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Title – Augmenting Phenomenology: Using Augmented Reality to aid Archaeological Phenomenology in the Landscape

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Abstract

Explorations of perception using GIS have traditionally been based on vision, and analysis confined to the computer laboratory. In contrast, phenomenological analyses of archaeological landscapes are normally carried out within the particular landscape itself; and computer analysis away from the landscape in question is often seen as anathema to such attempts.

This paper presents initial research that aims to bridge this gap by using Augmented Reality (AR). AR gives us the opportunity to merge the real world with virtual elements, including 3D models, soundscapes and social media. In this way, aspects of GIS analysis that would usually keep us chained to the desk can be experienced directly in the field at the time of investigation.

Keywords: Phenomenology, GIS, Augmented Reality, Archaeological Theory

Introduction and Scope

One of the great challenges in archaeology is hypothesising about and reconstruction of past perception and social behaviour. Some pioneering archaeologists have attempted to explore these issues through the use of Geographic Information Systems (GIS), however, these approaches have almost exclusively been based on vision, and analysis confined to the computer laboratory (see Gaffney et al., 1996). At the opposite end of the spectrum, other equally pioneering archaeologists have sought to explore the ancient landscape through the use of phenomenology – conducting their research within the landscape itself (e.g. Hamilton et al., 2006). To these scholars, computer analysis away from the landscape is anathema and totally at variance with their objectives (Thomas, 2008).

The importance of *embodiment* cannot be overstated when thinking about perception of the environment, and this is at the heart of using archaeological phenomenology to explore ancient landscapes. An experience is not limited to what can simply be seen from a point in the landscape, but includes what can be felt, heard, smelt, tasted and touched; and moreover, how our sensory reactions change as we move through and encounter landscapes from our situated body. In addition, we must consider the social aspects of the experience, as the space we move through is not only a construct of sensory perception, but also of social perception (Tilley, 1997:11). This sensory exploration is temporal, 'in the moment', and so difficult to reproduce.

The use of computer technology in archaeological research, by contrast, offers us a number of advantages, not least the ability to create detailed models of possible pasts. By modelling a number of different variables we can test, tweak and change these variables to explore different hypothetical situations. If the first model does not appear to fit the facts on the ground, then the controlled environment of the computer allows the variables to be changed and the tests to be re-run, sometimes many thousands of times.[1] This is of course impossible in the 'real world', as conditions on site are unpredictable and constantly changing.

This dichotomy between heavily simplified computational analysis in a laboratory, disconnected from the sites themselves, and the irreplicable phenomenological analysis undertaken within the landscape, has not yet been resolved. This paper introduces a number of mixed reality technologies that offer an innovative and timely way to approach the problem and proposes a conceptual framework for exploring their differences.

In order to demonstrate these techniques I undertake a simple case study: an exploration of the Peel Gap Turret (Figure 1), a small section of Hadrian's Wall in Northumberland. The wall was built

[1] Although we must acknowledge that a computer model being run in the laboratory requires all of the variables to be either modelled or heavily simplified, as it is as yet impossible to create an acceptably accurate model of the whole world.

across the entirety of the narrowest part of the northern British Isles by the Roman Emperor Hadrian in AD 122, as an attempt to keep at bay the fierce and barbaric Caledonian tribes to the north and protect the interests of the Roman Empire to the south. Although the wall was intended as an impassable barrier, evidence shows that in fact, many of the regularly-spaced forts and milecastles were places of traversal and exchange, with large communities of citizens growing up around the larger military camps. The area around the Peel Gap comprises some of the highest sections of the wall, with the large granite cliffs and outcrops of the Whin Sill an obvious location for a military wall. The Peel Gap is a break in the geological formation, cutting through this natural barrier and is therefore a clear crossing point, one of the few in this section of the Wall.

Although most of the structures along Hadrian's Wall are built at exact intervals, the turret that sits in the 'Peel Gap' is a slightly later addition and does not fit neatly within the overall sequence. A number of explanations for this have been offered: including the distance between neighbouring turrets being too great (Crow, 1991:53); the neighbouring turrets being in positions that are unable to see and monitor the landscape of Peel Gap (Breeze, 2006:259); and the Peel Gap turret itself being so situated to enable visibility and communication with other elements of the Hadrian's Wall complex (such as the Military Way and the Stanegate, roads running parallel to the wall itself) (Wooliscroft, 2001:78; Gillings and Goodrick, 1996:37). These studies used various techniques to examine the turret placement, including excavation, field-based visibility studies (using surveying equipment) and a virtual reality model. However, as yet no phenomenological analysis has been undertaken. Therefore, due to this amount of previous work to build on (both landscape and computer-based) but a lack of phenomenological analysis, Peel Gap would seem to be a suitable place to explore the middle ground between computer-based and phenomenological explorations of landscape.

