Aberystwyth University

Crowd-sourcing archaeological research: HeritageTogether digital public archaeology in practice

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Summary

Archaeologists are increasingly working with crowd-sourced digital data. Using evidence from other disciplines about the nature of crowd-sourcing in academic research, we suggest that archaeological projects using donated data can usefully be differentiated between *generative* projects (which rely on data collected by citizen scientists), and *analytical* projects (which make use of volunteers to classify, or otherwise analyse data that are provided by the project). We conclude that projects which privilege hyper-local research (such as surveying specific sites) might experience tension if the audience they are appealing to are 'cyber local'. In turn, for more 'traditional' archaeological audiences (when the primary motivating interests may be the tangible, physical nature of portable material culture or the archaeological site itself), then intangible, digital simulacra may not provide an effective medium through which to undertake digital public archaeology.

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1. Introduction

HeritageTogether is the umbrella name for a research project that uses crowd-sourced digital photographs to produce 3D models of Neolithic and Bronze Age remains from our study area of Gwynedd and Anglesey (See Griffiths *et al.* this issue). This is a collaborative Arts and Humanities Research Council (AHRC) project, with academic partners at Manchester Metropolitan, Bangor and Aberystwyth universities. The inspiration for the project was the prevalence of digital camera use in the UK, not least on mobile phones, to crowd-source archaeological research data. New advances in software mean that photographs produced by devices can be harnessed to create fully textured digital 3D models using structure-from-motion photogrammetry (Figure 1). The models contribute to a number of specific research aims – to produce accurate records of the sites, which can be located in GIS, and as condition surveys of the contemporary state of the sites. The images and models resulting from this work are freely available from the project website, and will be for at least ten years through the dedicated project server.

The project approach was explicitly experimental in terms of both public archaeology and computer science. There are two important interconnected themes in the archaeological approaches. Firstly, the project aimed to place working with citizen scientists at its centre, in order to produce digital archaeological research data. Secondly, emphasising tangible archaeological research outputs was central to the project design.

Since at least the mid-19th century, north Wales has been the subject of concerted research on standing stones and megalithic tombs, in part due to the concentrations of these monument types (Lynch 1969). Recently, this has included synthetic approaches to the earlier prehistoric record of north Wales (e.g. Lynch1991; Cummings and Whittle 2004; Smith 2002; 2003), and research devoted to important individual sites (e.g. Burrow 2010). At more well-known sites, damage has been identified as a risk; in terms of lesser known sites, limited documentation exists (Smith 2002; 2003). The digital modelling and conservation status evidence produced as part of this project represents an unprecedented survey of this kind in the UK, and a significant research contribution.

Figure 1: An example of one of the 3D models produced using structure-for-motion techniques, and data co-produced by citizen scientists working with HeritageTogether. The top image is a photograph of Presaddfed burial chamber, while the bottom is an image of a 3D model of the same site, produced from photos contributed by citizen scientists

The purpose of this article is not to discuss the results of the modelling, but to address some of the themes we have identified from working with members of the public to produce digital research data.

2. Integrating Digital Public Archaeology Research: scales of engagement

There are numerous approaches to the definition of 'community archaeology' and 'public archaeology', and the methods, theory, practice and ethics of these undertakings (cf. McGimsey 1972; Schadla-Hall 1999; Shanks and McGuire 1996; Marshall 2000; Moshenska 2009b; Skeates *et al.* 2012; Bonacchi and Moshenska this issue, fig. 1). The various approaches have been identified (Matsuda 2009, 41) as operating on a continuum from 'outreach', to more explicitly political critiques (Moshenska 2009b; Faulkner 2000).

In line with this continuum, we believe our project worked through different scales of digital public archaeology approaches. In addition, a number of 'spin off', 'bottom-up' digital public research projects have been undertaken as a result of work carried out for HeritageTogether (see discussion below). While digital data was at the heart of the project, our strategy was not simply to seek contributions from members of the public in order to produce 3D models; we deliberately also engaged with a range of more traditional forms of archaeology with the public (Figure 2).

