

Title: Current Digital Archaeology

Keywords: archaeology, virtual reality, posthumanism, materiality, ethics, craft

Abstract:

Digital archaeology is both a pervasive practice and a unique subdiscipline within archaeology. The diverse digital methods and tools employed by archaeologists have led to a proliferation of innovative practice that has fundamentally reconfigured the discipline. Rather than reviewing specific technologies, this review situates digital archaeology within broader theoretical debates regarding Craft and Embodiment, Materiality, The Uncanny, and Ethics, Politics, and Accessibility. A future digital archaeology must move beyond skeuomorphic submission and replication of previous structural inequalities to foment new archaeological imaginaries.

Introduction:

Digital archaeology is a vibrant subdiscipline within archaeology. Operating as a collective term for many kinds of practice, digital archaeology has been used to describe methods and theory that stem from the use of digital technology to investigate and communicate the past. Though at first primarily technological and skeuomorphic in practice and intent, digital practice has encouraged creativity, empathy, examinations of power and structural abuse, investigations of design, posthumanism and transhumanism, and has fundamentally reconfigured practice and the understanding of craft within archaeology. At once both highly visible as a practice and increasingly invisible as archaeologists become accustomed to using digital tools, one may state, as Eve and I wrote, “we are all digital archaeologists” (2012, 523) or as Huvila posited: “there is no digital archaeology” (2018, 1) and argue convincingly from either position.

The porous and shifting nature of digital archaeology will be evident throughout this article. Indeed, the range available for deploying digital tools contributes to ongoing boundary reclassification and neologisms to describe the field. Digital archaeology has at times been termed “cyber-archaeology,” (Forte 2011) or “virtual archaeology” (Reilly 1990) with an emphasis on virtual reality, and “phygital archaeology” (Reilly et al. 2021) or “cyborg archaeology” (Morgan 2019) to highlight mixed digital/physical experiences and interventions in archaeology. There is some discussion and unpacking of these terms by Tanasi (2020) and the relationship of archaeology within the larger digital humanities (see also Watrall 2016). Tanasi (2020) further provides a useful snapshot of the discourse and distribution of degree programmes in Digital Archaeology and the differences between disciplinary categorization in North America and Europe. For example, academic positions for Digital Archaeologists are advertised in Europe, whereas in North America, digital specialists are associated with a broad range of disciplines such as History, World Heritage and Classics and are instead classed as Digital Humanities positions (Tanasi 2020, 33). As a subdiscipline it has been subject to what is called an “anxiety discourse” wherein the “identity, nature and academic legitimacy of archaeological computing was questioned and concerns expressed about its theoretical core, the rigour and relevance of its methodologies, the value of its outputs, and the extent to which its contributions were recognised as having any significance to the broader field” (Huggett et al. 2018). This discussion will be taken up again in the conclusions, but the recent and ongoing growth in digital archaeology has

resolved some anxieties regarding its durability, usefulness and significance within archaeology and larger debates in anthropology and digital humanities.

There is also a burgeoning practice within digital heritage, which emphasises the creation of interpretive materials, the curation and documentation of objects and the examination of the digital reception of heritage, particularly through social media. Indeed, many important contributions to digital archaeology and digital heritage have manifested as digital ephemera in blogs and Twitter conference presentations (for example, Delgado-Anés et al. 2017). That this review primarily focuses on academic, peer-reviewed contributions may therefore be considered a weakness to a fulsome understanding of the subject. Beyond a focus on presentation and reception are highly technical discussions within digital heritage as well, for example the *Journal of Cultural Heritage* regularly features complex analyses of digitisation of museum objects with regard to research and preservation (eg Melendreras Ruíz et al. 2022) and ephemera (eg Tuno et al. 2022). Cutting-edge visualisation practice is reported in professional conferences such as the internationally renowned *2and3D Photography* conference hosted by Rijksmuseum in the Netherlands in cooperation with the Association for Historical and Fine Art Photography (AHFAP) in the United Kingdom. For example, in 2021 Kurt Heumiller discussed his work with the Museum of Modern Art in capturing Van Gogh's *Starry Night* in 3D.

