DRAFT: The work of the miniature in the age of digital reproduction.

Diffracting Digital Images in Art, Archaeology and Cultural Heritage. Unfolding Pixels, edited by: Ian Dawson, Andrew Meirion Jones, Louisa Minkin and Paul Reilly

Author: Stuart Jeffrey

Affiliation: Reader in Heritage Visualisation, the School of Simulation and Visualisation, Glasgow School of Art.

ORCID ID https://orcid.org/0000-0003-2084-4174

1 Introduction

For all representations of heritage sites and objects, including digital representations, there are multiple factors which affect the way we perceive what is being represented. These include factors such as material, colour and scale, as well as our preconceptions of the media being used. Broad economic and conceptual factors often differentiate a digital heritage object (or DHO) from other forms of media, such their complex modes of authorship, questions of use and re-use and ownership, but also their (apparent) transience in the world. Some qualities are even exclusive to digital representations and are incongruous with the analogue world; their imperviousness to aging, an inability to acquire 'pastness' (Holtorf 2013), their intrinsic untouchability and their unlocatability, attested to by our inability to locate them precisely at any given time and the necessity of mediating technology to conjure them into being (Jeffrey 2015). Digital Heritage Objects, which can represent anything from a single artefact to a reconstructed city or landscape, are often presented via a range of semi-immersive or pseudo-immersive technologies, such as via Augmented Reality or Extended Reality. In this chapter, however, I will mainly concentrate on their delivery via fully immersive Virtual Reality (VR) environments. While there is widespread discussion of how DHOs are received, including around the multiple factors mentioned above, we cannot yet say that a set of conventions has emerged that allows broad audiences to assimilate these factors such that they don't interfere with the understanding of the content being delivered. In comparison to many media, such as the visual arts and cinema where conventions may be contested, but are well developed (for a commentary on the psychology of this in cinema see Tan 2018 and also more generally Benjamin's seminal *The work of art in the age of mechanical reproduction*, 1936), the lack of these for DHO's remains problematic. One reason for this is that the lack of shared understanding of the how the media operates has the effect of drawing much of the focus of the audience away from the content itself and towards the means by which that content is delivered. The tendency is for audiences to be enthralled or distracted by the medium and focus less attention on the message. A further consequence of the lack of vernacular in the 3D world is that this disrupts a key means of more subtle messaging. If conventions don't currently exist then it becomes impossible to 'play with the conventions' with all the sophistication that implies in other media. There are a further two important points to consider, one is that VR conventions are in fact developing, but in the games and gaming domain, a domain which itself frequently borrows from other media,

especially cinema. The second point is that sets of conventions develop over extended periods of time and it is perfectly possible that there is no meaningful way of shortcutting this process. This last point could even mean that experiments in trying to define design standards or universally understood modes of presentation for DHOs, may be only bear fruit in the long-run as some unarticulated process of audience preference and selection takes place such that conventions emerge. Although the creator of a digital object can experiment to find the best and most meaningful way, or most easily understood way, of presenting that object to audience through AR/VR/XR, it may still continue to require a conscious effort from the audience to appreciate it. The audience must somehow consciously disentangle the medium from the message. Despite their value then, how a set of conventions may emerge is not well understood in the digital heritage domain. For this chapter I will examine one particular aspect of our relationship with DHOs, scale, and how digital media allows us to respond to a site or object through the conscious manipulation of scale. While the size of things in the real world is always meaningful, here I discuss an aspect of the relationship between viewer and representation that the translation to digital media disrupts in both the creative and heritage domains. I examine the issues of scale, or more precisely how scale in DHOs can transform from a fixed function of our lived experience, loaded as it is with meaning, to a fluid and dynamic aspect of our interaction with the digital. I will consider that although this transformation may in some ways disrupt a traditional avenue of communication it may simultaneously open up new modes of interaction where control of scale is consciously deployed by the creator and/or the viewer in direct response to the content on offer. This apparent dichotomy will be explored through examples looking at some of the ways size and scale have been deployed in the physical world; how this has operated in the past, how and why digital/analogue representations of the past utilise scale and how this encourages imagined journeys through a representation. I will begin with an overview of how scale is handled in two related domains, Western art where the affordances of relative scale have to a large extent been codified through convention, and in mis-scaled objects from the more distant past. Here the intention of the mis-scaling, miniaturisation or maximisation, is far less clear, even if its remains obviously significant. I will then turn to representations of the past via immersive systems, VR, where the main thrust of research has been to find was of making the scale of things appear real or realistic, often to enhance the sense of immersion. The last sections of this chapter turn to one of the less acknowledged functions of scale, which is its effect on our perception of the passage of time. Finally, I will discuss the potential for actively exploiting scale, and its relationship with our experience of time, for the purposes of engagement, communication and affect.

The definition of scale used throughout this chapter is that of relative magnitude or extent, especially as it is used to define the ratio of a model (or any representation) to that which it represents.

2 Between Bahamut and the Gigelorum

In the modern age we seem to be able to capture, in representation at least, all of existence, the famous all sky Cosmic Background Radiation image from NASA's COBE mission,

although it remains somewhat impenetrable for non-experts, represents in some way everything there is and everything there ever was, in short the Universe (Figure 1). The largest observable structures within the universe, galaxy filaments, are so impossibly large (200 to 500 million light-years long) as to be difficult to meaningfully conceive for many of us. Before the microscope and telescope such extremes of scale were accepted as being essentially beyond human apprehension (sometimes referred to as 'hyperobjects', Morton 2013). The extremes ranged from the invisible atoms of Classical Greek philosophy, to the Bahamut of ancient Persian cosmography, which "*is so immense "[all] the seas of the world, placed in one of [Bahamut's] nostrils, would be like a mustard seed laid in the desert*" (Lane 1883) or to the gigelorum of Gaelic tradition, which was the smallest living thing, which "*makes it's nest in the mite's ear and that is all that is known about it*" (Campbell 2008 [1900] p119). Between these extremes lies the world that we can bodily experience, or at least consciously grasp, and against which we measure ourselves. By actively manipulating the scale of representations of things in the world we are adding a layer of meaning to the representation that comes from the maker and is not necessarily intrinsic to what is being represented.

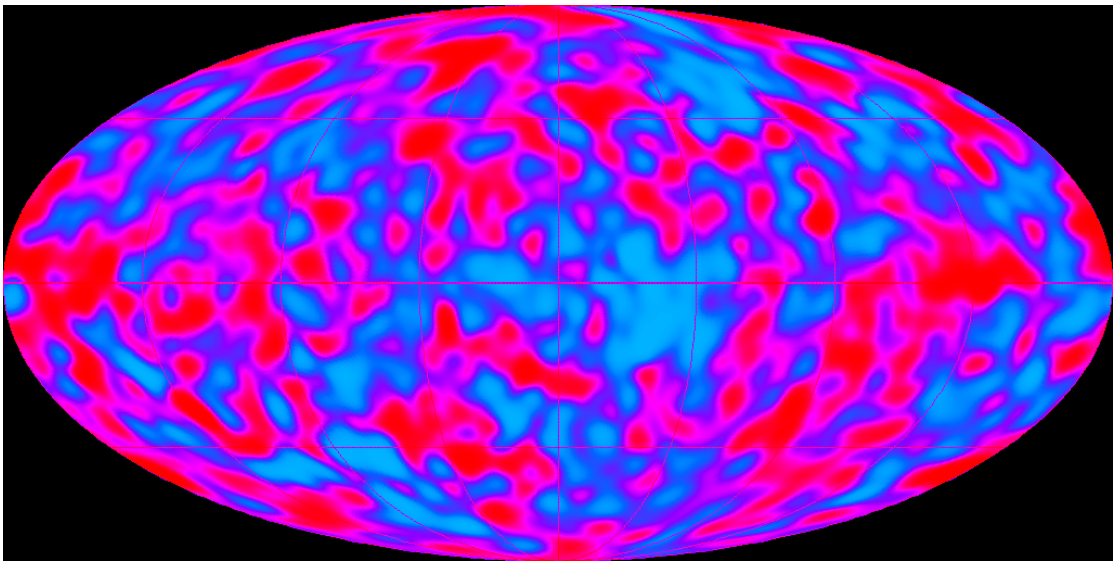

Figure 1.Cosmic microwave background radiation fluctuations, the density fluctuations give rise to the structures that populate the universe such clusters of galaxies and vast regions devoid of galaxies. Image Credit: NASA / COBE Science Team