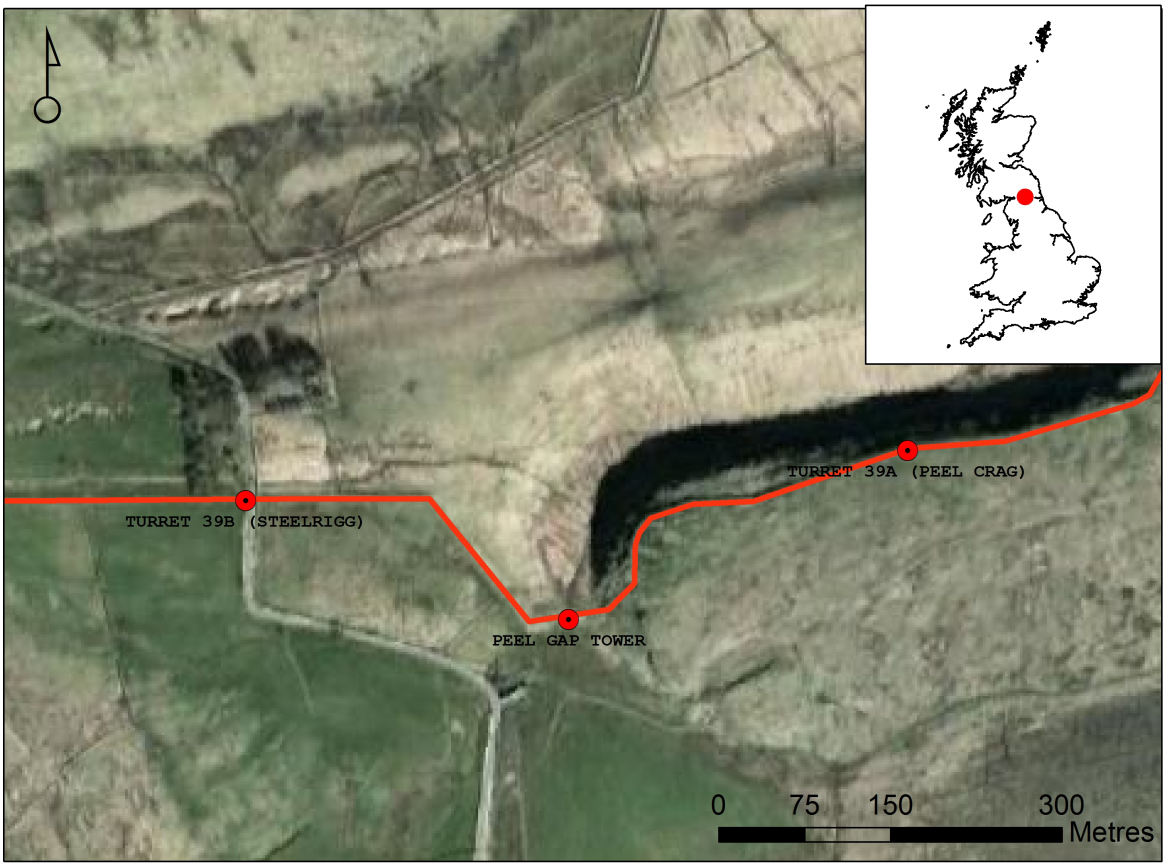
The Phenomenological Approach

In archaeology, 'phenomenology' has become a loaded term. Archaeological phenomenological practice has been criticised because in general, it lacks an explicit and rigorous practical methodology, is unscientific, and highly subjective (Hamilton et al., 2006:36) . Hamilton and Whitehouse have attempted to rectify this in their work on the Tavoliere plain (Hamilton et al., 2006) but the accusation can still be levelled at a number of published studies.

Phenomenological practitioners such as Barbara Bender, Sue Hamilton and Christopher Tilley have led the way in archaeology and anthropology (Bender, 1995; Tilley et al., 2000; Tilley, 1997; Hamilton et al., 2006; Bender et al., 2007). Their ground-breaking work on prehistoric landscapes brought phenomenological theory to the forefront of post-modern archaeological thought, and with it, a wider concern for 'thinking through the body' (Johnson, 1999:114). Their work was undertaken in a number of different ways, most involving an examination of modern-day embodied responses to sensory inputs, such as sight, and to a certain extent, sound. It is considered by some to be highly subjective, with the associated 'implication that phenomenology lacks methodology and is thus disqualified from serious consideration as a distinct archaeological approach' (Hamilton et al., 2006:32). Critics argue that by concentrating on the analysis of the embodied experience from the perspective of the archaeologist, we are merely recording the experience of the 'observer'. Hamilton et al responded thus, '[…] while the 'I' of the phenomenologist is resonant in descriptions of site experiences, the 'they' of past communities is rarely situated in the active tense'. Michael Shanks agreed, arguing that it is hard for the archaeologist to treat himself as 'a set of neutral algorithms for producing knowledge of the past' (Shanks, 2008:137).

However, some suggest that in fact, archaeologists have got it wrong, and '[…] have avoided the technical aspects of this philosophy [phenomenology] by simply using the term to label a particular approach towards the landscapes under study' (Barrett & Ko, 2009:276). A particularly salient point is that philosophical phenomenology (at least as argued by Edmund Husserl) is concerned with exploring the *essences* and *relations* of experiences but not necessarily the empirical study of one's own individual experiences *per se* (Smith & Thomasson, 2005:6). Husserl was interested in what the actual experience is in an abstract sense (not just how it feels) and how these experiences link to each other. Where contemporary archaeological phenomenologists have chosen to embrace their own emotional responses to experience as the key to getting closer to past experience, Husserlian phenomenology seeks to study experiences and their logical interrelations – *not* the actual sensuous experience itself. The recent concentration by archaeologists using phenomenology on the 'feel' of the experience rather than analysis of its constituent parts and its 'essence' reinforces the notion that the use of phenomenology is subjective and lacks clear methodology that is held by many of their contemporaries (Hamilton et al 2006:36). Hamilton et al attempt to correct this using a formal recording methodology (for an extended discussion on this see (2006:33-35)) however their work is the exception rather than the rule.

My own phenomenological analysis of the Peel Gap landscape involved visiting the site, approaching it from a number of different paths and at different times of day (morning, afternoon and evening), and recording my observations. I kept a video of each of my paths, shot using a forward-facing camera and recorded my observations in a field notebook. I recorded observations such as when the Gap became visible, when the milecastles on either side of the gap became visible, the weather conditions and the changing ground conditions. In this instance I did not keep a detailed recording sheet as I considered the notes detailed enough and the site small enough to make this unnecessary, however, if I was to undertake the analysis again or with a team of people then a more


TURRET 39A (PEEL CRAG)
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PEEL GAP TOWER
0
75
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formal recording methodology would be appropriate. In an attempt to make my analysis more complete, I also visited the fort at nearby Vindolanda, where there is a full-scale reconstruction of a section of Hadrian's Wall. Although it is not located at Peel Gap, or based on the exact dimensions of the turret, it is nevertheless useful as an exploration of interaction with the Wall as it would have been, rather than in its current, ruinous state. I therefore recorded my observations in the same way as the Peel Gap work as I approached and climbed the reconstruction. Although this might be considered a 'traditional' piece of archaeological phenomenology, my research attempts to broach the issues raised with phenomenological analysis in that I present my results later in this paper with reference to the 'Arc of Intentionality', a heuristic device developed from the study of Mixed Reality, to analyse the essence and constituent parts of the experience in a Husserlian manner.

Geographic Information Systems (GIS) and the Mixed Reality Approach

The moment we move out of the landscape and into the computer laboratory we lose the immediacy and perspective of being embodied in the space. However, computers allow us to conduct reproducible experiments, play with variables, and change conditions in a way that is not possible in the landscape itself. We can add natural or cultural landscape features and structures, change the topography, the lighting conditions and time of day. Once we have created our model we can run any number of experiments in it with empirical results that can be measured and compared and recreated by other archaeologists (see Fleming 2006:278). This limitless potential for experimentation and reproduction is of course impossible for phenomenological archaeologists working to understand ancient ways of being in the modern landscape.

A Geographic Information System (GIS) is the usual way of creating, manipulating and simulating space within a computer environment. GIS analysis usually involves the creation of a variety of 'sheds' – a computer representation of the area that can be *seen* from a specific location (viewshed) or the area in which one can *hear* church bells ringing (soundshed, Mlekuz 2004). Frieman and Gillings go on to suggest the creation of a global *senseshed* – calculated to represent the area in which all our senses are engaged. These 'sheds' allow experimentation and modelling, and have led to interesting conclusions about site placement and settlement patterns (Gillings 2009).