It is perhaps unsurprising then to note that describing the entirety of practice within digital heritage and digital archaeology is outside of the scope of this article. Happily there are many useful existing overviews of many topics, including remote sensing (Casana 2021), computational archaeology (Grosman 2016), and high-density survey and measurement (Opitz and Limp 2015). There are excellent discussions of the development of techniques in spatial analysis and geographical information systems (GIS) (Earley-Spadoni 2017; Gillings et al. 2020; Gupta and Devillers 2016; McCoy and Ladefoged 2009; Wheatley and Gillings 2013), social network analysis (Brughmans 2013; Brughmans et al. 2016; Peeples 2019) or agent-based modelling (Romanowska et al. 2021). There is an incredible culture of sharing and engagement with Open Science (Marwick et al. 2017; but see Fredheim 2020) and collaborative digital pedagogical approaches (Cobb et al. 2019; Graham et al. 2019). These reviews reveal the extent of digital practice but also the characterization of digital archaeology as individual skills or techniques in service to particular fields of inquiry. Rather than review a set of skills or techniques I will instead discuss digital archaeology as a site to think and theorize from. As such, some of these subjects will appear as interwoven into broader themes that can illuminate current and future developments within digital archaeology as a site of critical inquiry.

In this review, I discuss digital archaeology along four interlinked themes with considerable and inevitable crossover between them. These themes, craft and embodiment, materiality, the uncanny, and ethics, politics and accessibility, demonstrate how digital archaeology is responding to and reconfiguring broader debates within archaeology and anthropology at large. In identifying these themes, I have unmoored practice from specific technologies and situated individual methods in broader political and theoretical debates. I therefore situate digital archaeology within practice-based research, defined as a “principled approach to research by means of practice in which the research and the practice operate as interdependent and complementary processes leading to new and original forms of knowledge” (Candy et al. 2021, 2). Practice-based research emphasizes the “way the making process itself leads to a transformation of ideas,” centering the creation of “artifacts” or objects and the communication of this new knowledge to others (Candy et al. 2021, 29-30).

While this has been the largely unstated approach of some practitioners (eg Hacıgüzeller 2017; Ferraby 2019, Graham 2020; Morgan and Eve 2012; Reilly et al. 2021, Watterson et al. 2020), engagement with the robust literature supporting practice-based literature would alleviate some of the conceptual crises as previously delineated within digital archaeology (Huggett et al. 2018). Finally, a focus on these themes describes a digital archaeology that explores ways to prefigure a better future through our investigation of the past. Prefigurative practice, as drawn from anarchism, is the understanding that the “means create the end” (Borck 2019, 231) and resonates with a focus on practice-based research. There are considerable issues in digital archaeology with regard to access and inequality, deskilling, reproduction of corrosive and oppressive narratives of the past, boosting late capitalism and contributing toward the impact of climate change. I will discuss these issues throughout the text, through the costs and affordances of digital archaeology.

Craft and Embodiment

Using computing technologies to gather, manipulate and store data has been central to the development of digital archaeology. There are several accounts of the history and trajectory of digital archaeology (Beale and Reilly 2017; Daly and Evans 2004; Huggett 2015; Lock 2003); one particularly compelling example is the autobiographical account given by Ruth Tringham (2015) who describes her use of punch cards, hypertext, websites, and database narratives to create recombinant histories of Neolithic people. Through the many technologies used by archaeologists it has become increasingly clear that archaeological practice is changing. This is demonstrated in the account of archaeological visualisers offered by Opgenhaffen (2021a) who further draws on her experience as an archaeological illustrator to determine the chaîne opératoire of digital 3D visualisation (see also Opgenhaffen 2021b; Perry 2015). This change has generally been heralded as providing great savings in time and cost and contributing toward democratizing knowledge production (Roosevelt et al. 2015; Taylor et al. 2018). Of particular note is the volume, *Thinking beyond the Tool: Archaeological Computing and the Interpretive Process* (Chrysanthi et al. 2012) which positions the tools used for digital archaeology as prosthetic extensions of self and contains insightful investigations of analytical and visualisation strategies in archaeology. Others, notably William Caraher (2018) have been more critical, even proposing “slow archaeology” in reaction to neoliberal pressures that plagued the discipline; protesting the perceived loss of autonomy and the erosion of enskillment through the use of digital tools. Further, the use of digital tools has provoked an investigation of analog or “by hand” methods in archaeology including map making (Flexner 2009), photography (Morgan 2016; Shanks and Svabo 2013) and illustration (Morgan et al. 2021) and their role in archaeological knowledge production.