Size and scale are not the same thing, a thing can be large or small, but if it is the size it should be then it is to scale, when it is not the size it should be then it has somehow been scaled up (larger) or scaled down (smaller). Either way, this has implications for our appreciation of the meaning of that thing. The fundamental yardstick against which we appreciate scale, is as a function of our embodied experience of the world. We firstly understand the size of things around us relative to an internalised appreciation of our own size in the world. Following this measure, and our learnt experience of the world, we can determine that nearly everything has a 'correct size' (or range of sizes). Something that is too small or too large by this measure may disrupt our understanding of it, creating a dissonance

between what we expect and what we see. In representations of real world objects, such as the human body, re-scaling –i.e. changing its 'correct' size – can be deployed to achieve particular effects. If proportions are not maintained exactly, but subtly altered, conscious dissonance can be avoided, even though a deliberate effect in the user may still be created. While almost every representation or artwork somehow responds to the issue of scale, a good example of this complexity is the world renowned statue of the Biblical character of David (created 1501-1504) by renaissance artist Michelangelo Buonarroti (Galleria dell'Accademia di Firenze 2020). This statute (Figure 2, left) is 5.17m high, representing a substantial scaling up of the human form. At first glance then David is a giant, but of course he was not and it is important that he is not seen as such, his story involves killing a giant, so his achievement would be somewhat undermined if he is presented as a giant himself. Instead the viewer must see David as a normally sized human rescaled for effect. An understanding by the viewer of the conventions of renaissance statuary allows this to easily occur. However, Michelangelo did not scale David consistently, the statue's hands are famously (amongst art-historians) larger than they should be to be in proportion to the rest of the body. However, these are not the hands of a giant attached to a normal sized human, represented by a scaled up sculpture. Clearly scale is being used here to convey multiple meanings, the simplest interpretation is that overall scale is thought to be the result of its intended location at the top of Florence Cathedral and Michelangelo's desire for it to be appreciated from the Piazza del Duomo below, although the difference in scaling of his hands may have much more complex roots and point to an earlier classical tradition of signalling meaning by accentuating body parts (Richman-Abdou 2020; Hensher 2002).

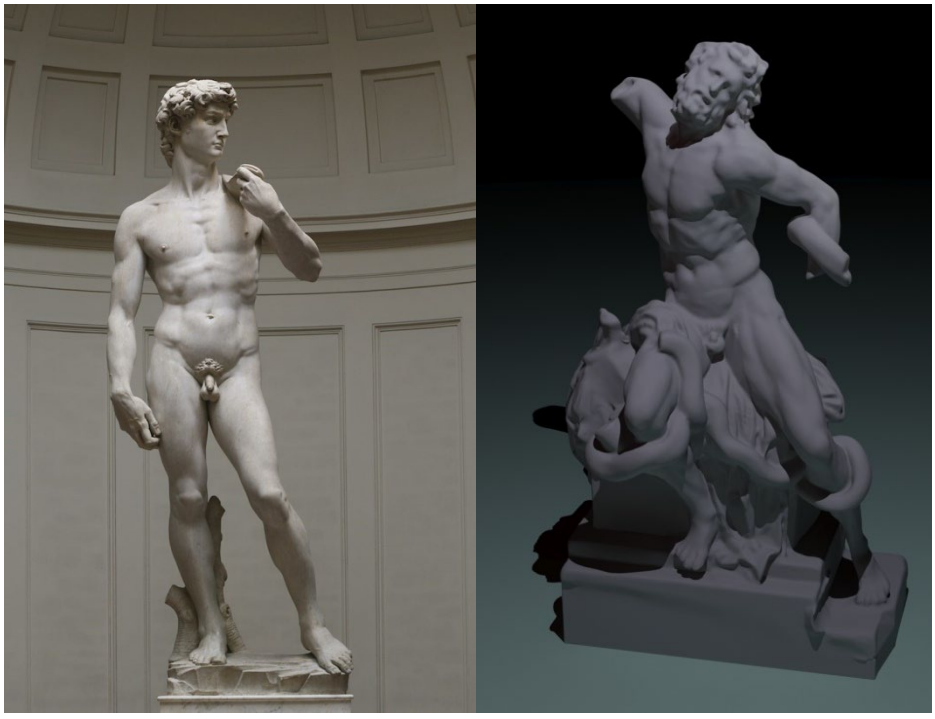

Figure 2. (Left) Michelangelo's 'David', 1501-1504, currently in the Accademia Gallery, Florence Photo: Jörg Bittner Unna [Wikimedia CC BY-SA 3.0]. (Right) A digital replica of a

plaster cast of Laocoön, cast from a marble copy of a Hellenistic original from ca. 200 BC found in the Baths of Trajan near Rome in1506, currently in the Museo Pio-Clementino. Image: Copyright GSA, SimVis.

When thinking about scale for a Digital Heritage Object, it is interesting to compare David to the representation of Laocoön, the priest of Poseidon, who, with his sons, met an unfortunate end in the jaws and coils of a giant snake (Thomas and Ziolkowski 2014). Michelangelo, was in fact was one of the first visitors to the sculptural group of Laocoön and his sons when it was unearthed near Rome in 1506 (Catterton 2005). This marble statue is thought to be a copy of an earlier bronze original and, due in no small part to its significance to art history, it has been replicated many times including multiple times in plaster. A plaster cast of Laocoön (without his sons) owned by the Glasgow School of Art was digitally replicated in 2014 (Figure 2, right) in the wake of a building fire, and became the centrepiece of an VR immersive telling the story of the fire, the plaster cast restoration and its eventual destruction in a further fire in 2018 (see Stevens 2020, Jeffrey 2021). In this example it is worth noting that throughout the multiple stages of the sculpture's long biography, beginning in classical antiquity, and its transition through multiple materials, bronze, marble, plaster, its scale has generally remained consistent. Although miniatures of the sculpture exist, the tradition has been to replicate the group at the original scale, i.e. life size, this is after all the original artistic intent. The VR representation of the Laocoön attempts to maintain this tradition of representing the statue at the scale originally intended. Our means of judging the scale of an object in an immersive include taking advantage of visual clues to its size relative to something else we know the size of, as mentioned above, primarily this is our own bodies. Crucially, it is this sense of our own bodies, an embodied presence, that is often missing from an immersive experience where there is (most frequently), literally no representation of the users body, we as viewers are present in the environment, but our bodies are absent. Other cues to scale rely on interaction with the DHO in question, to ability move around or to go nearer or further away (the significance of sound in this context is dealt with in a later section). In designing immersives much attention is paid to trying to achieve a correct sense of scale. However, what if, as creators of representations of representations (i.e. a digital version of a marble version of a bronze version of a human in the case of the Laocoön) we intervene, untether ourselves from the fixed scale of the original and use the ability of the digital to manipulate scale, or allow users to manipulate scale themselves?