Figure 2: Composite picture of forms of public archaeology undertaken for HeritageTogether. As well as digital public archaeology outreach provided through our website, we made use of a range of more traditional forms of engagement. It was at these events that nearly all of the spin-off 'bottom-up' collaborative projects we have been involved with came about

In terms of the digital work, the project website was launched in January 2014, and by November 2014 it had had 2,897 unique visitors, and 20,024 page views. However, the site had a high bounce rate of 55% – people looking at the site then leaving straight away, either because they were not interested in the site or were spam bots. Taking a very crude approach to the statistics, in November 2014, our website gallery had *c.* 11,000 page views by people who were at least interested enough to stay and take a look round, and probably by *c.* 1600 real people. These figures give us a measure of relatively 'superficial' engagement. We cannot claim that these views represent deep and meaningful forms of digital public archaeology, or that these experiences were

transformative for the individuals, but we argue that they do represent engagement with self-selecting members of a digital public (see discussion below; Figure 3).

At a more developed level, our gallery – the actual output of our digital public collaborative research project – had received, in November 2014, 380 unique and most probably real visitors (rather than bots), had 9,974 page views, and an average visit duration of 9 minutes and 36 seconds. Again, we think that although this might not represent a 'deep' and 'transformative' example of digital public archaeology, this might be analogous to the kind of experience at archaeological sites when visitors read official site notice boards or guidebooks. These visitors are self-selecting; they choose this use of their time and resources, akin to visiting a real-world archaeological site. We feel that this represents an important aspect of digital public archaeology.

At the most developed and engaged end of the spectrum, members of the public signed up to the site, producing and contributing thousands of photographs of sites. These photographs formed the basis for our digital 3D models. Photographs were contributed by a relatively small number of people. We have 114 people signed up for an account that allowed posting rights in the forum. Of these, 34 people produced data for 80 models of 78 sites across Gwynedd and Anglesey. In total, in November 2014, 13,064 digital images had been co-produced. The sites to record were selected by members of the public, though open days at the Neolithic passage tombs of Bryn Celli Ddu and Barclodiad y Gawres, and archaeologist-led walking tours or site visits at other sites may have directed attention to a specific sub-set of archaeological sites in our study area. Bryn Celli Ddu is a Neolithic chambered tomb, with a complex development sequence of activity. The Bryn Celli Ddu landscape became a focus of attention for the project, which eventually led to the start of a landscape public archaeology project jointly run by Manchester Metropolitan University and Cadw.

3. Digital Viewing as Digital Public Archaeology

Our website is the interface across which people can engage to varying degrees. While our website architecture structures what users can achieve, we argue that even at the 'lowest' level of engagement (the casual visitor) the process of looking and navigating the website is an active form of digital engagement (cf. Moshenska 2009a). As part of a series of scales of engagement, the process of viewing, the digital gaze, is one means for public access and accountability in archaeology.

Looking critically – gazing – at things or people can denote or articulate power relations, and can link to wider discussions about how archaeological material is presented, represented and understood. Gazing is not a

neutral undertaking. The importance of the unequal gaze as a means of providing control and regulation was represented by Foucault (1977) as critical to the ultimate development of Western 19th-century punishment. Looking critically at archaeological material culture – on sites, in museums, or digitally – is one means of entering into a relationship with these things. Expectations that public archaeological projects need to be fully immersive perhaps speaks more of the nature of archaeologists than the requirements of many members of the public. The mitigation by specific power relationships of seeing, of looking, and of engaging does not make the processes of looking any less active. Feminist readings of 'normative' – male, white, heterosexual, Western – representations of viewing (e.g. Mulvey 1975) emphasise the subjectiveness of the gaze. We contend that especially as '...computers [allow] active manipulation versus passive observation...' (Carusi *et al.* 2014, 3) and in the case of this project, in the manipulation of 3D simulacra in a digital workspace, the process of critically looking – of digitally gazing – moves the engagement beyond 'simply' a passive, non-communicative, didactic digital viewing platform (cf. Moshenska 2009a, 50). These are virtual windows, but with dynamic interfaces (Carusi *et al.* 2011, 9), with malleable 3D models in digital space. Though the website structures engagement with the material – the nature of access still 'disciplines' the material (Foucault 1977) – this does not necessarily mean that the encounter is passive.

The digital context of the presentation and representation of our models has specific implications for this form of engagement. The notion of the 'Romantic gaze' has long been recognised as important in the consumption of archaeological material culture and the representation of archaeology, so that traditional archaeological media – finds, sites, the written and drawn records – are seen to contain '...an emotive power...that personal connection [to] the authentic, the historical reality...' (Piccini 1999, 196).

