More than Modal? Exploring Affect, Affordance, Invitation and Solicitation

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Abstract The aim of this chapter is to make a strong case for the adoption of a radically different approach to the archaeology of the senses. This is an approach that focuses not on what is sensed per se (or any ingenious mapping or digital representation of such) but instead the emergent *affects* that may have arisen in any given sensory encounter, and the impact(s) of such on the assemblage of individuals, things, animals, environments, landscape elements, memories, expectations and anticipations (to name but a few) that were bound up within it. This is not to say that we should abandon attempts to, for example, delineate, visualise, map and analyse what could be seen, heard or smelled. Instead, it is to stress that such efforts should always be treated as a means-to-an-end and never taken as definitive end-products. In the discussion that follows, we build the theoretical framework needed to effect such a re-orientation, drawing upon affect theory and notions of relational capacity and affordance. We then go on to demonstrate the value of this through a case study involving the mapping and exploration of visibility and foreground the unique (yet largely untapped) interpretative potential of virtual, mixed and augmented reality approaches to move beyond mere representation, to instead evoke affects directly.

Keywords Affect · Affordance · Aura · GIS · Gaming · Augmented-reality

1 Introduction

In this chapter we argue that to get the most out of computational approaches to the senses we need to treat the results of our analyses as heuristic building blocks rather than end-products, solutions or answers. This requires not only methodological innovation, but also careful theory-building, as whilst a range of computationally

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elegant approaches to the investigation/mapping/modelling/exploration of sensory modalities have been (and as this volume demonstrates, continue to be) developed, we still lack the theoretical frameworks needed to unlock their full interpretative potential. It is often the case that we construct elaborate theoretical justifications for carrying out our analyses or simulations of seeing, hearing, smelling, touching etc. most commonly through various strands of phenomenology and the archaeologies/anthropologies that have themselves drawn upon them (e.g. Tilley 1994) qualified and quantified through thresholds and metrics derived from the formal modelling of sensory capacities (e.g. Mlekuz 2004; Ogburn 2006). When it comes to interpreting the results of such studies—i.e. what does knowing what was potentially seen, heard, smelled etc. tell us about the past that we did not know (or suspect) before the study was carried out?—we are largely left to our own devices. This then is a chapter about how we can best use the results of modal simulations in order to shed light on the past.

Our basic argument is that our current focus is wrong. We should not concern ourselves with the senses at all, but instead *affect*, and as a result we should abandon efforts to delineate a sensory archaeology and focus instead upon the development of a coherent and persuasive archaeology of affect. This is an archaeology where methodological and theoretical developments are closely entwined. To demonstrate the value of such a shift we explore one pathway for moving beyond simple modalities to consider instead the impact a particular bundle of sensory engagements may have had on a perceiving animal. Rather than limit ourselves to mapping or quantifying what could be seen, heard, felt etc. the aim is to explore what emergent impacts a given tangle of sensory impacts may have had in the particular context of engagement in which they occur. The aim is not to restrict or formalise, but instead to offer a helping-hand for thinking beyond the senses. The key point is that rather than set out to explore perception, studies should always set out to explore affect, treating individual sensory engagements as at best partial proxies and always means to an end. As we demonstrate, the benefits of doing so can be enormous.

We explore this through the study of elements of the prehistoric monument complex at Avebury (Gillings and Pollard 2004). Reaching across 3.5 km of chalkland, this takes the form of an intensive collection of earthen, timber and megalithic structures spanning the 4th–3rd millennia BC, centred upon the standing stone circles of the Avebury henge (Fig. 1). Recent research focusing on the heart of this landscape (Gillings et al. 2019) has argued that the very beginnings of what would become the largest standing stone circle in the world lay with a small, unremarkable domestic house dating to the very introduction of Neolithic ways of life in this part of Britain. After gradually falling into disrepair and decay, the footprint of this short-lived house would come to be marked and dramatically amplified by a series of monumental constructions that radiated out from it, like ripples on the surface of a pond; each new addition enclosing and enfolding the last. To date the explanation for this has been couched in terms of memory-work and memorialisation; the location of the very first settlement and thus the site of a founder's house, being successively re-inscribed, albeit on an increasingly dramatic scale and in very different media. Kept in active memory, as the physical remains of the house proper were lost to the forces of entropy and decay. Whilst this explanatory framework certainly accounts

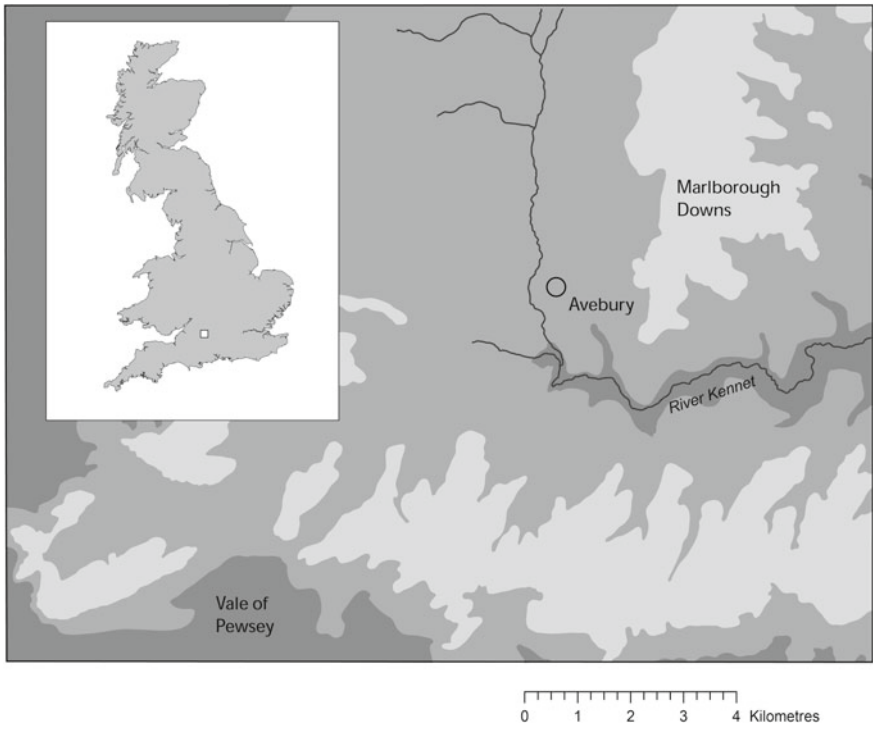

Fig. 1 General location plan of the Avebury region

for the progressive (aggressive?) monumentalisation that took place at the site, it has little to say about how exactly, this memory-work manifested itself in everyday practice or the complex relationships that may have existed between the memory (as a malleable fluid thing) and the thing it was purported to be memorialising (the fragmentary remains of a rather unprepossessing rectangular house). Or to put this another way, how did this memory-work *work*?

We explore this through the development of a new interpretative framework based upon the closely linked concepts of affect and relational capacity (or affordance), using computational approaches to capture and explore not sensory modalities but instead the affective atmospheres or fields that emerged from the coming together of certain configurations of people, structures, materials, imperatives and motivations. Here we treat the construction of elements of the monumental fabric as the creation of deliberate engines for shaping and focusing sensory affordances and thus affects; mechanisms that could have undesired as well as desired consequences and that are bound up in the emergence of new constructions and new affects. Our argument is that rather than passive entities to memory—memorials in the traditional sense of the word—the various standing stone settings that were progressively constructed around the house were active engines of affect—deliberate mechanisms of fascination that through their particular configuration and relations with other material objects served to intensify and shape a particular set of affective atmospheres (sensu Ash 2013).

2 Houses, Squares and Circles

The Avebury henge comprises a 420 m diameter earthwork enclosing a circle of approximately 100 substantial megaliths—the largest of its kind in Europe. This ring of stones in turn encloses two smaller circles each around 100 m in diameter and containing a large, distinctive stone setting at its approximate centre. Extending from two of the four entrances that punctuate the surrounding bank and ditch are Avenues of paired standing stones that together extend for some 3.5 km across the surrounding landscape (Fig. 2). With regard to scale and complexity, the Avebury henge is an unusual structure, and it is not alone. The immediate landscape is home to further enormous structures of chalk and turf (e.g. Silbury Hill) and timber (the West Kennet Palisade Enclosures) as well as a host of more modest monumental structures (e.g. the Sanctuary, Falkner's Circle, Longstones enclosure). Avebury is very much a monument amongst monuments and this accounts for its inscription, along with Stonehenge, as a World Heritage Site (Gillings and Pollard 2004).

