Interpreting Rock Art from afar: the potential for disseminating heritage through enhanced digital media and simulation

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Abstract

The interpretation of petroglyph/pictograph sites has become increasingly less-invasive over the course of the twentieth and twenty first centuries, with professionals citing concern for the preservation of the remains amid increasing public interest and tourism. Following in the trend of Lascaux II, many cave sites have been partially reconstructed using modern materials to give context and accessibility to the art without further destruction of the original material. While these sites provide cultural visitors with a comprehensive experience, developing full digital interpretation can assist further in the protection of integral heritage, while at the same time engaging a community unable to travel to a museum or the site. Current two and three dimensional digitisation of rock art fails to capture the immersive atmospheric qualities and intentional intricacy of the art, much of which uses the natural forms of the cave to enhance artistic three-dimensionality. Increasing digital technology, particularly ‘4D’ equipment and virtual reality simulation, introduces a potential advancement for world engagement and intricate interpretation, capturing and recreating the immersive and atmospheric qualities of cave sites, but must be weighed against the potential of heritage ‘Disneyfication’ and increasing isolation of the virtual explorer.

Introduction

As one of the most widespread forms of aesthetic expression, petroglyphs and pictographs also represent some of the most difficult historic monuments to preserve and interpret for the general public. Consisting of natural pigments, and/or delicate carving, these sites can be easily damaged by uncontrolled tourism and even natural elements if left in situ. Despite their relative sensitivity, rock art caves, shelters, and freestanding stones remain popular tourism sites, forcing many of the most admired caves to close their doors to the outside world in an effort to ensure preservation. To accommodate the rise in public interest, however, many of the most famous rock art sites around the world have physically or digitally reconstructed the ancient remains, in order to document and disseminate the information for a broader and sometimes more distant audience. The film and images can relay information across the world, producing broader visibility and accessibility for sites that are difficult to access, or too sensitive to be opened to the general public.

More recent advances in photogrammetry, laser-scanning, simulation, and four-dimensional technologies as utilised at theme parks, cultural/archaeological sites, and in a virtual reality setting, may provide a reconstruction advancement that heritage sites can leverage for engaging new, broad, and modern communities. As archaeological and rock art interpretations have evolved in the past to accommodate more visitors and include more immersive environments on-site, applying new and modern technologies to heritage interpretation could be used to ‘transport’ visitors through heritage sites in an increasingly sustainable and authentic, though completely simulated, way.
The increasing digital interpretation, however, introduces new concerns, particularly in the initial expense of the equipment and processing, the recreation of the intricacies in a virtual environment and in the ‘Disneyfication’ of heritage as a method of increasing tourism. As historic and heritage sites must be carefully situated at the crux of entertainment and education, there is the potential for creating ‘archaeological Disneylands,’ stressing entertainment over authenticity, particularly where environments are completely created or simulated (Silberman 2010: 68; see also Roy 2005; Cleere 1989). The opportunity for exposing world communities to the information and heritage provided by developing entertainment technology, however, contrasts these concerns, suggesting the need for a delicate balance of traditional interpretation and ‘infotainment’ as technologies advance.

**Modern rock art presentations**

As rock art is found on six of the seven world continents, the current material presentation for the public remains diverse. Where available, rock shelters, freestanding stones, and caves are left *in situ*, and interpreted in place, in line with recent heritage discourse (Barry 2014; Bonn et al. 2007). Southern and eastern African shelters have been generally interpreted as part of natural landscapes in national parks, helping to protect the remains, also assisted by their remote locations. Sites such as the uKhahlamba Drakensburg World Heritage Site and National Park [Figure 1] mainly offer environmental tourism, with archaeological and rock art sites promoted as excursions within the park. Similarly, in Australia and the southwest United States, many rock art shelters and free-standing stones are incorporated into national or state parks [Figure 2], and allow visitors access along hiking trails.