In the *digital* representation of archaeological sites or material culture, the process of seeing occurs through media that become symbiotic with the archaeological content (cf. McLuhan 1967). Both in the nature of the engagement – the extended archaeological place in virtual 3D space – and in the co-produced and composite data sources for these models, these representations are digital hybrids of collective undertakings (Carusi *et al.* 2011, 9). The products of this research are accurate scaled 3D facsimiles of the sites in their contemporary conditions, with a precision of millimetres. Experiencing these models emphasises the '...cognitive import of visualisation...their transformative and performative roles in vision and knowledge' (Carusi *et al.* 2014, 3). There is a shift both in the nature and experience of these archaeological objects, as the reality of these sites change in their digital forms. Rather than simple representations, the digital models become 'part representations' of these places that are completed by the active human engagement through the website (Carusi *et al.* 2011, 10). While the nature of these models continues to be imbued with some aspects of

'authenticity', so too do they gain additional qualities as digital archaeological artefacts (cf. Morgan 2012). The aesthetics of these models are quite specific; they have a kind of 'photo reality', which includes all the inherent mitigation of photographs as visual media (Sontag 1978; Barthes 1980), but they also include specific historical context resulting from the ground conditions when the data were generated. Because these models are *composite*, so they bring with them inherent multi-temporality which is compressed into a single representation. The presentation of the 'finished' model on the website creates the lasting 'authentic' digital version of the site, and one that will not be changed. As the models are experienced through the Internet, or as digital files remotely from the site, so concurrently space is stretched and a degree of time depth collapsed.
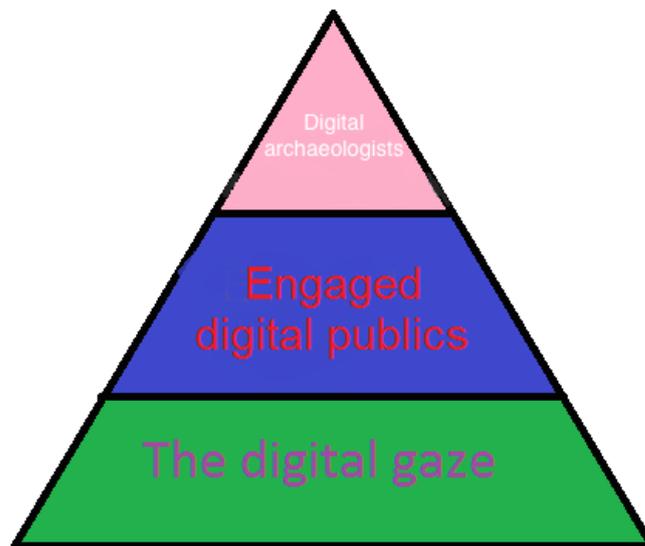
Figure 3: Scales of involvement that took place during the HeritageTogether project. Not all of these scales necessitated the same type of involvement by members of the public, but we feel even the arguably 'least' transformative form of engagement, website traffic, represents an essential part of archaeological outreach and public accountability

Recent reviews have highlighted in considerable detail the contributions and challenges that digital media can offer to archaeologists (Richardson 2009; Bonacchi 2012). We contend that the digital aspect of our project facilitates a range of scales of engagement (as opposed to one single scale of engagement) that are available to members of the public (Figure 3). This moves from the digital gaze, through to forum members contributing comments, and digital public archaeologists who contribute data. We further contend that all aspects of these engagements are active, and that members of the public should be entitled – if they wish – to turn their digital gaze on us; digital media increasingly provide a means of archaeological accountability by demonstrating how publicly funded research projects are undertaken.

4. Emergent Themes in our Digital Public Archaeology Practice

Drawing on our experience, we have identified a number of themes relevant to the practice of *doing* digital public archaeology. We do not suggest that they are universal; there are as many different approaches as there are archaeological undertakings, but we do suggest that doing digital public archaeology might create specific tensions and negotiations.