Despite the scale of the surviving archaeology, the visibility of which has been greatly enhanced by a programme of restoration and reconstruction carried out in the 1930s, and over 350 years of learned study, knowledge of Avebury's chronology remains sorely lacking (Pollard and Cleal 2004; Gillings and Pollard 2004: 192–193).

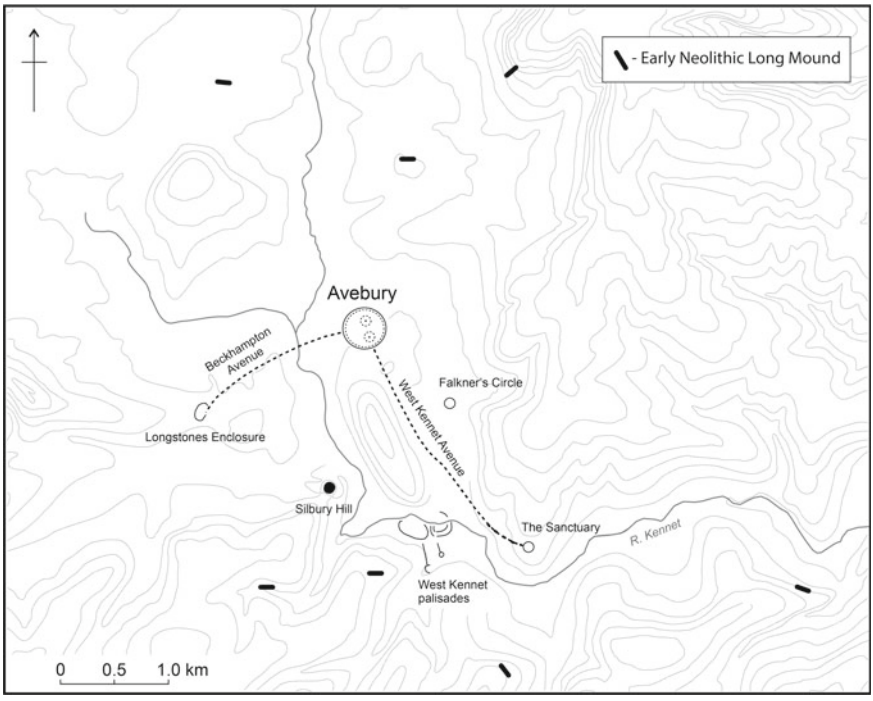

Fig. 2 The Avebury henge and surrounding monumental structures

This situation results in large part from the lack of excavation within the henge since 1939 compounded by a tendency for excavated features (such as stone holes) to be largely free of material that can be used for radiocarbon determinations. Whilst we are confident that the main phases of construction took place in the 3rd millennium BC, the precise sequence of earth-working and stone erection remains elusive. We do not know when the first activity at the site took place or the form it took.

The scale of the challenge is brought into stark focus by the small suite of C14 dates we do have, which suggest that alterations and additions were being made to the stone circles well into the 2nd millennium BC, possibly extending into the Iron Age/early Romano-British periods (Pollard and Cleal 2004: 127).

Recent archival and survey work has raised the distinct possibility that the largest prehistoric stone circle in the world began its life a millennium or so earlier as a small domestic house (Gillings et al. 2019). The proposed sequence can be summarised as follows. At some point, most likely during the first half of the 4th millennium BC, a small domestic house was constructed, square in shape and some 7 m across (Fig. 3a). After this had fallen into disuse and collapsed (Fig. 3b), a large standing stone (called the Obelisk by 18th century observers) was erected in the corner of the house; a thick pillar of unworked stone standing some 6 m high (Fig. 3c). By this stage, all that would have been left of the house were a few low earthworks. At some point the

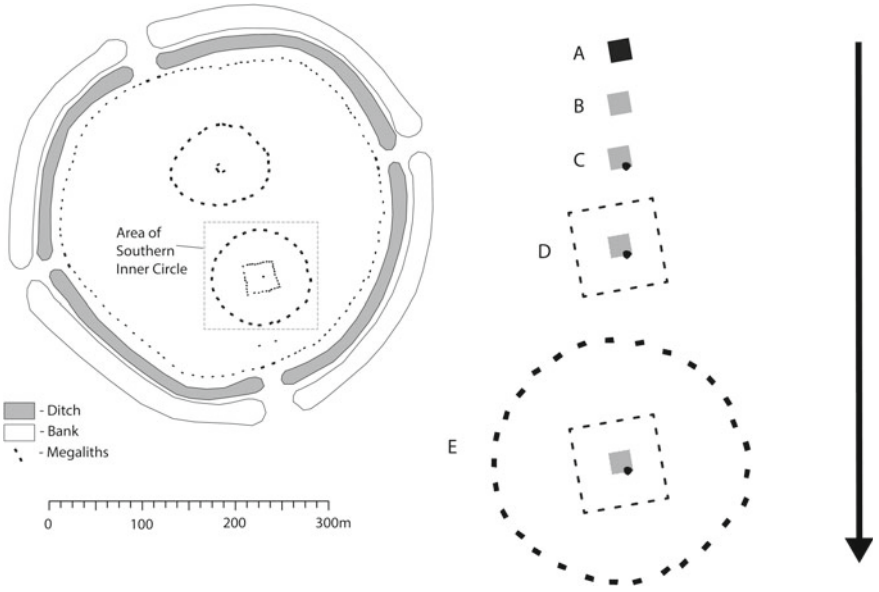

Fig. 3 The location of the house structure and surrounding settings. The published phasing begins with a rectangular house (**A**). After a century or so all that is left of the house are subtle surface traces (**B**). At some point a substantial megalith—the 6 m high Obelisk—is erected in the southeast corner of the former structure (**C**). A 30 m wide square of megaliths is then erected around the house respecting, yet exploding and exaggerating, its orientation and proportions (**D**). The final phase of activity sees the square itself enclosed by the 100 m diameter Southern Inner Circle (**E**)

footprint of the house was quite literally exploded and monumentalised. A square setting of standing stones 30 m across was raised centred upon the earlier structure and echoing its shape and orientation (Fig. 3d). As far as can be reconstructed, this megalithic square comprised alternating large and small standing stones though the precise frequency and pattern are not clear (nothing of this setting survives apart from geophysical anomalies, some excavated stoneholes and a line of small megaliths re-erected in the 1930s). This square was in turn enclosed by a 100 m diameter circle of very large megaliths, with an average height of 3.4 m), forming what is today referred to as the Southern Inner Circle (Fig. 3e). The picture is essentially one of the sequential ripples or progressive 'wrappings' (sensu Richards 2013: 16–23). The lack of conclusive evidence for any re-working (i.e. the reconfiguration of existing stone settings) suggests progressive elaboration and enhancement, the remains of the house structure receding behind enclosing settings of substantial standing stones.

3 Affect and Affordance

So what exactly do we mean by affect? Having highlighted the way in which affect emerges in contexts as varied as language, narrative, poetics and performance, as well as the complex relationships that exist between affect and terms such as emotion, feelings, personality and attitude, Besnier has argued that 'adopting a broad (but malleable) definition of "affect" can be seen as a wise empirical stance' (1990: 421). We agree and in the current discussion follow Bonta and Protevi (2006: 49) and Seigworth and Gregg (2010: 1) in using the term 'affect' to refer broadly to the profoundly relational capacity of bodies to both act (affect) and be acted upon (be affected). Looking to the latter, this is to acknowledge that certain processes, activities, practices, dispositions, happenings, events, encounters and assemblages can provoke/invite responses—emotional, anticipatory, practical, reflective, evaluatory etc.—and through these lead to tangible change and transformation in the bodies bound up in them. One of the most interesting developments to emerge from the 'affective turn' that has taken place across the humanities and social sciences (see Gregg and Seigworth 2010) has been the notion of the affective field or atmosphere (Harris and Sørenson 2012; Anderson 2009, 2014) and the idea that certain relations (or motleys and entanglements) of and between things can, and do, have an affective reach that can be both spatial and temporal. The notion of the affective atmosphere was introduced by Anderson and is a concept that, in Anderson's work at least, seems to work tirelessly to elude concise definition. The key element we would like to draw from his discussions is the attention that is placed upon atmospheres as collective affects—the 'shared ground from which subjective states and their attendant feelings and emotions emerge' (2009: 78). Atmospheres have an inherent spatiality and can be strongly agentic. They are singular yet (in Anderson's terms) indeterminate—qualities that 'exceed that from which they emanate' (2009: 80). Bille and Simonsen have stressed that these atmospheres emerge ("unfold") as relations located in spatially embedded practices—'created by both materiality and the presence and practices of