In later sections I will explore this question further, but first I will look at other instances of scaling than those of classical antiquity or the Italian renaissance. In the following section some aspects of re-scaling, specifically miniaturisation, as they occurred in the archaeological past are discussed. However, while I will only scratch the surface of the plethora of meanings and intentions behind miniaturisation, I hope it will give an impression of their variety and richness

3 It's the Little Things That Count

While there is no universal understanding of what either gigantism or miniaturisation in representation actually means across time and across cultures, there are some themes that

emerge that might have broader currency than others (e.g. see the *World Archaeology*, Volume 47, Issue 1 (2015) special edition on Miniaturisation and also Jones and Cochrane 2018). Things that are bigger than us are more likely to be seen as dominant, or threatening or simply more important. This can be seen in the giant statues of important figures, exemplified by Paul Landowski's 30m high Christ the Redeemer statue dominating the skyline of Rio De Janeiro, Brazil (PaulLandowski.com 2020). Things that are smaller than they should be may seem less threatening, perhaps less important, but definitely more controllable and more manipulable (Bailey 2005). However, there are other ways of conceiving what the deployment of scaling represents, for example scaling something up beyond its natural size could be interpreted as an act of dilution or dissipation. In this conception of scale, miniaturisation might not be diminishing an object, but distilling and intensifying it, or perhaps meaningfully signalling that its scale is not as important as other aspects of its form. It is interesting to think about what is meant by the scale of the Christ the Redeemer and compare it with that of a small crucifix on a silver chain, both representing the same individual, but with clearly different semiotic systems in operation.

Some of earliest forms of representation are striking in their scale, some objects, such as ivory or bone carved objects, e.g., the Vogelherd Horse (Mammoth Ivory, 4.8cm max, Aurignacian, c.33,000 BCE), or the so called 'Venus' of Brassempouy, a human head, (Ivory, 3.65cm max, Upper Palaeolithic c.23,000 BCE). As discussed by Cook (2013) these are potentially unusually small scale survivals of a representative tradition that operated across multiple scales, however, where material or space are not an obvious constraint, as with cave paintings, scale is still very noticeably reduced, horses, animals, people are all represented as much smaller than their real life counterparts (see e.g., the Palaeolithic paintings in the caves at Lascaux, UNESCO 1979). While the scale of what is being represented has a clear relationship with the concept of perspective in representation, and there are many other forms of abstraction and distortion being used, it still begs the question why is scaling being deployed at all if there is space and material to create a 1:1 representation?

Perhaps some of the answer to that question can be seen in Meskell's 2015 analysis of miniatures recovered from Çatalhöyük. In *A society of things: animal figurines and material scales at Neolithic Çatalhöyük*, Meskell expands the meanings and affordances of miniatures by pointing out that *"(t)heir miniature quality allows them to do what real animals, plastered animal installations and wall paintings cannot – to socialize, and to facilitate embodied and immediate interaction between humans and wild animals. … (f)igurines are active things in themselves and their small scale invites an intimacy, control and democratization of experience that was not possible with large-scale narrative paintings democratization: everyone can make and engage with zoomorphic figurines"* (p14). Later still, in the Aegean Bronze Age, a very powerful and significant form of miniaturisation and abstraction took place where small scale representations of elements of the real world were ultimately transformed into written language. Karnava (2015) describes pictographic or iconographic writing systems as a form of miniaturisation. At the same time as miniaturisation was being practiced for objects such as clay pots or animals or humans as figurines engaged in various activities, various scripts were being developed that began as a scaled down visual rendering

of an array of tangible objects. The roots, of some types at least, of written communication themselves lie in a form of miniaturisation. While the tradition of the miniature signifying its realia in a very direct way can be exemplified by their use as in the form of a votive offerings, even this apparently straight forward relationship is open to question. Barfoed argues that the occurrence/scarcity and particular forms of miniature pottery considered as offerings from the Sanctuary of Zeus at Olympia, indicate that these miniatures had a broader commemorative role and/or a function in ritual processes at the site (2015).

A further value of miniatures over their referents is as proofs, this reflected in their use in architecture and shipbuilding as technical aides (see Milner and Davy 2019), but the production of miniatures a can also be used as proof of the skill and quality of the model's production processes itself. While this practice appears in a number of contexts an excellent example of this is the production of miniatures in the French journeyman tradition going back as far as the mediaeval period (Adell 2003, 178). Here the miniatures act both as masterpieces, proving the makers skill, and as physical elements in initiation rituals centred on trade guilds (Adell 2003). Building on the theme of miniature as demonstrator, their use in didactic contexts is also significant. Miniature diorama's have long been used in museum and other contexts such as churches and places of religious education. A key feature of these diorama's is their ability to impart information, hold a narrative and enchant an audience without the extensive use of text. As noted by Kiernan in the much earlier context of Iron Age miniatures (Mithrassymbole) "*the quality of workmanship of the miniature swords is very high, and the sense of wonder generated by the tiny size of the pieces in relation to real swords must have been part of their attraction"* (2015, 5). Ironically, despite the museum tradition of creating miniature dioramas, as institutions, they can struggle with how to display actual historic and ethnographic miniatures, finding their complex and multi-layered associations difficult to curate (Davy 2019). In his analysis of this issue Davy observes that *Miniatures bear iconic, mimetic association with another object or thing, a 'prototype', defined … as 'the entity which the index represents visually … or non-visually' (Gell 1998, 26), they are then reduced in scale and complexity from this prototype, which does not need a physical presence; neither does the miniature have an absolute maximum or minimum size: the Sistine Chapel is after all a miniature of the end of the world… (Lévi-Strauss [1962] 1966, 23)"* (2018).

The process of miniaturisation, or rescaling things in prehistory is likely in fact clearly go beyond recognisable versions of realia, the complexity of miniatures, their use and miniaturisation archaeologically are discussed in Jones and Cochrane's discussion on miniaturisation and scale (2018, 57-74). Beyond what is obviously miniature, Davy points out (above),that a miniature does not have a maximum or minimum size and some large monuments also appear to be representations of even larger landscapes or territories, e.g. the strong structural echoes observed by Richards between the Neolithic and Bronze Age monuments at Stenness in Orkney and the surrounding landscape, which he describes as "*monuments as landscape*" (Richards 1996). Such monuments may be considered large things in their own right but they are still miniature in comparison to what they may represent. Some monuments may even be miniature versions of other monuments, for

example the anomalous Hill o'Many Stanes, Caithness, which has over 700 small stones (none larger than 1m high, and over 200 earthfast) arranged in 22 stone rows some time in the Neolithic (National Record of the Historic Environment, Canmore No. 8604 http://canmore.org.uk/site/8604). Hill o'Many Stanes may be redolent of the more common and larger stone rows, and even collections of these rows a sites such as Carnac in Brittany (Bradley 2002), but the meaning of its peculiar scale in relation to these others, if any, is irrecoverable.