*In-situ* remains provide a way for visitors to understand the geographic and regional context of the art, but require individual conservation and the addition of signage at the site. Visitors can damage the images through touching, carving, rubbing, graffiti [Figure 3], or leaving trash around the remains, yet remote sites with dozens of individual decorated stones see substantially fewer yearly visitors to each stone than high-profile cave sites, making human contact less of a concern than concentrated collections with public access. Citing conservation concerns, many countries in southern Africa have initiated the process of ‘caging’ rock art sites by fencing either the surrounding landscape [Figure 4], or the shelter itself in an effort to allow people visual but not physical access. This practice is in contrast to interpretation in the western United States, which allows direct human access to indigenous imagery, sometimes without any interpretive material or physical restriction. Weathering of *in-situ* images from exposure to the natural environment is also a possibility, though in some cases, this exposure enhances preservation due to the lack of climate moisture in drier environments (Darvill & Bartada Fernandes 2014; Hoerlé 2005).
It is in the inaccessibility of an original, however, that establishes the need for physical or virtual reproductions of rock art sites, in an effort to make the art available to the general public. The International Council on Monuments and Sites (ICOMOS) guidelines dictate that archaeological or heritage reconstructions be completed with up-to-date research, not disturb archaeological remains when possible, and be used for one or both of two functions: experimental research and interpretation (International Committee 1990). Conditions at rock art caves in particular have necessitated reconstructions because the original archaeological material is often not available for presentation to the public due to the sensitive nature and requirement for conservation efforts. Cave art sites, therefore, became popular places for physical reconstructions at the end of the twentieth century in order to make the visual material available, while preserving the ancient material for future research.

The reconstruction trend was led by the Lascaux Cave¹ in Montignac, France, which was closed in 1963 by site managers citing deterioration from over-tourism and exposure. To recreate the experience for visitors, Lascaux II [Figure 5], a partial underground replica, was opened in 1983 with the intention of making the largest and most decorated spaces available to the general public in some form. As with many cave sites, when initially opened to the public Lascaux quickly suffered from conservation concerns due to fungal, bacterial and microbial populations developing on the art as a result of human interference in the air and on the walls (Montelle 2009; Bastian & Alabouvette 2009; Portillo et. al. 2008, Dupont et. al. 2007; Gonzalez & Saiz-Jimenez 2008). The newly created space as a 1:1 scale replica made from modern materials but painted using ancient techniques, saw 300,000 visitors a year by 2005, many of whom purportedly did not know that the cave was a reproduction (Barry 2014: 147; Castellani 2005). The Lascaux II project was revolutionary in rock art interpretation, as it created a total immersive environment using the technologies of the time. Projects such as the Museo de Altamira in Spain [Figure 6], Origins Centre in South Africa [Figure 7], and the new Centre International d’Art Pariétal Montignac Lascaux (also referred to as Lascaux IV or Lascaux Caves Museum) each followed the movement of physical reconstructions to accommodate interested visitors while

Figure 3: Modern graffiti over famed Newspaper Rock petroglyphs, Utah, USA. Photo by author, 2013.

Figure 4: Fence installed to protect rock art shelter at Drakensburg World Heritage Site, South Africa. Photo by author, 2012.

Figure 5: Entrance to the underground Lascaux II physical reconstruction, France. Photo by author, 2012.
Virtual heritage and tourism

Multimedia technologies, which were once thought to be tools for interpretation to be used only alongside traditional methods, have advanced enabling them to be used as the primary interpretive method for some heritage, advocating for the potential application of complete virtual heritage spaces outside of museums (Witcomb 2007: 36-37). The use of virtual and digital technologies for proposed heritage spaces has increased substantially in the last decade, with researchers suggesting everything from laser scanning and video game technologies, to desktop computer navigation and full scale virtual reality to reconstruct heritage sites for the public. ‘Virtual Heritage’ is a growing trend that helps to preserve original sites, while making the information and monuments available to an international audience. Projects and organisations such as the virtual Pompeii Project (1995), Ball State Institute for Digital Intermedia Arts (IDIA) lab, MIRALab at the University of Geneva, CERHAS at the University of Cincinnati, pioneered the use of laser-scanning to (re)create navigable virtual spaces, where avatars (virtual patrons) can explore international environments from their home (Cameron & Kenderdine 2007; Kalay, Kvan, & Affleck 2008; Noh, Sunar, & Pan 2009).