Digital technologies have also changed how archaeologists embody their craft, perceive the bodies of past people, how they delegate perception of archaeological evidence and how archaeological interpretations are disseminated. Taylor and Dell’Unto (2021) note that while skeuomorphic emulation of analog tools by digital technologies socialize these technologies and make them more likely to be incorporated into practice, they may inhibit truly transformative uses of these technologies. In conducting research on digital drawing and craft in archaeology, one of the first observations that members of the *Aide Memoire Project* made was the awkward, uncomfortable stance archaeologists took while drawing archaeological remains on a tablet (Morgan et al. 2021). This observation was followed by several more that showed how digital tools acted to distance archaeologists from their observed subject and led to insights into mental model creation in support of archaeological interpretation. Drawing is a “forcing function” (sensu Van Meter and Firetto 2013), the drawing cannot progress until

the subject of the drawing, the archaeological remains, is fully understood, causing the person to exercise meta-cognitive awareness and control (Morgan et al. 2021, 616). The *Aide Memoire Project* survey of archaeologists found social and political ramifications in the change to digital recording in archaeological fieldwork. These primarily manifested in a resistance to digital tools that echoed Caraher's (2018) perception of erosion of enskillment and mourned the loss of by-hand drawing as a way to reflect on and engage with archaeological remains (Morgan et al. 2021). Yet Sapirstein (2020) found that the greater efficiencies allowed by the use of digital recording allowed engagement with a more thoughtful recording process (see also Danis 2019).

Digital technologies have changed how archaeologists embody our craft but also how we imagine past embodiment. *Dead Man's Eyes* is a project by archaeologist Stuart Eve that provides an augmented reality overlay that simulates past vision and viewsheds (2014; 2018). This accompanies auditory projects that reconstruct past soundscapes that are acoustically correct (eg Cooper 2019), and augmented olfaction (Eve 2017). The integration of multisensorial approaches are perhaps a reaction against the early dominance of the visual within digital archaeology through GIS and persisting through photogrammetry and 3D laser scanning (Eve 2018; see also Frieman and Gillings 2007; Wickstead 2009). Archaeological entries into multisensorial transhumanism verge on the uncanny, which will be further described below, but I have argued (Morgan 2019) for the creation of a cyborg archaeology that integrates posthuman principles to create a viable interstitial space where things from the past and present can commingle in commensurate space. This draws from posthumanist feminists such as Donna Haraway (1985; 2016), Karen Barad (2003) and Rosi Braidotti (1997; 2013) and runs parallel to ongoing materialist and ontological discussions amongst archaeologists (for example the issue on *Debating Posthumanism in Archaeology* in Cambridge Archaeological Journal 31:3, 2021). The contribution of digital methods and artefacts to these discussions has hereto been limited, but compelling. For example Stobiecka discusses an advertising campaign that equipped ancient sculptures with 3D-printed artificial limbs to argue for a prosthetic archaeology that promotes a "materially oriented digital practice" (2020, 336). Engagement with feminist posthumanism and understanding the past through digital embodiment has manifested in *OTHER EYES*, a project that creates mixed-reality avatars based on bioarchaeological data from Romano-British human remains. *OTHER EYES* explores the digital embodiment of past people to evoke empathetic responses from present people, a proposition that is both uncanny and ethically fraught (Morgan et al., forthcoming). Avatars can lend feelings of immersion and copresence (for further discussions of presence in heritage see Pujol-Tost and Champion 2012); a form of self-expression in our deserted digital archaeological ruins. One of the past people selected for the project has altered mobility, which decentres normative, able-bodied perceptions of the experience of past personhood.