While this methodology can take account of more than just vision, it is difficult to see how this really changes our understanding of past perception. Instead, the people, settlements and sites exist within a mathematically-calculated sensory bubble – but no account is taken of other aspects that need to be addressed to create a fully phenomenological picture: including the intra- and inter-site social ties, the unknown connections people have with the world surrounding them, or the indeterminate features of their world outside simply sensory inputs. We need a way to marry the advantages of computer-based analysis (simulation, prediction, etc.) with embodiment (being able to travel through and experience the landscape from a situated perspective). Emerging technologies using mixed-reality can go some way to bridging this divide.

What is Mixed Reality (MR)?

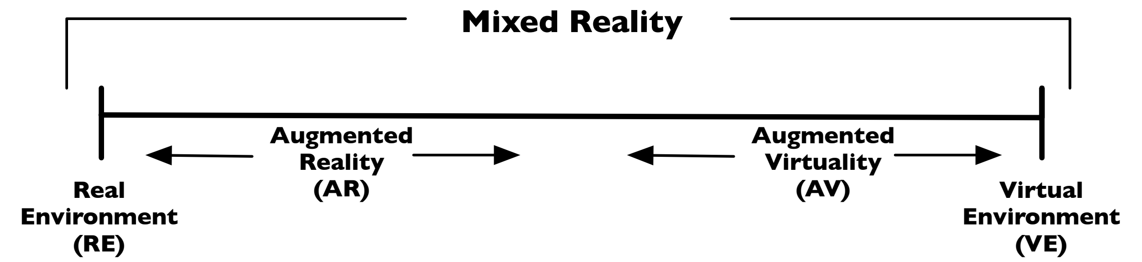
Virtual Reality (VR) has become a mainstream term for referring to the creation and manipulation of a virtual world within a computer environment. VR has been applied to a number of projects in the heritage sector, mainly relating to the virtual reconstruction of past monuments or landscapes (Renfrew 1997). Some scholars have suggested that use of VR may be the paradigm shift that is needed in GIS studies, enabling an entire 3D landscape to be created and analysed (Neves and Camara 2005).

However, the term 'Virtual Reality' now really only covers one aspect of so-called virtuality. As technology has advanced, it is possible to merge computer-generated 'reality' with the real world: creating *Mixed Reality* (Ohta & Tamura, 1999). Milgram et al (1994) created a scale of virtuality (the Reality-Virtuality continuum) that will be helpful to elaborate on here (Figure 2).

The scale runs from the Real Environment (RE) through Augmented Reality (AR), Augmented Virtuality (AV) to a full Virtual Environment (VE). Virtual Reality is no longer the only alternative to real life: it is instead the polar opposite to full or 'Real Reality', with many dimensions in between. Augmented Reality makes it possible to incorporate virtual elements directly into the Real World. Augmented Reality '[…] allows a user to work in a real world environment while visually receiving additional computer-generated or modelled information to support the task at hand' (Schnabel et al, 2007:4). This normally involves overlaying virtual objects onto live video feed from either a web-camera, a Head-Mounted Display (HMD) or a mobile device. There are a wide number of applications of this technology: interactive greeting cards (Hallmark, 2010), advertising (such as interactive brochures allowing you to test 'drive' a car (Citroen, 2010)), visualisation of computer-generated GIS data overlaid onto actual locations (Ghadirian & Bishop, 2008), indoor and outdoor gaming (Bernardes et al., 2008), even heads-up displays in modern aircraft are a form of Augmented Reality – projecting information onto the pilot's display.

The importance of Augmented Reality for archaeology is that it makes possible the *combination* of virtual elements with the real world, without necessarily making them the focus of activity, whereas in Virtual Reality, the experience is predicated on the fact that one enters an entire virtual world to the *exclusion* of Real Reality.

As I will demonstrate, a pertinent application of this is the ability to take a device such as a modern mobile telephone to a heritage site, and, by use of the telephone's in-built GPS and video camera, display reconstructions or information about the site directly over the remains at which one is

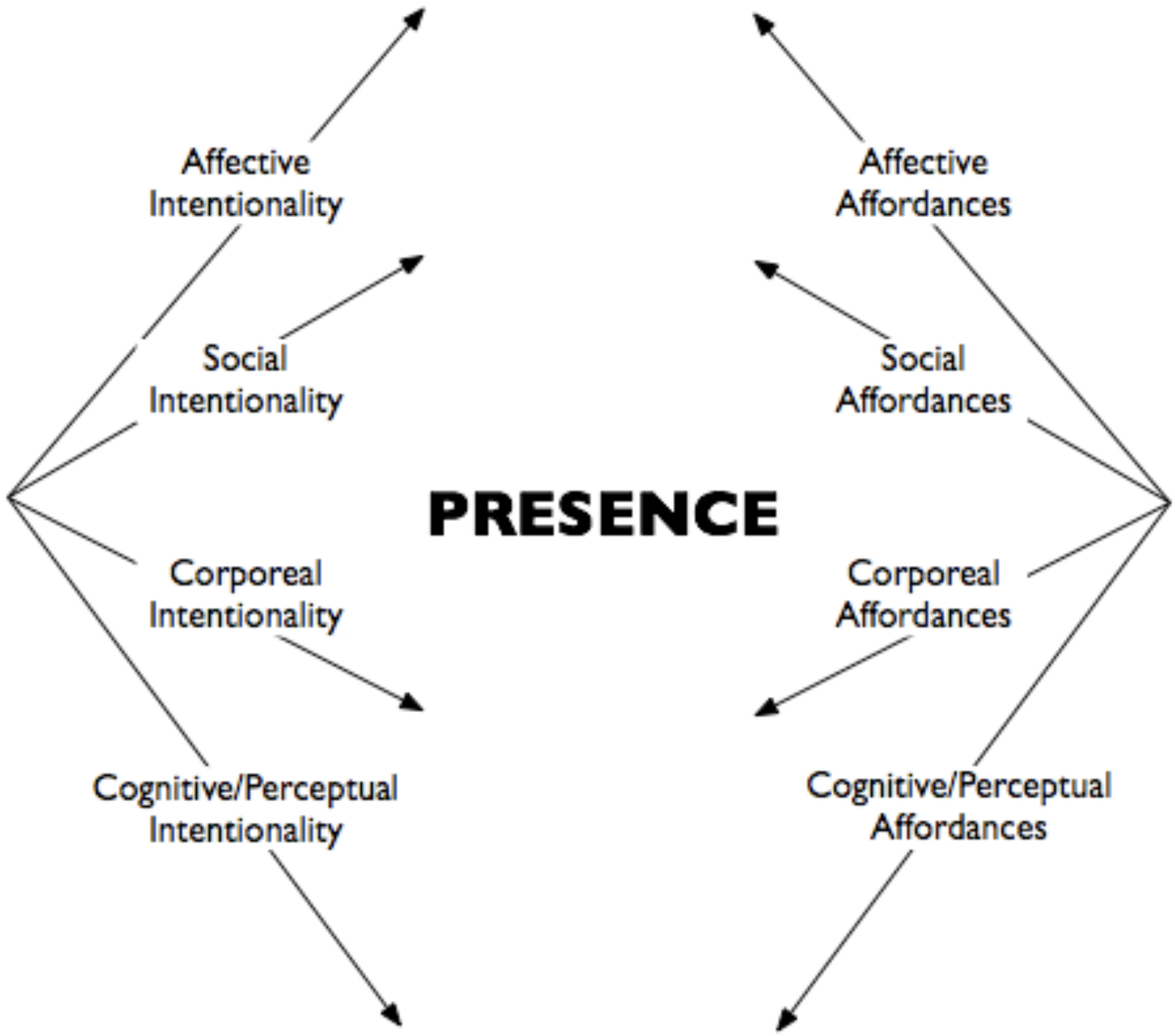

Mixed Reality
Augmented Reality (AR)
Augmented Virtuality (AV)
Real Environment (RE)
Virtual Environment (VE)