- o   [Crowd-sourcing research; data collection versus data analysis](#)
- o   ['Value' and success](#)
- o   [Materiality and immateriality; hyper-local sites versus cyber-local users](#)

4.1 Crowd-sourcing research; data collection versus data analysis

Our project sought to use data produced by members of the public. As such it fits into the context of 'citizen science' projects, which have been long established, especially in natural history research, with the US National Audubon Society's annual Christmas bird count first undertaken in 1900 (Cohn [2008](#)). There is also a relatively long association of intellectual radicalism with what are now called citizen science projects (cf. Silvertown [2009](#); Zimmerman *et al.* [1972](#)). Citizen science projects can have a commendable ethos of inclusivity and political engagement, raising awareness around important issues for contemporary society (e.g. Cohn [2008](#), 197). Such projects are therefore potentially rich tools for the promotion of archaeology.

What is relatively new is the number of citizen science projects with a digital collection component and the volumes of data generated. In 2008, Cornell University noted 200 US citizen science research projects (Cohn[2008](#)). The potential to organise scientists, collate and share data through the Internet means that digital technologies are now critical in the rise of such projects, [GalaxyZoo](#) being one of the most famous examples (Raddick *et al.* [2010](#); Nov *et al.* [2014](#)).

As part of the gamification of these research projects, many provide in-play rewards, such as conferring levels of expertise. Some, such as [StarDust](#), list successful contributors as authors on publications (Nov *et al.* [2014](#)).

Far fewer citizen science projects appear to be associated with the arts or heritage. In British archaeology, the *Hillforts Atlas* project relies on 'citizen scientists' to record and survey details of Iron Age hillforts, while the ACCORD project is engaged in another public photogrammetry project (cf. Bonacchi 2012). In the arts field, TAGGER classifies paintings to produce a robust inventory of the publicly available catalogue. It is possible to assess the success of these projects at various levels, from the number of contributors, number of records created and so on. The diversity of such project research aims makes assessing 'success' in digital public archaeology challenging.

Attempts at classifying digital citizen science projects have varied according to the discipline, goal of the project, and the degree of the virtual component of the project (Wiggins and Crowston 2011). We believe that a more fundamental distinction is between projects that work with members of the public to *classify* and *characterise* extant data, and those that ask members of the public to help *generate* data. Classification is ideally suited to a digital platform; as the success of GalaxyZoo demonstrates. Digital public archaeology projects often crowd-source classification and characterisation, for example the AncientLives, and MicroPasts projects.

'Generative' projects are particularly common in the natural sciences. There may be specific tensions with undertaking *generative* digital archaeological projects; these tensions may be most notable in projects that seek to research material culture or sites with specific hyper-local physical presences, i.e. that are rooted in the fundamental materiality of archaeological sites and finds, and those that attempt to work with a cyber-local community to generate digital data.

The approach taken in the HeritageTogether project was a 'generative' one. The archaeological fieldwork is done by volunteers. By asking members of the public to actively go to sites and photographically survey them, we were asking people to work with us on a relatively specific set of fieldwork undertakings. We suggest that 'generative' rather than 'analytical' projects will probably always see fewer participants, but this may be especially so when dealing with a specific set of material culture or landscapes. We would probably have seen more 'digital archaeologists' actively contributing data if we had been more ambitious in our study area.

4.2 'Value' and success

Digital projects offer defined statistics such as registered users (our 'digital archaeologists' who contribute digital data to our project), which we can employ to address 'engagement'; however, these statistics do not provide us with any absolute means of negotiating the long-held debates about the definition of 'value' in public archaeology. How do we value the thousands of hits we have had from users, who stayed for a relatively short period of time, against the 'value' of the local volunteer archaeologists who are going to excavate with us?

Without entering into an extended discussion of value, we suggest that even relatively 'superficial' engagement with digital resources is an important aspect of doing archaeology, and that a range of digital approaches should feature as an *essential* point of contact in an increasingly digitally engaged society (Griffiths *et al*. this issue). For reasons of privacy, we elected not to record the location or other personal details of the users in our web analytics. An indication of some aspects of the digital project reach can be given by our Facebook page for the HeritageTogether project, which (at the time of publication) has over 400 'likes', and demonstrates an international reach even in this sub-set of our audience. The majority of our Facebook fans are based in the UK (n=257), but we have supporters in nine countries (Table 1). A surprising number of our Facebook supporters were not based in the UK, with supporters in America, Australia, north Africa, and across Europe. There were 133 non-UK based Facebook supporters, with 181 supporters using a language that was not UK English. Despite the regional emphasis of our study, only 3% of our supporters used Welsh in their Facebook language.