people' (2019: 12). In an important discussion, Harris and Sørenson have introduced the notion of the affective field as an adjunct to that of atmosphere. The former comprises an active, dynamic field of relations that emerges from tangles between things and locations. Perhaps most importantly, these relational fields are 'productive' of practice (2012: 150). In distinction, they use the term atmosphere to refer to the instantiation of a particular affective field through (for example) certain combinations of materials such as architecture (2012: 152). Put another way, certain affective fields are revealed, intensified or actualised by certain configurations of materials and people. This echoes Thrift's suggestion that specific combinations of locales, things and systems can create what he terms *fields of captivation* and *mechanisms of fascination* (2012: 290). We will return to these notions later in our discussion of Avebury. Clearly, the distinction Harris and Sørenson draw between fields and atmospheres is subtle and whilst we would support the emphasis they place upon temporality and spatiality in their consideration of atmosphere, we are less comfortable with the distinction that is drawn in relation to practice. To Harris and Sørenson, whilst atmospheres can shape and texture practices, it is argued that they need not necessarily emerge from them, which seems a little arbitrary. As a result, in the current discussion we have folded the affective field into our consideration of atmosphere. Atmospheres are spatial, temporal and (following Bille and Simonsen (2019) and practice theorists such as Reckwitz (2017)) for atmospheres to affect—whether through emergent fields of relations or as generators/enhancers/focusing-devices—they need to be fully embedded in practice.

Some stark illustrations of precisely the kind of affective atmosphere we are evoking can be gleaned from archaeological and ethnographic studies of place and place-making. In her seminal study of the 'hills and hollers' of the decaying coal mining communities of southern West Virginia, Kathleen Stewart stressed how place inscription could be small and deeply personal; the resultant places emerging as a series of vignettes—complex affective fields that bound together the location, the visitor and events that had unfolded there (1996). Clearly, places such as this could serve a didactic role (e.g. Basso 1996), but they could also be rawly affective—serving to weave emotion and feeling into the very fabric of the landscape. In Stewart's case nostalgia, yearning, tragedy and suffering were articulated through a scatter of places into a starkly visceral geography of loss and despair. This was a deeply relational and emergent approach insofar as the place was made less by any given event/doing/happening (and simple memory of that event) but instead the way the echoes and ripples of the event reached out across space and time to shape practices in the present. This has echoes in Lorimer's claim that certain places exert a 'holding power' and have the ability to 'charm' (Darling cited in Lorimer 2006: 501). We might just as well simplify this to say that as a consequence of the web of performances and relations of which they are part, certain places *affect*.

Having introduced our use of the term affect, through the notion of the affective atmosphere, we would now like to argue that critical to understanding the relations that lie at the heart of any given affective atmosphere, is the notion of affordance. If affect is a relatively recent addition to our heuristic toolbox, affordance has a longer history within the discipline, particularly in the context of computational

approaches that deal, in one way or another, with archaeology and the senses (e.g. Llobera 1996; Gillings 2009, 2012; Eve 2014). Since its introduction by Gibson (1979), the attractiveness and utility of the term has resulted in it being co-opted across a range of disciplines and in a range of contexts, including archaeology (e.g. Gillings 1998; Knappett 2005; Hodder 2011; Eve 2012). However it has proven rather slippery in each case, with more (or less) orthodox definitions emerging and arguably as much intellectual energy spent on policing its boundaries as developing it as a useful heuristic (e.g. Chemero 2003; Burlamaqui and Dong 2014). This is a consequence of Gibson's failure to define exactly what he meant by the term in the first instance. The definition of affordance followed here takes its inspiration from DeLanda's concept of *relational capacity*, and Ingold's *affordance*, both drawing upon specific readings of the foundational work of Gibson (DeLanda 2013: 66–67; Ingold 1992: 46). In short, we are using it to refer to relational rather than intrinsic (or essential) properties that emerge in the context of practical activities carried out by animals (like us) in an environment. In this formulation, relations or assemblages (containing things, animals, materials, expectations, motivations, memories etc.) afford certain experiences or engagements, that are integral to the emergence and/or realisation of specific affects. This is not to argue that affects are somehow built from affordances in a simple and direct way, or that the former represents a higher-order phenomenon. The particular value of affordance here is in its direct link to sensory perception and the framework it offers for interpreting our carefully modelled sensory data. To give the explicitly sensory example of vision, to an animal seeking to hide, a location that affords seclusion and concealment (i.e. that is not over-looked or perceived to be so) may allow an atmosphere of security, relief and even confidence to emerge and saturate it. Likewise, a particular assemblage of materials (whether deliberately assembled or emergent) can afford a particular odour that if only sporadically encountered, can immediately and vividly evoke other times and places, feelings and responses (alongside a host of other affects ranging from disgust and pleasure to indifference).

For a more concrete example we can turn to Kassung and Schwesinger's (2016) first-person simulation of the Forum Romanum (http://www.soundstudieslab.org/events/how-to-sound-out-the-past/). Through careful acoustic modelling, the simulation allows a virtual participant to explore the relationship between an orator, their speech and the surrounding architecture in order to map the degree to which specific locations impacted one's ability to hear and understand. Degree of audibility mapped as an affordance. Once mapped, that affordance can then be employed as a frame through which to explore the atmosphere of relative satisfaction, comprehension and clarity on the part of a listener seeking to actively hear the words being spoken. Likewise, in Paliou's (2014) study of past built environments (https://eleftheria121.wordpress.com/research/visibility-analysis-in-fully-3d-spaces/) we can use isovists to map the visibility of wall paintings through apertures such as doors and windows as an affordance, and then go on to study the changing textures of frustration and revelation that this partial obscurement encourages in a curious viewer desperate to see what is going on. The range of affordances possible in any relationship therefore helps us to frame, characterise and interpret the likely atmospheres it engenders. They

offer us a methodological 'way-in' to investigate affect. For example, we can map degrees of in-view/out-of-view (affordance) in order to explore relative concealment and feelings of security, comfort versus insecurity, fear and frustration (affect).

So far so good, but this reliance upon affordance raises the thorny issue of how we decide which affordances or relations (out of what is often a large field of possibilities) are germane in a certain situation or context. A useful way of filtering the almost infinite set of potential affordances that could theoretically playout in a given relational context, is through the notion of 'invitations' (Withagen et al. 2012; Käufer and Chemero 2015). The argument here is that whilst any potential set of relations may indeed afford a near infinite set of possibilities, the nature of the practices being carried out will mean some affordances are more inviting than others. For example, to return to the example of Cicero, a raised piece of architecture may well afford the opportunity to rest, but to an individual trying to catch a glimpse of the illustrious orator, it is its ability to raise their viewpoint that will be more inviting. In a similar way, in his application of assemblage theory to the analysis of Cache Cave, California, Robinson has used the notion of value and the technique of capacity analysis to identify, characterise, compare and contrast, the range of relational capacities that emerge from creating and engaging with material culture at different locations in the site (Robinson 2017).

4 Exploring Affective Atmospheres

To return to our case study, as the importance of the house as a foundational structure grew over time, its physical presence diminished as it decayed; its traces subtle (a change in vegetation, some slight lumps and bumps, a spread of artefactual material in and on the surface of the soil). This was a site that had to be carefully looked for if it was to be found, the intimate visual clues it afforded perhaps conjuring an atmosphere of reverence and deep memory. If the proposed sequence is correct (Fig. 3) with the construction of the Obelisk this atmosphere would have changed. Once raised, the 6 m high bulk of the Obelisk made visible the fact that there was something there that demanded to be seen and left the viewer in no doubt as to where it was. As a result it generated its own affects, drawing viewers in; orienting them towards the location of the house traces and stoking the expectations they carried with them. The Obelisk affords visibility that in turn evokes an atmosphere of anticipation and reverence, an anticipation that intensifies the closer the viewer gets. It is almost as though the Obelisk had to be constructed on the exaggerated scale that it was, towering above the other megalithic settings at the site, as a direct consequence of the virtual invisibility of the structure it was signalling. In this sense it is interesting (but not surprising) that over time it was the Obelisk itself that took on this role—moving from a 'signpost towards', to the object of veneration itself as the house structure finally slipped from memory (or perhaps more properly, relevance). This was certainly the case by the early 18th century and persists to the present day. With the construction of the surrounding square of stones, the atmosphere was transformed

once again, as whilst the Obelisk itself was clearly visible, and the presence of the foundational house structure was re-inscribed and amplified, the lumps and bumps at the foot of it and the aura they radiated were now partially hidden from view, shuttered by the interrupted lines of standing stones. The use of aura is deliberate here, referring to Benjamin's use of the term (2008) to denote authenticity, and the particular quality that encounters with originals (rather than reproductions) can have. Aura offers another productive way of thinking about affect, particularly in the context of digital reproductions such as VR models (Gillings 2005). In many ways we might think of aura as an atmosphere in its own right. The key point is that the creation of the square subtly altered the atmosphere which now began to take on a more teasing texture of frustration, anxiety and potential confusion. From a free field-of-view viewers now had to actively jostle and manoeuvre to catch a glimpse. This in turn was amplified and extended further from the site of the former house by the construction of the enclosing circle.