From an archaeological perspective Kiernan (2015, 45) notes that "*miniatures are usually considered first as ritual objects, as substitutes for larger items, or as signifiers of abstract concepts*", while he argues for more attention to be paid to them as useful indicators of realia, most art-historical analysis has focussed on their role as substitutes and signifiers, for example see Susan Stewarts insightful analysis of miniatures, souvenirs and memory in *On Longing* (1993). The fascination with miniatures is very much alive today, as is their production and debates on their role in the world and how they act upon it (many of these arguments are covered in depth in the recent volume: Worlds in Miniature: Contemplating Miniaturisation in Global Material Culture (Davy and Dixon 2019). The Wonder of Miniature Worlds blog, by artist and academic Louise Krasniewicz ('Dr K') (2020) gives an excellent insight into this world and includes a Manifesto for Miniatures, which argues strongly that they should be thought of primarily as things in themselves (echoing Meskell's analysis above), rather than in their usual role as substitutes an signifiers. This is an argument that coincides with broader heritage debates around the value of replicas including those translated into new material forms (Foster and Jones 2019) and even into immaterial (i.e. digital) media (Jeffrey 2021).

One key aspect of miniatures that captures their specific qualities, beyond being simple signifiers, is their prominent role as catalysts for the imagination. They facilitate a kind of imaginative projection of oneself into another world and another time. In her fascinating exploration of miniatures in *Crafting the Past: Mission Models and the Curation of California Heritage,* Kryder-Reid (2015) observes this quality. Dealing with a tradition of highly detailed models of historic Mission buildings, she notes that these function as what Sherry Turkle calls "*evocative objects"* or things we think with (Turkle 2007) ... *"Their appeal stems in part from the objects' repositioning of time, space, and scale and in part from the accrued significance of mission model-making practices across generations.* (Kryder-Reid 2015, 73*).* Kryder-Reid also observes that unlike the 'immersive' tourist experience of visiting the missions, the models are primarily explored visually, the use of miniatures and their presentation at waist height *"encourages visitors to peer through the models' arches, scrutinize details of shrubbery and tile work, and study their craftsmanship. The models' artistry is seductive, directing attention to the craft of the maker and the pleasure of entering into an exquisite miniature world".*(Kryder-Reid 2015, 73)

There are of course means, other than by the use of minaitures, by which our sense of scale in relation to the world around us can be disrupted. In any discussion of human scale in representation we need also to think about the dysmorphic effect of psychoactive substances. As colourfully alluded to in the song *White Rabbit*, Jefferson Airplane's drug culture inspired

1967 response to Lewis Carroll's classic novel *Alice in Wonderland* "*One pill makes you larger, and one pill makes you small. And the ones that mother gives you, don't do anything at all. Go ask Alice, when she's ten feet tall*", chemical substances are well known to alter our perceived physical relationship with the world. Our understanding of the consumption of intoxicants in the distant past is partial, however it is supported by numerous recent historical and ethnographic parallels and archaeological evidence, that magical activity, if not day to day activity, was enhanced by the use of intoxicants (see Guerra-Doce 2015). The idea that miniatures act as catalysts and/or props for imaginary journeys has been mentioned above and it is easy to think that intoxicants plus miniatures offer a potent magical springboard. Hand in hand with, and possibly related to, the dysmorphic effects of psychoactive substances is their ability to disrupt the user's perception of the passage of time (for an overview see Ogden and Montgomery 2012). This leads to the next question prompted by scale, how does our relative size relate to the passage of time when we take a magical journey, with our without chemical assistance?

4 Away with the Fairies

One aspect of scale which may very well be intrinsic to how early miniatures should be understood is the complex relationship between scale and time. Perhaps surprisingly, there is an observable relationship between the scale of our surroundings and our experience of the passage of time. This is a psychological phenomena, for example DeLong states that "*spatial scale-the size of an environment relative to the size of an observer-is a principal mediator in the experience of time and temporal duration"* (1981, 681), and he goes on to argue, less convincingly, that this relationship can be precisely codified. DeLong essentially posits that the smaller we feel in relation to our environment, the faster we experience time passing. Building on the neurophysiological work of Eichenbaum (2014; 2017) and others, Riemer *et al* asserts that "*while cross-dimensional interference between spatial and temporal processing is well documented in humans,… the direction of these interactions remains unclear."*(2018, 539). Despite this, they confidently state that "*By investigating space-time interactions in large-scale environments using VR techniques, we found that perceived time was influenced by the spatial size of the environments" (p540)* Reimer and his co-authors are explicitly exploring what may be a *"neuronal mechanism underpinning the interactions between temporal and spatial processing" (*ibid., 539). However in introducing and contextualising their work they point out that culturally and linguistically (specifically in metaphor) space and time are already intimately linked.

An interesting aspect of this psychological research is that at least some of it uses models or environments to unpick the relationship between the scale of our surroundings and our perception of time. Reimer et al's work actually uses a form of VR and has results *'in line with the effect of scale size on temporal judgments of DeLong'* (p547). DeLong himself was experimenting with physical (cardboard) models at different miniature scales, participants were "*instructed to imagine themselves the scale figure in the space, to engage in one of the activities previously identified, and to inform the investigator when they subjectively felt (not thought)"* (DeLong 1981, 681) This is significant as the later deployment of virtual reality by

Reimer *et al* reinforces the previous work which required participants to imaginatively insert themselves into a model as discussed in the section above.

This combination of technology and psychology is something I will return to in the final section of this chapter. However, in thinking about representational conventions, it is not necessary for the exact neurological mechanisms at work to be unpicked. As noted by Reimer et al (ibid., 539) in his comment on metaphor, prior to the observations of scientists, the complexity of the relationship between size and time was somehow unconsciously understood. I would argue that, in additional to linguistic and metaphorical expressions of this entanglement, there are multiple examples of the same phenomena in our understanding of the world, traceable through centuries of modern and historical popular culture, and perhaps reaching back into prehistory. It has been commented upon since the 1800s that there are many situations in which humans experience the passage of time running at different speeds (Dawson and Sleek 2018). Compare the slowness engendered by a sense of boredom to the accelerated sense of time passing at moments of heightened excitement or danger. Changes in the way time passes is a common enough human experience that extending a comprehension of the fluidity of time to other aspects of the physical world is not a leap. One indicator that time runs at different speeds at different scales is the observation that small creatures seem to live their lives more quickly than we do. It is not just that the small animal has a shorter life, its life actually does run faster. Beyond the common understanding of this concept expressed by the idea of 'animal years', e.g., 'dog years' being some fraction of a human years, there are multiple examples of creatures in the animal kingdom seeming to experience the passage of time more rapidly, such as the heart beats of smaller creatures in comparison to ours or the beating of tiny wings so fast as to be imperceptible to us. As with many of these anecdotal observations, close examination reveals an underlying truth. In their paper, *Metabolic rate and body size are linked with perception of temporal information,* Healy et al (2013) observe that smaller creatures literally experience time passing as a different rate compared to larger creatures. For example, dogs can see the flicker of lines on a CRT television screen. In a subsequent newspaper interview, one of paper's co-authors went as far as to say "*It's tempting to think that for children time moves more slowly than it does for grownups, and there is some evidence that it might*" (Press Association 2013). Our interest here is not in metabolic rate *per se,* but the fact that the majority of creatures with metabolic rates faster than our own are also smaller, even much smaller, than we are.

This relationship between size and the passage of time also appears to resonate in folklore, while notoriously difficult to date, many such tales potentially originate from at least the early modern or mediaeval period and most likely earlier (similar arguments to those below could be made in relation to the myths and legends of classical antiquity, often populated by e.g. gigantic creatures). One such striking example of time distortion are the 'Seven-League Boots'. These boots are a common motive in much European folklore appearing in tales from Germany, France and Britain. In this tale, by borrowing the boots of the giant a protagonist can travel rapidly across the mythical landscape with each stride covering seven leagues (Figure 3). Implied in this action is the idea that time runs more slowly for the giant than for smaller beings in the same world, what would require thousands of ordinary human steps

takes only one for the giant, i.e. a normal sized person would experience thousands of steps in the same time period the giant experiences one.