Table 1: Spatial and linguistic information on the Facebook fan sub-set of our supporters	
Location of fan	**No. of Facebook fans**
United Kingdom	257
Austria	37
Germany	12
Australia	11
United States of America	9

Egypt	9
Spain	8
Italy	6
Greece	5
Ireland	4

Language used	No. of Facebook fans
UK English	209
USA English	103
German	37
Welsh	10
Italian	6
Spanish	3
Czech	3
Vietnamese	2
Spanish	2
Turkish	2

This can be contrasted with our physical engagement at one of our focus sites, Bryn Celli Ddu. Here an open day for the excavation, an event run by Cadw, attracted over 600 visitors, with total media reach (excluding social media and the project website) for the fieldwork aspect of the project over 500,000. We suggest that the value of the digital engagement needs to be situated within the wider project scope, and emphasise its role as part of a continuum of public archaeology work. In our experience, digital data collection and analysis has

worked especially productively when deployed as part of a range of approaches, including talks, open days, and school and local society visits. These undertakings often include an archaeological 'expert voice' to communicate the 3D modelling approach and an understanding of the archaeology.

4.3 Materiality and immateriality; hyper-local sites versus cyber-local users

An emphasis on material culture is often the primary trigger for many people's interest in archaeology. Material culture in the form of artefacts, sites, and records generated as part of archaeological practice serve as tangible points of articulation – situated and sanctioned by our own art-historical and social backgrounds. Digital mediation of these material remains provides both a potential means of engagement with people (including those who are geographically distant from these things), but also creates the perception of another level of remove from the 'things themselves'. The mediation from the physical into digital versions creates things that have unclear ontological statuses (Tringham 2010; Carusi *et al.* 2011), and distinctly different aesthetic qualities (see above). In some cases, *especially* in generative crowd-sourced projects, digital mediation may discourage some members of the public who seek a tangible encounter with remains from 'the past'.

The may be tensions between what we have termed the 'hyper-local' archaeological sites of interest, and attempts to generate digital data from what we have termed the 'cyber-local' community. We define 'hyper-local' sites or landscapes as those that are in physical close proximity to a group of members of the public, and which can be explored in their 'authentic' contemporary settings *and* through digital representations. We differentiated these sites from 'cyber-local' members of the public who are physically remote or for another reason cannot actually access the site or study area, and whose access to a site or landscape is articulated through the Internet. If the primary motivating factor for peoples' interest in archaeology is the tangible, physical nature of portable material culture or the site, then they may not be especially interested in intangible, digital simulacra.

Other digital undertakings that document archaeological sites in 'democratic' ways, for example the Modern Antiquarian or Megalithic Portal websites, may embody a more 'bottom-up' approach to monuments (cf. Richardson 2014; Beale 2015). However, in these examples, the absence of the archaeological expert can be replaced with other interpretations of the past (cf. McDavid 2004; Holtorf 2005), and through self-regulation

mechanisms surrounding the nature of 'appropriate' knowledge or content. Many cyber-local groups with 'other' interests in sites may present challenging approaches for archaeologists (Schadla-Hall 2004; cf. Blain and Wallis 2007; Holtorf 2005). Negotiating the line between an expansive and engaging tone, and a more structured narrative or authorship in any digital outreach is critical to both on-site and digital aspects of research projects.

From our experience, differentiation between 'bottom-up' and 'top-down' archaeology projects was not always useful. Aspects of both these approaches came into play at different points in the project lifecycle, and to different degrees. We firmly subscribe to the maxim that 'there is no private archaeology' (McGimsey 1972), and that accountability and openness should be part of any research approach. The many opportunities for 'bottom-up' collaborations that this research has enabled – including both digital data collection, home educator events, fieldwork and excavation, including digital recording aspects – would not have occurred without the initial 'top-down' project design.