Over time the memory-work taking place in Avebury became characterised by a growing tension between a visitor's desire to gaze upon and perhaps touch the object of veneration, and the degree to which this was actually possible. As physical traces slipped away, the increasingly elaborate proxies and signposts that radiated out from them, like ripples in a pond, served as much to inhibit access as permit it, allowing a series of complex and textured atmospheres to emerge in the web of relations between the traces of the house, the megalithic settings, desires, memories and movement. Needless to say, if we can begin to unravel and explore the sequence of perceptual affordances that emerged, we can begin to understand these changing atmospheres and in turn begin to shed light upon the practices and engagements that would, over the course of a millennium and a half, result in the construction of one of Europe's pre-eminent prehistoric monument complexes.

In seeking to explore affective atmospheres two approaches are offered—abstraction and evocation. The first relies upon familiar modes of cartographic representation. In this a 2D abstraction of affect is mapped through the delineation of a single sensory modality (vision) as an affordance. The aim here is to render affect as something tangible, the atmosphere or field (however fuzzily defined) translated to a definable spatial footprint. The result is a thematic map whose novelty lies in the theme that is being represented. The second seeks to eschew representation all together by seeking to evoke the very affect the analysis is seeking to explore. In this case frustration-revelation. This is through the sketching out of an approach that employs AR and sound to prompt emplaced performances of seeking and glimpsing.

5 Methodology

To explore the affective power of the fragmentary remains of the founder house, four analyses have been carried out. In the first of these a GIS has been used to map the affective field generated by the aura of the house using a specific visual affordance—glimpsing—as a proxy for affective atmosphere. This is produced in

relation to an individual (or group of such) who wants to directly see (and perhaps physically engage with) these original traces, and is comprised of a variable cocktail of curiosity, revelation, awe, impatience and frustration; different elements rising to the surface as glimpses become progressively more snatched and elusive.

The data used for this analysis comprises a Digital Elevation Model (DEM) of the henge which incorporates a reconstruction of the original final phase earthwork; a substantial bank and ditch reaching maximum heights/depths of six and ten metres respectively. Although undoubtedly later than the megalithic phases discussed, this serves as a useful frame for the analysis. Standing stone positions likewise represent a blend of known megalithic settings, former stone holes recorded through survey and excavation (Gillings et al. 2019), and educated guesswork, using known patterns to infill areas currently under the modern village (Fig. 4). Although there would undoubtedly have been significant variation in the shapes and heights of the standing stones (these were unmodified blocks of locally available sandstone) for the purposes of the analyses carried out the stones have been modelled as regular lozenges with the heights of the megalithic settings estimated at a conservative 1 m for the stones of the square setting and 3 m for the southern inner circle (for structural detail of the Avebury henge please see Gillings and Pollard 2004).

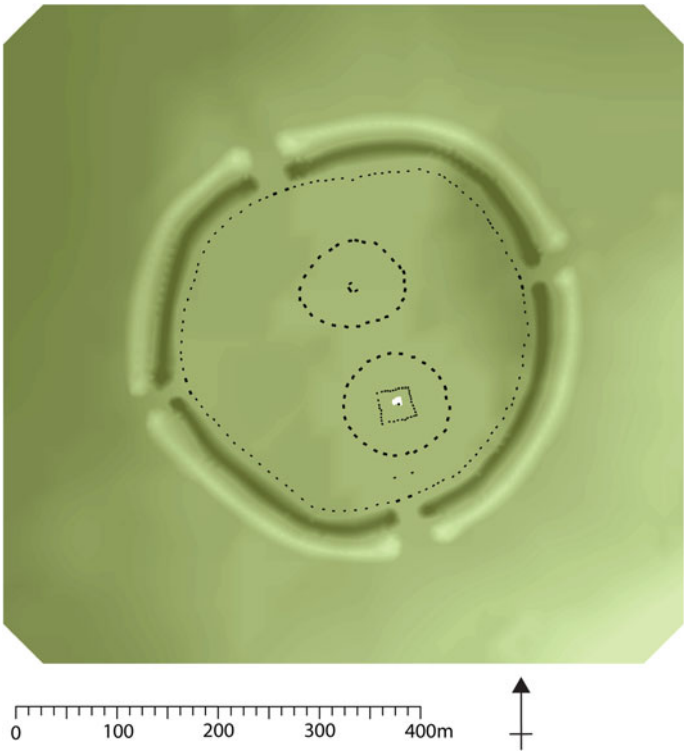

Fig. 4 The reconstructed DEM and stone setting positions used in the analyses. The footprint of the house structure is indicated in white

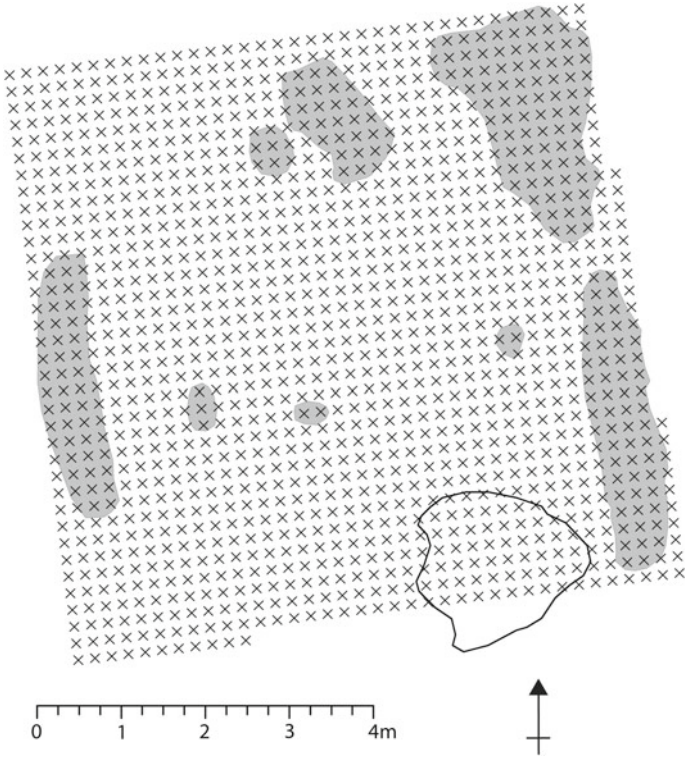

Fig. 5 The viewpoints spaced on a 0.2 m grid across the area of the house. The gulleys of the former structure are shaded grey; the stonehole of the obelisk in indicated in black

5.1 Analysis 1—Catching a Glimpse of the Founder's House

To map the areas from which the house remains could be fully and partially seen (i.e. glimpsed) the footprint of the house was converted into a 0.2 m grid of potential viewpoints—1,271 points in total (Fig. 5). On the assumption that the house remains would be essentially flat a reverse (i.e. views-to) cumulative viewshed was then generated, with a viewpoint offset of 0 and observer offset of 1.6 m. The maximum viewing distance was set to 420 m to approximate the maximum short-distance view (i.e. view where the target would be recognisable) for a 7.4 m spread of subtle earthwork traces—the maximum dimension of the original house (Ogburn 2006, Table 1). The analysis was carried out using the visibility function in ArcGIS 10.6.1 (for a detailed discussion of the methodology behind GIS-based visibility analyses see Gillings and Wheatley 2019). The resulting summed viewshed identified the areas from which a viewer would see the house remains (Fig. 6). With the exception of some partial views beyond the east and southern entrances, these were full views, with the entire area of the house either visible or not; the affective field an otherwise