Finally, there has been some experimentation with the algorithmic delegation of archaeological investigation, interpretation and dissemination. For example, Opitz created a digital environment with a model of Knowth, a Neolithic passage site in Ireland and found that the rock art associated with the passage was not necessarily important to the visual experience of the place, counter to the received interpretations of archaeologists (2017, 1220). There has also been work on the detection of archaeological sites by combining remote sensing techniques with machine learning (eg Davis et al. 2021). The ArchAIDE project developed a workflow and an app that uses automated image recognition to identify and classify ceramic sherds (Anichini et al. 2020). Another team designed a chatbot, ChatÇat to interact with users from the Çatalhöyük Facebook page, providing automated answers but

also to attempt to challenge the assumptions of people interacting with the bot (Roussou et al. 2019). I have characterised this technological delegation of archaeological work as part of a cyborg archaeology (Morgan 2019, cf Stobiecka 2020); such transhuman interventions can also be linked to the concept of the extended mind (Clark and Chalmers 1998) and part of digital cognitive agency in archaeology (Huggett 2017; Rabinowitz 2016).

An emphasis on craft and embodiment within digital archaeology brings a satisfying fleshiness to methods that have been used with relatively little consideration of their construction of the lived experience of people in the past or of their impact on the bodies of people living today. Posthuman feminist scholars have noted the particular importance of embodiment in the context of virtual, dematerialized futures (Hayles 1993, 14) and I have echoed these in discussions of a posthuman digital archaeology (Morgan 2019). An empathetic understanding of both would encourage a more thoughtful and nuanced understanding of the past and more solidarity with the current crippling labour conditions and alienation of commercial archaeologists. More experimentation regarding the expressive, fleshy affordances of experiencing the past beyond the boundaries of the human would be welcome. Posthuman approaches to digital archaeology have great imaginative potential.

Materiality

That the digital is material is well-established; archaeologists have been exploring the boundaries of this materiality, mixing media archaeologies with archaeological methods to understand computing assemblages, video games and virtual environments, and 3D printing. Media archaeology focuses on understanding media culture through methods inspired by archaeologies of power and knowledge of Michel Foucault and “excavations” of modernity by Walter Benjamin (Parikka 2013). Piccini notes that media archaeology and archaeology-as-such shares “concerns with dismantling and reconstructing media technologies in order to reveal secret histories and lost lineages” (2015, 5), yet archaeology-as-such has relatively little impact on scholarship regarding the materiality of digital media (2015, 3). In the same dedicated forum on Media Archaeologies in the *Journal of Contemporary Archaeology*, media archaeologist Jussi Parikka outlines a programme of shared research interests in abandoned hardware and digital waste and the profusion of digital objects and the curation crisis (2015, 13). Indeed, archaeologists have been intervening in this digital-material space for some time, and this review will focus primarily on case studies generated from archaeologists.

Most discussions of archaeologists examining digital artefacts begin with Christine Finn’s early “excavation” of Silicon Valley (2002) and survey of computer collections (2003) heralded the superabundance of material waste that is a marker of late capitalism. Various computing materials have been investigated through archaeological methods. Moshenska (2014) uncovered a USB drive during a community excavation in London and described the exterior condition of the drive as well as the contents, which revealed an assemblage of schoolwork, MP3s and MPEG movie files, including some adult content. Schofield et al. (2018) examined the computer mouse as a means to challenge technological determinism at the moment of obsolescence. Sara Perry and I (2015) excavated a hard drive, during which we found the application of archaeological methods to a digital context both absurd and illuminating, and noted the interplay of Foucauldian media archaeologies, forensic digital archaeology (recovering data from dead drives) and digital archaeology.