Virtual heritage initiates digital historic sites for three basic domains: documentation, representation, and dissemination. ‘Documentation’ strictly reports what exists, while ‘representation’ recreates using evidence, and ‘dissemination’ simulates an augmented reality through which to understand the representation (Tan & Rahaman 2009; Addison 2000). Documentation can involve non-archaeological/heritage researchers and administrators, but representation and dissemination typically require specialised interpretation, and therefore field experts (Roussou 2002: 98). Each method is able to facilitate heritage accessibility to widespread communities through the internet, whereas in-situ physical excavated archaeological remains cannot. As visual/virtual accessibility can include researchers from all over the world, additional introspection can help to solve archaeological questions that either become more apparent through reconstruction, or through the availability of additional experts (Frischer et al 2000).

Virtual simulated environments have been used for video gaming, such as the ‘Assassin’s Creed’ series (Dow 2013), but also instruction (Kuo & Lewis 2002), ‘Edutainment’ (Di Blas,
Paolini, & Hazan 2003), documentation, and interpretation or representation as identified by Addison (2000), Tan & Rahaman (2009: 145-146). Virtual environments on heritage sites as conceptualised in the *in-situ* Ename 974 Timescope project put the technology to specialised use, allowing visitors to walk through an environment digitally reconstructed on a screen to better conceptualise architectural phasing (Plentinckx et al 2000; Plentinckx, Silberman, & Callebaut 2001). The award-winning project was innovative, proposing a sensory experience, but required the patron to be at the site in order to partake in the virtual environment. Since the Ename experiment, researchers have expounded on the use modeling technology to present fully virtual and navigable ‘tourism’ sites, which provide information to the virtual ‘traveller’ (Laing et al. 2007; Salgado, Rendon, & Artola 2001; Webb & Brotherhood 2002). Although many of these studies are limited, the Humanities Virtual Worlds Consortium (HVWC) developed a shared code system in an effort to make virtual historic spaces more available to the international community, for use in better understanding world history and culture. As heritage and museum patrons continue to become more technologically dependent and savvy, the availability of these types of resources is key to engaging modern audiences, who demand information presented in a modern, entertaining way (Duff, et al. 2009).

**Digitally recreating rock art caves**

These remotely accessed virtual worlds offer opportunities for international engagement and immersion, particularly for remote, scattered or publically inaccessible rock art sites. The Nottingham Caves Survey was developed in part to increase economic benefits of physical tourism, and record the manmade cave network under the city (University of Nottingham 2010). Over two years, the Survey (the first generation of the Caves of Nottingham Regeneration Project) recorded roughly one fifth of the 539 caves under Nottingham Castle, UK. Many of the spaces were open to the public as part of organised tours, but other private sections were not, making the scans supplemental to a physical visit, but necessary in the case of private portions. The survey used high-accuracy laser scanning with the intention of documenting and making accessible a coherent, photo-realistic 3D visualisation of the network (Figure 8), which was not possible through other traditional documentation methods. The model could then be broadcast on the internet and allow virtual visitors to ‘zoom in and out of and crawl through, just as they might a real cave’ (Strange-Walker & Clarke 2012; Bhanoo 2010). Another research team from the University of Nottingham proposed using Vision-Mediated Interaction in the cave itself, to illuminate certain portions of the space in response to an audio information track, bringing a multimedia experience to in-person visitors (Ghali 2003).

The technology used to both document and digitally facilitate the network of Nottingham caves is applicable to the continued generation of digital spaces, yet caves with art represent a potentially greater challenge to the rendering, as the surfaces present pigments and intricacies that must be accommodated in a digital recreation for full contextual understanding. Paleolithic cave art uses a highly sophisticated practice of accentuating imagery with undulations in the wall surface, creating a highly three-dimensional aesthetic to be reproduced. High-resolution digital photography has failed to represent this in the past, making a full three-dimensional reconstruction an ideal expression of aesthetic information. Laser-scanning and point cloud
reconstruction allow for millions of data points that can detect acute changes in texture and even pigment, but provide neither color or texture, meaning that these attributes must be supplied by interpreters. Where the artistic caves must differ from the Nottingham reconstruction is in the application of archaeological interpretation to substitute missing information.