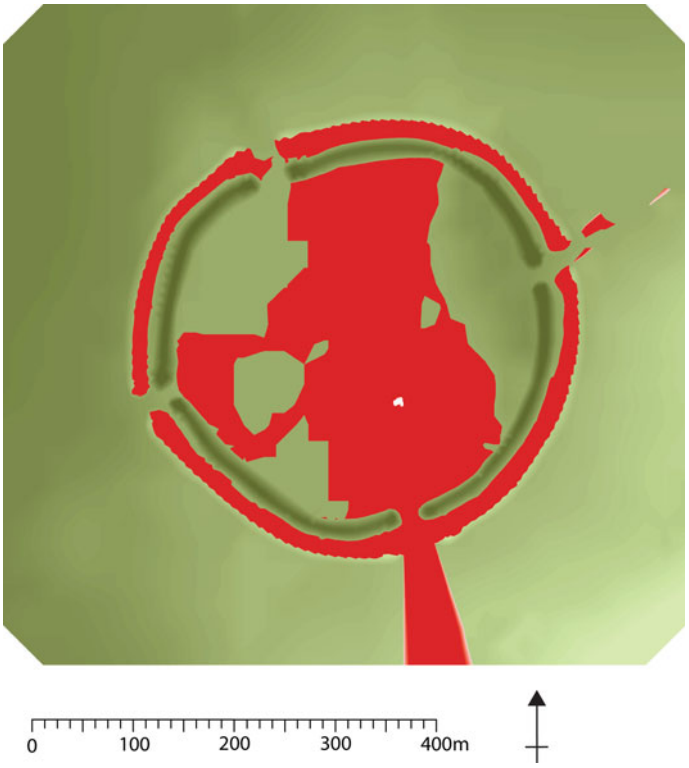

Fig. 6 The area (red) from which a viewer would have had an unobstructed view of the former house structure assuming no megalithic settings

undifferentiated block of clear views. The impact upon this field of the construction of the square setting of megaliths was dramatic; put simply the atmosphere of revelation had changed (Fig. 7). The effect of exploding and exaggerating the footprint (and thus visual signature) of the house was to create an intense zone within and around the square of direct and total visual engagements, whereas beyond the square acts of looking and seeing were now broken down into a complex, spoke-like pattern of partial views—glimpses. The original atmosphere was now restricted to the interior and immediate border of the square; outside of it, a viewer would need to position themselves carefully, and potentially jockey and jostle, just to catch a glimpse. Frustration, exploration and negotiation (not to mention strategy and tactics) would come to the fore as they sought, and evaluated, a sequence of partial, fragmentary views. What is interesting is that there is a directionality to the strength of the fragmentary views available, with more rewarding channels to the south and west. These coincide broadly with what would later become the southern and western entrances, monumentalised breaks in the earthwork bank that connected to lines of paired megaliths (the West Kennet and Beckhampton Avenues) that together extended out into the surrounding landscape (Fig. 2).

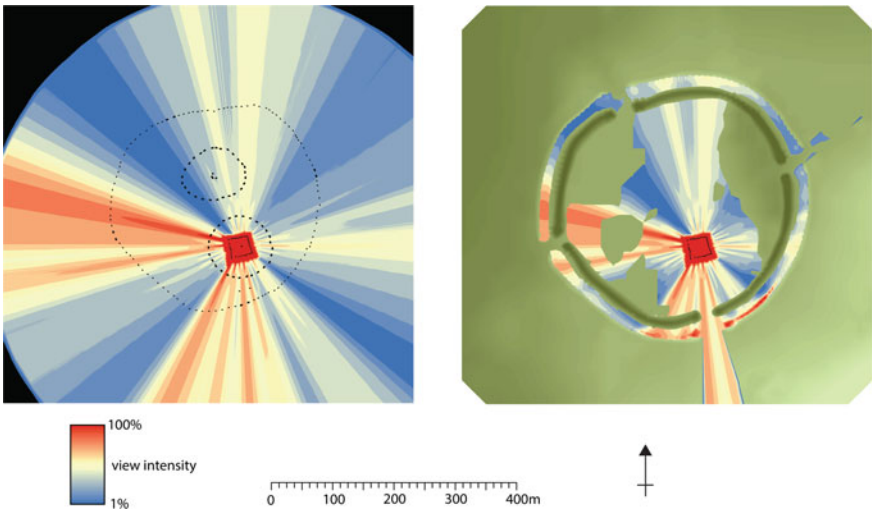

Fig. 7 The impact on the possible view of the construction of the square. To allow broader patterns to be discerned and compensate for the fact that the outer earthwork of the henge (used here to frame the analysis) is undoubtedly a later feature, the result is shown both with (right) and without (left) surrounding terrain and earthworks

With the construction of the Southern Inner Circle surrounding the square, the atmosphere changes once again (Fig. 8) becoming more fractured and frustrating beyond the exploded footprint of the square and more intensified within, the channels that afforded glimpses of the founder structure becoming narrower and the chance of losing sight entirely increasing. The alignment of the broadest of the southern enhanced visibility bands with the southern entrance is again worthy of note. Here a sensory modality has been simulated as the first step in mapping out the extent and form of an affective atmosphere and dramatic changes in the form and composition of that atmosphere have been suggested. Throughout, the remains of the founder's house served as a powerful engine of fascination, however its aura was progressively focused, intensified and contained; that which managed to seep out past the nested layers of megaliths generating a very different kind of atmosphere.

The analysis presented here is undoubtedly crude—not least in its depiction of the standing stones as undifferentiated, uniform rectangular slabs. A sensitivity study would be required to compensate for this, carrying out multiple iterations of the analysis whilst varying both the precise positions of the stones and their heights and widths (using the surviving fabric of Avebury to set ranges). Following Fisher (1994) one solution to this would be to employ a Monte-Carlo approach in order to generate a probable viewshed, only with the modelled 'error' relating to the stones themselves rather than underlying DEM.

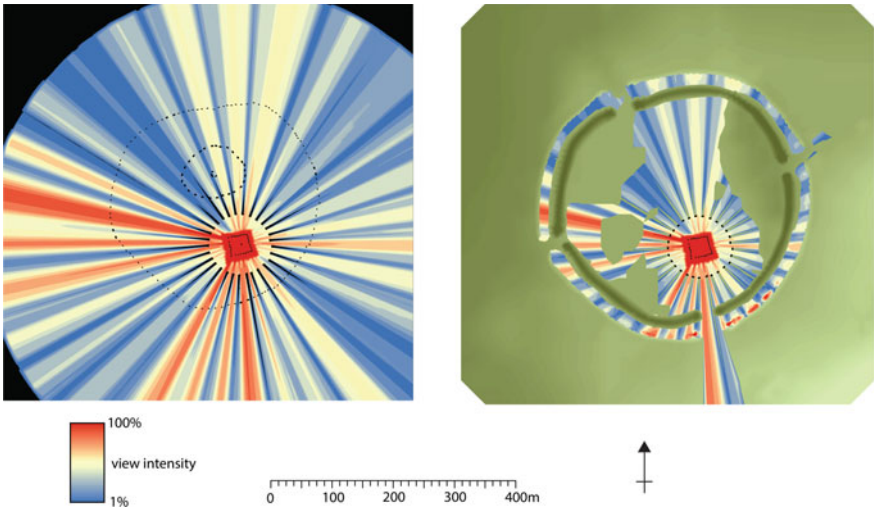

Fig. 8 The impact of adding the Southern Inner Circle. As with Fig. 7, the result is shown both with (right) and without (left) surrounding terrain and earthworks

5.2 Analysis 2—But What is Being Glimpsed?

In his seminal study of the visual impact of the megalithic settings at Stonehenge, Wilson made the important observation that whilst knowing whether the monument as a whole could, or could not, be seen from points in the surrounding landscape was useful, the real interpretative gold lay in establishing which specific parts of the monument were visible or not (Wilson 2012: 65–141). To explore this he developed a unique 'hybrid' viewshed approach that combined traditional 2D GIS approaches with modelled environments visualised using 3D Studio Max and analysed using multiple in-world camera positions (Wilson 2012: 23–64).