Figure 3. Hop o' My Thumb stealing the Seven League Boots, by Gustave Doré [Wikimedia CC BY-SA 3.0]

If there was any doubt that the magic of the Seven League Boots directly links the passage of time with scale then the continued use of it as a metaphor, for example in a 1940's Philips Electrical Industries advert, makes this explicit "*progress will have advanced by half a century in a few short years*" (Figure 4).

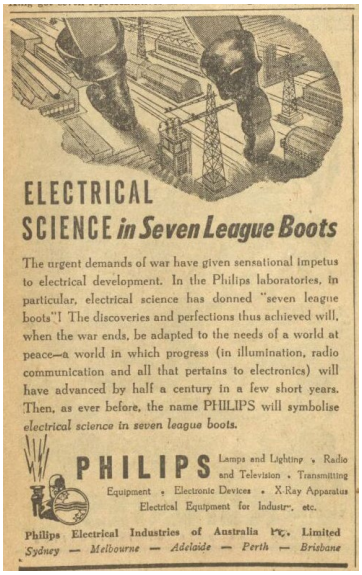

Figure 4. Philips Electrical Industries (Australia) advert from ABC Weekly magazine in 1945, Image: National Library of Australia.

On the other end of the spectrum from Giants are smaller folkloric creatures, fairies, goblins, pixies, elves and so on. While it is important to note that the size of these otherworldly beings should not be assumed to be much different to humans (see Campbell 2008, and for British and Irish fairies generally, Young and Houlbrook 2018), many are and many have the power to change size as well as shape. Additionally many seem to have an interesting relationship with the passage of time. Perhaps the most well-known set of folk beliefs regarding the disruption of the passage of time is the notion that when a person finds themselves, frequently by accident, in the kingdom of the Fairies, they may experience the passage of a day or two, but when they eventually escape they find to their horror that many years have passed. It seems that time passes more slowly in the kingdom of the fairies, and this is also linked to scale, or at least shifts in scale. The places where the unfortunate victim finds themselves drawn into the kingdom of the fairies is often at 'fairy knolls' and other landscape features long associated with prehistoric burial mounds or cairns. These contain the halls in which the fairies hold their revels and therefore the scale of the magical creatures is implicitly smaller than humans even if this is not always explicit in the folk tales themselves. In this example, counter to the Seven League Boots and counter to much of the neurological research above, time appears to be travelling slower in the magical realm, despite it being conceptually smaller than the real world. Perhaps these inconsistencies should reflect that changes in scale *disrupt* our relationship with time rather than changing it in a simple linear or culturally universal fashion. The notion of an unequal passage of time noted in the otherworld of the fairies has also reappeared in modern popular culture, often based on the laws of physics as currently understood. For example, as a consequence of General Relativity, for a rapidly travelling space explorer, time does indeed pass more slowly than for those they leave behind on Earth, and the fairy abductee's sorrow at returning to find his youthful family now dead or aging is echoed by the sorrow of the space traveller at experiencing the same (for example the Oscar winning 2014 film written by Jonathon and Christopher Nolan, *Interstellar*).

While it is not at all clear what exactly the relationships between the passage of time and the representation of things at incongruous scales actually is, there does appear in some instances to be a powerful connection between the two things, even if this neither consistent nor universal. As mentioned in earlier sections, immersive digital virtual environments offer challenges in the representation of relative scale, but this must also mean that they can express the disruptive nature of scale on our perception of time. These challenges are discussed next.

5 Microchips and Miniatures

In the previous sections the focus has been on a static scale relationship between the symbol and the simulacra. The significance of scale tumbles down through time from cave paintings onwards and it should be clear that the manipulation of relative scale has been used in all forms of representation from antiquity to the present day to signify how we should consider the object being represented. Fundamental to these signals is the immutability of the scale relationship between the representation and its audience. The fixed nature of this relationship, e.g. that a giant statue always remains giant to us is what makes it so powerful. In our

experience of the analogue world this immutability makes the decision on what the relationship should be the sole domain of the creator. In this world we are unable to either shrink the statue or to magically grow ourselves to match or exceed its scale.

There are however, DHO media that don't have to consider the issues of scaling. Augmented Reality (AR) avoids this, by operating with the real world as visible context for the what is being delivered. For example by overlaying a reconstruction on to a ruined building apparently at the same scale. For an early and influential version of this approach see the Archeoguide project (Vlahakis et al 2002) and, more recently, Kenderdine's cutting edge work on China's Mogao Grottoes (2015). However, counter to these two examples, AR is frequently used to actually invoke 3D miniatures and in some cases a 3D physical miniature can be used to invoke an augmented digital version of the same (e.g. Ha et al 2012). In the Digital Laocoön project mentioned in the first section, a miniature 3D printed (c.30cm tall) Laocoön can be used as a trigger for what appears to be a 'full scale' AR representation of the statue to spring into being and become explorable in real world space.

However, in the world of fully immersive systems, i.e. the digital representation of a space in which a user can be made to feel an occupant, creators have long wrestled with how the relative scale of objects can be well represented in relation to the user. If the intention of the model is to allow the user to suspend their disbelief and feel they are immersed in a real environment, populated with real world things, then there is a premium on representing these objects to scale as accurately as possible. Technically this poses a number of challenges such as the user's lack of embodiment, and some qualities of VR delivery systems play on our senses in ways that can make scale and distance difficult to judge (see Held et al 2010). The creators of immersive environments may attempt, frequently with sub-optimal results, to evoke a real world space through a focus on visual realism including a sense of scale. More sophisticated attempts to generate a sense of presence focus on engagement through, for example, interaction with 'human's' digitally represented within the environment (see Pujol, and Champion 2012 for an overview of these approaches). In striving towards realism however, we may be neglecting the possibilities that such spaces offer. Immersive VR has unique affordances and allow modes of interacting with an environment that transcend the reality of human experience. Our size in relation to virtual objects and virtual worlds can become mutable and our ability to manipulate objects superhuman and magical. The intrinsic weirdness of the digital (Jeffrey 2015) in combination with these unnatural affordances might instinctively seem counter-productive to deploy if the actual objective of the immersive is to represent some aspect of the real world, to tell us something about it or appreciate it differently. However, I would argue that these affordances can be deployed in immersive systems in a way that in fact enhances a sense of immersion and more honestly positions the immersive environment as a creatively and subjectively constructed space. We can do this if we conceive and present immersive spaces in the same way that, throughout history, miniatures have been presented.

