to form the dorsal line of the bison depiction (Figure 8.27). Although this feature is

not necessarily evocative of a bison, its integration into the depiction alludes to a dialogical interaction between the artist and the wall with topographic features directly influencing the artist's material engagement. It is possible that the pareidolic response occurs within this material engagement; as the artist extends or interacts with the wall's topography through the application of pigment, a form gradually becomes distinct. This may have been the case for EC1.1 – conversing with the wall through extending natural cracks with pigment during an initial material engagement may have subsequently determined the form and orientation of the depiction.



*Figure 8.27. Digital tracing of EC1.1, with the initial line depicted highlighted and its direction indicated by an arrow. This draws out from a natural crack, visible in the upper left image, extending the natural feature and directly integrating it into the dorsal line of the bison. Image: Author.*

Although the initial lines are difficult to distinguish due to the degraded nature of depictions EC1.7, EC2.2, and EC2.3, all exhibit a similar pattern of extending and integrating natural cracks to form salient features (Figure 8.28). For depiction EC1.7, this involves tracing and extending natural cracks to form the head and horns of the bison. Similarly, depiction EC2.2 appears to intentionally use a natural crack to suggest the head of the aurochs, one horn depicted to emerge from this crack, implicitly integrating it into the form. Another elongated crack may have also been used to suggest the front leg of the aurochs with a faint line perhaps suggesting the intentional integration of this natural feature too. Depiction EC2.3 also utilises natural cracks to complete the head and horns of an aurochs, with the dorsal line drawing out from this feature and the jawline and eye positioned to complete the head. These instances appear to further support the insights from the visual

and perceptual response; the particular way the artists engaged with the wall mattered and the way they “read” the surface informed their subsequent response, influencing the form of the depiction.

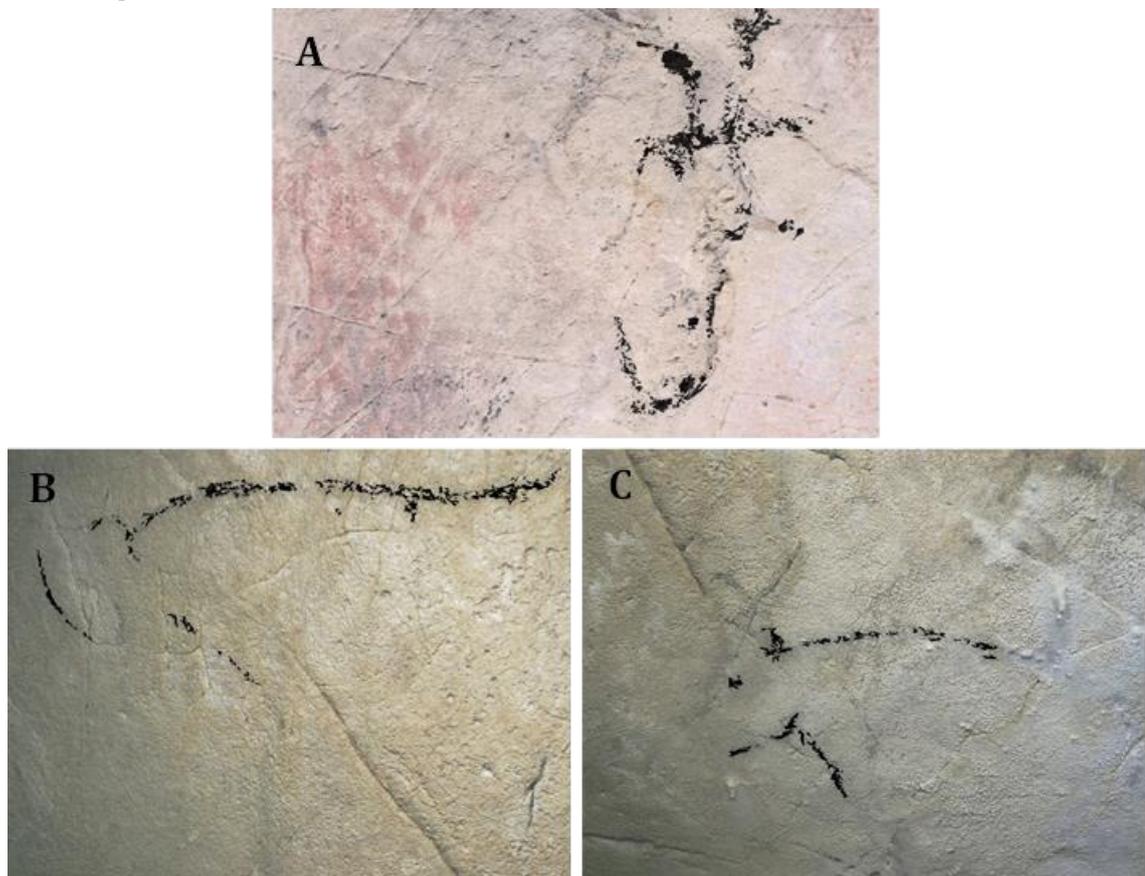


Figure 8.28. Digital tracings emphasising the way depictions integrate natural cracks, with the head of depiction EC1.7 (A), depiction EC2.2 (B), and depiction EC2.3 (C). Images: Author.

There are several depictions that do not directly relate to the cave wall in their initial material engagement i.e., pigment does not appear to be applied to integrate natural features nor trace undulating topographies. Whilst it may be tempting to cast these as representing cases where the artist’s psychology had less influence on form, instead, it may be the case that these reflect a different initial engagement. It is important to keep in mind that the particular reading of the cave wall surface, as demonstrated by the breadth of participant’s visual responses, may have been a culturally coded and subjective experience. The specific way Upper Palaeolithic artists may have initially interacted with the wall – the movement of light, the tactile interaction, the application of pigment – cannot be fully captured within this approach. Subtle relationships between the topographic features of the cave wall, the initial material engagement for depictions, and the particular visual response this may embody (as with these depictions) can thus only be speculatively discussed.

For depictions EC1.8 and EC1.9, the initial material engagement appears to relate to the most salient features of the animal, with ears of the hinds depicted first, followed by lines representing the head and back (Figure 8.29). Although perhaps not the most salient

features of hinds, their ears may have been paid particular attention by Upper Palaeolithic people. As discussed in Chapter 5, the behaviour of hinds can be anticipated by close observation of their ears which may indicate, for example, whether the hind has become alerted to the presence of a potential threat. It is possible that, when manipulating the light in a particular way, the deep cracks and fissures that feature on the surface of the wall used for these depictions were perceived as evocative of a hind's ears and cervico-dorsal line, implicitly cueing the visual system. This subtle influence of natural features on the form of depictions also appears to be reflected in depiction EC2.1. Although the initial line depicted is difficult to discern, the form of the depiction appears to be influenced by the shape of the surface, which appears evocative of a horse's head (Figure 8.30). These less overt relationships between natural forms and depictions may reflect a subconscious influence on the visual system, with the initial material engagement reflecting this priming of salient features, as has previously been suggested by Hodgson (2008).

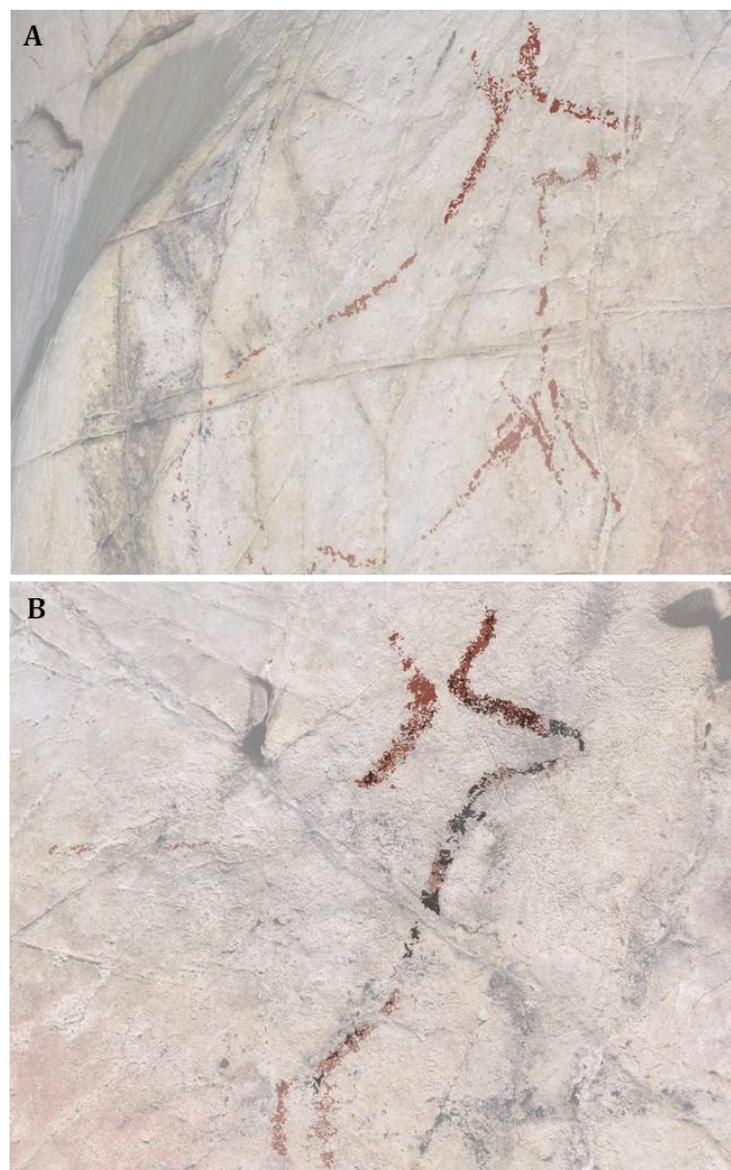


Figure 8.29. Digital tracings of depiction EC1.8 (A) and EC1.9 (B), emphasising the initial lines used to represent the ears, top of the head, and dorsal line. Images: Author.



*Figure 8.30. Depiction EC2.1, which appears to imitate the natural shape of the cave wall which is subtly evocative of a horse's head. Image: Author.*

The initial material engagement thus appears to reflect a breadth of dialogical relationships between the artist's initial visual response to natural features, and the subsequent engagement with these features to begin representing animal forms. For certain depictions, this initial material engagement clearly embodies the artist visually perceiving evocative forms in the surface. The first lines drawn in the depiction either trace or draw out from these suggestive features, extending and integrating natural forms into the animal. For others, however, the relationship between the artist's visual response to a surface and the material engagement appears more subtle. The manipulation of light or a particular cultural encoded way of reading forms into complex surfaces may have implicitly cued the visual system with salient features of particular animals, and the initial material engagement depicted these primed salient features. Although varied, the initial material engagement appears to support the insights provided by the psychology results discussed in stage 2. The dialogue occurring with the wall appears tentative within this initial engagement appears; natural features are traced and extended, with the animal representation not yet taking form. This resonates with the voluntary experience of pareidolic forms expressed in participant responses; in few examples was the visual imagery potent or involuntary. Instead, the gradual reading of the surface, perhaps augmented by the application of pigment onto certain features, may have allowed pareidolic forms to emerge or become more distinct.