5. Conclusions

Digital research and digital engagement offer a number of opportunities and challenges for archaeological projects. We suggest that there are a number of themes that may be of specific relevance for digital archaeological crowd-sourced projects. We suggest firstly that a useful distinction may be drawn between *generative* and *classificatory* archaeological digital public research. While co-produced citizen science projects can create vast volumes of *analysis*, the generation of citizen science *data* may be more challenging. We received more data submissions after open days or events *on site* where authoritative archaeological voices were present. When citizen scientists are asked to generate data there is more potential for things to 'go wrong' and people might be more subject to self-doubt; when people are asked to analyse data within a relatively prescriptive framework they may have more confidence in their work. We suggest that in projects which emphasise the production of archaeological data through a digital collection medium, or that use predominantly digital data, tensions may be encountered in the motivation of citizen scientists. For many archaeologists, whether they receive paid remuneration or not, the tangible material aspects of the discipline are important; the immateriality of digital projects may have implications in terms of recruiting citizen scientists. People who want to engage with digital recording may not be especially interested in archaeological sites or vice versa. If we want to recruit people to digital archaeology projects, it may be that the citizen scientists who produce most data will be those who are most interested in the methodology; for digital public

archaeology projects more contributors (and data) may be achieved by targeting, for example, local digital photography or computer science groups rather than archaeological local societies.

While digital public archaeology may be a means to engage with large numbers of cyber-local individuals, it might make undertaking hyper-local research more challenging because the methods and the study sites may appeal to quite distinct interests in members of the public. In these instances, events and activities that draw together a self-selecting, geographically dispersed community can be invaluable.

Bibliography

Barthes, R. 1980 *Camera Lucida*, London: Hill and Wang.

Beale, G. 2015 'Peer comment', *Internet Archaeology* **39**. http://dx.doi.org/10.11141/ia.39.2.com1

Blain, J. and Wallis, R. 2007 *Sacred Sites, Contested Rites/Rights*, Brighton: Sussex Academic Press.

Bonacchi, C. (ed) 2012 *Archaeology and Digital Communications. Towards strategies of public engagement*, London: Archetype Publications.

Burrow, S. 2010 'Bryn Celli Ddu passage tomb, Anglesey: alignment, construction, date and ritual', *Proceedings of the Prehistoric Society* **76**, 249–70. http://dx.doi.org/10.1017/S0079497X00000517

Carusi, A., Novakovicm G. and Webmoor. T. 2011 'Are Digital Picturings Representations?', September 17, 2011, *EVA 2010 Conference Proceedings, 2011*. http://ssrn.com/abstract=1929438. Last accessed 24 Nov 2015.

Carusi, A., Sissel Hoel, A., Webmoor, T. and Woolgar, S. 2014 'Introduction' in A. Carusi, A. Sissel Hoel, T. Webmoor and S. Woolgar (eds) *Visualisation in the Age of Computerisation,* London: Routledge. 1–15.

Cohn, J. 2008 'Citizen Science: can volunteers do real research?', *BioScience* **58(3)**, 192–97.http://dx.doi.org/10.1641/B580303

Cummings, V. and Whittle, A. 2004 *Places of Special Virtue; Megaliths in the Neolithic Landscapes of Wales*, Oxford: Oxbow Books.

Faulkner, N. 2000 'Archaeology from below', *Public Archaeology* **1(1)**, 21–33.http://dx.doi.org/10.1179/pua.2000.1.1.21

Foucault, M. 1977 *Discipline and Punish,* London: Allen Lane.

Holtorf, C. 2005 'Beyond crusades: how (not) to engage with alternative archaeologies', *World Archaeology* **37(4)**, 544–51. http://dx.doi.org/10.1080/00438240500395813

Lynch, F. 1969 'The megalithic tombs of north Wales' in T. Powell, J. Corcoran, F. Lynch and J. Scott (eds) *Megalithic Enquiries in the West of Britain,* Liverpool: Liverpool University Press. 107–48.

Lynch, F. 1991 *Prehistoric Anglesey*, Second edition, Llangefni: Anglesey Antiquarian Society.

Marshall, Y. 2000 'What is community archaeology?', *World Archaeology* **43(2)**, 211–19.

Matsuda, A. 2009 'The concept of "the public" and the aims of public archaeology', *Papers from the Institute of Archaeology* http://pia-journal.co.uk/article/view/257/297 [Last accessed: 13 Feb. 2015].

McDavid, C. 2004 'Towards a more democratic archaeology? The internet and public archaeological practices' in N. Merriman (ed) *Public Archaeology*, London: Routledge. 159–87.