The approach adopted here has been to generate a view-to viewshed for each of the 1,271 viewpoints spaced in a grid across the house footprint (as per analysis 1), extracting the viewshed area which was then written as an attribute to each vector viewpoint using a bespoke Python script. In this way each viewpoint is given a value that corresponds to the area that it could be seen from. The resultant gradient of values was then mapped across the area of the house to identify the view intensity for each location. The results for the open terrain (i.e. before any megaliths were placed) confirmed that the full area of the house was in view (mean viewing area for each point = 902,845 m^2 with a Standard deviation of just 4.2 m^2 and Relative Standard Deviation (RSD) of 0.0004%). In the case of the Square (RSD = 1.75%) and combined Square & Southern Inner Circle (RSD = 12.5%) the results were much more patterned, with the most highly visible elements consistently towards the southeast (Fig. 9). Full and open views of the whole house progressively became partial views of parts of the house. The most visible element of the house is precisely

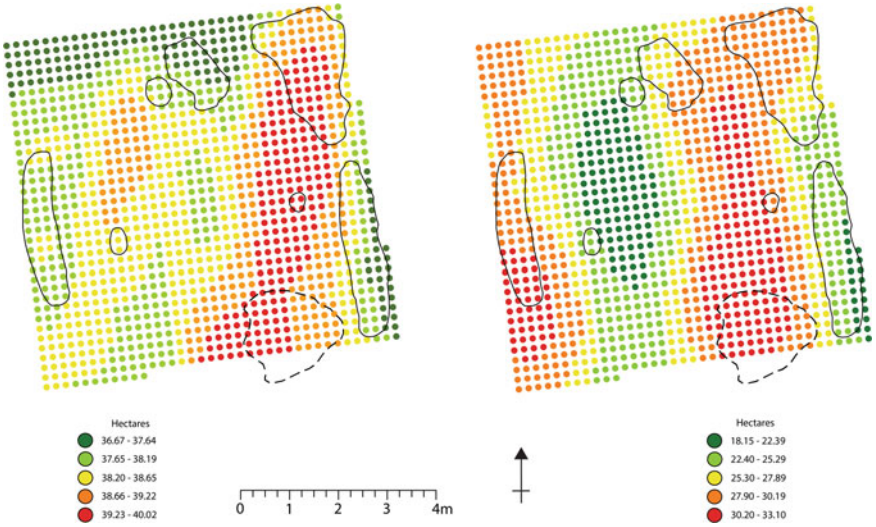

Fig. 9 View intensity of the footprint of the house structure with the square (left) and square and Southern Inner Circle (right). In each case the legend indicates the area that the particular element is viewable from

where the 6 m high Obelisk was erected, and this result raises some interesting questions regarding the sequence of construction in this part of the henge. The published sequence assumes a progressive 'spreading out' with the raising of the Obelisk the first intervention and then the successive wrapping offered by the square and then the Southern Inner Circle progressively enclosing it. However, as the visibility of this area of the house footprint was only concentrated and intensified as a result of the construction of the Square and Southern Inner Circle, it could be argued that the Obelisk came at the end of the sequence. This may very well have been an attempt to address the growing disconnection that was taking place as a result of the megalithic settings by enhancing the most visible portion of the former structure. At this point the atmosphere changes again, as the Obelisk is fully visible from across the area of the henge (Fig. 10); the 6 m high megalith becoming a very literal omphalos.

5.3 Analysis 3—On the Outside, Looking in

So far, so flat. Although the results of the initial GIS-based analyses were stimulating, we were conscious that any approach that relied upon the projection of complex 3D worlds into a two dimensional plane may result in a loss of information; this was a particular concern given the known variability in shape and proportion of Avebury's standing stones. Using a 3D engine to explore the viewshed, and thus potential affective atmosphere may counteract this. Greenwood et al use the example of a

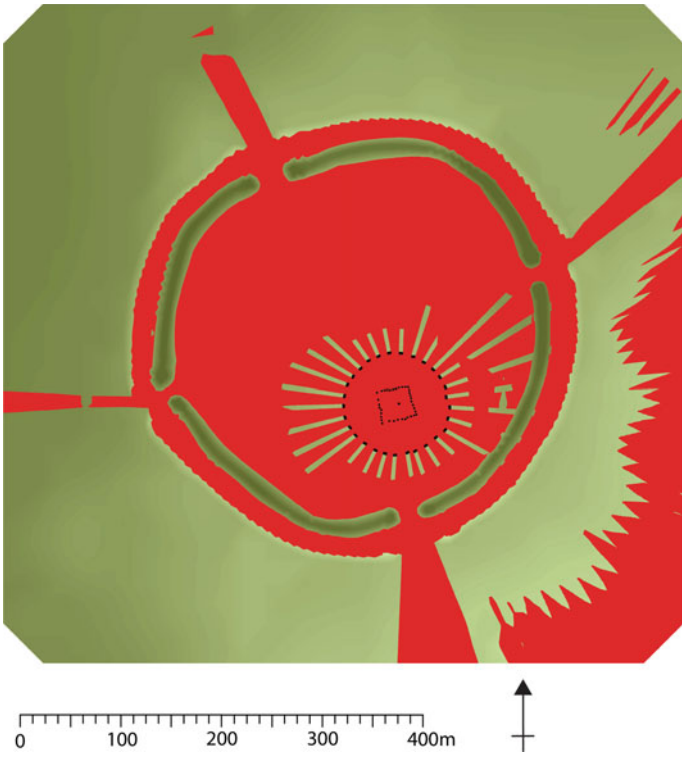

Fig. 10 The visual envelope of the Obelisk

viewshed performed next to an overpass. From the plan it would appear that all views are obstructed by the overpass, in reality, however, only a small part of the view would be obscured and views would still be possible under and above the structure (Greenwood et al. 2009: 2234). In our Avebury example, this effect would translate to the shapes of the stones, many of which taper to a point, or have very irregular profiles (Fig. 11). The basic GIS analysis reduces these irregularities to a single square pixel value that can either be seen over or else obscures the view. As we are interested in the power of 'glimpsing' and the associated satisfaction/frustration of seeing/not seeing the founder's house—it seemed sensible to also attempt to model the subtleties of seeing 'around' the stones.

Once we had completed the GIS-based viewshed analysis, we decided to expand on the basic viewshed concept and undertake a similar analysis, but this time using a 3D gaming engine. The use of 3D modelling software and gaming engines to undertake 3D viewsheds has been applied successfully in the past for diverse applications such as the assessment of road infrastructure (Greenwood et al. 2009), lightscapes (Kaufman 2014), humanistic views of the landscape (Richards-Rissetto 2017), and, as already mentioned analysing the relative visibility of the individual elements that together make up Stonehenge (Wilson 2012).

Fig. 11 Examples of surviving Avebury megaliths. This gives a sense of the variability and irregularity of the component standing stones

The methodology developed uses a 3D engine (Unity) to create different views to the founder's house across the landscape that are then analysed to assess how much of the house is visible from each location. One of the challenges when using gaming engines to represent real world locations is the translation from real world coordinates to 'game-space' coordinates. Whilst Unity can support vast gaming areas, experimentation has shown that due to performance issues it is necessary to keep the maximum terrain size quite small (e.g. a 10 km × 10 km grid). Therefore a mechanism is needed to translate the real world coordinate of each stone's centroid to the game space. This was achieved using the Real World Terrain asset (Infinity Code 2019) which has a built-in converter for moving between real world and game space coordinates. The basic digital elevation model (as used in the GIS-based viewshed analysis above) was imported into Unity using the methodology laid out by Eve (2013). The Real World Terrain plugin was then extended through custom written C# code, to batch place objects according to a Comma Separated Values file of the megalith centroids, exported from the GIS. Each megalith centroid included a path to a 3D model that would represent the specific standing stone within the 3D space (Fig. 12).

Once the basic reconstruction of Avebury was imported, the area of the founder's house was textured bright red, and the rest of the model black. A virtual camera was then created representing the field of view of a human standing 1.6 m above

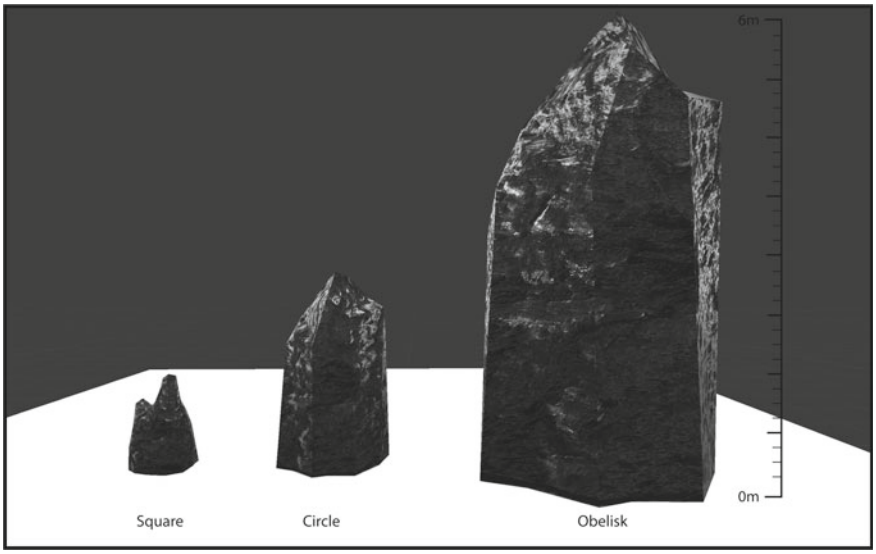

Fig. 12 Examples of the 3D models used to depict the stones

the ground surface. This camera was programmatically moved along a 1 m grid of viewpoints (in total 21316 unique viewpoints) that encompassed the area of the Southern Inner Circle (Fig. 13). At each point the camera was rotated to face the area of the founder's house and a screenshot was taken of the camera's view. This procedure was completed for three different scenarios: no stones present; only the stones of the square present; and the stones of the square and southern inner circle present; and resulted in three sets of 21316 screenshots (Fig. 14).