#### 8.4.4. Stage 4: Drawing out animal form

After the initial material engagement, the artists in El Castillo continued to apply pigment to the wall, with the form of an animal – perhaps relating to visual imagery they had previously experienced – gradually emerging from the surface. In several cases, the drawing out of animal form appeared to be directly influenced by the topography of the wall with either natural features shaping the placement and form of the animal, or a more dynamic utilisation of natural features to playfully manipulate the perspective of observers. Intriguingly, both of these aspects were noted by two participants (EP14 and P10) in reference to the small rock outcrop to the lower-right of the undecorated version of panel EC1, used by Palaeolithic artists to depict a bison in left profile. Both participants focused their visual gaze on this outcrop for some time, which is clearly reflected in the heatmap of P10's eye movements during a period of approximately 25 seconds (Figure 8.31). For P10, this visual attention to the feature corresponded with a pareidolic response, where they noted that they would:

*“use this rock as kind of a horse shape, I think. Because you've got the bum, and then the head or the neck. Or bison. So, I'd probably use that because it's already shaped like an animal”.*

Similarly, EP14 appeared to have a potent visual response to this feature, and was visually drawn to it due to its morphology and potential for realising a dynamic image of an animal:

*“I really like that rock over there as a really clever animal design, really dynamic. It appears to be jumping out and running towards you”.*

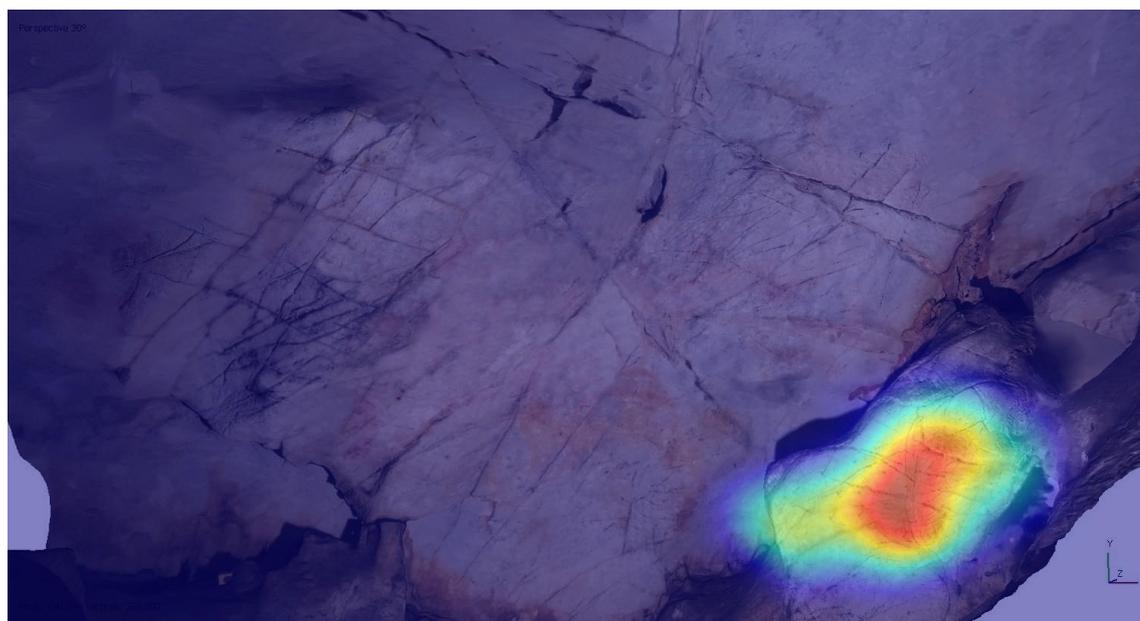
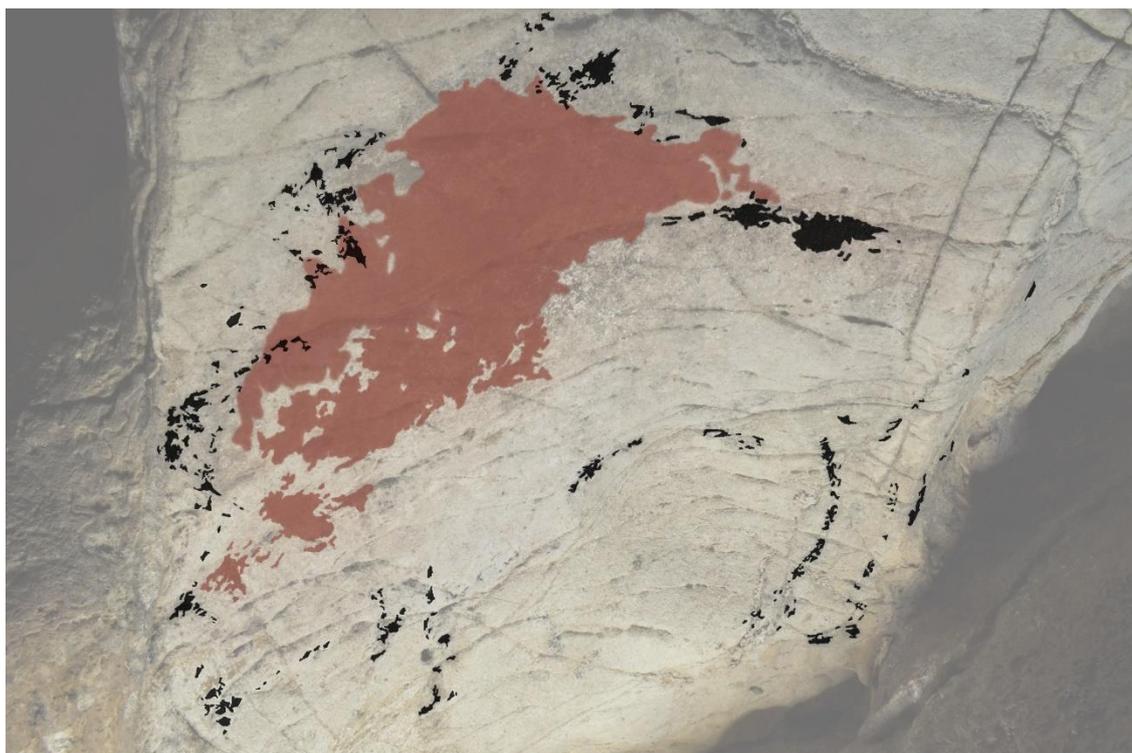


Figure 8.31. Heatmap representing 25 seconds (00:14:15 – 00:14:40) of P10's active observation of the wall. This corresponds to P10 stating *“I'd use this rock as kind of a horse shape, I think. Because you've got the bum, and then the head or the neck. Or bison. So, I'd probably use that because it's already shaped like an animal.”* Image: Author.

The visual attention of these two participants directly corresponds to the area used for depicting EC1.6, which appears to make use of both characteristics identified by the participants. Although degraded, this completion of the form of this depiction follows the shape of the rock's surface, with the cervico-dorsal line and rear legs shaped around the curvature of the surface (Figure 8.32). Additionally, it appears to have been depicted as animated, with the body twisted towards the observer and legs partially extended forwards. This may be intentionally trying to capture the dynamism identified by EP14, with the depiction "leaping out" of the rock.



*Figure 8.32. Digital tracing of depiction EC1.6, which depicts a partially infilled bison facing left. Image: Author.*

The following of the natural topography of the cave wall to draw out the form of an animal is expressed in other depictions. Notably, EC3.2 almost entirely follows suggestive features in the wall's surface, with the dorsal line and tail represented by cracks, the rear leg mapped onto a convex undulation, and the front and rear legs integrating natural cracks. The drawing out of animal form for this depiction, therefore, may represent the artist tracing a form they perceived as pre-existing in the rock surface; even a homogeneously coloured version of the 3D model for this panel appears to hold this evocative form (Figure 8.33). The lack of detail in this depiction is also consistent with what is expected of both the form of a hyper-image and the abstraction caused by construal level effects in low light, as discussed in Chapter 4. The depiction of EC3.2 was likely a visceral and potent experience for the artist, with the form of a bison appearing embedded within the cave wall and emerging as a distinct image as the artist traced the visual image triggered by natural features.

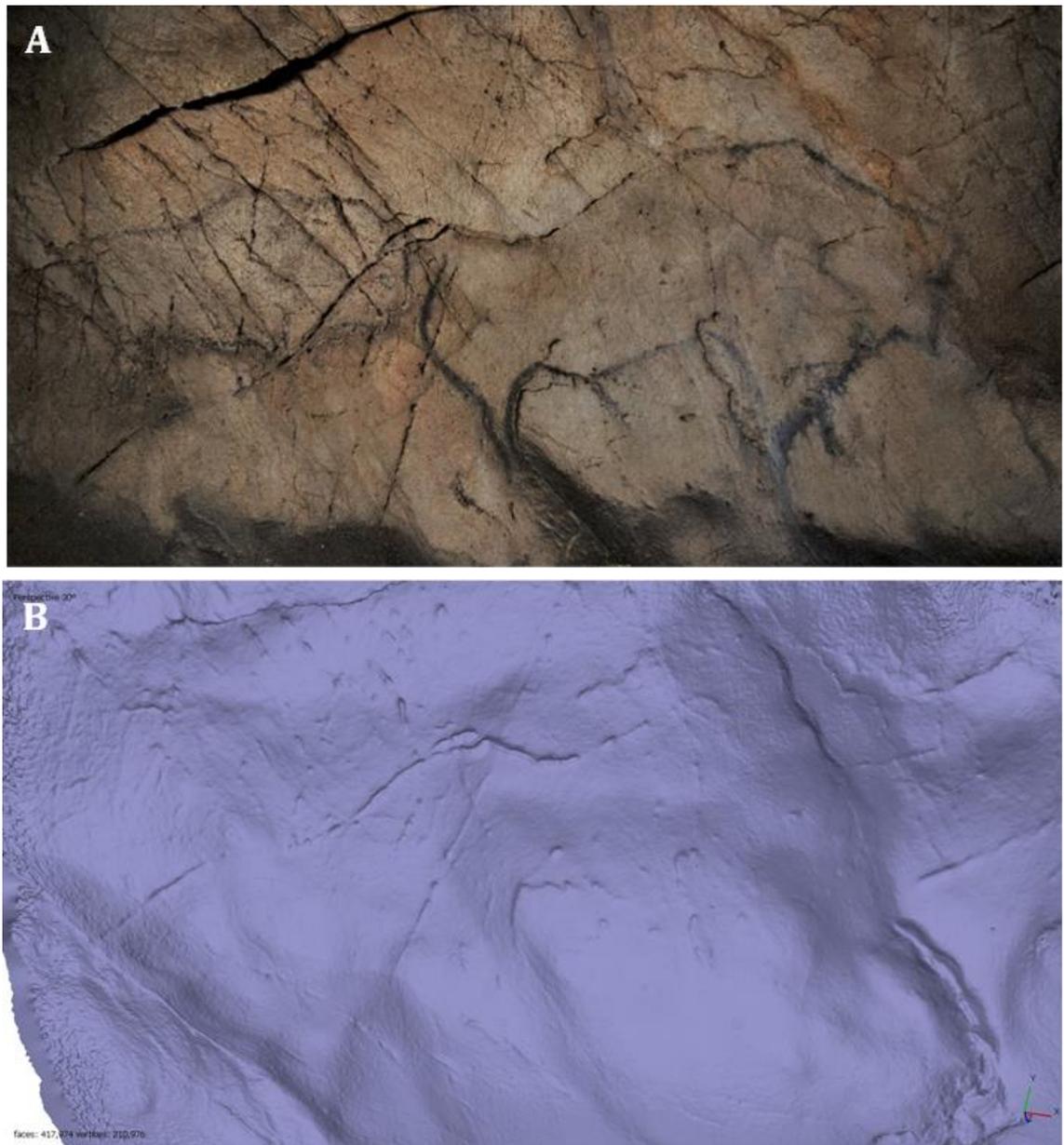
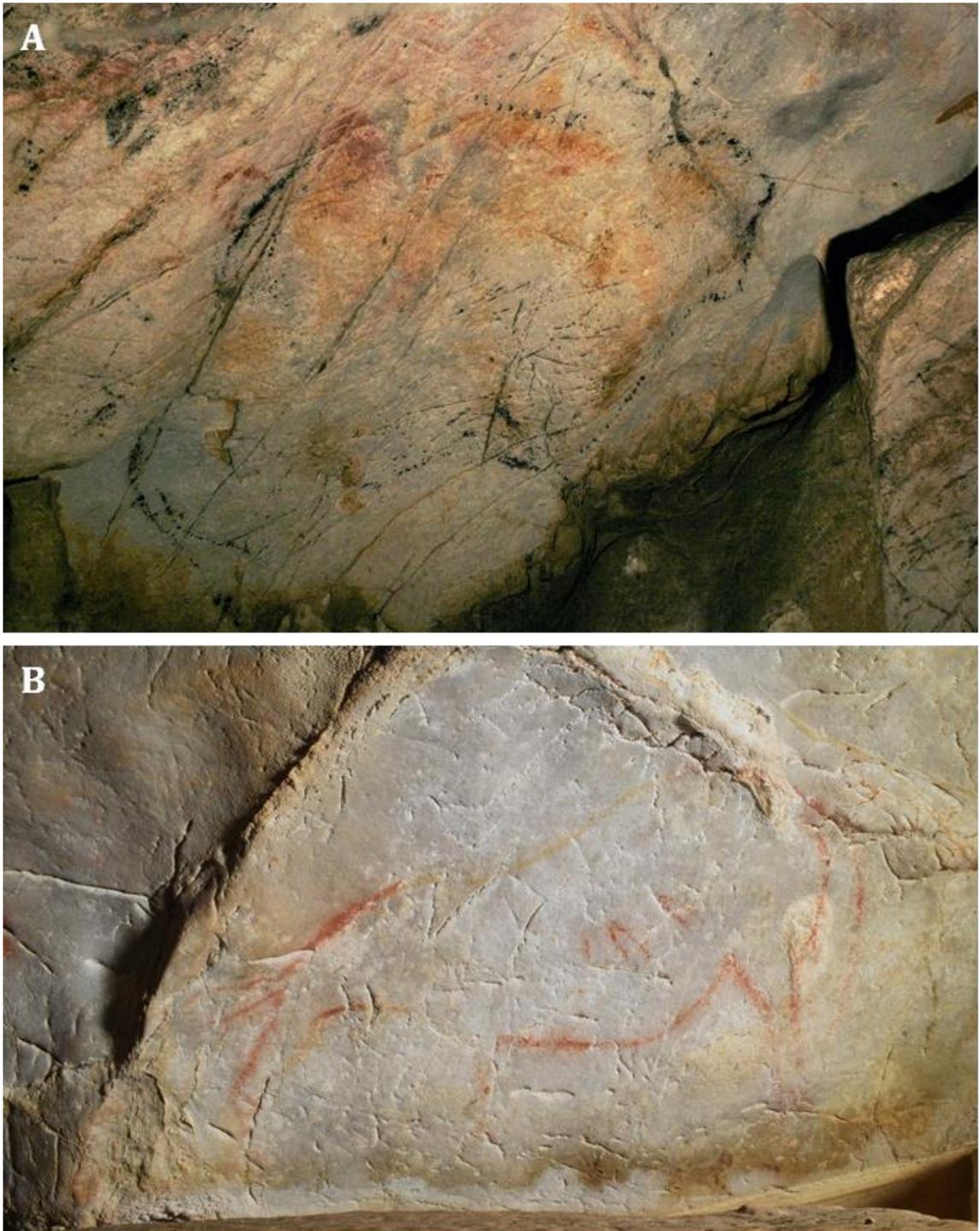


Figure 8.33. Comparison between image of panel EC3 (A) and a solid-filled photogrammetry model of the same panel (B). Note how depiction EC3.2 clearly follows topographic features of the panel, visible in B. Images: Author.