Following the success of Lascaux II, professionals developed other projects to make the site accessible to potential remote patrons, including a travelling exhibit (Lascaux III), which physically reconstructed several scenes from the cave alongside Paleolithic artefacts and multimedia information, and will tour major world educational institutions until at least 2020 (Dowson 2014: 1). Researchers also digitised the cave in its entirety in 2013 and made it available through the site’s webpage [Figure 9] and as part of the Lascaux III exhibition, providing users with a navigable experience through different portions of the cave. The technology uses high-resolution stereoscopic photography alongside laser mapping to reproduce the color and a simulated texture to make the interpretation as digitally true-to-life as possible. The combination of technologies has proved popular in cave art interpretation, with several other European sites also utilising the practice to present information to a broader audience.

Altamira cave was scanned to create the Museo de Altamira replica, as well as for scientifically analysing changing conditions in the cave, but researchers later applied the techniques to create a digital, navigable three-dimensional model reconstructing the experience. Researchers soon followed with digital reconstructions of other caves in the Altamira region (González-Aguilera, et al. 2009).

The introduction of virtual environments to supplement photographs and other two-dimensional information has a significant ally in contextual interpretation of history. As Donald Sanders (2014: 30) aptly asserts, ‘The past happened in 3D,’ suggesting that three-dimensional technologies not only reconstruct the physical artefact or landscape that the patrons wish to see, but help to reconstruct the context of creation, context of discovery, and even potentially the context of the interpretation. As he goes on to describe, ‘now we can begin to appreciate, and even “see,” ancient places in ways that approximate the viewpoints of the original inhabitants’ (Sanders 2014: 31). This has thus far been difficult for heritage managers to accomplish with in-situ interpretations that would damage authentic historical remains, or be based on archaeological speculation.

Disseminating visual information in such a universal and international capacity introduces the potential for far-reaching community engagement with particular sites that were originally closed to professionals or researchers, but also emphasises a visual approach to the study of the humanities, which often results in different viewer impressions than non-visual information (Joffe 2008). Image-based humanities, at the juxtaposition of representation and technical research, weighs the knowledge gained from experiencing authenticity of physical objects against the availability through facsimiles, digitisations, and other electronic media (Kirschenbaum 2002). While the 21st century concept of Digital Humanities often emphasises the digital availability of manuscripts, artwork, and other two-dimensional media, virtual spaces are likely to become the next point of discussion as technologies make them more available in heritage interpretation.

The first-person narrative that virtual heritage creates for cave spaces can broaden the international community’s connection to millennia old artistic traditions, weaving heritage connections with individuals or groups interested in art, archaeology, speleology, anthropology,
travel, etc. The possibilities of community connections are endless where information can be provided on the internet and across borders. Yet it may be Sander’s concept of ‘seeing’ ancient places where there may be additional opportunity for engagement, while at the same time potentially encouraging isolation of experience.

**Edutainment and the sensory experience**

Accessibility is key in providing and promoting digitally reconstructed heritage spaces; in an increasingly digital and sensory world, the tourist, or virtual traveller, seeks ‘places of play’, where the authenticity involves sensation and emotion (Costa & Melotti 2012: 52). These new trends have been integrated into physical archaeological spaces, which use a variety of media to present educational material, yet are more difficult to facilitate for the online tourist. Despite increased internet accessibility, caves suggest additional constraints for full virtual reconstruction, particularly as they feature sensory or atmospheric qualities difficult to reconstruct in cyberspace. The shift in ‘authenticity’ expectations in favor of more info/edutainment might be rectified with the sensory experience itself serving as educational.

In 2005, Pompeii unveiled a new ‘augmented reality’ environment, where visitors could rent and wear a computer and interact with animated characters and virtual frescoes (Papagiannakis, et al. 2005; Vlahakis, et al. 2003). The point of the experiment was to ‘push the limits of current [augmented reality]...where visitors can experience a high degree of realistic immersion’ (Ibid; Cinotti, et al. 2006). By 2009, Pompeii further provided a ‘sensory platform’, which would allow visitors to ‘feel’ an earthquake, and participate in the final moments of the destruction of the city (Costa & Melotti 2012: 55). The technology had some limitations, importantly in its location/subject specificity and provision that the technology be provided by the site, but postulates a precedent for understanding the methods of reconstructed reality in heritage tourism.