Using a python script and the cv2 computer vision library each of the screenshots was analysed and the number of red pixels that were present in each were counted (after Wilson 2012)—a relative measure of how much of the founder's house could be seen from each of the viewpoints. The results of this analysis were fed back into the GIS and surfaces were created showing the areas of highest and lowest 'glimpsability' of the founder's house (Fig. 15). Once again, it is clear that the raising of the megalithic settings had a direct impact on the affective atmosphere. As with the GIS analysis, visual access becomes progressively more channelled, albeit this is in a much more subtle and graded fashion than was suggested by the first set of analyses. As for why this is the case, this is undoubtedly a consequence of the shape of the megaliths (see Fig. 12). Put simply, the irregularity of the stones creates more opportunities to glimpse than the undifferentiated blocks implemented by the raised raster cells in the original analyses. In this sense, in the absence of extensive sensitivity testing (as discussed earlier) it might be best to view the results of the GIS analyses as representing the most extreme scenario.

Taken together the results would argue that whilst we can begin to map affective fields using either approach, in the case of more organic, or complex structures a 3D

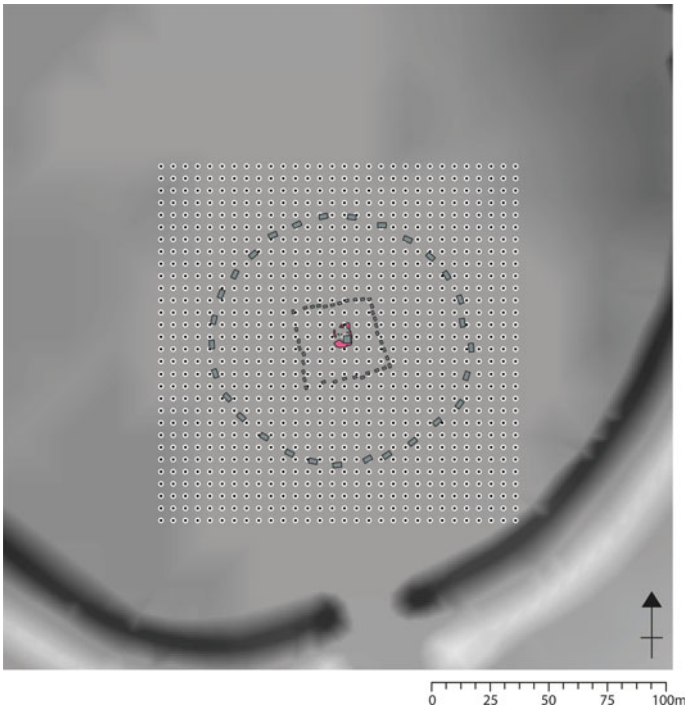

Fig. 13 The location of the viewing points. For clarity only a subset of the 21,316 actual viewpoints have been depicted

approach is preferable. However the 3D approach tendered is very much an experiment, and does not yet represent a full set of stress-tested results. For example, at this stage we are using representative digital stone models—what might be thought of as regularly irregular stone proxies—rather than 3D models created by photogrammetry or laser-scanning. This is because the bulk of Avebury's standing stones have been either buried or destroyed, with their precise locations (and in many cases size and shape) either known only from excavation and geophysical survey, else estimated. A further confounding issue is that the majority of the stones which are currently standing have been re-erected or reconstructed in the past, therefore their locations and orientations may not be original. As with the GIS analyses, the next stage in the research project will be to carry out sensitivity analyses to explore the impact of varying stone shape, size and position on the trends identified.

There is, however, a further—and we would argue critical—limitation with the methodology developed that derives from our stated aim to 'model the subtleties of seeing 'around' the stones'. If curious viewers feel a sense of frustration or disappointment when a view is partially blocked, they rarely slide their position sideways whilst maintaining a rigid sightline. Particularly when trying to see around irregular obstacles. Instead, they bob, stoop, dip and lift themselves in order to catch the elusive

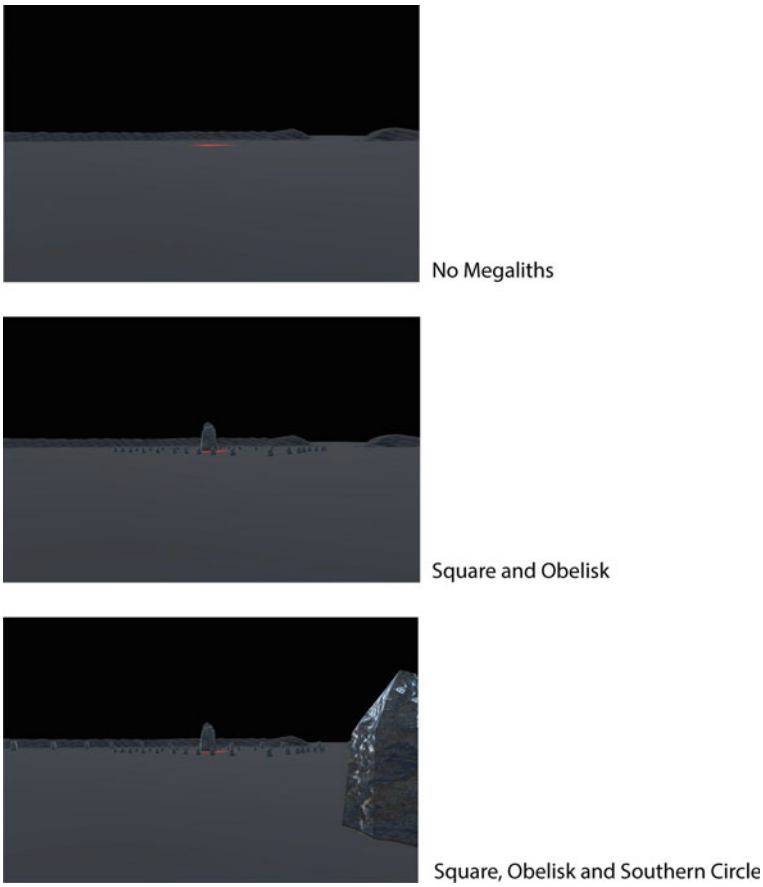

Fig. 14 A representative view to the founder's house, in the three different scenarios

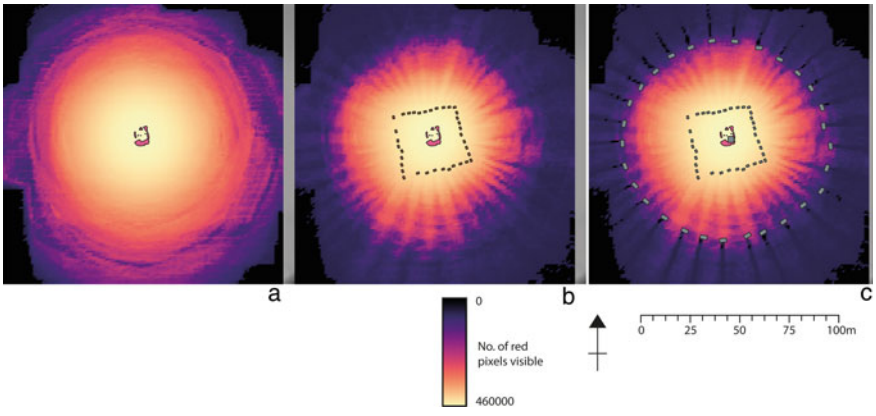

Fig. 15 The amount of the founder's house visible from each of the 21,316 viewpoints

glimpse. This would require our cameras to be mounted (effectively) on springs at each viewpoint location and in potentially constant motion. Whilst this is technically achievable, using a comparable multiple iteration approach to that sketched for the GIS analyses, another solution is possible. That is to replace indifferent, simulated cameras with curious people. This leads us to our final mode of analysis for exploring affective atmospheres.