Several other depictions similarly make use of the cave wall's natural features to draw out the form of the animal and add depth to the depiction. The completion of depiction EC1.5 appears to follow the topography of the wall; the dorsal line is shaped around the edge of the concave surface, legs are placed on convex undulations, and the head appears shaped around a shadow cast by the small rock in-front of the panel (Figure 8.34). EC1.7 similarly has been scaffolded onto natural features, with natural cracks integrated to partially represent the head and horns, the dorsal line mapped onto cracks and a gentle contour, and the legs placed to again utilise convex undulations. This use of topographic undulations to suggest the muscular features of a bison is also expressed in depiction EC3.1, where a convex feature adds dimension to the dorsal hump. Depiction EC4.1 also follows

the topography of the cave wall, with the dorsal line and head of the horse shaped around the edge of the concave shape of the surface (Figure 8.34).



*Figure 8.34. A) Depiction EC1.5 which appears to be partially shaped around the shadow cast by the rock in-front of the panel, and utilises undulations to add dimension to the legs. B) Depiction of EC4.1, where the dorsal line and head follows the curvature of the concave shape of the wall. Images: Author.*

Three of these examples capture different behaviours of animals: EC1.5 represents a bison partially kneeling; EC1.7 represents a sleeping or rolling bison, with legs curled underneath; and EC4.1 depicts a horse grazing. The attention to animal behaviour here not only demonstrates the intimate understanding of animals held by Upper Palaeolithic artists,

but perhaps gives a deeper insight into the relationship between visual response, topographic features, and the completion of animal form. Modern participants did not identify the topographic features used for depictions EC1.7 and EC4.1 as evocative of animals, and this may reflect their lack of familiarity with different animal behaviours which deviate from the “usual” canonical form that people tend to conform to when depicting and recognising animals (Blnaz *et al.* 1999; Hodgson 2003, 103; Hodgson 2013, 3; Dobrez and Dobrez 2013; Dobrez and Dobrez 2014). Upper Palaeolithic artists, however, may have been able to appreciate how a curved shape of the wall is redolent of the dorsal line of a horse grazing, or the constrained undulating features of the surface is evocative of a bison lying down with its legs curled underneath its body. These forms would be unusual to modern participants, not used to closely observing animal behaviours, yet would have been familiar to Upper Palaeolithic people. This, in turn, may have facilitated a more potent visual response, informing the drawing out and completion of animal forms that break from the “usual” canonical form.

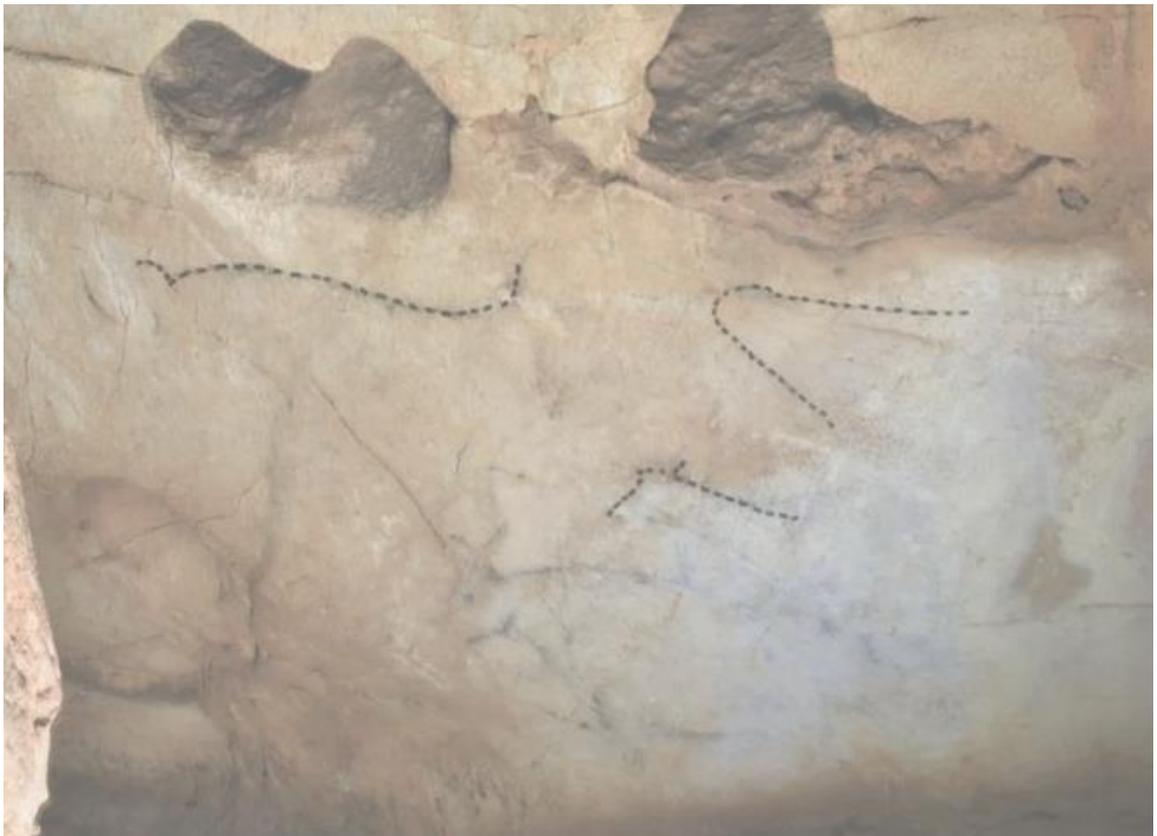
This fitting of forms that capture animal behaviours to morphologically complex surfaces further suggest the dialogical aspect of making cave art. Not only do natural features trigger visual imagery, but they are also interacted with throughout the making of art; the artist “listened” to the wall and allowed its features to shape and enhance the form of the depictions. The artist thus appears to negotiate between their perception of the surface, the effects of light and shadow, and their own knowledge of animal forms to draw out the depiction. Whilst this is the case for a number of depictions evaluated in this pilot study, it is not the case for all; certain depictions (e.g., EC4.2 and EC4.3) do not appear to be influenced by a relationship with the surface. In these cases, the role of the cave wall in the making may have been quieter, with different factors contributing to their form and placement. As elucidated by participant responses, these may instead relate to manipulating the perspective of an observer. Several participants (P1, P2, P3, P5, P10, P11) indicated they would depict small representations of animals on the area used for depictions EC4.2 and EC4.3 that related to depictions on the back wall, with some generally noting this area frames the rear wall. This relates to the final stage of the biography, suggesting that the subsequent reception and relations formed with the depictions may have also influenced their form.

#### *8.4.5. Stage 5: Enduring relations*

Once depictions were completed, it is likely they were subsequently interacted with and based on the presence of repeated artistic behaviours in El Castillo, the relations with particular depictions may have endured for millennia. The responses of participants

viewing panels with the art visible provides some insight into the possible perception and reception of the art, and how this may have been engaged with after its making.

Several participants had pareidolic responses when viewing depicted panel; a phenomenon that has been noted to be an issue when rock art researchers are recording and examining depictions (Bednarik 2013b; 2017). Depicted forms were frequently misinterpreted by participants, who despite correctly identifying the area where an animal was depicted, perceived a different form represented on the wall. The most frequent misinterpretation regarded the group of depictions situated on the amorphous section of panel EC2 (Figure 8.35). Several participants (P2, P5, P8, P10, P11, P12, EP14) perceived these depictions as representing the head of a large animal, often described as bovine or horse-like in form. The frequency of this misinterpretation, in addition to the presence of non-figurative lines that formed part of the misinterpreted animal form, may suggest that this ambiguous form was intentional. The presence of the non-figurative lines may, speculatively, have been placed to manipulate the Gestalt principle of good continuation, where the eye prefers to continue and connect lines rather than perceive a break in form. If so, this intentional ambiguation of the animal forms on the panel, particularly when observed from a distance of ~1m, adds a playful dimension to their reception.



*Figure 8.35. Traced image of the pareidolic image perceived by participants, which appears to be a bovid head in right profile. A non-figurative line forms the horn and dorsal line of the head, depiction EC2.2 forms the dorsal line, and EC2.4 completes the jawline of the head. Image: Author.*

It is clear that under low light conditions, depicted forms can appear ambiguous and stimulate their own pareidolic responses. For some participants (P3, P6, P7, P12, P13, EP14), the observation of depictions on panel EC1 also elicited pareidolic responses, with these participants seeing depicted forms not present on the panel. These responses were not merely participants misidentifying animals, but rather corresponded to the participants perceiving forms within a combination of pigmented areas and natural features of the wall. This appeared potent for participant P13, who expressed surprise at visually resolving the group of depictions EC1.7 – EC1.9 and the natural shape of the cave wall in this area as evocative of a large cat head:

*P13: "I'm not seeing any animals. Oh okay, maybe here a. Antelope in motion? Just where the thing is. Uhm. Oh sh\*\*. Okay. Big cat head."*

This not only emphasises that the lighting conditions are conducive to triggering pareidolic responses, but suggests that this may have been an experience shared with Palaeolithic artists that viewed and interacted with walls that had been previously depicted on. This invites a consideration of the visual experience of Upper Palaeolithic artist(s) viewing faded depictions that were potentially produced millennia before. Would artists have been influenced by the theme of pre-existing depictions? Or perceived these as "natural" marks?

The palimpsest of depictions associated to depiction EC1.7 perhaps provides some insight into these questions. Hand-stencils appear to intentionally overlies and partially obscure depictions EC1.8 and EC1.9. These may have been produced contemporaneously or millennia after EC1.8 and EC1.9, but nevertheless appear to represent a physical engagement with these hind depictions. This group of depictions faded, with the hand-stencils only being clearly identified today through augmented DStretch images. At some point, perhaps tens-of-thousands of years after the hinds (if the Gravettian attribution is correct), a bison – EC1.7 – was superimposed over these depictions. The hand-stencils may have been indistinguishable at this point, and perhaps may have been perceived as natural stains; reddish discolouration is common in caves where iron oxides are naturally deposited by flowstones. These may have been visually resolved alongside natural undulations and cracks as evocative of a bison, but depictions EC1.8 and EC1.9 were still recognisable as animal representations. EC1.7 appears to be intentionally depicted to ensure these depictions are still visible with EC1.9 even being retraced in black pigment, perhaps the same pigment used to produce EC1.7. This series of engagements captured within this palimpsest represents different enduring relations, from potential visual responses triggered by the presence of faded depictions through to the redrawing of pre-existing depictions. Both culminate to have perhaps encouraged a cultural expectation that animal

forms exist in the cave surface; the tracing of a faded depiction and the tracing of suggestive natural features may have been considered indistinguishable.

## 8.5. Summary

The pilot study presented in this chapter provided deeper insights into the psychological responses involved within the making of cave art. Testing participant responses to cave walls within an immersive VR environment that simulating conditions similar to those experienced by Palaeolithic artists enabled an understanding of the pareidolic responses triggered by these conditions, and how these may have subsequently informed the depiction of animals. Areas of the cave wall used by Palaeolithic artists to depict on drew the visual attention of participants and elicited potent visual responses, where pareidolic forms were perceived in the complex morphological surfaces. Through the biographical framework, the data generated through the psychology experiments were integrated into an evaluation of the art's making. This emphasised the dialogical making of the art, where the application of pigment appeared to trace evocative forms in the cave wall's surface; bringing to life the visual imagery initially experienced by the artist. The nuanced interactions embedded within this making were elucidated. Artists appear to have listened and engaged with the surface, allowing their perception of the commingling of light and natural features to guide the form of depictions. The consideration of how relations with depictions may have endured within El Castillo – a site frequently revisited and representing millennia of artistic behaviours – allowed for an appreciation of how pre-existing depictions may have further encouraged artists to perceive evocative animal forms in natural features.