Within these digital archaeologies, cellphones are a particular locus of interest. Archaeologists have been working toward using tablets and smartphones for archaeological recording, citing “paperless” workflows as important to innovations in fieldwork (eg Ellis 2016). The earliest examination of the cellphone as a digital artifact is Cassie Newland’s (2004) MA dissertation on the archaeology of mobile phones. Newland combined approaches from Science and Technology Studies with fieldwork such as an urban walking survey to identify and photograph types of base stations, documenting a protest and the destruction of a mast, which has resonance in the 2020-21 protests that identified 5G cellphone service as a cause of the spread of COVID-19. Maxwell and Milligan (2013) discuss the utopic and dystopic aspects of cellphones, alluding to their ability to “deliver happiness, development, and revolution” as well as increased social fragmentation, alienation, and environmental destruction. Robb (2021) discusses the materiality of cellphones through a fictional plenary address to a Material Culture conference in the future. He traces familiar archaeological tropes regarding innovation and the use of technology, noting the future as being characterized by by “obligate symbiosis” and a “new integrality between things and the people they make” (2021). Finally, I have noted the utility of by-hand drawing of cellphones using archaeological recording standards to support archaeological pedagogy, both in terms of teaching detailed, professionalized observation of artifacts and as an exploration of the cellphone as our most intimate artifact and emotional connections to objects (Morgan, forthcoming).

The above excavations primarily focussed on the broader social context, the hardware or the user interface and generally did not include an examination of code. Reilly et al. (2016) performed such an investigation, recovering the earliest animated virtual tour of a cultural heritage reconstruction, the Old Minster in Winchester, UK (Burrige et al. 1989). During this investigation they managed to convert the code and modernise the models, eventually creating a 3D print, but cautioned that 3D models “have a very limited shelf-life” and may prove inaccessible to future historians and curators (2016, 39) yet other uses of these models is described below. Similarly, Computer Scientist Aycock (2021) implored archaeologists to prepare for the profusion of digital “things” and identified archaeogaming as a particular nexus of interest for such investigations. Archaeogaming explores video games, coding and virtual environments, encompassing creation, representation and dissemination of archaeological interpretations (cf Reinhard 2018). There is a large and thriving archaeogaming community with a burgeoning list of publications. Pertinent to this discussion of digital materiality, Reinhard (2018) discusses the use and adaptation of the Harris Matrix for software stratigraphy of the video game *No Man’s Sky*. He concludes that archaeological visualisation techniques are useful for documenting software development. In my response to Aycock’s invitation to explore digital things as archaeologists, I drew from an artefact, flint, in the popular *Minecraft* sandbox video game to examine Deleuzian notions of repetition and interplay between the concept of flint and the code manifestation of such (Morgan 2021). Another intervention in this area is Mol’s (2019) “In Gold: A Materiality Simulator, a playful take on Ingold’s (2007) request at the beginning of *Materials against Materiality* to find a stone and immerse it in water. In Mol’s video game you must try to read Ingold’s entire article while keeping the stone wet. The stone refuses to obey, jumping out of the bowl of water, and the text subsequently fades from view, resulting in a hilarious, playful and frustrating experience that perhaps mirrors the encounter with Ingold’s text.

Digital materiality is also the subject of an important, recent issue of *Museum & Society* (2021); the contribution of these papers directly speaks to challenges in archaeological interpretation of digital objects, covering affordances, assemblages, provenance, copyright,