An example of the affordances of the real world versus an immersive VR, especially one that represents a large landscape, is the challenge of how to move around it. The discussion on scale and time in the above sections has a real bearing on this question for immersive

systems. When representing large spaces or landscapes, these may be navigable, but if scaling is actually effective, we instinctively sense how long it will take to move from one place in the environment to another. If this were to take a long time, a real world time (say many hours) then the patience of the user may be tested (although there may be some arguments for 'Slow VR'). This strange problem is that the achieved realism of the represented scale actually interferes with the utility or experience of the representation. In response, this is traditionally an area where realism is simply put aside, potentially undermining all the effort expended on visual realism. Multiple interface devices are deployed to allow rapid movement within these spaces, teleportation, flying, or the use of other artificial modes of transportation such as a boat, used in the Fingal's Cave example below. In a pleasing echo of the folkloric tradition discussed in previous sections, a recent article, *I'm a Giant: Walking in Large Virtual Environments at High Speed Gains* (Parastoo et al 2019) specifically conjures the metaphor of the Seven League Boots to describe the novel mechanics of moving a user through a large VR environment at speed, and how to do this *without* making them feel like a giant. In this paper, Parasoo et al also reference an earlier interface concept - 'Worlds in Miniature' (Stoakley at al 1995) - which does in fact use physical miniatures as a navigation device to negotiate a VR environment. The opposite effect to becoming a giant is also perfectly allowable in the VR domain, for example a recent project on the work of Hieronymus Bosch "*Eye of the Owl* project " (VRX 2016) allows the user to conceptually (although not entirely successfully) miniaturise themselves and enter and explore Bosch's "*Garden of Earthly Delights*" triptych. In fact, even real world environments can be presented visually as being miniatures. Tilt- Shift photography is a technique in where manipulation of the lens in relation to the recording plane can alter perspective and give the resulting image a very strong impression of being of a miniature, even when it is not, this is known as miniature faking or the diorama effect (Figure 5). This effect is possible to achieve in an immersive environment, where it is being recorded by a virtual camera for example in Unity games engine (Unity 2019), the effect can be strengthened by speeding up the motion through the virtual world to counter the perception of inertia (Held et al 2010). If deployed in real-time interactions, this effect presents the virtual environment as I would argue it actually is, i.e. as a miniature.

Figure 5. A tilt-shift image of a real world landscape showing the 'miniaturising' effect (diorama effect) of the technique. Credit: pixel2013, Pixelbay.

A further consideration of scale in immersives is the role that sound plays in informing us of the scale of the surroundings we are in. An incongruity between what is seen and what is heard (even as ambient sound) is physically dissonant. For example, immersive systems physically being experienced in a small room, but representing a large landscape, are disrupted by the acoustics of the real world space. Many DHO immersives don't employ sound at all. However, spatialised sound, that is, sound that aligns with the scale of the virtual surroundings and gives it direction, acts powerfully to enhance the sense of immersion. An example of this in action involves the famous Fingal's cave on the Isle of Staffa in Scotland, where, perhaps unusually for a natural site, sound is intrinsic to its understanding. The striking natures of the cave's acoustics have long been noted by visitors including artists such as Walter Scott and Jules Verne. Felix Mendelssohn famously drew inspiration from its soundscape for the *Fingal's Cave* overture of his *Hebridean Suite* (Op.26, published 1832) (McCulloch 1975). Recent work digitally modelling the acoustics of the cave created a spatialised auralisation for inclusion in an immersive representation of the cave (see Noble 2018 for a full description of this process on Staffa). Collaboration with BBC Radio subsequently led to an entirely new musical composition and digital soundscape being created by composer Aaron May. In one version of this model, the VR audio handling allows the user to speak, sing, and shout into the cave space and hear their own voices reflected back in (near) real-time as if from within the cave, While another version features a single camera track that moves the user on a journey from the outside of the cave to the back of the cave and back again. Aaron May's music was written specifically to complement the position of the user in the cave (Figure 6) (HARPS/BBC 2019; BBC Sounds 2019). The relationship between the quality of what we hear and the scale we perceive again offers an opportunity to manipulate the scale of the user relative to the representation, in the example of Fingal's Cave this could be done by scaling the environment relative to the user using acoustics effects only.

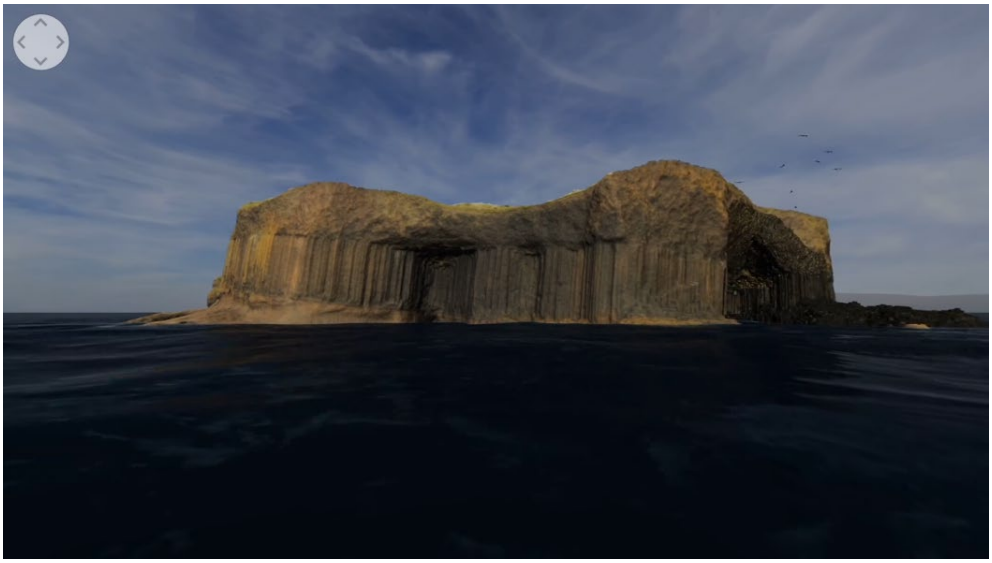

Figure 6. Isle of Staffa: Screen shot of 360 video from the HARPS/BBC immersive (HARPS/BBC 2019). Image Credit: HARPS

Much of the effort expended in visual realism in immersives with the object of enhancing immersion seems to misconstrue the nature of digital heritage objects. They are better considered as part of that long tradition of mis-scaled representations with a genesis in prehistory. Our ability to control and manipulate the DHO manifests very similar desires to those described by Meskell in relation to the pre-historic miniature (2015). In many important respects the Digital Heritage Object presented via an immersive system is a miniature masquerading as something that somehow seems to be the correct size. Thinking about virtual objects and virtual worlds in this way lays the path to much more exciting possibilities than enhanced levels of precision or sense of immersion. Engaging with the mutability of scale rather than fighting against it allows us to experiment with manipulability, including the exploration of some power structures implicit in human scale. For example, we could explore the world with a child's eye view, or experience the world as an adult if we are a child. These effects can all be deployed without undermining any sense of the veracity of the virtual environment, because it *is a miniature,* a thing in itself and not simply a signifier, struggling to stand only for something else. However, I would suggest that it is the role of the miniature as portals allowing us to undertake imaginative journeys by inserting ourselves into such miniature worlds that is most exciting. Crucially, the malleability in scale allowed by immersives means that we can get the best of both worlds, in that we can scale ourselves such that the miniature becomes real-sized or even gigantic (or we can shrink to the size of the miniature). We should also remember though, that shrinking ourselves or enlarging our environment do not have the same psychological effect, especially with regards to our perception of the passage of time. This too may have value in in engaging with a virtual environment, rapid changes in scale, for example scaling up and then scaling back down, could be used as a visual cue to indicate the passage of time, potentially giving rise to a convention that circumvents the need for intrusive tools for manipulating time, such as sliders or date dials. I would argue that we should be embracing these new ways of interacting with representations of the past, actively finding new ways of using scale to imbue our DHO with new meaning, including using scale based cues to manipulate a user's perception of the time. This requires thinking about two different types of scale: the relative scale between the user and what is being represented, but also the scale at which the immersive scene exists *relative to the real world,* each would operate on the user in different ways. Are we projecting ourselves through the windows offered by our devices into a miniature world or is the miniature world growing in size until it envelops us?