However, whilst this pilot study demonstrates the potential of utilising VR psychology experiments to test hypotheses related to the influence of psychological responses on the making of Upper Palaeolithic cave art, there are several methodological issues that need to be addressed by future research. A key limitation of the pilot study was the need to manually process eye tracking data, which restricted a statistical comparison between participant's eye tracking responses. Whilst this was difficult to resolve for the pilot study, due to the novelty of eye tracking in virtual reality, addressing this in future research may allow for a more robust evaluation of the differences between participant responses to viewing certain cave walls. For example, this may allow for an evaluation of whether all participants were visually drawn to a particular feature of the cave wall, rather than giving one or two examples, and if this corresponds to a feature integrated within a Palaeolithic depiction. Integrating salience models from visual psychology may also help to determine whether participant's visual attention was indeed being directed by their pareidolic responses (i.e., they paid more attention to natural features they perceived as

evocative of animals) by comparing their areas of visual attention to a statistical model of the areas that should be of most visual interest based on their saliency, i.e., texture, colour, contrast, which determines how people look at a scene “normally”. Developing this pilot study further, as discussed in the following chapter, thus has great potential for harnessing this tool to answer much deeper questions of the psychological responses that may have informed the theme and placement of Upper Palaeolithic figurative cave art.

# Chapter 9.

## Discussion and Conclusion

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### 9.1. Introduction

Chapters 6, 7, and 8 developed a unique approach for understanding the making of art within three cave art sites around Monte Castillo, integrating insights and methodologies from visual psychology. The desk-based approach developed in Chapter 6 enabled lighting conditions to be simulated in VR, to discuss how the commingling of light and cave wall topography may have triggered visual responses which, in turn, informed the making of depictions at Las Monedas. This approach was built upon in Chapter 7, integrating primary observations to evaluate the role of haptic and visual stimuli for producing depictions in La Pasiega. Chapter 8 presented the results from a novel pilot study, that utilised the VR environments to determine how participants responded to experiencing cave walls from El Castillo under simulated lighting conditions. This demonstrated promising results regarding the role of the visual system in Upper Palaeolithic cave art production, suggesting pareidolic responses likely informed the placement and form of depictions. Nuance was breathed into understanding art making at each site, with the approach revealing depictions produced through intimate, discrete moments of tactile interaction through to those that playfully manipulated perspective and lighting to create dynamic images.

Distinct biographies were generated through this approach for each of the case studies, with points of resonance across the sites but also notable disparities in the way the art was likely produced and interacted with. These are conceptually explored further within this chapter, with the different stages of each biography compared. The comparison of biographies also provides an opportunity to discuss the strengths and limitations of the approach developed throughout this thesis, drawing out areas which could potentially be developed for future research. This chapter also explores the potential implications of the interdisciplinary approach developed throughout this thesis for Palaeolithic art research, discussing whether the visual and perceptual mechanisms identified as influencing the production of art within caves was an inherent feature of figurative representation during this period. The future directions of this research are then explored, outlining how this approach might be developed and the potential areas for future research.

### 9.2. Comparing Biographies for the Monte Castillo Art

#### 9.2.1. Stage 1: *To what extent does context influence making?*

For each of the case studies, the initial stage discussed involved determining the specific cultural and ecological context which may have had an effect on both the visual

expertise anticipated for the people entering the cave (whether Cro Magnons in the Upper Palaeolithic, or modern participants entering VR). This related to the broader contextual background outlined in Chapter 5, and aimed to provide specific details for how the context may have varied for each site. This revealed the potential influence of the climatic downturn during the Older Dryas which contextualised the art making at Las Monedas, the shifting climatic and ecological conditions for the art of La Pasiega that may have necessitated learning behaviours of “new” species in the immediate environment, and helped to inform the priming stage for the VR psychology experiments related to the art of El Castillo. For each case study too, this stage of the biography served to emphasise that the art was situated within a much wider corpus of art making behaviours within Upper Palaeolithic societies: either through the immediate presence of other art objects at a site or the depiction of animals within the habitation areas of the cave.

The specific way this stage provided insights into the extent ecological and cultural context may have influenced the art making in any one site was variable, and dependent on the resolution available within the dating of depictions. At Las Monedas, the availability of direct dates enabled the art to be better contextualised, and in turn allowed insights into the depiction of cold-adapted animals such as reindeer. It was proposed that the depictions may have been produced as part of a broader cultural process of learning new animal behaviours and/or reinforcing the knowledge of species that remained relatively stable during this climatic downturn. It was also emphasised that the preparation of materials for depictions at Las Monedas suggested a degree of premeditation to depicting animals in this cave, and this point resonated with this biographical stage for the art of La Pasiega. The presence of depictions within occupation areas of La Pasiega and clear evidence for the preparation of pigments into paints again suggested a degree of premeditation to this art; the artists entered this area of the cave with the intention of producing depictions. For both of these sites, this aspect of the making tempered interpretations of the extent artists may have been beholden to their psychological responses. The different ecological context and potential visual expertise of Cro Magnons in different animal species at La Pasiega contextualised the different themes observed between the art of these two caves. The shift in focus of this stage for El Castillo, which instead evaluated participant’s priming response, makes it difficult to compare to Las Monedas and La Pasiega. However, the participants familiarity with certain animals which later corresponded to those they described as perceiving in suggestive forms reinforces the point that the particular context likely influenced the subsequent biographical stages of the art making.

This stage of the biography was therefore able to tease out subtle differences between the influence of the particular milieu for each of the case studies. However, there

were some limitations in evaluating this stage of the biography. Despite some of the art being broadly contemporaneous (i.e., the Magdalenian depictions at El Castillo and all depictions at Las Monedas), there were still variations in the form and theme. Whilst this may be due to the presence of particular species in the immediate environment due to different climatic conditions, such as colder-adapted species represented in the art at Las Monedas, this stage of the biography perhaps does not allow for enough resolution to determine exactly why this variation may have occurred. For example, the expertise in hunting red deer and horse during the late Solutrean and early Magdalenian provides some insight into the dominance of these species in Gallery A of La Pasiega, but is juxtaposed against the high presence of bison and aurochs depictions in broadly contemporary examples from El Castillo. The particular ecological and cultural context may have informed this variation in theme, but perhaps cannot be adequately captured through this approach. Deeper theoretical considerations of the potential relationships between Cro Magnons and animals within their immediate environment, beyond dependency on particular animals for subsistence, may allow for this to be better explored in future. The particular cultural significance of depicting certain animals and why this may vary between sites may never be fully appreciated, but is a key point to be sensitive to in future research.

The huge swathe of time that constituted this stage of the art making for El Castillo also highlights some additional issues both with this stage of the approach, and the biography in general. The smaller scale that was intended to be achieved through this approach, revealing intimate insights for individual depictions, becomes somewhat lost where time is collapsed to the extent that the making of depictions potentially separated by tens-of-thousands-of-years are evaluated concurrently. To some extent, this is difficult to resolve; the issue with secure dating in Palaeolithic art invariably results in lower resolution within these kinds of approaches. However, it invites a consideration – particularly for the psychology experiments – of how different contexts may produce shifts in visual responses and subsequently the art produced. Priming participants with specific species that correspond to those present during certain ecological conditions (i.e. cold-adapted species like reindeer, mammoth, compared to forest-adapted species like red deer, roe deer, and wild boar), may allow this to be better evaluated in future research. Additionally, this issue also encourages the consideration of how particular artistic styles in depicting animals may further affect the art making process. By priming participants with particular styles of animal depictions from different cultural periods in the Upper Palaeolithic will enable future research to determine the extent cultural, as well as ecological, factors may have influenced the form of depictions. Whilst the full extent to which this stage influenced the art making in the case studies is difficult to assess, it encourages further research that builds

on the pilot VR psychology study to distinguish in greater detail the role of ecological and cultural context.

### *9.2.2. Stage 2: Are there variations within the visual and perceptual responses?*

The second stage of the biographical approach focused on the crux of this research; the visual and perceptual responses triggered in cave environments. Integrating insights from psychology for Chapters 6 and 7 allowed this to be discussed conceptually, evaluating how the interaction of light across areas of cave wall used for particular depictions may have been conducive to eliciting certain visual responses. This was tested within a pilot study in Chapter 8; comparing this stage across the different approaches here allows for the conceptual insights generated in Chapter 6 and 7 to be critically evaluated against those elicited through an experimental approach.

Although this stage across the three cave art sites was approached in distinct ways as the methodology developed throughout the thesis, there are points of resonance regarding the visual and perceptual responses that invite a comparison for this stage of the biography. The VR simulations of the effect of a low lumen light source across cave surfaces for the art of Las Monedas and La Pasiega demonstrated that not only does the light emphasise topographic features of the cave wall, but the undulating surface can cause steep declines in relative luminance. For both of these examples, it appeared depictions that directly integrated natural features (e.g. topography, cracks, fissures) appeared to correspond to areas of the cave wall where this steep drop-off in luminance occurred. It was conceptually proposed, therefore, that the ambiguity of visual stimuli caused by the commingling of a low and fluctuating light across complex wall morphologies likely resulted in the artists perceiving pareidolic imagery in evocative features of the wall that took the form of animals. This was further supported by the results of the pilot psychology experiment, that demonstrated that participants that manipulated the light to cause significant variations in relative luminance experienced pareidolic imagery, perceiving animal forms in the cave wall surfaces.

There was also a pattern observed across the case studies in the variation of the potency of visual responses experienced, albeit caveated by this being a conceptual interpretation for Las Monedas and La Pasiega. For Las Monedas, the visual response for certain depictions was proposed to be visceral, with significant variations and low lighting conditions potentially resulting in involuntarily visual responses, akin to Hodgson's (2008) hyper-images. For these examples, such as depictions 5 and 30, the visual response may have resulted in perceiving a loose and intangible image that had animal-like qualities. This was, however, proposed to be the exception for depictions at Las Monedas. Instead, more subtle relationships between perceiving certain features as evocative of specific parts of

animals, such as the use of natural cracks to represent the rear leg of depiction 12, were more common. If the hyper-imagery response represents one that is involuntary and impulsive, then these subtle responses were measured and voluntary. This pattern, where the majority of the visual responses appear to be deliberate readings of features as representing was observed in the participant responses for El Castillo and, to an extent, reflected in the haptic engagement with the cave wall at La Pasiega. This emphasises intra-site variation between the visual responses to different areas of the cave wall within a site, demonstrating that different depictions may have been influenced by visual and perceptual responses to varying extents within the sites.

However, this stage of the biography was perhaps limited in capturing inter-site variations in the visual responses. Only one clear divergence in visual responses was elucidated; the coalescing of haptic stimuli with visual stimuli to clarify perception of natural features in La Pasiega. For the most part, this stage of the biography was limited to discuss the extent to which pareidolia may have been triggered by the relative luminance across cave wall morphologies. Although this provided deeper insights into the role of the visual system in influencing the form of depictions, the generalising of vision and perception perhaps oversimplified these responses. The focus on variation in relative luminance allowed several attributes related the effects of light on a cave wall, including topography, colour, and shadow, to be considered at once, but perhaps prevented a deeper appreciation of how any one of these attributes may affect visual responses. For example, the colour of a wall may have been perceived as reminiscent of particular animals, and may have been another aspect that informed the perception of areas of the cave walls as being evocative of animal forms in addition to, or distinct from, pareidolic responses to suggestive natural forms. Future research that appreciates the different types of stimuli that may inform perception and how these have manifested in the visual responses of artists in caves may enable greater nuance to be understood for this stage of the biography.

### *9.2.3. Stage 3: Does the initial material engagement necessarily reflect dialogical interactions?*

As elucidated throughout this thesis, the making of cave art was likely a dialogue that occurred implicitly between the artist and the commingling of the cave wall, light, and pigment. It was proposed, inspired by ethnographic accounts of art making, that the initial material engagement would likely reflect this dialogue; using the allegory of a conversation, this stage reflect the first words spoken. There were clear instances of the initial material engagement reflecting this dialogue across all three case studies, where the first line depicted in a depiction appeared to draw out from or extend natural features in the cave wall. This occurred for both areas of the cave wall that may have evoked visceral visual

responses, where the initial material engagement appeared to be a direct response to capture the visual imagery experienced, but also for areas of the cave wall that perhaps did not trigger these potent visual responses. For examples of the former, depictions 5 at Las Monedas, PA2.3 at La Pasiega, and EC3.2 at El Castillo appeared to be produced by the artist tracing natural features of the cave wall, perhaps reflecting an attempt to capture the intangible perceptual image evoked by these features. Additionally, across all three sites there were examples where this initial material engagement perhaps responded to a more subtle or voluntary visual response, where the first lines depicted appeared to intentionally extend natural features (Figure 9.1). The results from the VR psychology experiments further supported this, with participants that directly related the descriptions of their depictions to utilise natural features expressing greater ease and detail. Taken together, this stage of the biography appears to further support the influence of visual and perceptual responses in informing the form of depictions across the three case studies.