looking. For instance, one is able to point the telephone's camera at a stub of *real* Roman wall and see the *virtual* reconstruction of that wall at full height. It is then possible to walk around the site in the real world and view that virtual reconstruction from different angles and distances, and even to change the reconstruction to experiment with different colours, designs, heights, and so on. It is also possible to deliver location-dependent sound through attached headphones. The virtual data is held within standard GIS software and so can be manipulated in the normal way, but also viewed and experienced within an embodied environment. Technological development is moving at an incredible rate, and already it is possible to wear transparent glasses with forward-facing cameras to overlay the AR information directly onto your field of vision, rather than having to use a portable handheld device such as a mobile telephone. As this develops further, this will go some way towards mitigating the disconnectedness of having to hold up a mobile device in order to experience the virtual objects.

Much interest has been garnered by the role of embodiment and perception within AR. In the computing sphere and the majority of AR literature, the concept of 'presence' is much discussed (Heeter, 1992; Wagner et al., 2009; Witmer & Singer, 1998; Zahorik & Jenison, 1998; Pujol and Champion 2011). This has stemmed from early discussions of telepresence and immersion by the VR community, where one of the overriding aims of creating an 'authentic' immersive experience was the re-creation of a 'feeling of being there' (Heeter, 1992). This feeling of *presence* – 'being in the world' – is particularly pertinent in light of our earlier discussion of phenomenology. Presence is subjective and psychological as well as objective and physical (Slater & Steed 2000). Ditton and Lombard (1997) argue that presence can be divided into *social* and *perceptual* realism: every part of the experience needs to feel 'correct' or 'real' - including the social interactions - in order for a feeling of presence to be maintained.

Although difficult to define precisely, most agree that 'presence' means the perceptual illusion of non-mediation, and the 'user' acting in a mediated environment *as if the mediation is not there*. That is, they behave the same way in a virtual or augmented environment as they do in the real world (see Sylaiou et al 2010). For our purposes, a particularly pertinent exploration of presence is undertaken by Phil Turner (2007). Using the concept of Gibsonian affordances (Gibson 1977), Turner explores how presence can be maintained within a 'synthetic' environment or set of objects. His work encompasses both phenomenological study of the embodied self and the individual's relationship with the surrounding environment. He presents an 'intentional arc' which brings together the embodied being and the environment and is a useful way of analysing the level of presence felt in an Augmented Reality experience.

The Arc of Intentionality (AoI) (FIGURE 3)


Affective Intentionality
Social Intentionality
Corporeal Intentionality
Cognitive/Perceptual Intentionality
PRESENCE
Affective Affordances
Social Affordances
Corporeal Affordances
Cognitive/Perceptual Affordances

Turner builds on the concepts of social and perceptual realism put forward by Ditton and Lombard (1997), outlining four types of *intentionality* (defined as internal, psychological, embodied experiences), all of which are coupled with external events, things and people (described as affordances). Together these form a so-called 'arc of intentionality', comprising:

Corporeal Intentionality: This describes the notion that while our corporeal body moves, it is our *perception* of this movement that creates the world around us. In this way the world *affords* us opportunities; the coffee cup's handle *affords* grasping.

Social Intentionality: described as our ability as social animals to predict, relate to and attribute mental states to others and to ourselves. It has been argued that it is this ability that enables us to create and maintain complex social relationships (see Humphrey 1976). This can be thought of as our ability to 'anticipate the behaviour and intentions of others' (Turner 2007:129) - the behaviour of other people gives us *cultural affordances* that we interpret and react to.

Affective Intentionality: this refers to the feeling of our own body and its relationship to our mental state. This is a combination of the bodily responses to external and internal stimuli (affordances) and the mental states produced as a consequence. Confronted by an axe-wielding maniac, the mind and body command you to run for your life. The associated physical consequences, such as a pounding heart, breathlessness, and kick of adrenaline, all contribute to the mental state of being afraid. As Turner explains, 'the association of characteristic bodily states with hypothetical experiences and responses establishes a connection between the emotion and the world (that was or might have been)' (Turner 2007:129).

Cognitive/Perceptual Intentionality: this is set out as the interplay between action and thought. Our perceptual senses are directed at the external world – the information they collect is about things and events in the world (Turner, 2007:130). However, this perceptual sense is also closely connected to the way in which we move and the actions we perform. We would not be able to walk successfully across a city without adjusting to the constant perceptual inputs. Turner therefore suggests that this interplay is of note and is important in assessing presence.

This Arc of Intentionality must be maintained if one is to experience a sense of presence in any of the environments proposed on Milgram et al's scale (Figure 2). How well the arc is maintained will govern how well one receives the virtual information. For instance, if a knife is augmented into a real-world scene, it must afford us the same characteristics as it would if it were a real object. This means one would expect to see light glinting from the blade (the surface affording reflection), would expect to be able to pick it up (the handle affording grasping), and would expect it to be able to cut another object (the blade affording slicing). In addition, if one were to pick it up and use it violently on another person, one would expect to have the same feeling of horror or guilt as if it were real (the use of the knife in that social context affording those emotions).

If all these affordances tally with the state of one's intentionality, then the arc is maintained. However, if something does not quite fit (for instance, the light reflects oddly) then the arc is broken and there is a jarring in our experience. Turner refers to this as a Break in Presence (BiP) (Turner, 2007:132). This is not confined to virtual experiences – for instance if I pull the trigger of what I believe to be a real gun and find it is in fact a cigarette lighter – I am jarred in the same way. I then learn that this is a special type of gun with a different set of affordances and know better next time. Therefore, it is possible to learn how to use new objects within a virtual environment: although the augmented knife may not look anything like a knife (creating a BiP from its visual affordances), but it may cut virtual objects as a real knife does – thereby satisfying other aspects of the expected (or learned) affordances of a knife.