I started this chapter with a discussion of the value of media conventions, they are a fundamental element in the process by which people comprehend what is being presented through a particular media. Once learnt and internalised, they allow the viewers focus to settle on the content being presented rather than the media. Perhaps if we actively choose to contextualise immersive systems as miniatures, with all the affordances and ways of interacting that this implies, then we can then borrow conventions of the miniature to apply to our immersives. It could be argued that there already exists a set of conventions, a way of

understanding immersive Virtual Reality, by thinking off immersives systems as an extension of the tradition of model making, and specifically miniaturisation, creating not a new imperfect representation of the world, but (to borrow from Turkle) a thing through which we can think.

Amongst many others, I have argued that the production and presentation of DHOs should embrace creative response (Jeffrey 2015), echoing the longstanding arguments of many others on the benefits of art in heritage and archaeological practice (for a recent discussion see Cochrane and Russell 2014). And in this chapter I have also discussed the development of conventions for understanding works of art and representations of the world, specifically those relating to scale and those relating to our perception of time. Conventions may be constantly evolving and contested, but they are routinely deployed, and playfully challenged, by creators who know that their audience understand them, consciously or not. Immersives system, such a VR can borrow from and take advantage of the many conventions already at play in our understanding of miniatures in terms of power, imagination, time and space. This approach has the added benefit of allowing us to insert digital representations back into the long history of miniature making thus further eroding the anomalous status of digital immersives as entirely novel and distinct forms of representation. Digital representations are not separate from the pre-existing human practice of creatively manipulating scale, ultimately, we can re-learn the lessons of earlier forms of miniaturisation, exploring and rediscovering the diversity of conceptions of what the work of the miniature is, perhaps even helping us to better understand how they worked in the past.

6 Acknowledgements

Thanks firstly to editors of this volume for inviting me to make this contribution and to the other authors and discussants who generously shared their insights through helpful comments and suggestions. I would also like to thank Perry Stewart who during her time on the MSc Heritage Visualisation course at SimVis in 2020, developed a small scale AR project and pointed me towards some less obvious texts relating to scale.

7 References

Abtahi, Parastoo, Gonzalez-Franco, Mar, Ofek, Eyal and Steed, Anthony. 2019. *I'm a Giant: Walking in Large Virtual Environments at High Speed Gains.* In: Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems (CHI '19). Association for Computing Machinery, New York, NY, USA, Paper 522, 1–13. https://doi.org/10.1145/3290605.3300752

Adell, Nicolas., 2013. The French Journeymen Tradition: Convergence between French Heritage Traditions and UNESCO's 2003 Convention In: *Heritage Regimes and the State*. Göttingen: Göttingen University Press, 2 ISBN: 9782821875470. http://books.openedition.org/gup/385 [Accessed 25 April 2019].

Barfoed, Signe., 2015. The significant few. Miniature pottery from the Sanctuary of Zeus at Olympia, *World Archaeology*, 47:1, 170-188. https://doi.org/10.1080/00438243.2014.992077

Bailey, D. 2005 Prehistoric Figurines. Representation and corporeality in the Neolithic. Routledge.

Baudrillard, Jean 1988 Simulacra and Simulations. In: Jean Baudrillard: Selected Writings, edited by Mark Poster, pp. 166–184. Stanford University Press, Stanford.

Benjamin, W., The Work of Art in the Age of Mechanical Reproduction. In: Illuminations, 217-51. New York: Schocken Books, (1936), 1968

Bradley, R. 2002 The Past in the Past. Routledge.

Campbell, John Gregorson, 2008 [1900/2] *The Gaelic Otherworld*. Edinburgh: Birlinn

Catterson, Lynn. 2005. Michelangelo's "Laocoön?". *Artibus et Historiae.* 26. 29. https://doi.org/10.2307/20067096

Cook, J. 2013 Ice Age art. The arrival of the modern mind. BM Press.

Eye of the Owl: https://store.steampowered.com/app/420020/Eye_of_the_Owl__Bosch_VR/

Davy, J. and Dixon, C. (eds.). 2019. Worlds in Miniature: Contemplating Miniaturisation in Global Material Culture. London: UCL Press. https://doi.org/10.14324/111.9781787356481

Davy, Jack William,2018. Miniature dissonance and the museum space: reconsidering communication through miniaturisation, *International Journal of Heritage Studies*, 24:9, 969-983, https://doi.org/10.1080/13527258.2018.1428669

DeLong, A., 1981. Phenomenological Space-Time: Toward an Experiential Relativity *Science*, Vol. 213, Issue 4508, pp. 681-683. https://doi.org/10.1126/science.7256273

Dawson, Joe and Sleek, Scott., 2018. The Fluidity of Time: Scientists Uncover How Emotions Alter Time Perception. *Observer Magazine*, The Association of Psychological Science. https://www.psychologicalscience.org/observer/the-fluidity-of-time [Accessed 19 December 2020]

Eichenbaum, H. (2014). Time cells in the hippocampus: A new dimension for mapping memories. Nature Reviews Neuroscience, 15(11), 732– 744. https://doi.org/10.1038/nrn3827

Eichenbaum, H. (2017). The role of the hippocampus in navigation is memory. J Neurophysiol, 117(4), 1785–1796. https://doi.org/10.1152/jn.00005.2017

VRX 2016. *Eye of the Owl - Bosch VR,* https://store.steampowered.com/app/420020/Eye_of_the_Owl__Bosch_VR/ [Accessed 6 December 2020]

Foster SM & Jones S., 2019. Concrete and non-concrete: exploring the contemporary authenticity of historic replicas through an ethnographic study of the St John's Cross replica, Iona. *International Journal of Heritage Studies*, 25 (11), pp. 1169-1188. https://doi.org/10.1080/13527258.2019.1583272

Foxhall, Lin., 2015. Introduction: miniaturization, *World Archaeology*, 47:1, 1-5. https://doi.org/10.1080/00438243.2015.997557

Galleria dell'Accademia di Firenze 2020. Website. https://www.galleriaaccademiafirenze.beniculturali.it/david/ [Accessed 17 December 2020]

Garstki, K. 2017. Virtual Representation: the Production of 3D Digital Artifacts. *Journal of Archaeological Method Theory* 24: 726. https://doi.org/10.1007/s10816-016-9285-z

Guerra-Doce, Elisa., 2015 Psychoactive Substances in Prehistoric Times: Examining the Archaeological Evidence, Time and Mind, 8:1, 91-112, https://doi.org/10.1080/1751696X.2014.993244

Ha, Taejin,. Sangchul Seo, Kiyoung Kim, Woontack Woo, Nohyoung Park, 2012. Miniature Alive: *Augmented Reality based Interactive DigiLog Experience in Miniature Exhibition*. In: Proceedings of the 2012 CHI Conference on Human Factors in Computing Systems (CHI '12). Association for Computing Machinery, New York, NY, USA, 978-1-4503-1016-1/12/05.

HARPS/BBC, 2019 Edinburgh Festival BBC Virtual Reality experience at Summerhall - Fingals's Cave 360 Video VR. Summerhall, Edinburgh, 19-23 August 2019 https://www.youtube.com/watch?v=RHt6QIJI9cU&feature=youtu.be [Accessed 6 December 2020]

Healy, Kevin, Luke McNally, Graeme D. Ruxton, Natalie Cooper, Andrew L. Jackson, 2013. Metabolic rate and body size are linked with perception of temporal information, Animal Behaviour, Volume 86, Issue 4, 2013, Pages 685-696, ISSN 0003-3472, https://doi.org/10.1016/j.anbehav.2013.06.018

Held, R. T.; Cooper, E. A.; O'Brien, J. F.; Banks, M. S, 2010. Using blur to affect perceived distance and size. *Association for Computing Machinery Transactions on Graphics*. 29 (2): 19:11. https://doi.org/10.1145/1731047.1731057

Hensher, Philip, 2002. Review of Il Gigante: Michelangelo, Florence and the David 1492-1505 by Anton Gill, *The Guardian.* https://www.theguardian.com/theguardian/2002/aug/08/guardianweekly.guardianweekly1 [Accessed 17 December 2020]

Holtorf, Cornelius, 2013. On Pastness: a Reconsideration of Materiality in Archaeological Object Authenticity. *Anthropological Quarterly* 86(2), 427–43.