*Figure 9.1. Depiction 8 from Las Monedas, which shows an example of where the initial lines depicted draw out from and extend a natural feature. Digital tracing: Author. Base image: Blanca Ochoa.*

However, there are key considerations that temper this interpretation of the initial material engagement. Primarily, this pertains to the difficulty of determining the line order within depictions. For a number of depictions within each site, this could not be evaluated either due to a lack of overlapping lines within the depiction, the degraded nature of the depiction, or insufficiently high-resolution images to distinguish the order of overlapping lines. The discussion of the initial material engagement often was constrained to making assumptions based on the overall direction of lines in a depiction (i.e. if most lines were depicted left-to-right, it was assumed the leftmost line was depicted first), or generally discussing the relationship between several lines in a depiction and the natural features of the cave wall. As a result, it is difficult to assess the extent that this initial material

engagement reflects a dialogue occurring between the artist and natural features of the cave wall. Whilst some depictions appear to clearly reflect this, as discussed, this relationship is more ambiguous for others. Additionally, several depictions within all three case studies do not appear to reflect this dialogue, particularly those depictions that do not appear to integrate or relate to features of the cave wall. As discussed within each chapter, this may reflect variation within the making of particular depictions where in some instances, the form of depictions was directly influenced by visual responses to evocative features and in others, the cave wall played a quieter role in influencing the form and placement of depictions. There is scope to evaluate this further in future research, to explore the particular types of variation that occur with the initial material engagement and potentially elucidate further insights into how this may relate to visual responses to the cave wall.

#### *9.2.4. Stage 4: Were animal forms completed in the same way?*

This stage of the biography intended to explore the extent the topography of cave walls continued to inform the making of depictions. For certain examples across the three case studies, the form of the animal appeared to be almost entirely shaped through engagements with the natural features of the cave wall. This was evident for depiction 5 at Las Monedas, where the dorsal line, ventral line, and legs of the depiction appear to be placed onto contours and cracks in the surface, and similarly for depiction EC3.2 at El Castillo, again where the animal form appeared to trace natural features. This pattern was more prevalent in La Pasiega, however, and may have been facilitated by the tactile interaction with the cave wall surfaces. For example, PA1.1, PA2.2, PA9.4, PA12.6, and PA12.11 all reflect depictions of animals produced through tactile interactions that almost entirely trace natural features of the cave wall (Figure 9.2).



*Figure 9.2. Depiction PA12.11 of a hind, produced through finger smears that trace a natural crack and follows parallel to the contour of the surface to form the head and anterior line of the chest. Image: Author.*

However, this interaction was not always the case; other depictions across the different caves appeared to reflect different engagements in the completion of the animal form. For example, some appeared to be deliberately completed to manipulate the effects of light and shadow, with areas of shadow occasionally intentionally truncating the depictions or with the depictions placed to appear as though animals were emanating from shadows. This conscious awareness of the lighting effects appeared to influence the completion of a number of depictions at Las Monedas. Depictions 2 and 3 appeared to have been placed so that shadow partially truncated the reindeer; the addition of detail for depiction 20 and the infilling of the head in depiction 5 appeared to artificially create shadow, adding depth to depiction 20 and ambiguating the form of depiction 5; and depiction 7 appeared to emanate out from the shadow cast by a fissure and “return” into another crack. Similar effects were observed at La Pasiega, where depictions PA7.4, PA9.6, PA9.7, PA10.1, and PA12.1 appeared to have been deliberately depicted so that shadow fell across the lower part or rear of the animal, again creating the impression of animals emerging from the darkness.

This completion of animal forms with a conscious awareness of the visual effects of lighting added a new dimension to the making of the art. Artists appeared to be responsive to the interaction of light across a surface, both in terms of the lighting conditions triggering pareidolic responses in the artists, but also through the artists deliberately manipulating the effects of light to enhance their depictions. This playful interaction adds levity to the understanding of this making across the three case studies. Visual and perceptual responses may have been an initial impetus for the form and placement of depictions, but the artists were not merely beholden to their psychology; they *engaged* with the visual effects caused by a dynamic light source.

Whilst this stage enabled these insights to be generated, allowing a deeper appreciation of how depictions were produced to relate both to natural features and particular lighting effects, there were some limitations. Firstly, the assessment regarding an intentional association between depictions and particular light effects was a subjective one, based on the VR lighting simulations. Although these provide an insight into the way light interacts with the cave wall surface, they are only a simulation rather than a reconstruction. The particular position of the light source and its intensity is unknown, and variations in these variables would affect exactly where shadow fell across the depiction. Thus, whilst some depictions may have intentionally manipulated lighting effects, it’s difficult to say for certain whether these effects were the same in the initial making of the depiction nor if these were consciously recognised by the artists. Further, within this stage it was difficult to assess the reasons behind the variation in completing animal forms. For each cave, some depictions were anatomically complete and detailed, some were partial but had additional

detail, and others were complete but simplistic. The decisions taken by the artist in the completion of depictions, i.e., to partially represent an animal but include details such as pelage, were not fully understood within this biographical stage. In particular, omitting certain anatomical features – such as the lack of representing heads of animals in Las Monedas – alludes to this being a deliberate and unusual stylistic choice by the artist. Future research that explores this experimentally, by evaluating what features participants decide to depict and how priming participants in different ways (i.e. with visually ambiguous animals, different Upper Palaeolithic styles of depicting animals, detailed images of the same animal), may provide one way to achieve fuller insights into this stage of the biography.

#### *9.2.5. Stage 5: Do relations endure?*

The final stage of the biography intended to capture whether the depictions were engaged with after their form had been completed. This stage perhaps reflected the greatest variation across the three case studies, with different examples of the way the depictions may have been interacted with. The manipulation of light to enhance or truncate depicted animal forms was proposed to allude to the depictions being produced with their reception in mind, and thus may have been repeatedly interacted with after their production. Across the three caves, it was proposed that depictions that evidenced this relationship with light – particularly where the animal depiction appeared to emanate out from shadow – embodied narrative elements, and speculatively may have been used for these purposes after their making. This was further supported by the presence of depictions that appeared to capture animal behaviours, such as depictions 2 and 3 at Las Monedas of walking reindeer PA7.8 and PA7.9 of hinds with heads raised or twisted, or depictions EC1.5 and EC1.7 of resting bison. The placement of depictions that appeared to constrain and/or manipulate the observer's perspective, such as depictions swirling above an observer's head for panel PA7 and PA9 in La Pasiiega or the placement of depictions on a low overhang feature on panel EC4 in El Castillo also appeared to reflect depictions that were made with the intention of being engaged with after their making. For Las Monedas and El Castillo, the placement of depictions with an audience in mind was juxtaposed against the presence of depictions intentionally hidden from view. These were likely not intended to be engaged with after their making, instead reflecting an intimate and discrete moment between just the artist and the cave wall.

These discussions were based primarily on the observation that certain depictions appeared to have characteristics that captured animal movements or had narrative elements embedded into their form, and thus these interpretations had a degree of subjectivity. Consequently, it is difficult to tangibly evaluate whether relations did endure

with these depictions. Behaviours such as repeated visits to the same area of a cave, narratives and storytelling, manipulating light to make depictions appear or disappear into darkness, or even tactile engagements with depictions, would leave no physical traces in the archaeological record. However, there was one clear and tangible example of enduring relations observed at El Castillo: the redrawing of depiction EC1.9. This simple action represented tangible evidence for the temporally distanced interaction with pre-existing depictions in a cave. The presence of pre-existing depictions within caves that may have been revisited over millennia, not only suggests enduring relations with place and particular motifs, but also may have further enticed visual responses to natural forms that perceived these as animal-like (as discussed in Chapter 8).

Out of all biographical stages, this was therefore the most speculative; the lack of rigorous chronologies for the art meant that discussions of superimposed forms or subsequent engagements with depictions are restricted to conjecture. Additionally, the assumption made for Las Monedas and La Pasiega A that the similarity in style indicated the depictions were all made over a relatively short time span and thus may reflect a relatively short burst of artistic behaviour may be inaccurate. These depictions could be separated by generations, reflecting repeated revisits to the same area of the caves to gradually accumulate depictions over time and creating enduring relations in the process. Equally, the long engagements suggested for El Castillo, particularly panel EC1, may be inaccurate – the extent to which the same cultural group returned to one site, or if later people entering the cave recognised the presence of previous depictions is difficult to assess. Due to the issues with dating cave art, these issues may be difficult to resolve. However, future research that intends to produce more rigorous chronologies for the phases of art making with a site may be able to address some of these issues.

### 9.3. Wider Implications for Understanding Upper Palaeolithic Art

The insights generated through this research appear to demonstrate how the making of figurative art may have been influenced or constrained by Upper Palaeolithic people's psychology; their expertise in animals, the ambiguous visual stimuli and fluctuating light conditions all commingled to influence the form of depictions. Yet figurative depictions did not only exist within caves, encouraging a consideration of whether this particular influence of visual psychology is a unique feature of parietal cave art, or an inherent aspect of all figurative art produced within the Palaeolithic. There are consequently key questions pertaining to the wider implications of this research for Upper Palaeolithic art in general that emerge from this thesis, which will be concisely and conceptually discussed here.

### 9.3.1. Are certain psychological mechanisms an inherent feature of figurative art in the Upper Palaeolithic?

The results presented throughout this research supports the broad hypothesis that psychological mechanisms triggered in cave environments, particularly pareidolia, had significant influence over the theme and placement of figurative depictions. Although the particular conditions of caves were conducive to evoking this visual psychological response, it invites a consideration of whether these psychological underpinnings of figurative art were unique to the art produced within caves, or can be observed more widely in other forms of art. The artistic repertoire of the Upper Palaeolithic is vast and diverse, and undoubtedly emerged through multifaceted processes that were spatially and temporally distinct. However, the fundamental ability to perceive forms in materials, engage with the material, and subsequently draw out an animal form may have shared underlying psychological processes across different art forms.

Portable art is a natural category to focus on to conceptually explore this. Although portable art is a broad category, encapsulating everything from decorated tools such as *bâton percé* to personal ornaments, it is often generally cast in opposition to parietal cave art, perceived as a domestic behaviour intrinsically part of the rhythms of Upper Palaeolithic life (Sieveking 1991; Moro Abadía 2006; Fritz *et al.* 2016) when compared to the “exceptional” nature of cave art. This is perhaps by virtue of portable art being usually found within occupational sites, and thus is assumed to be an object used in daily life. There are notable examples that allude to the complex and diverse uses of “non-functional” examples of portable art, such as the exploding loess figurines at Dolni Věstonice (Vandiver *et al.* 1989). This, particularly when considered alongside the huge diversity in the objects classed as “portable art”, stresses that this generalisation of portable art interpretations intends only to capture the categorical boundary often drawn between portable and parietal art. Despite this division, a breadth of portable art examples appear to superficially express similar relationships between natural features of the material support and the form of the depiction as has been evaluated for the art of the Monte Castillo caves in this research. In a cursory review of 251 examples of portable art from 44 sites across Western Europe (Figure 9.3), synthesised from Sieveking (1987a; 1987b) and Arias Cabal and Ontañón Peredo (2005), 18% appeared to directly integrate features of the material support into the form of the depicted animal, 38% appeared to have forms that were depicted in parallel to natural features, and 26% were constrained by the dimensions of the support.