By using the Arc of Intentionality to measure presence felt during an experience we are better placed to judge where and why these BiPs occur and to think about what this means. For example, if the aim of a project is to create a fully-immersive environment where the virtual world is indistinguishable in every way from the real world (full VR) then *any* BiPs would impact heavily. However, if the aim is to create an augmented virtual meeting room (with real and virtual representations of the participants) – then the arc could be stretched a little and only certain affordances (such as those affording cultural/social interactions) would be necessary to get exactly right – other aspects (such as the recreation of the virtual meeting room décor) could be seen as secondary. These 'secondary' aspects could then be isolated, discussed and acknowledged. There are complementary ways of identifying and investigating the level of presence of an experience, such as monitoring physiological effects (i.e. increased heart-rate or sweating) and partaking in structured questionnaires (although see Slater 2004 for a critique of this) and a full investigation of presence would benefit from a combination of approaches.

The Arc of Intentionality fits the aims of true phenomenological investigation to explore the essence and inter-relationships of experience. Using the clear methodology and clear language of the Arc of Intentionality, we are able to dissect an experience and examine its constituent parts.

Case Study: Peel Gap and the Arc of Intentionality

To illustrate these arguments, I now compare three different methods for exploring the landscape of Peel Gap: one wholly computer-based, one traditional phenomenological, and one augmented reality. I use the AoI to frame and present the results. I examine each of the four categories of intentionality as outlined by Turner (corporeal, social, affective and cognitive) in relation to each reconstruction and what this means for the level of presence achieved by each method. By distinguishing where the obvious Breaks in Presence (BiPs) occur, the experience itself can be examined, pulled apart and either improved or the BiPs acknowledged and ignored.

Experiment 1: 'Virtual Reality' using a gaming engine

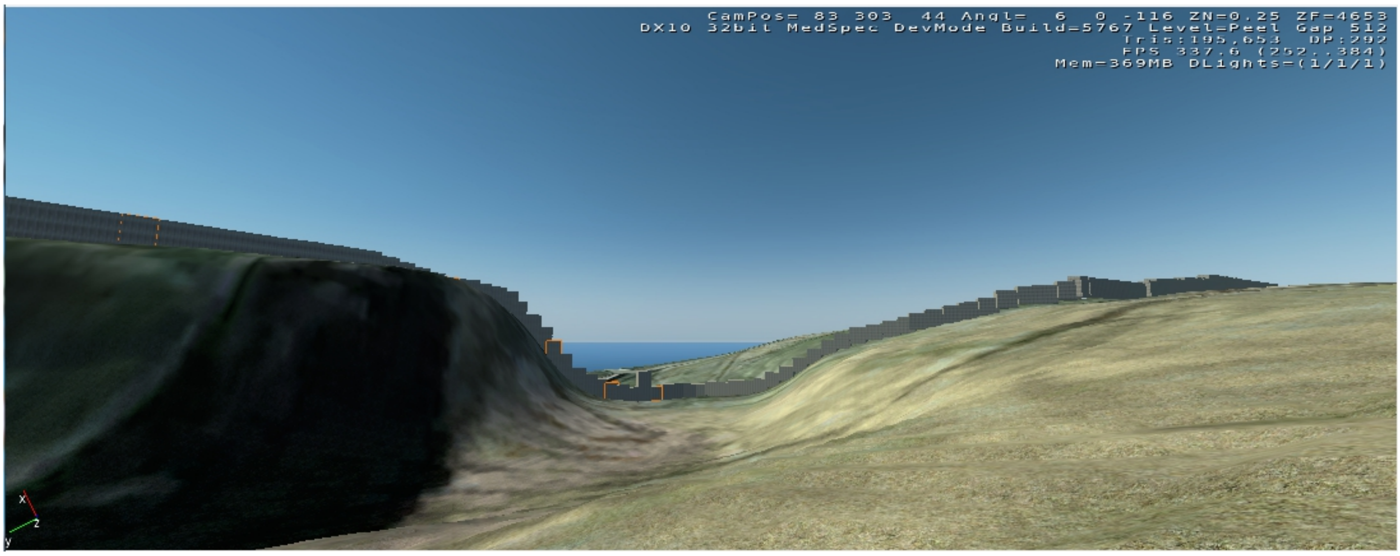
Gillings and Goodrick were early adopters of Virtual Reality in archaeology and in 1996 used the Virtual Reality Modelling Language (VRML) and the Fountain Modelling package to explore the 3D surface of Peel Gap. I have upgraded this analysis by using the Crysis 3D gaming engine. Although essentially the same concept, I have used a modern gaming engine to provide the 'sensual communication' part of their analysis. The Crysis CryEngine2 (Crytek, n.d.) editor allows 1:1 virtual reconstructions of environments with photorealistic modelling and a physics engine to accurately simulate the physics of the real-world. Originally designed for a video-game, the engine has been used successfully in a number of 'serious game' applications, including in heritage (Stone et al., 2009). The physics model allows the user to walk around the virtual environment as if they were an average height male[2], and there are realistic restrictions on jumping heights and the level of slope that can be walked up. I imported the Digital Elevation Model used by Gillings and Goodrick and a modern satellite image of Peel Gap into CryEngine2 and built a simple model indicating the position of the turret and Hadrian's Wall. Although not hyper-realistic, the initial model gives a good impression of the technique and serves as a useful update to Gilling and Goodrick's VRML model (Figure 4). I used the Arc of Intentionality to assess the level of presence achieved:

Corporeal - The gaming engine allows movement around the reconstructed Peel Gap environment. While this does not include any kind of feedback from the haptic affordances (for instance the feeling of grass under the feet, or being able to touch the fabric of the wall) the visual affordances are well-represented. Our character can walk up the slight slopes, but is denied the possibility for clambering up the crag itself (which in reality requires using the hands for support).

By virtually walking around the environment the world changes around us and we are afforded the changing views and encounters. The walls and towers can be turned on and off, to see how the environment changes with them present and without. It is possible to programme birds singing, or distant shouts from nearby turrets. We can add anything to the environment, so can insert animals or other humans. However, the confinement of the movement to the computer screen and the movement necessarily being enacted with the use of a mouse and keyboard creates a Break in Presence, meaning that we see this experience as a simulation.

Social - While the relatively simple model does not allow any experience of the social affordances, it would be possible to create a multiplayer environment, where other people could also play characters. However, at this present time, the social aspects are not represented. The lack of social

[2] That the 'player' is assumed to be an average height male implies a number of things about the user and the situation. This height value can (and should) be changed dependent on the user.


CamPos= 83 303 44 Angl= 6 0 -116 ZN=0.25 ZF=4653
DX10 32bit MedSpec DevMode Build=5767 Level=Peel Gap 512
Tris:195,653 DP:292
FPS 337.6 (252..384)
Mem=369MB DLights=(1/1/1)

interaction therefore is a BiP.

Affective - Video games do have the ability to elicit emotional responses, although this is normally due to developing storylines or engagement with the characters within them. When playing games we do experience excitement, surprise or fear. The development of this scenario into a fully-fledged computer game, involving a back-story, the adoption of an in-game character, and so on may well create the possibility of simulating the affective affordances and reactions to them.