Jeffrey, S. 2015. Challenging Heritage Visualisation: Beauty, Aura and Democratisation. Open Archaeology. Vol.1, Issue 1, De Gruyter, ISSN 2300-6560. https://doi.org/10.1515/opar-2015-0008

Jeffrey, S. 2018. Digital heritage objects, authorship, ownership and engagement. In: P. Di Giuseppantonio Di Franco, F. Galeazzi, and V. Vassallo, (eds) Authenticity and cultural heritage in the age of 3D digital reproductions. McDonald Institute for Archaeological

Research, Cambridge, pp. 49-56. ISBN 978-1-902937-85-4. https://doi.org/10.17863/CAM.27037

Cochrane, A., and Russell, I. 2014. Art and archaeology: collaborations, conversations, criticisms. New York: Springer https://doi.org/10.1007/978-1-4614-8990

Jeffrey, S., Love, S., and Poyade., M., 2021. (In Press) The Digital Laocoön: replication, narrative and authenticity. *Museums and Society*

Jones, A.M. and Cochrane, A. 2018 The Archaeology of Art. Materials, Practices, Affects. Routledge.

Karnava, Artemis., 2015. In the land of Lilliput: writing in the Bronze Age Aegean, *World Archaeology*, 47:1, 137-157. https://doi.org/10.1080/00438243.2014.991807

Kenderdine, S. 2015. Embodiment, Entanglement, and Immersion in Digital Cultural Heritage. In A New Companion to Digital Humanities (eds S. Schreibman, R. Siemens and J. Unsworth). https://doi.org/10.1002/9781118680605.ch2

Kiernan, Philip, 2015. Miniature objects as representations of realia, *World Archaeology,* 47:1, 45-59. https://doi.org/10.1080/00438243.2014.991802

Krasniewicz, Louise., 2019 *The Wonder of Miniature Worlds* (Blog) https://thewonderofminiatures.home.blog/ [Accessed 17 December 2020]

Kryder-Reid, Elizabeth. 2015. Crafting the Past: Mission Models and the Curation of California Heritage. *Heritage and Society*, Vol. 8 No. 1, May, 2015, 60–83 https://doi.org/10.1179/2159032X15Z.00000000038

Lane, Edward William, 1883. Lane-Poole, Stanley (ed.) *Arabian society in the Middle ages: studies from the Thousand and one nights*. London: Chatto & Windus.

Mc Culloch, D. B., 1975. Staffa. 4th edition, Newton Abbott: Newton Abbott: David and Charles (Holdings) Limited.

Meskell, Lynn. (2015) A society of things: animal figurines and material scales at Neolithic Çatalhöyük, World Archaeology, 47:1, 6-19, https://doi.org/10.1080/00438243.2014.991800 Nicky Bird "Heritage Site": https://nickybird.com/projects/heritage-site-2014-2016/

Morton, T. (2013). Hyperobjects: Philosophy and Ecology after the End of the World. University of Minnesota Press. Retrieved March 31, 2021, from http://www.jstor.org/stable/10.5749/j.ctt4cggm7

Ogden, Ruth and Montgomery, Catharine., 2012 High time. *The Psychologist* Vol 25 pp590-593. https://thepsychologist.bps.org.uk/volume-25/edition-8/high-time [Accessed 17 December 2020]

PaulLandowsski.com, 2020 http://www.paul-landowski.com/en/le-christ-de-rio/ [Accessed 17 December 2020]

Press Association (The Guardian), 2013 Time passes more slowly for flies, study finds, The Guardian, 16 September 2013. https://www.theguardian.com/science/2013/sep/16/time-passes-slowly-flies-study [Accessed 17 December 2020]

Pujol, Laia. and Champion, E. 2012. 'Evaluating presence in cultural heritage projects', *International Journal of Heritage Studies*, pp.83-102.

Richards, Colin. 1996. Monuments as Landscape: Creating the Centre of the World in Late Neolithic Orkney." *World Archaeology* 28, no. 2 (1996): 190-208.. http://www.jstor.org/stable/125070 [Accessed 17 December 2020]

Richman-Abdou, Kelly, 2020. Why Michelangelo's 'David' Is an Icon of the Italian Renaissance, in *My Modern Met*, https://mymodernmet.com/michelangelo-david-facts/ [Accessed 18 December 2020]

Riemer, M, Shine, JP, Wolbers, T. On the (a)symmetry between the perception of time and space in large-scale environments. Hippocampus. 2018; 28: 539– 548. https://doi.org/10.1002/hipo.22954

Stewart, Susan., 1993. On longing : narratives of the miniature, the gigantic, the souvenir, the collection Durham: Duke University Press.

Stevens, Thea 2019. The Plaster Cast Collection of the Glasgow School of Art: History, Aura and Experience. *Journal of the Scottish Society for Art History*, Vol.23, 2018-19, pp. 23-30. ISSN 1362-248X

Stoakley, Richard, J. Conway, Matthew J., and Pausch, Randy. 1995. Virtual Reality on a WIM: Interactive Worlds in Miniature. In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI'95). ACM Press/Addison-Wesley Publishing Co., New York, NY, USA, 265–272. https://doi.org/10.1145/223904.223938

Tan, E.S. 2018 A psychology of the film. *Palgrave Commun* 4, 82. https://doi.org/10.1057/s41599-018-0111-y

Thomas, Ewart A. C. and. Cantor, Nancy E., 1975. On the duality of simultaneous time and size perception. *Perception and Psychophysics* 1975, Vol. 18 (I), 44-48

Thomas , R.F., and Ziolkowski, J.M., 2014 (eds). Laocoön in art, *The Virgil Encyclopedia*. https://doi.org/10.1002/9781118351352.wbve1179

Turkle, Sherry, 2007. What Makes an Object Evocative? In: Evocative Objects: Things We Think With, edited by Sherry Turkle, pp. 307–326. MIT Press, Cambridge, Massachusetts.

UNESCO World Heritage List 1979, *Prehistoric Sites and Decorated Caves of the Vézère Valley*. https://whc.unesco.org/en/list/85 [Accessed 17 December 2020]

Unity User Manual (2019.4 LTS), 2019, *Tilt Shift Script*, https://docs.unity3d.com/540/Documentation/Manual/script-TiltShiftHdr.html [Accessed 17 December 2020]

Vlahakis, V. & Ioannidis, M. & Karigiannis, John & Tsotros, M. & Gounaris, M. & Stricker, Didier & Gleue, T. & Daehne, P. & Almeida, L., 2002. Archeoguide: An augmented reality guide for archaeological sites. *Computer Graphics and Applications*, IEEE. 22. 52 - 60. https://doi.org/10.1109/MCG.2002.1028726

Wilsher, M. (2019) Virtual and other bodies, Art Monthly 427, 11-14.

Young, S., and HoulBrook, C. (eds) 2018. *Magical Folk, British and Irish Fairies 500 AD to the Present*. London: Gibson Square.

Lévi-Strauss, Claude. [1962] 1966. The Savage Mind. Chicago: University of Chicago Press.

Gell, Alfred. 1998. Art and Agency: An Anthropological Theory. Oxford: Oxford University Press.