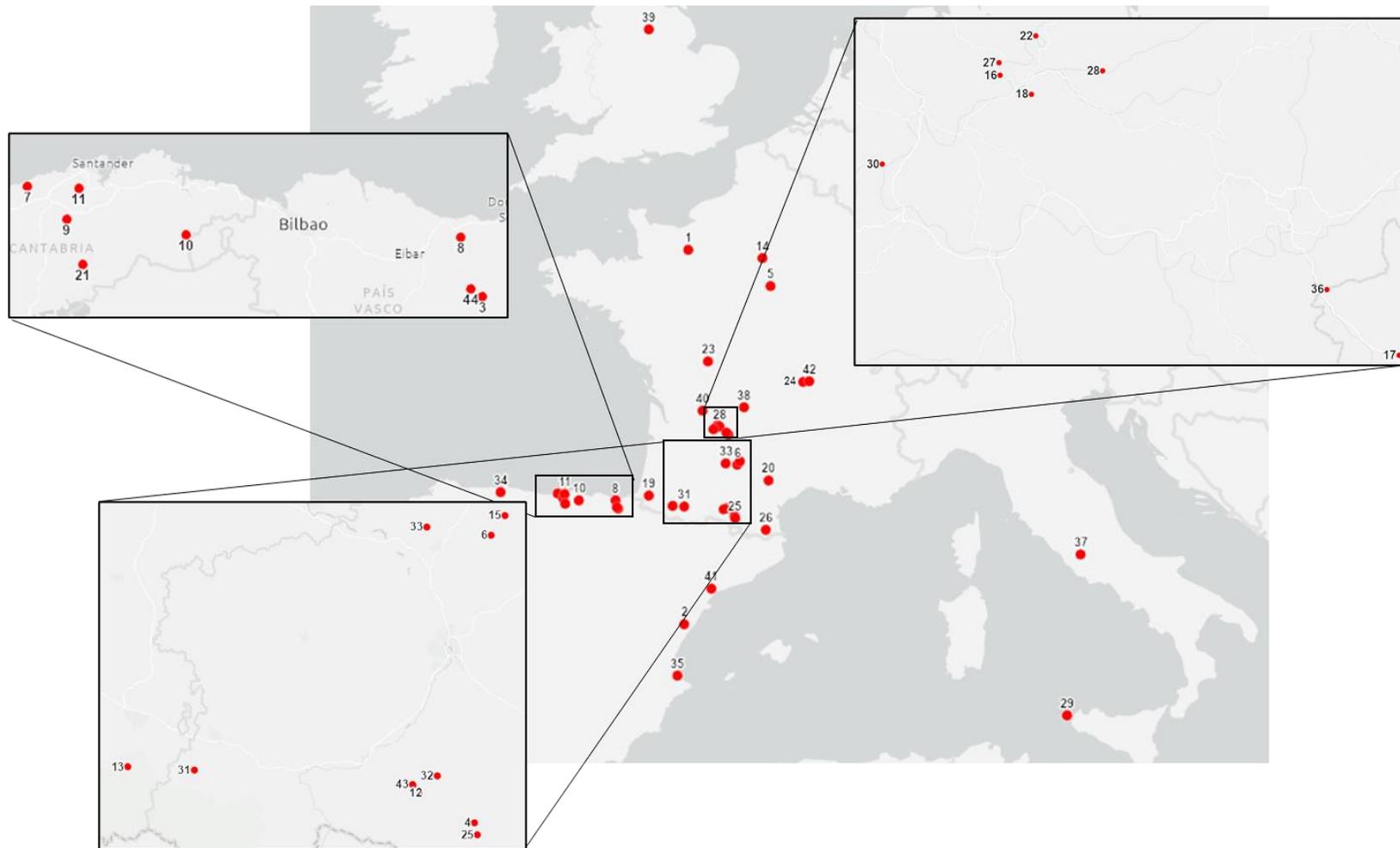


Figure 9.3. Distribution of the portable art sites. 1: Abri Morin, 2: Abric d'En Melia, 3: Altamira, 4: Bedheilhac, 5: Cepoy, 6: Courbet, 7: Cuaventi, 8: Ekain, 9: El Castillo, 10: El Miron, 11: El Pendo, 12: Enlène, 13: Espalungue, 14: Etoilles, 15: Fontales, 16: Gorge d'Enfer, 17: Gourdan caves, 18: Grotte des Eyzies, 19: Isturitz, 20: La Colombiere, 21: La Garma, 22: La Madeleine, 23: La Marche, 24: La Tuiliere, 25: La Vache, 26: Labastide, 27: Laugerie Basse, 28: Laussel, 29: Levanzo, 30: Limieul, 31: Lourdes, 32: Mas d'Azil, 33: Montastruc, 34: Paloma, 35: Parpalló, 36: Pechialet. 37: Puy-de-Lacan, 39: Robin Hood Cave, 40: Rocheriel, 41: Sant Gregori, 42: Samt du Perron, 43: Tuc d'Audoubert, 44: Urtiaga. Image: Author. Base map: Esri.

The portable art examples with direct relationships to the support, although a relatively small percentage of the examples reviewed, perhaps allude to similar psychological mechanisms being involved within their making. Several variations were observed within this category: natural features were used to inform the shape of depictions; animal forms were constrained or positioned in unusual ways to fit to the support's morphology; and some cases where the animal form appeared to mimic the natural shape of the support. For example, engraved antler fragments at Laugerie Basse represent examples where both the natural shape of the antler has influenced the animal form, and also constrained the animal to unusual positions (Figure 9.4). A similar pattern is observed on a *bâton percé* from La Madeleine, where two horse depictions are placed with certain anatomical features placed to fit the shape of the material support (Figure 9.5).

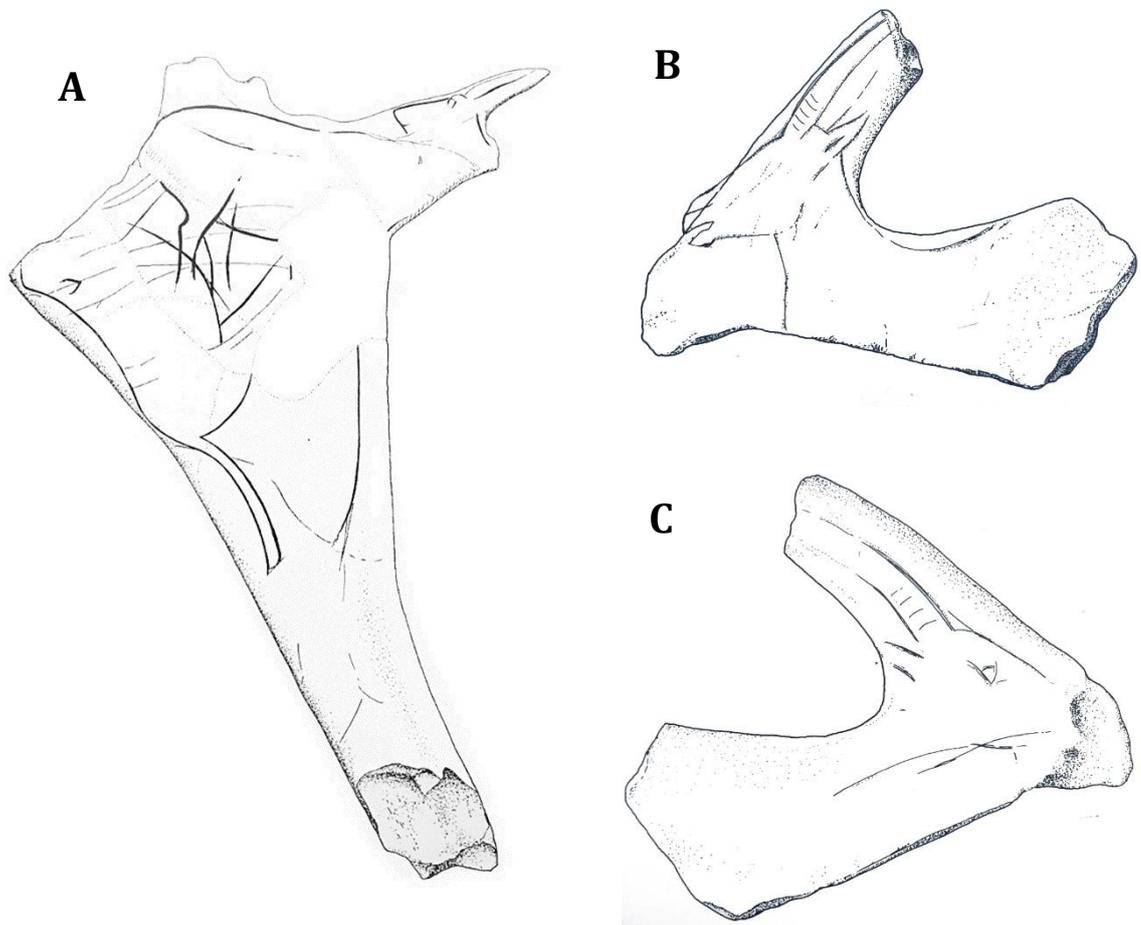


Figure 9.4. Tracings of antler portable art objects from Laugerie Basse. A) Antler palmate with ibex depiction. B) and C) an antler fragment with ibexes depicted on either side. Image after: Sieveking 1987a.

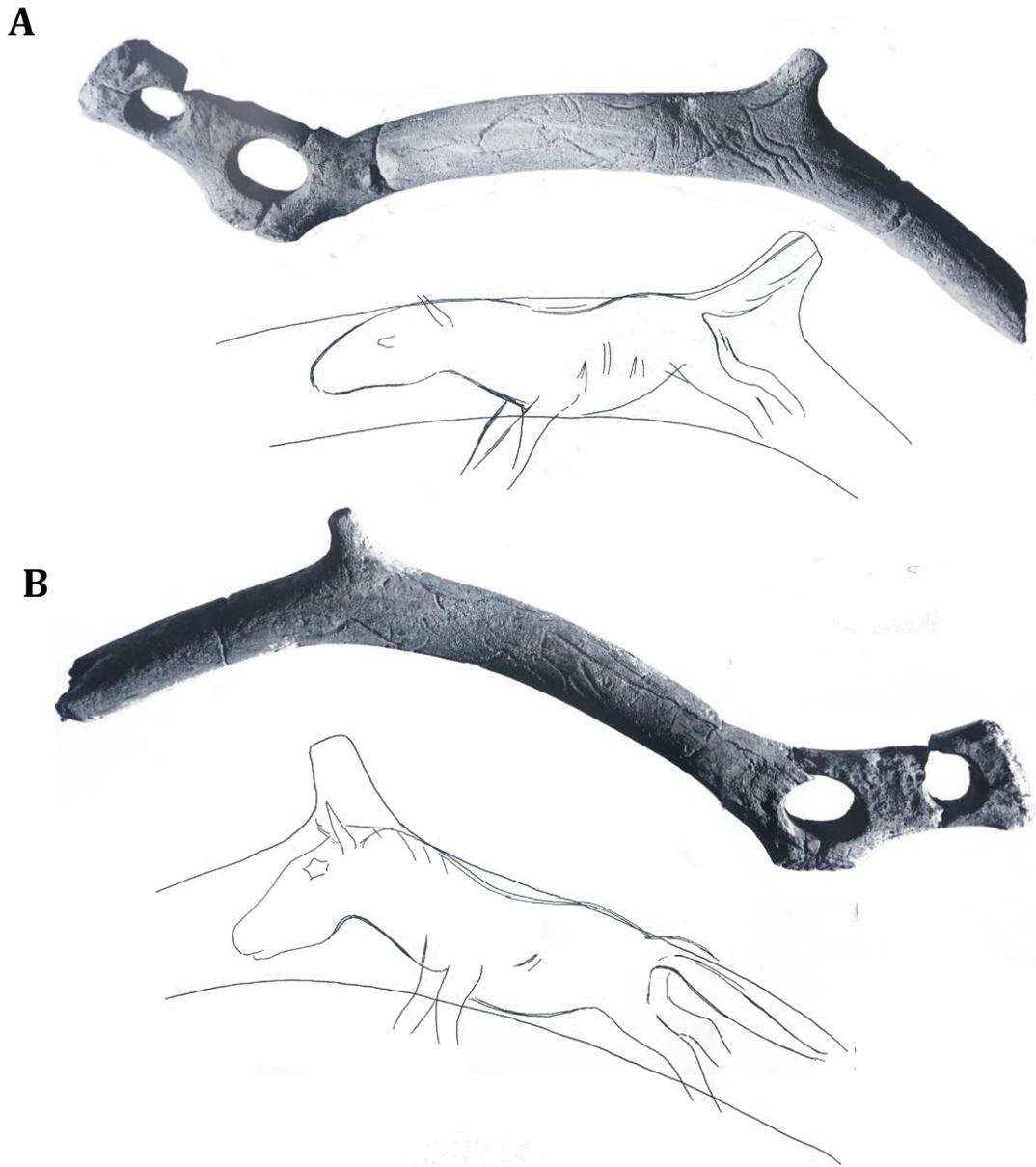
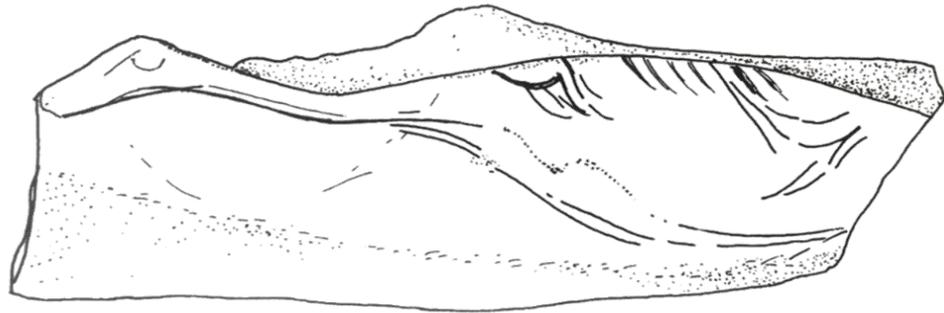


Figure 9.5. A bâton percé from La Madeleine, with A) a horse depicted on the obverse with the tail fitted to the material morphology and B) on the reverse, the same feature used to position the ear of another horse. Images after: Sieveking 1987a.