The AGAMEMNON project, a platform of multimedia to be used at tourism heritage sites in Europe and funded by the European Union, features similar objectives. The system distributes an ARCHAEOGUIDE (Augmented Reality-based Cultural Heritage On-site GUIDE) through a cellular device and wearable head-mounted display with the intent to ‘provide a customised electronic guide to cultural site visitors’ (Ancona, et al. 2006). ARCHAEOGUIDE is a newer generation of the PAST project and MobiDENK (Ancona, et al. 2000; Krösche, Baldzer, & Boll 2004). The technology was developed to work with several archaeological sites, and wirelessly supplies information for visitors when photographing monuments through image recognition.

Like Pompeii, the system can be rented at the entrance, and communicates with a network to provide information, and even digital monument reconstructions from the head mounted display (Pittore, et al. 2005). Since points of interest are selected by the patron, it is considered personalised, unlike universal information through signage, brochures, or even interactive multimedia displays at the site which choose the subject for the viewer.

Augmented reality devices are the next generation of smartphone edutainment, which has become almost commonplace at museums and cultural/historical sites, where personal platforms can be used by institutions to encourage visitors to interface with educational material (Kovavisaruch, et al. 2015; Scagliola 2005). Personal devices have largely replaced rentable audio tours, as patrons will not only use their device anyway, but may prefer a technology with which they are already familiar. The interaction encouraged by augmented or virtual reality is in stark contrast to the former paradigm of the adult-oriented and informational archaeological ruin. It encourages dialogue between patrons and context, therefore making the experience more engaging and ‘edutaining.’ Yet while context is important to understanding, too much simulation could diminish the authentic qualities of the places, cartooning over archaeological remains in favor of digital reconstruction and animated experience, suggesting the Disneyfication of heritage.

While the term ‘archaeological Disneylands’ has been used to describe the undesirable side of interpretation, increasing technological allowances have blurred the once-strict boundaries between education and entertainment, suggesting the use of entertainment technology in educational experiences, instead of the other way around (Cleere 1989). Even the four-
dimensional technology used at Disney and other theme parks provides a program for engagement that could be used as much for historical education as children’s entertainment. Disney’s onsite ‘4D’ experiences combine three-dimensional movies with ‘Sensory Effects’, including water, smoke, seat movement, and air, with the intention of engaging the visitor further in the narrative. The 4D experience was applied to heritage in 2009, when a team of researchers suggested the implementation of a 4D movie theater for the new Grand Egyptian Museum, citing the ‘more dynamic and lively way’ that the theater could represent Egyptian history and increase tourism (Hamed & Hema 2009: 35). While the theater would still be in a major institution, the possibility of these film experiences travelling across borders could bring interactive virtual heritage to international audiences.

The ability to create atmospheric changes consistent with original cave spaces in particular—moisture, smell, texture, etc.—is directly applicable to improving virtual reconstructions of cave art where the total sensory experience provides additional context to the aesthetics. The moisture in caves significantly impacts the art, either in deterioration or occasionally preservation. In adapting this context to be felt by visitors, would not only allow for an enhanced sensory experience, but also a deeper understanding of conservation and atmosphere. The move away from visualisation as a primary interpretive method toward a multi-sensory narrative could also engage visitors with visual impairment by emphasising other sensations applicable to cave art. The ability to conceptualise the creation of rock art caves in four dimensions already has a waiting ally in Werner Herzog’s film, ‘Cave of Forgotten Dreams’ (2011), which provides a visual experience that could be supplemented with a sensory environment for use in a major institution theater. As 4D technology is currently being developed for home use, the further transition to personal use may not be too distant (Park, et al. 2012).

For augmented reality currently employed on archaeological sites, the atmosphere is provided: the visitor experiences the weather, the region, and the sensory information as the ancient inhabitant did. Sites that are unavailable to the public must add these qualities as part of the contextual virtual reconstruction in order to achieve a similar experience. Through emerging personal 4D technology, these sensory attributes could be programmed in to a fully immersive experience, to be provided at local cultural institutions or even at home. While the possibilities for sensory ‘edutainment’ abound, preliminary research on audience reactions to 4D experiences suggests that the added sensory features can distract the patron from ‘presence’ if not applied ideally, suggesting that there is still substantial development needed (Oh, Lee, & Lee 2011). Should this technology become commonplace, however, the virtual tourist could tour sensitive sites closed to the general public, complete with sensory and information context, from their living room.