Cognitive/Perceptual - The ability to move through the landscape offers us a number of different ways to cognitively involve ourselves with the environment. It is easy to change our viewpoint and explore the landscape. By allowing interactive simulation and changing of the environment's parameters it is possible to test different hypotheses. Whereas the perceptual inputs are restricted to vision and sound, we can still use these to engage with the model.

INSERT TABLE 1

As can be seen in Table 1, the gaming-engine creates a number of significant BiPs, although some of these would be mitigated by deploying the virtual reconstruction within a fully immersive VR environment (using goggles and VR gloves, etc.). However, it demonstrates that a simple VR reconstruction does not allow a fully embodied engagement with the past. The VR reconstruction does have the advantage of being a perfect environment for experimentation, enabling any number of different scenarios to be reconstructed and examined.

Experiment 2: Real-Life Reconstruction

The fort at Vindolanda, a few miles from Peel Gap, has a full-scale reconstruction of a section of Hadrian's Wall. Although not at the actual location of the Peel Gap turret, or based on its exact dimensions, it allows us to experience the original scale of the Wall. I visited the site and recorded my observations as I approached and also as I climbed the reconstruction (see previous discussion for my recording methodology).

Corporeal – Real-life reconstructions allow a complete experience of the corporeal affordances within the present environment. By being able to walk around the reconstruction we can feel the grit on the stairs, hear and feel the wind on the parapet, and the physiological aspects of climbing the monument are present. We have full sensory engagement. However, as the reconstruction (at Vindolanda at least) was not in the correct position for this study, we are left with an embodied experience of the *reconstruction,* and not how it relates to the landscape of Peel Gap.

Social - There is no engagement with the 'Roman' social affordances, however there is naturally engagement with the other people who are visiting the site. If we and these other people were 'playing a role' we might reduce the feeling of the social BiPs, but it would be difficult to argue that

we were feeling the 'real' Roman or British social affordances.

Affective - Due to the nature of the embodied experience we are aware of a number of the natural affective affordances of the environment. The height of the turret can give us vertigo, and we feel the claustrophobic effect of the confined space of the interior of the turret as we climb. There is no 'authentic' smell, although the mustiness of the reconstruction evokes a certain atmosphere.

Cognitive/Perceptual - The power of the reconstruction lies in the full embodied experience. By walking up the turret and along the wall we can easily engage with the past experience and it allows us to vividly imagine what it may have been like, for instance, to stand looking over the parapet at an advancing army. By using reconstructions we can also assess the practicality of modern ideas about Roman architecture (e.g. did the Wall have a wall-walk? And if it did, how would the whole construction have fitted together?).

INSERT TABLE 2

As we can see from table 2, the real-life reconstruction affords a great feeling of presence, it is a fully-engaged embodied experience and the corporeal and affective elements of the AoI are well satisfied. There are, however, serious social BiPs and the fact that the reconstruction is not of the correct dimensions or in Peel Gap impacts on the cognitive aspects of the experience. In addition, a real-life reconstruction is an expensive undertaking – allowing only one interpretation, one phase of building, and there is little scope for experimentation.

Experiment 3: Augmented Reality

In 2005 Michael Shanks described Augmented Reality as having the potential to design enriched learning encounters. 'Archaeologists are in relationship with what is left of the past. These are relationships that have no necessary end because any artifact made of the past is only ever the provisional outcome of a particular encounter' (Shanks 2005). While AR applications are currently being used at some heritage sites (Archeoguide 2010) these are mostly aimed at enriching the tourist experience and have not yet been used to explore past experience or approach archaeological research questions.

Augmented Reality allows the experience of *virtual* objects within the *real* world. By using the ARToolkit (ARToolKit 2010) and a fiducial marker to act as a physical anchor for the virtual objects in the real world, I created an AR application that allowed me to examine a simple 3D model illustrating the dimensions of the turret and the attached wall within the modern landscape. First, a paper marker is placed in the landscape on the remains of the Peel Gap turret. When a video camera is pointed at the marker the live feed is analysed by the application and the marker replaced with a 3D reconstruction of the turret, overlaid onto the video feed. The computer or smartphone screen therefore acts as a kind of magic mirror that allows a view into the virtual world and a view of the virtual objects, but still maintains the connection to the real world. In addition the inbuilt GPS receiver recognises where the observer is standing and can play appropriate sounds (such as distant shouts) dependent on the location.

Corporeal - Augmented Reality allows a complete experience of the corporeal affordances within the present environment. By walking around the landscape itself, in real time, all of the affordances of the landscape can be experienced and interpreted. We feel the ground, hear and feel the wind, and the physiological aspects of walking around the landscape are present. We have full sensory engagement.

When introducing the virtual elements, such as the sounds that are activated dependent on location, and the view of the virtual turret – we certainly feel a Break in Presence, not least because currently it is necessary to look through a handheld device to experience the additional visual affordances. These BiPs will be mitigated in the future by the use of AR glasses, or a non-intrusive headset. Sounds are delivered through a pair of headphones, and therefore do not feel or sound completely natural.

It should be noted that there is currently little possibility of allowing haptic engagement with the virtual objects, that is, it is not possible to climb the stairs in the turret or experience the environment from the top of it. However, by combining real and virtual objects, for example, by constructing a scaffolding tower virtually 'painted' to appear as a Roman turret, this BiP could be reduced.

Social – Although there is no engagement with the 'Roman' social affordances, because we are experiencing the virtual objects directly within the physical space, there is naturally engagement with the other people who are visiting the area. In addition, it would be possible for more than one person to experience the same virtual objects at the same time, and there is scope for multi-user engagement. It would also be possible to combine real-life people with the virtual objects – meaning that the BiPs may be reduced as interaction with a real human being is more natural than with a computer-generated artificially intelligent character, especially if that person is seeing and interacting with the same virtual objects as the observer. However, as with the previous experiments it would be problematic to conclude that we are close to experiencing the social affordances of the past society. Therefore there is a large social BiP.

Affective - Due to the nature of the embodied experience we are aware of a number of the natural affective affordances of the environment. For example, when standing at the edge of the Peel Crag we feel real vertigo. In a more abstract sense, by being in the real landscape we have more of an ability to imagine what we might feel if we were stationed on Hadrian's Wall; standing in Peel Gap in the pouring rain and howling wind is certainly very evocative.

Cognitive/Perceptual - AR offers a number of ways to cognitively involve ourselves with the environment. As with the gaming engine we can move around the landscape and change the parameters of the virtual objects on-the-fly. However, as we are standing in reality, there are no edges, and no limits on where we can and cannot go (beyond those set by our corporeal and social interaction with the affordances of the physical and social environment). We have the world as a playground and can virtually insert anything into it. This allows many opportunities not only to engage cognitively with our perception of the real world, but also the virtual world as well.