The portable art from Montastruc forms a large proportion of the portable art evaluated in this coarse review, by virtue of the collection within the British Museum which was the focus of Sieveking's (1987a) study. This site in particular expresses a pattern of fitting animal forms to natural features, as identified by Needham's (2017) research on the Montastruc limestone plaquettes. Animal forms across both the organic and limestone art appear to be depicted to make use of natural features or even pre-existing depictions. For example, a fragment of bone has been used to depict a water bird with its dorsal line fitted

onto the broken edge, and a limestone plaquette features a horse depiction that has its head placed in twisted perspective to fit the suggestive edge of the support (Figure 9.6).

**A**



**B**

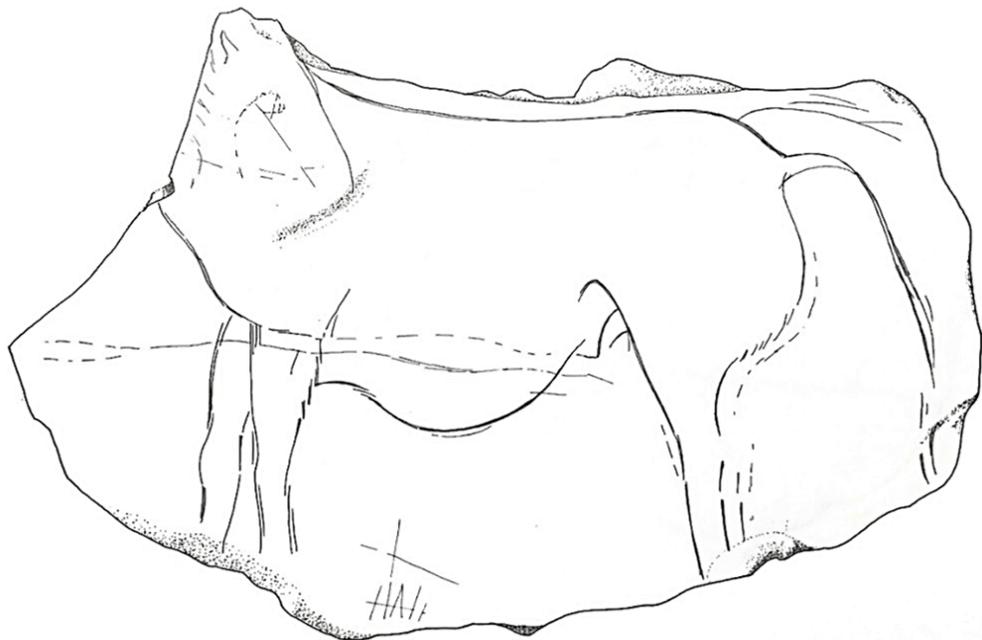


Figure 9.6. Tracings of two portable art examples from Montastruc. A) Bone fragment with an engraved water bird depiction. B) Limestone plaquette with an engraved horse depiction. Images after: Sieveking 1987a.

These examples appear to reflect a similar pareidolic response to natural features, where the material's morphology is perceived as evocative of a particular animal or anatomical features of an animal. This has been noted elsewhere; Needham's (2017) research commented on this particular aspect of visual psychology as informing the engraving of animal forms on limestone at Montastruc, and potentially enriching the experience of mediating animal-human relationships through art making. Conneller (2011, 35 - 36) also alluded to this in describing the use of the suggestive horse-like shape of horse hyoid bones in the production of horse *contour decoupé* (Figure 9.7). Artists may have

depicted horse heads on this material both due to their evocative shape and the explicit relationship with horses emphasised in using horse osseous material to produce horse representations. Additionally, Conneller (2011, 36) stresses that the association between horse heads and hyoid bones may have only been apparent to those who knew how to see it, relating to the idea of visual expertise and a particular reading of material surfaces as informing both a pareidolic response to the material, and the subsequent art making.

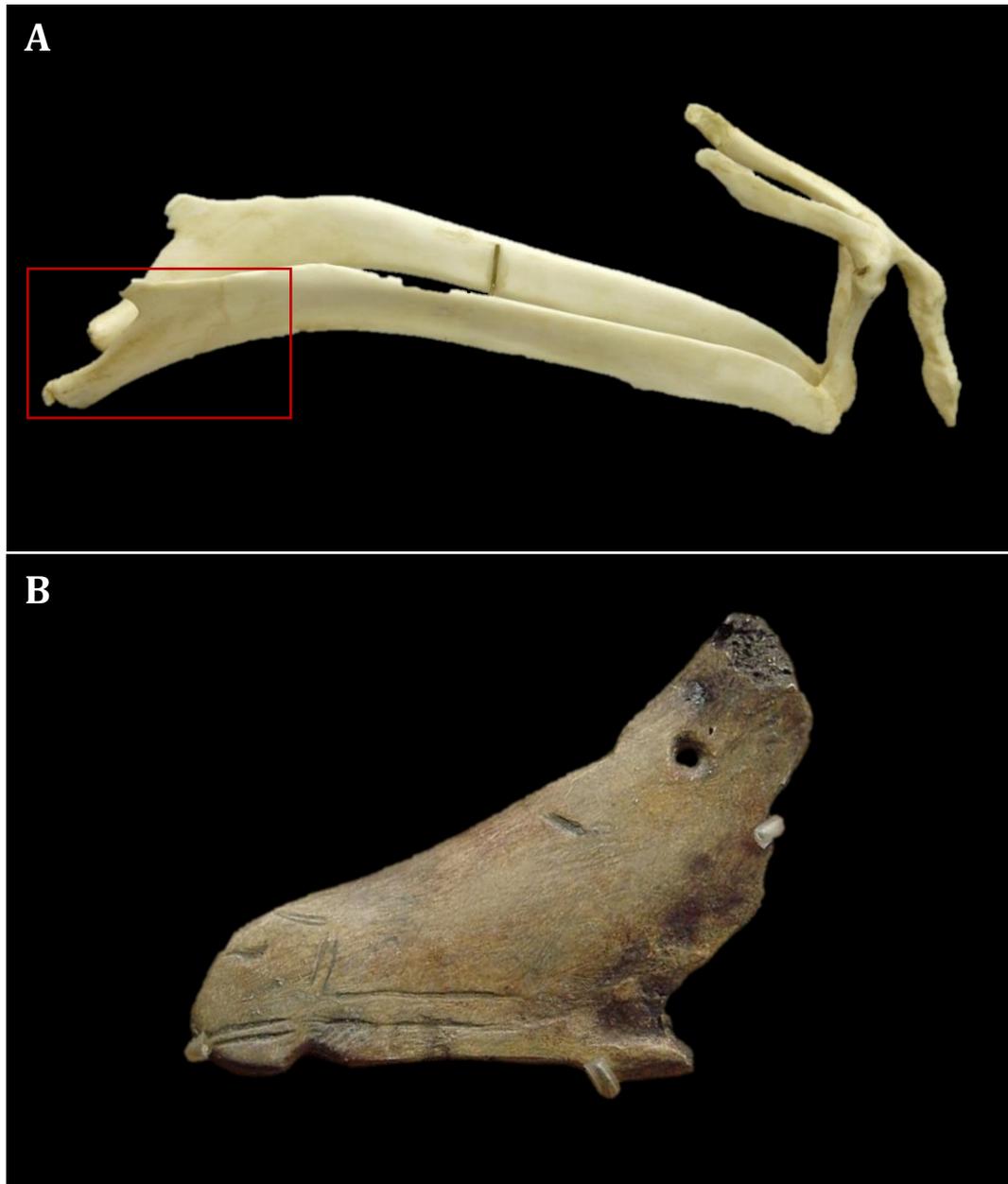


Figure 9.7. The relationship discussed by Conneller (2011, 35-36) between utilising a suggestive part of a horse hyoid bone (A) to create contour decoupage representing horse heads such as (B) an example from Grotte des Espéluques (France). Images after: A) 2008 © Bone Clones. B) Wikimedia Commons.

Albeit limited to a brief and broad-sweeping discussion, this apparent presence of similar mechanisms underpinning the fitting of animal form to different materials may, speculatively, suggest that visual psychological responses were a central aspect of art

making in the Upper Palaeolithic. Pareidolia, in particular, may have facilitated the representation of animals, acting as a scaffold to transfer visual information of the 3D world onto flatter and fixed surfaces. If so, the emergence of figurative art may have depended heavily on pareidolia and, in turn, pareidolia may have been an essential mechanism to allow for the 2D representation of animals within the world. Tentatively, this may provide an explanation for the proliferation of animal representations in the Upper Palaeolithic world. The pareidolic responses of Cro Magnons, who had visual expertise in recognising animal forms, may have near exclusively featured animals, just as faces are prolific in the pareidolic responses of people today. This undoubtedly would have manifested in a multitude of ways within the making of different forms of art that were spatially and temporally distinct. The meaning potentially layered onto the ability to see animal forms in the random natural patterns of material supports would have also been significantly varied across different cultures and societies. This discussion thus only intends to identify the potential existence of similar mechanisms in other Upper Palaeolithic art forms. To appropriately and thoroughly evaluate this, an approach akin to the one adopted in this research that appreciates the nuanced differences in the role of the visual system within the making of the art would be needed.

### 9.3.2. *Was cave art “exceptional”?*

The potential existence of similar psychological mechanisms in Upper Palaeolithic portable art also encourages a consideration of whether cave art was “exceptional”. If psychological responses, such as pareidolia, were present in the making of other art forms, then was there anything distinct about the process of making art in caves? Was making art in caves perceived as an exceptional behaviour, or just another facet of the broader artistic repertoire of Upper Palaeolithic societies? As with Clottes’ (2013) question of “*why did they draw in those caves?*”, the response to these questions may tend towards grand narratives; it unhelpfully entices an answer that generalises about the particular reasons individuals may have entered caves in the Upper Palaeolithic to make art. Drawing back to the evidence presented through the case studies is one way to root this discussion within specific examples from the archaeological evidence.

One perspective may be that the particular environments of caves infused the art with a more sensory experience; evoking emotionally charged responses, that enhanced the potency of pareidolia (as has been suggested by Hodgson 2008). As explored in each case study, viewing unusual calcite formations and complex wall morphologies under firelight within the all-encompassing darkness of caves, undoubtedly had powerful effects on the visual system. Pareidolic responses appear to have been viscerally felt under these conditions, as emphasised by the low and fluctuating RLV conditions demonstrated for

areas of the cave wall with depictions that directly integrate topographic features in both Las Monedas and La Pasiega, and the involuntary pareidolic responses of some participants in the VR psychology experiments. Visually resolving ambiguous stimuli to suddenly perceive animals in the complex morphologies of rock surfaces within caves may have also been layered with deep cultural meaning. The centrality of animals within Upper Palaeolithic societies undoubtedly would have been matched with complex understandings of animal-human relationships and particular cultural meaning associated to the perception of animals within rock surfaces in caves. Making art in caves may have been one means to mediate relationships with animals, allowing the artist to engage in a dialogue with the animal form as they drew it on and, in a sense, *out from*, the rock. This is not intended to allude to ideas of hunting magic or shamanism. Rather, it intends to emphasise the intimate nature of making this art that was not exceptional nor restricted to particular individuals (i.e. “shamans” as has been suggested elsewhere: Davenport and Jochim 1988; Clottes and Lewis-Williams 1996; Lewis-Williams 1997; Lewis-Williams and Clottes 1998), but had the potential to be experienced and engaged with by all members of Upper Palaeolithic society. Taken together the visceral, yet universal, experience of pareidolia in caves, alongside the deeper cultural significance layered onto perceiving and depicting animals, may not place cave art as an “exceptional” behaviour but certainly emphasises its potential significance to Upper Palaeolithic societies.

Another alluring aspect of making and engaging with art in caves may have been the manipulation of the ever-shifting nature of the torch or lamp light to enrich the depicted animal forms. The depiction of animals in Las Monedas as emerging from dark fissures or shadow, and the animal behaviours captured in depictions at La Pasiega and El Castillo, supports the intentional placement of depictions to make use of visual light effects. The role of light in this sense has also been discussed elsewhere, as an “animating” effect for examples of animals depicted with multiple anatomical elements (Azéma and Riviere 2012) or imbuing a sense of liminality into depictions, giving the impression of animals emanating out from the darkness (Pettitt 2016). There is also some emerging evidence that portable art may have been experienced in a related way, under comparable lighting conditions. Heating patterns on engraved limestone plaquettes from Montastruc suggest that they may have been deliberately orientated around hearths, perhaps to make use of similar visual effects of the dynamic firelight (Needham *et al.* 2022). This is further supported by the presence of portable art within caves such as at Tito Bustillo (Balbín-Behrmann *et al.* 2017), La Garma (Ontañón and Arias 2012), and Enlène (Bégouën and Clottes 1991). Taken together, this evidence suggests that the visual psychological effects caused by firelight in dark conditions may have been an integral feature of interacting with certain art forms in the Upper Palaeolithic, just as the contextual conditions of caves (e.g. constrained spaces,

humidity, unusual acoustics) have been proposed to be fundamental to the experience of parietal cave art (Arias and Ontañón 2012; Pettitt 2016, 14; Fazenda *et al.* 2017; Intxaurbe *et al.* 2020). The environments of deep caves implicitly necessitate viewing art under firelight, and the coalescing of different senses stimulated by these conditions may have enriched the experience of art.