McGimsey, C. 1972 *Public Archaeology,* New York: Seminar Press.

McLuhan, M. 1967 *The Medium is the Massage: An Inventory of Effects,* Harmondsworth: Penguin.

Morgan, C. 2012 *Emancipatory Digital Archaeology*, Unpublished PhD thesis, University of California: Berkley.

Moshenska, G. 2009a 'Beyond the viewing platform: excavations and audiences', *Archaeological Review from Cambridge* **24(1)**, 39–53.

Moshenska, G. 2009b 'What is Public Archaeology?', *Present Pasts* **1**, 46–8.

Moshenska, G. 2014 'Public archaeology (some common types)', Available: https://gasmasquerade.wordpress.com/2015/01/11/public-archaeology-some-common-types/ [Last accessed: 13 Mar 2015].

Mulvey, L. 1975 'Visual pleasure and narrative cinema', *Screen* **16(3)**, 6–18.

Nov, O., Arazy, O. and Anderson, D. 2014 'Scientists@Home: what drives the quantity and quality of online citizen science participation?', *PLoS ONE* **9(4)**, 90375. http://dx.doi.org/10.1371/journal.pone.0090375 [Last accessed: 13 Feb. 2015]

Piccini, A. 1999 *Celtic Constructs: The Production and Consumption of Heritage Media in 1990s Britain,*Unpublished PhD thesis, University of Sheffield.

Raddick, M., Bracey, G., Gay, P., Lintott, C., Murray, P., Schawinski, K., Szalay, A. and Vandenberg, J. 2010 'Galaxy zoo: exploring the motivations of citizen science volunteers', *Astronomy Education Review* **9**, 010103. http://dx.doi.org/10.3847/aer2009036

Richardson, L-J. 2009 *Measuring the Success of Digital Public Archaeology: Towards a Model for Public Participation in Internet Archaeology*, Unpublished MA thesis, University of London.

Richardson, L-J. 2014 'Understanding archaeological authority in a digital context', *Internet Archaeology* **38**. http://dx.doi.org/10.11141/ia.38.1

Schadla-Hall, R. 1999 'Public archaeology', *European Journal of Archaeology* **2(2)**, 152–8.
http://dx.doi.org/10.1179/eja.1999.2.2.147

Schadla-Hall, R. 2004 'The comforts of unreason: the importance and relevance of alternative archaeology' in N. Merriman (ed) *Public Archaeology*. London: Routledge. 255–71.

Shanks, M. and McGuire, R. 1996 'The craft of archaeology', *American Antiquity* **61(1)**, 75–88.

Silvertown, J. 2009 'A new dawn for citizen science', *Trends in Ecology and Evolution* **24(9)**, 467–71.
http://dx.doi.org/10.1016/j.tree.2009.03.017

Skeates, R., McDavid, C. and Carman, J. 2012 *The Oxford Handbook of Public Archaeology,* Oxford: Oxford University Press. http://dx.doi.org/10.1093/oxfordhb/9780199237821.001.0001

Smith, G. 2002 'Prehistoric funerary and ritual sites project: west Conwy and north Gwynedd', GAT project no. G1629, Report No. 449, Bangor; Gwynedd Archaeological Trust.

Smith, G. 2003 'Prehistoric funerary and ritual monument survey: west Gwynedd and Anglesey', GAT project no. G1629, Report No. 478, Bangor; Gwynedd Archaeological Trust.

Sontag, S. 1978 *On Photography*, London: Allan Books.

Tringham, R. 2010 'Forgetting and remembering the digital experience and digital data' in D. Borić (ed)*Archaeology and Memory*, Oxford: Oxbow Books. 68–104.

Wiggins, A. and Crowston, K. 2011 'From conservation to crowdsourcing: a typology of citizen science', Proceedings of the Forty-fourth Hawai'i International Conference on System Science (HICSS-44) Available: http://crowston.syr.edu/content/conservation-crowdsourcing-typology-citizen-science [Last accessed: 13 Feb 2015].

Zimmerman, B., Radinsky, L, Rothenberg, M. and Meyers, B. 1972 'Towards a science for the people'. Available: http://ist-socrates.berkeley.edu/~schwrtz/SftP/Towards.html [Last accessed: 13 Feb 2015].

Acknowledgements