INSERT TABLE 3

While AR necessarily has BiPs, for example, the visual and auditory experience of the virtual objects, it allows us a degree of exploration and experimentation not possible with the real-life reconstructions. The reconstruction (at least at Vindolanda) is not situated in the exact location of interest, and it is a snapshot of a single individual's vision of a section of wall, that is very expensive and difficult to change or remodel. By contrast, the AR model can be changed relatively easily and potentially can be combined with real-life elements, for example by reusing as much as possible of the current standing remains – or by building simple scaffolding structures that can then be augmented.

Discussion of the Experiments

As outlined in the introduction, there have been a number of reasons posited for the placement of Peel Gap turret, such as the great distance between neighbouring turrets; the neighbouring turrets not being able to see Peel Gap itself ; and the turret being placed for visibility and communication with other elements of the Hadrian's Wall complex. Due to the inherent military nature and construction of Hadrian's Wall the three possibilities for the turret placement are functionalist and heavily reliant on visibility studies – and indeed it is likely that the reason for the placement is one (or a combination) of these possibilities. However, it is important to note that Crow, Breeze and Woolliscroft do not take any account of the encounter of the turret in the landscape from an embodied perspective, instead they are concerned purely with the views from and to the turret itself. The use of Augmented Reality does not preclude or displace any of these former approaches, instead it adds an extra dimension to the previous interpretations. It allows the user to explore the reasons for the turret placement in the field and test those assumptions in the real world. By combining the visibility data with the fabric of the real world the phenomenological aspects of the turret placement can also be explored – was it possible to hide in the landscape in a place not visible from Peel Gap? Would it be possible to sneak up on the turret itself? How would a continuous wall stretching across the landscape make you feel as you approached it? How does this change with and without the presence of the tower in Peel Gap? How would the views change if the turrets were taller or shorter? By using AR it is possible to ask phenomenological questions such as these as well as and complementing the data that we gain from the more global analyses previously undertaken.

The social affordances for each of the experiments created problematic BiPs and currently it may in fact be impossible to move through the landscape as if in the body of a social individual from a past society, a Roman centurion, say, or an indigenous camp follower, or a child in a Romano-British village beyond the Wall. It may only be possible instead to investigate the social aspects using modern 'actors' such as the work by Hamilton et al in the Tavoliere Plain (2006), where they, for instance, investigated the distance that voices or shouts could be heard in various different conditions. This does not get us much closer to the *cultural* affordances of past social individuals however and therefore is an example of the utility of the Arc of Intentionality, in that we can acknowledge the social BiPs and either devise a methodology to resolve them or alternatively accept that they are insuperable and ignore them at this time. The important thing is to identify the BiPs so that the condition of the experiment is recorded and future researchers can come back to the analysis once the technology or method has developed enough to be able to tackle the BiPs.

As I have shown, the AR approach combines a relatively low-cost approach (compared with a full-scale reconstruction) with a manageable level of BiPs that results in an excellent compromise between a fully computer-based and a fully-phenomenological analysis of the turret. It is now possible to combine the approaches and take the best parts of both, which can only result in a richer interpretation of the archaeological site.

Conclusion

Over the last 20 years, theory and practice in archaeological phenomenology and archaeological GIS have been moving forwards at a fantastic rate – unfortunately however, they have largely been moving in opposite directions. Despite some attempts at uniting the two (Llobera 1996; Hamilton et al. 2006; Frieman & Gillings 2007) the disconnect between computer-based analysis and phenomenological fieldwork has rarely been greater.

I suggest that phenomenological approaches in archaeology have developed away from Husserl's original ideas, with more emphasis laid on the *content* of the experience, rather than the *structure* of the experience. By concentrating instead on the structure of the experience, analysing what makes it ‘feel right’ and why, we can better design our augmented phenomenological investigation. By identifying the Breaks in Presence of an experience, we can identify which parts of the experience are not needed, parts we need to change or parts that are irrelevant. The BiPs can be used as a common language across computer-based and phenomenological experiments and the conceptual framework can be used to evaluate the strengths and weaknesses of each approach.

This paper presents the initial results of my own subjective phenomenological investigation of Peel Gap and a re-examination of previous Virtual Reality approaches. The next stage in the project is to use the concept of BiPs and Augmented Phenomenological Investigation with a group of sample users, using a clearly defined recording sheet on a range of different sites. The experiments can then be re-run by different practitioners (with different technologies and approaches) and the same BiPs can be considered, discussed, and perhaps resolved. BiPs provide a much-needed way to record the conditions of the experiment and so the conditions of the discussed experience.

The new opportunities offered by using Augmented Reality provide a timely way to combine the strengths of a computer-based approach (reproducibility, experimentation, computer reconstruction) with archaeological phenomenology (embodied experience in the field). The addition of Augmented Reality to phenomenological investigation means we are able to weave new experiences using any kind of virtual object (building reconstructions, vegetation, artwork, stone circles) but embed them firmly (and seamlessly) within the real world, share them with other users in our augmented world and refine them enough to be able to undertake real archaeological research into the past experience of the people that inhabited the archaeological site in question. The same virtual elements can be re-used in any number of different experiments by any number of different practitioners, and the BiPs can be used as a common language to compare and contrast the experiments.

Any type of geographically-located information can be augmented into the real landscape, thereby allowing GIS practitioners to take their previous ‘god’s-eye-view' of the landscape and create what might be considered an *embodied* GIS, where the data can be explored and experienced in real time and in the real location. Although more research and fieldwork needs to be undertaken before the potential of this technology is fully realised, it nevertheless seems to offer a logical step forward in beginning to resolve the current office-based computer analysis vs fieldwork-based phenomenological stalemate.

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References Cited

Archeoguide (2010) 'ARCHEOGUIDE'. http://archeoguide.intranet.gr/. Accessed April 2010.

ARToolKit (2010). 'ARToolKit Home Page'. http://www.hitl.washington.edu/artoolkit/. Accessed April 2010.

Barrett, J.C. & Ko, I. (2009). A phenomenology of landscape: A crisis in British landscape archaeology? Journal of Social Archaeology 9, 275-294.

Bender, B. (1995). Landscape: Politics and Perspectives. Oxford: Berg Publishers.

Bender, B., Hamilton, S. & Tilley, C. (2007). Stone Worlds: Narrative and Reflexivity in Landscape Archaeology. Left Coast Press, California.

Bernardes, J. (2008). Augmented Reality Games. In O. Leino, H. Wirman, & A. Fernandez (Eds.) Extending Experiences. Lapland University Press.

Breeze, D.J.,(2006). J. Collingwood Bruce's Handbook to the Roman Wall 14th ed. Society of Antiquaries of Newcastle upon Tyne.

Citroen, (2010). 'NEW CITROËN DS3 official website'. http://www.ds3.citroen.com/uk/#/virtual-reality/. Accessed January 2010.

Crow, J.G. (1991). A Review of Current Research on the Turrets and Curtain of Hadrian's Wall'. Britannia 22, 51-63.