**Virtual futures?**

While navigable 4D heritage spaces are not yet available in a personal setting, the opportunity for using the technology as a form of broader exposure may help sensitive international archaeological sites engage broader and more distant communities. ‘Heritage’ has been repeatedly conceptualised in UNESCO’s World Heritage List, which identifies cultural sites integral to the progressive history of a world population. For sites with living descendants, the denotation is important for the sake of preservation, awareness, and social engagement (Colwell-Chanthaphonh & Ferguson 2008), but for Neo- and Paleolithic rock art sites, the descendant community is more difficult to trace, suggesting that communities with a proposed heritage connection to the site could be very diverse. If any audience who feels a connection to the rock art could engage with the site virtually or digitally, than 4D technology could provide both the accessibility and context needed to broaden the felt connection.

The potentials of using these tools for classroom or group education experiences is also in line with developing trends in education, which have analysed 3D virtual worlds as immersive spaces for learning (Camilleri, et al. 2013). Interacting with other users or historical avatars integrates the video gaming technology with education to be used in the classroom as a form of ‘symbolic immersion’, which can augment the learning experience by providing multiple
perspectives (Dede 2009). A ‘Four Dimensional Framework’ of education (de Freitas 2008) comprised of Learner Specifics, Pedagogy, Representation, and Context, is parallel to what 4D technologies could provide in an educational setting—most importantly, expanded sensory context. In 2010, EDUCAUSE Learning Initiative embraced the concept of Virtual Worlds in virtual libraries using RPGs (Role Playing Games), which purportedly would provide reference services, access to collections, outreach, and instruction (Ryan, Porter, & Miller 2010).

While advances in technology assuage practical limitations for using digital and sensory reconstruction, experiential hurdles are more difficult to overcome and may provide the most relevant argument to implementation. Introducing the technology in the form of individual experience eliminates the community experience in heritage, the act of touring a site with a local guide and community group. The sociality of heritage tourism currently relies on group tours with a guide, who provides public relations and discussion. While these could also potentially be simulated through online engagement with precedents in the online gaming community, the virtual heritage would still remain outside the local community, breaking the connection between the broader geographic context and the individual site: Community vs. community. Digital experiences using virtual reality may encourage isolation when used individually, whereas heritage tourism encourages collaboration.

The economic impact is another aspect that might be difficult to overcome and engages with heritage questions related to the ‘value’ or ‘cost’ of interpretation and heritage tourism. Currently, heritage sites rely on a variety of funding to continue operation, from grants to national/local assistance, or income from ticket sales. While the virtual world may include purchasing a ‘ticket’ or other funding agent for the site, removing the visitor from the community entirely would significantly impact local economies that rely on international tourism. The outright cost of the digitisation and upkeep of the virtual site would be minimal compared to the upkeep of the physical site, but the trickle-down economic loss of income would impact local, and potentially national communities, making the human cost significant.

If a virtual tourist could choose to visit a site using a 4D experience as if picking an application on a smartphone, the prospect for edu-engaging new audiences is endless, while many of the constraints and cautions that cultural heritage sites have always faced remain. Should the technology become more entertaining than educational, or weaken the context or understanding of the material to create merely an commercialised 4D experience, than the possibility exists that the technology developed to engage communities would eventually hinder progressive cultural gains, creating a new generation of archaeological Disneylands in the twenty-first century.

Bibliography


**Biography**

Kristin Barry holds a Ph.D. in Art History from the Pennsylvania State University and a professional Master of Architecture from the University of Cincinnati. She is currently an assistant professor of Architecture at Ball State University where she teaches architecture history/theory, and design studio. Her research on the interpretation of archaeological and heritage sites through architectural and digital design has been published in a diverse selection of international scholarly journals and books.
Endnotes

1  The paintings at Altamira were reproduced by the Archaeological Museum of Madrid and Deutches Museum of Munich at full scale using stereophotogrammetry in the 1960s before Lascaux had to be closed. The techniques were later used by the Institut Géographique National to map Lascaux for its reconstruction, but the neocueva reconstruction at the Museo de Altamira was not instituted until 2001, leaving Lascaux II to pave the way in physical reconstruction (Delluc & Delluc 1984: 195).

2  In the case of Altamira, the point cloud three-dimensional model was then used to create a CNC routed physical space that could be painted in 1:1 scale.