Tentatively, this may allude to the experience of making and viewing art in caves being entwined with other cultural behaviours, such as storytelling. Whilst scenes are rarely pictorially represented in Upper Palaeolithic cave art, this does not implicitly mean scenes or narrative were completely absent from this art form (Dobrez 2012; Pettitt 2016; Aubert *et al.* 2019; Davidson 2021). As seen within the three Monte Castillo sites, the animation of forms, manipulation of light, and the harnessing of other sensory attributes of caves (e.g. tactility, spatial placement, acoustics) are all indicative of the immersive nature of this art, with narrative elements embedded within the experience of viewing and engaging with it. Firelight, in particular, has been recognised to be a social space (Dunbar 2014; Wiessner 2014) which may have been conducive to the exchange of stories (Nakawake and Sato 2019) and psychologically, warm light encourages creativity and sociality (Kombiez *et al.* 2017). The role of light in storying rock art and, in turn, prehistoric worlds has also been discussed for late Mesolithic and early Neolithic open-air rock art (Nyland and Steberggløkken 2021), emphasising how the manipulation of light and shadow – either the shifting daylight for open-air art or the dynamic firelight for cave art – can enrich parietal art with narrative elements.

Narratives, like art, are universal in human societies (Scalise Sugiyama 2001, 222). Across a breadth of contemporary societies, including Western societies, folktales frequently feature animals and embed cultural knowledge regarding predator-prey relationships and particular animal characteristics (Scalise Sugiyama 2001; Nakawake and Sato 2019). It is likely animals would have similarly been central within stories in Upper Palaeolithic societies. Upper Palaeolithic people would have been orientated around observing, tracking, and hunting animals, and consequently animal-human relationships may have permeated into narratives as a way to transmit and embed cultural information, just as with contemporary folktales. Narratives regarding animal-human relationships may have been ever-more potent within the psychological experience of perceiving animal forms in the ambiguous visual stimuli of cave environments, the dialogical making of cave art, and the perceptual effects of subsequently viewing animal depictions under a dynamic light; the agential animal characters in stories came alive and emerged from rock surfaces.

This is not to suggest all Palaeolithic art was used in this way, and undoubtedly the particular engagements with art would have varied across time and space. Indeed, even

within the Monte Castillo sites, there is significant variety between “hidden” depictions, depictions visible but in constrained spatial areas, and depictions in open chambers, which alludes to different ways of engaging with the art – from discrete, intimate interactions through to social experiences. Instead, this discussion serves to emphasise that the particular conditions of making and perceiving art in caves, particularly the visual psychological effects caused by these conditions, were conducive to cultural behaviours such as storytelling that are not preserved in the archaeological record. Caves may have been attractive, and indeed *exceptional*, spaces for engaging in these kinds of behaviours.

Making art in caves was, therefore, perhaps not “exceptional” in the sense that its production and reception was limited to a restricted number of “exceptional” individuals in a society, that had to be in a certain trance or altered state; the experience of seeing and then depicting animal forms in complex rock surfaces had the potential to be experienced by all. However, the particular visual effects and sensory conditions intrinsic to art making and viewing in caves perhaps had some exceptional attributes. The experience of pareidolia in these highly sensory environments may have been more potent and visceral than pareidolic responses experienced in daylight, with animal forms emerging in rock surfaces under the low light cast by a torch. Additionally, the playful manipulation of light and relationship between animal depictions and shadow inherent within certain depictions at Monte Castillo that may have been wedded to deeper cultural behaviours, such as storytelling, perhaps alludes to caves (or specific areas within them) being perceived as exceptional spaces within these Upper Palaeolithic societies.

## 9.4. Future Directions

### 9.4.1. *Areas for development*

As highlighted through the comparison of biographies in section 9.2., there are several areas for potential development in this approach that pertain to both conceptual and technical issues. The former concerns the resolution of the approach, and the extent to which a relative biography is appropriate for understanding the process of making figurative art in caves. The adoption of this theoretical framework intended to allow the research to move away from a focus on the final aesthetic form of Upper Palaeolithic art and breathe nuance into its particular making. Whilst it certainly achieved this overarching aim, there is still conceptual issues that arose through this approach as elucidated through the comparison of biographies. By compressing time within each biographical stage, issues with a lack of robust chronologies were mitigated, but perhaps at the expense of appreciating deeper nuances between intra-site depictions produced during different periods. A potential resolution to this conceptual issue is difficult to address from a theoretical stance; more detailed biographies necessitate more detailed chronologies. Rigorously evaluating

relative chronologies within a site may facilitate this. Using securely dated examples and conducting in-depth microscopic and macroscopic evaluations of the techniques and pigment composition of securely dated and undated depictions, may allow for undated depictions to be “anchored” to secure dates. Moving away from a biographical framework may be another potential resolution, with relational or materialist focused approaches as an alternative theoretical framework. These kinds of approaches would allow for deeper theoretical nuance in the particular ways depictions may have mediated animal-human relations, for example, or the experiential aspects of making art. These may still relate to visual and perceptual psychology, but would reframe understandings of vision and perception as providing deeper insights into the experiential or relational (i.e., placing visual perception as one of a multitude of sensory experiences in the making of art), rather than exploring the role of the visual system in cave art making. The insights generated through different theoretical approaches, therefore, would have not addressed the overarching aim of this thesis, but may allow for alternative perspectives that resonate with some of the themes in this research.

The latter primarily concerns refining the novel digital techniques used in both understanding the techniques used in making the depictions and further developing methods related to the VR psychology experiments. Several aspects can be refined to provide better resolution to understanding the making of the art. A key limitation of the approach was poor resolution in reconstructing the line order for certain depictions, which limited the extent to which insights could be made regarding the initial material engagement. For certain depictions that do not have sufficient overlapping lines, this is an inevitable issue that cannot be resolved; the line order will always be speculative. However, the use of macrophotography may better enhance understanding of both the specific techniques used to depict each line and the order of lines within a depiction. Macro-lenses provide greater resolution of close-range images of surfaces than a standard lens, and thus may provide the resolution needed to better distinguish individual lines. Additionally, non-invasive methods for determining the composition of the paint, such as portable X-Ray Fluorescence may provide deeper insights into the production of depictions, particularly to determine those which may be contemporary with one-another. Although *in situ* pXRF is limited in caves (Chanteraud *et al.* 2021), it has the potential to determine which depictions were likely produced using the same paint mixtures (Gay *et al.* 2016; Trosseau *et al.* 2021) and has been used to distinguish a relative chronology for depictions at Rouffignac (Gay *et al.* 2020).

The VR pilot study, despite generating novel insights into the visual responses of participants in simulated cave environments, had some logistical limitations that can be

developed for future research. The eye tracking analysis, by virtue of being a new approach in VR more widely, was restricted by the need to process the eye tracking data manually. Seeking out methods to automate this approach will not only allow for much larger amounts of this data to be processed, but will also provide comparative datasets between participants that can be statistically evaluated. One potential option is to use the intersection of the gaze-direction of participants and the mesh of the 3D model they are observing to automatically plot eye movements and generate heatmaps. This is currently being explored by Prof. Bob Kentridge, and if successful will significantly improve the eye tracking data generated from the VR experiments.

Additionally, exploring avenues for more interactive and realistic VR environments may further enrich these experiments. The VR environments produced in this research were simplified to allow participants to navigate them with ease, at the expense of understanding how spatial constraints may have affected visual responses. Future research could produce low-resolution models of sections of the cave, allowing participants to experience a much more realistic environmental setting in VR to evaluate how navigating through the cave itself or being constrained when observing a cave wall may affect visual perception. Another addition to the VR experiments would be to give participants the ability to depict animals on the cave walls themselves, by creating a virtual tool that would allow them to recolour and draw on the 3D models in VR. Not only would this enhance the immersion of the VR environments, allowing participants to actively engage with the space, but would provide greater clarity in understanding participant responses. Audio responses alone regarding the placement and form of the depictions that participants would produce can be vague; allowing participants to draw their depictions would clarify their responses. Further, there are additional variables that can be manipulated in the VR experiments to better understand participant psychological responses and the factors that may influence these responses. For example, recruiting participants from specific subgroups that have a greater familiarity with animals (e.g. farmers) may allow a more in-depth evaluation of whether visual expertise with animals influences pareidolic responses (do farmers have pareidolic responses that take the form of their cattle?). Other elements can be manipulated within the VR environments themselves, to further explore how certain engagements with Palaeolithic art may have influenced its making, particularly for sites that had repeated artistic phases. For example, the walls viewed by participants may already feature some depictions (i.e. of a particular species or style), to determine whether this encourages participants to have pareidolic responses that correspond to the animals already represented on the wall and/or whether participants decide to continue or diverge from the theme and style of the pre-existing depictions.

#### 9.4.2. *Future research*

There is significant potential for future applications of the approach developed in this research, to explore further questions regarding the role of the visual system in Palaeolithic figurative art production. As elucidated conceptually within the discussion, there appears to be precedent for determining whether the ability to produce figurative depictions arose out of visual psychological phenomena, such as pareidolia. Pareidolia may have facilitated the emergence of this ability, allowing for perceptions of 3D objects in the world to be scaffolded onto flatter, albeit still 3-dimensional, surfaces that were naturally evocative of forms such as animals. The VR psychology experiments piloted in this research are well suited to addressing this hypothesis. By evaluating whether participants both have pareidolic responses to cave walls and accurately “predict” which areas of the cave wall were used for depiction, an assessment can be made regarding the extent to which some of the oldest figurative representations were dependent on pareidolic responses to evocative natural forms. This can be further explored through evaluating whether the development of figurative representation might reflect a divergence away from this dependency on pareidolia, as cultures became more adept at representing 3D things as 2D representations in art.

Future directions may also move beyond depictions in cave art, to consider different types of art forms from the Upper Palaeolithic. The apparent presence of similar mechanisms occurring in animal representations for some forms of portable art encourages a deeper exploration of how psychological responses may differ for the making of portable art. Understanding the extent to which the visual system influences the form of animal depictions in the making of this portable art, which was likely produced in daylight conditions, may provide further insights into how the experience of the light conditions of caves affected the art making process and whether this process significantly differs for art made in daylight.

### 9.5. Conclusion

As set out at the start of the thesis, this research has reimagined approaches to Upper Palaeolithic figurative cave art through an interdisciplinary approach that refocused attention on its meaningful making. By doing so, this research mitigated some of the issues with the historical, and predominately Western, approaches towards Palaeolithic art research. These previous approaches have tended to create single, grand narrative explanations for this behaviour at the expense of more nuanced and intimate insights into the art made within a certain period, region, or even a restricted area of a cave. Articulating non-Western ontologies to challenge some of the implicit assumptions made by Western researchers about art elevated this research, allowing art to be redefined through the

insights offered by non-Western perspectives and informed a framework for evaluating the making of depictions in caves. Integrating insights from visual psychology allowed one way to “listen in” to the dialogue that occurred within this making, allowing for hypotheses to be generated and tangibly tested against the archaeological record. Through the development of an approach that integrated novel digital techniques, new perspectives were generated for the art of Las Monedas, La Pasiega, and El Castillo. These fundamentally revealed the importance of visual and perceptual phenomena in shaping the form of depictions, and the material engagements that occurred in response to this visual experience.

Important questions still remain: did the ability to create figurative art emerge from psychological phenomena like pareidolia? Does this manifest differently in other forms of art in the Upper Palaeolithic? Did the influence of visual and perceptual responses vary over time? These questions encourage approaches that move towards greater resolution into aspects of the art making process in the Upper Palaeolithic, revealing deeper and more intimate insights into this behaviour. Their answers perhaps lie in the development and future directions of this research, which in turn represents a move towards more context-sensitive and small-scale approaches to understand Upper Palaeolithic art. As demonstrated by this research, approaches of this kind articulate individual human actions – from tracing intangible animal-like images perceived in natural features with a pigment-covered finger to evoking the sense of animals creeping out of the darkness by manipulating light. Answering these questions in future therefore has great potential for realising the innately *human* nature of Upper Palaeolithic art.

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