Crytek, (2010). 'Crytek | CryENGINE2' http://www.cryengine2.com/. Accessed April 2010.

Fleming, A. (2006).'Post-processual Landscape Archaeology: a Critique. Cambridge Archaeological Journal 16(03), 267.

Frieman, C. & Gillings, M. (2007). Seeing is perceiving?World Archaeology 39(1),4.

Gaffney, V., Stancic, Z. & Watson, H. (1996). Moving from Catchments to Cognition: Tentative Steps Toward a Larger Archaeological Context for GIS Anthropology. In M. S. Aldenderfer & H. D. G. Maschner (Eds.), Anthropology, space, and geographic information systems, (pp. 132-154). Oxford University Press US.

Ghadirian, P. & Bishop, I.D. (2008) Integration of augmented reality and GIS: A new approach to realistic landscape visualisation. Landscape and Urban Planning 86(3-4),226-232.

Gibson, JJ. (1977) The Theory of Affordances. In R. Shaw and J. Bransford (Eds.), Perceiving, Acting, and Knowing (pp. 67-82). Lawrence Erlbaum, US.

Gillings, M. & Goodrick, G. (1996) Sensuous and Reflexive GIS Exploring Visualisation and VRML. Internet Archaeology 1(1).

Gillings, M. (2009). Visual Affordance, Landscape, And the Megaliths of Alderney. Oxford Journal of Archaeology 28(4), 335-356.

Hallmark, (2010). Hallmark | Augmented Reality.

http://www.hallmark.com/webapp/wcs/stores/servlet/article%7C10001%7C10051%7C/HallmarkSite/Cards/AUGMENTED_REALITY. Accessed January 2010.

Hamilton, S. & Whitehouse R. (2006). Phenomenology in Practice: Towards a p Methodology for a `Subjective' Approach. European Journal of Archaeology 9(1), 31-71.

Heeter, C. (1992). Being there: The subjective experience of presence.Presence: Teleoperators & Virtual Environments 1(2), 262-271.

Humphrey, N. (1976). The social function of intellect.In P. P. G. Bateson & R. A. Hinde (Eds.) Growing Points in Ethology (pp. 303-317). Cambridge University Press.

Johnson, M. (1999). Archaeological Theory: An Introduction. WileyBlackwell.

Kelly, S. (2003). 'Edmund Husserl and Phenomenology. In R. Soloman & D. Sherman (Eds.) The Blackwell Guide to Continental Philosophy (pp. 112-142). Oxford: Blackwell.

Lake, M.W. & Woodman, P.E. (2003). Visibility studies in archaeology: a review and case study. Environment and Planning B: Planning and Design 30(5),689-707.

Llobera, M. (1996). Exploring the topography of mind: GIS, social space and archaeology. Antiquity 70(269), 612-622.

Lombard, M. and T. Ditton (1997). At the heart of it all: The concept of presence. Journal of Computer-Mediated Communication 3(2).

Merleau-Ponty, M. (2002). Phenomenology of perception. Routledge.

Milgram, P. Takemura, H., Utsumi, A. & Kishino, F. (1994). Augmented-Reality: A class of displays on the reality-virtuality continuum. Proceedings of Telemanipulator and Telepresence Technologies 2531,282-292.

Mlekuz, D. (2004). Listening to Landscapes: Modelling Past Soundscapes in GIS. Internet Archaeology 16.

Neves, J. & Camara A. (2005). Virtual Environments and GIS. In P.A. Longley, M.F. Goodchild, D.J. Maguire & D.W. Rhind (Eds.) Geographical Information Systems – Principles, Techniques. Management and Applications (pp. 557-565). Wiley.

Ohta, Y. & Tamura, H. (1999). Mixed Reality: Merging Real and Virtual Worlds. Springer.

Pujol, L. & Champion, E. (2011). Evaluating presence in cultural heritage projects. *International Journal of Heritage Studies*, 18(1), pp.83–102.

Renfrew, C. (1997). Virtual Archaeology. London: Thames & Hudson Ltd.

Schnabel, M.A. et al., (2007). From Virtuality to Reality and Back. In Proceedings of the IASDR 2007 Conference. International Association of Societies of Design Research. Seoul, Korea.

Shanks, M. (2005). 'The science question in archaeology'. http://documents.stanford.edu/michaelshanks/77. Accessed September 2009.

Shanks, M. (2008). Post-Processual Archaeology and After. In R. A. Bentley, H. Maschner, & C. Chippindale (Eds.) Handbook of Archaeological Theories (pp. 133-147). New York: AltaMira Press.

Slater, M. (2004). How Colorful Was Your Day? Why Questionnaires Cannot Assess Presence in Virtual Environments. Presence: Teleoperators and Virtual Environments 13(4),484-493.

Slater, M. & Steed, A. (2000). A Virtual Presence Counter. Presence: Teleoperators and Virtual Environments 9(5), 413-434.

Smith, D.W. & Thomasson, A. (2005). Introduction. In D. W. Smith & A. Thomasson, (Eds.) Phenomenology and Philosophy of Mind (pp. 1-15). Oxford: Clarendon Press.

Stone, R. et al. (2009). The Virtual Scylla: an exploration of "serious games", artificial life and simulation complexity. Virtual Reality 13(1),13-25.

Sylaiou, S., Mania, K.,Karoulis,A. & White, M. (2010). Exploring the relationship between presence and enjoyment in a virtual museum. International Journal of Human-Computer Studies 68(5),243-253.

Thomas, J. (2008). On the ocularcentrism of archaeology. In V. Jorge & J. Thomas (Eds.) Archaeology And The Politics Of Vision In A Post-Modern Context (pp. 1-12). Cambridge:Cambridge Scholars Publishing.

Tilley, C. (1997). A Phenomenology of Landscape: Places, Paths and Monuments. Oxford: Berg Publishers.

Tilley, C., Hamilton, S. & Bender, B. (2000). Art and the Re-Presentation of the Past. The Journal of the Royal Anthropological Institute 6(1), 35-62.

Turner, P. (2007). The Intentional Basis of Presence. In Proceedings of the 10th Annual International Workshop on Presence (pp.127-134).

Wagner, I., Broll, W., Jacucci, G., Kuutli, K., McCall, R., Morrison, A., Schmalsteig, D. & Terrin, JJ. (2009). On the Role of Presence in Mixed Reality. Presence: Teleoperators & Virtual Environments 18(4),249-276.

Witmer, B.G. & Singer, M.J. (1998). Measuring Presence in Virtual Environments: A Presence Questionnaire. Presence: Teleoperators & Virtual Environments 7(3),225-240.

Woolliscroft, D., (2001). Roman Military Signaling. London: NPI Media Group.

Zahorik, P. & Jenison, R.L. (1998). Presence as Being-in-the-World. Presence: Teleoperators & Virtual Environments 7(1),78-89.