5.4 Analysis 4—Being Affected

For our final analysis, we would like to sketch out a very different approach to the exploration of affect and one that we feel exploits the power of Mixed Reality to move beyond representation to instead offer powerful new heuristics for making sense of the past. The point of departure is straightforward; why simplify, abstract and represent (map) fields and atmospheres when we can generate and evoke them directly? In this way researchers will be encouraged to engage more viscerally; being directly affected as opposed to distilling out particular impacts and emotions for the purposes of calculated study. This may well reveal a range of affects not considered as well as inform on the likelihood and character of those presumed.

Mixed Reality (MR) offers a methodology to combine digital data with the real world, usually through the medium of a smartphone or virtual reality headset. MR is an all-encompassing term that covers both Virtual Reality (the entire experience created within a computer environment) and Augmented Reality (the experience involving virtual objects appearing to be placed within the real environment). MR techniques are being increasingly used within archaeology to enhance the experience of heritage sites, museums and artefacts (see Eve 2017; Ellenberger 2017 for examples). Building on our previous analyses we would argue that Mixed Reality offers perhaps the most useful pathway for engaging with the affective power of the founder's house.

One approach would be to re-use the virtual 3D environment already created within analysis 3. The model is already mapped to geographic space, therefore could theoretically be presented at the correct scale and orientation when visiting Avebury itself. Existing smartphone libraries, such as ARKit (https://developer.apple.com/augmented-reality/arkit/) or apps such as Sketchfab (https://sketchfab.com), could be used to overlay the 3D models of the stones onto a smartphone video screen. The user would then be able to walk around the real monuments of Avebury, and also encounter the virtual models as well. We could create the 'viewpoint on springs' that was lacking in analysis 3—effectively making the smartphone of the user a dynamic viewpoint, allowing the user to duck, sidestep or peer over the stones at will.

A more mischievous implementation would be to model not the obstructions but instead the target, the house itself. This would only be stable and visible from the correct locations (as determined by analyses 1–3), flickering and becoming increasingly fractured and ghostlike (i.e. frustrating) as the views become more partial. If a group of potential viewers were engaged in 'seeing' the house then they would end up

carrying out precisely the kinds of movement, exploration, evaluation, negotiation, flocking, jostling and clumping we have speculated about.

This process, however, is much easier to write down than it is to actually make happen. Most AR applications have been designed for indoor use and their use in outdoor situations is problematic due to GPS and compass inaccuracy. This leads to virtual objects being placed in the incorrect spatial location in relation to the viewer and a certain amount of spatial drift (Eve 2014). Our preliminary attempts to put the virtual stones in the real location by using 'off-the-shelf' apps were not successful. The spatial drift resulted in the stones appearing to float above the ground surface and also moving slightly when the user moved—so rather than providing a fixed set of virtual monuments to glimpse around, the monuments were in constant motion, swimming across the video feed. This was certainly strongly and directly affective, evoking a feeling of intense frustration, and as a result, achieving in a way exactly what we intended. However, the frustration was directed and prompted by the break in the presence (Turner 2007; Eve 2012) caused by the software, rather than by the placement of the stones themselves. To counteract this inaccurate and inappropriate rendering of the stones, a dedicated AR application could be written—perhaps using fixed markers to anchor the virtual objects in their correct spatial locations, however this would require significant extra resources.

Rather than concentrating on recreating the visual appearance of the missing stones, we could also use more abstract methods to conjure the affective atmosphere we want to investigate. Sound has been increasingly used in AR applications to both guide and surprise the user (Eve and Graham 2020). By re-framing the results of our GIS analyses to be measures of volume or pitch it would be possible to walk across the real landscape and 'hear' the visibility of the founder's house. Following the methodology used for the 'Historical Friction' application by Graham et al. (2019), the GPS location of the smartphone can be continually queried against the results of the visibility mapping—which then returns the value (in the case of analysis 2 how much of the founder's house can be seen from that location). This value can then be used to set the volume of the sound that is playing in the user's headphones. The volume changes as the user moves around Avebury—getting louder or quieter depending on how much of the founder's house they should be able to 'see'. As we are exploring the frustration of *not* seeing the founder's house, the volume increases as the founder's house goes out of view—becoming louder and louder as the calculated view becomes more obstructed. Immediately, the user is actively engaged in attempting to find the location within the monuments where the cacophony is muted by the unrestricted view of the founder's house. With no monuments at all silence reigns across the entire site, but as the square, obelisk and finally the circle are (virtually) erected, it becomes increasingly more difficult, and frustrating, to find somewhere that is not noisy and that does not disrupt quiet contemplation. As with the example of the flickering house, if a group is involved then the listener may well find themselves far from alone, allowing etiquettes and behaviours to emerge.

6 Conclusions

In this chapter we have argued that whilst considerable energy has been spent in developing increasingly ingenious methodologies for the analysis and simulation of sensory engagements, we still lack the theoretical frameworks to reap their full interpretative potential. Here we have argued that an archaeology of affect offers precisely the framework needed, particularly through the concept of the affective atmosphere, and the ideas of affordance, relational capacity and aura that it encapsulates. Through a case study exploring the affective power of a founder's house, we have showcased how the analysis of a single sensory modality can serve as the building block for a more nuanced study of the changing character of place. Through the complex memory-work bound up in their emergence as the genius loci of a founder lineage, the surviving traces of a flimsy house structure gained an aura that in turn acted as a powerful mechanism of fascination. Subsequent structural elaborations, bound up in the practices of lifting and raising standing stones, served as lenses, focusing, distorting, moulding and shaping the affective atmosphere thus generated. If the house was an affect generator, the megalithic settings were affect manipulators.

It is perhaps an irony that the sheer scale of this process ultimately resulted not in heightened memory of the house but eventual forgetting. In this case (and with apologies to McLuhan) the megalithic medium became the message. By mapping and analysing sensory affordances we have been able to conjure the affective atmospheres that emerged in the complex interplay between materials, people and practices that were bound up in the recognition and elevation of a 'founder' lineage. This revealed a fundamental tension as successive attempts to emphasise and reify the physical traces of a single, small structure led instead to its distancing and obscuration, to the point where it was able to slip from memory entirely. In the last centuries of the 3rd millennium BC the result was a monumental complex of stone and earth spanning some 3.5 km of the surrounding landscape, yet one whose own origins had been lost.

Although we have focused in the present study on archaeological reconstructions and the modelling of sensory affordances as a way to access affective atmospheres, it is important to stress that we can instead model affect directly. To put this another way, the possibilities offered by AR/VR allow us to move beyond the mere representation and abstraction of affect as a heuristic device, to instead evoke the very affects we are seeking to understand. This is to eschew verisimilitude completely and instead use AR/VR models as direct provocations (see Goodrick and Gillings 2000). This can be achieved through deliberate anachronism, play, disruption and a host of other techniques. For example, if we made the Obelisk 50 m high and covered in polka dots, we may directly engender on the part of the viewer the same feelings of disbelief and incredulity as the erection of a 6 m high column of stone back in the early 3rd millennium BC. This would open the methodological doors to a completely new kind of archaeology. Take for example Augmented Reality; could we use emerging AR techniques to create a form of what Grossberg has termed *mattering maps* (Grossberg 1992; Seigworth and Gregg 2010: 21). To Grossberg, such maps constitute the way in which the affective world is structured—they "are deployed in relation to the

formations in which they are articulated. They tell people where, how and with what intensities they can become absorbed—into the world and their lives" (Grossberg 1992: 82). To this we might add 'the past' as well.

To conclude, in this chapter we have presented a new theoretical framework for GIS/AR/VR applications in archaeology and have developed a range of methodologies through which it can be put into practice. In each case these methodologies can be further developed. For example, in the case of analyses 1–3, given the uncertainties that exist with regard to many of the stone positions and the shape of the stones themselves, an obvious next step is to carry out a series of sensitivity analyses. Here the aim would be to vary: the positions and dimensions of the various megaliths; the heights of the viewing points that represent the footprint of the collapsed house; and the heights of the prospective viewers. This will allow more confidence in establishing the veracity of any patterns or trends revealed in the affective fields. In the case of the augmented methodologies we have sketched in analysis 4, the challenge lies more with field-testing and delivery. Only then will be able to assess the effectiveness of the mechanisms of fascination and affect generators we have put in place. This is not only in conjuring the anticipated affects we are striving for, but the unexpected affects that emerge amongst viewer-participants through the practices of moving, glimpsing, listening and jostling that takes place.

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