and embodiment (Arvanitis and Zuanni 2021, 143). Ireland and Bell (2021) examine low-performance digital things as ‘weak surrogates,’ to “creatively interrogate the conditions of the ‘in-between’ of physical and digital forms” (2021, 150; cf Morgan 2019). Through the village of Asinou in the Troodos foothills in Cyprus (unphotogenic, mundane yet affective) and a model created through Agisoft PhotoScan they explore the potential for reflexive engagement grounded in practice-led methods. Jeffrey et al. (2021) build on Jeffrey’s past consideration of authority and authenticity in digital objects (2015) to understand the agency of digital objects through a VR exhibit, the Digital Laocoön Immersive, a response to the 2014 and 2018 fires at the Mackintosh Building of the Glasgow School of Art. A digital replica of a plaster replica of Laocoön, a marble classical statue (itself likely a replica of a bronze statue) that was badly damaged and restored in 2014. The digital version remained the only version of the statue left after the next fire completely destroyed the plaster replica in 2018 (Jeffrey et al. 2021, 167). The authors call on assemblage theory and the extended object (Deleuze and Guattari 1987) to shuffle through this elaborate versioning, connecting to authenticity as determined by creator communities. Finally, they make kin between and with the objects by likening the assemblage of Laocoön replicas to a family (2021, 178). Exploring digital artefacts and places, people and things through relationships (eschewing networks) helps dismiss a perceived and misconstrued immateriality of digital things.

Finally there is a broader and arguably more urgent discussion in the materiality of digital things, which is the climate impact of digital archaeology. This is a broad ranging concern in terms of resources used to create digital things, the mining of rare earth materials to create hardware and its eventual disposal, and the maintenance and cost of our digital archives. Taffel (2015) approaches e-waste as a media archaeologist, noting the particular violence of material encounters with digital detritus, earning low wages “whilst conducting work whose numerous harms are not understood by the laborers themselves, and who often lack any formal education and are often children” (Vasel Action Network and Silicon Valley Toxics Coalition 2002, 26, cited in Taffel 2015, 83). The pace and proliferation of digital artefacts is mentioned by Aycock (2021), and while this presents exciting opportunities for archaeological investigation, I cautioned that “a full preservation and documentation effort would increase our own participation in the mass extinction event currently occurring under ‘Empire,’ what Bergman and Montgomery term as the ‘organised destruction under which we live’” (25, 2017; Morgan 2021). Though there has been continuous encouragement for the evaluation of the appropriate use of digital technologies for archaeology (London Charter, 2006) a more active proscription against using resource-heavy digital tools, and an encouragement toward degrowth principles (eg Flexner 2020) would temper the impact of burgeoning technological growth in archaeology.

The Uncanny

There is a haunting visual from the Digital Laocoön Immersive: a legion of Laocoöns, digital, physical, some emerging from the dark, some retreating from view (Jeffrey et al. 2021). This is perhaps unsurprising, as Jeffrey has previously described the past as “very weird place” and the digital object as having a strange immateriality (2015, 145-46). A sense of weirdness or the uncanny features in digital archaeology. In his discussion of the Uncanny, or the *Unheimlichen*, Freud (1919) links the concept to novelty, unfamiliarity and intellectual uncertainty. He cites Jentch in identifying that the feeling manifests in particular with respect to “doubts whether an apparently animate being is really alive; or conversely, whether a lifeless object might not be in fact animate” (1919, 5). Freud notes that “an uncanny effect is often and easily produced by effacing the distinction between imagination and reality, such as

when something that we have hitherto regarded as imaginary appears before us in reality” (1919, 15); he notes a particular link to past ideas that are not commensurate with modern understanding of causality. Finally, he identifies the important association to a setting perceived as real as opposed to that which is perceived as fiction. Moshenska notes that “archaeology is an inherently uncanny subject” (2006, 91) in his discussion of the spectacle of anatomical dissection and the archaeological gaze, as it “brings dead people, dead places and dead things into the world of the living” (2009, 98). He argues that the uncanny spectacle of archaeology as mediated through popular culture contributed to the alienation of the public audience from archaeological practice. Other contemporary archaeologists have strived to make the familiar strange through disassociation (Buchli and Lucas 2001; Graves-Brown 2011). It is similarly reflected in Lowenthal’s (1985) use of the L.P. Hartley’s quote: “The past is a foreign country” to describe the reception of heritage.

Linking to the digital, Mori (2012) draws from Freud in his discussion of the famed “uncanny valley” in which increased verisimilitude of robotic near-humans provokes unease in the human audience. Digital resurrection of the dead has increasing *jus* in popular culture, from dead movie stars appearing in new films, to a deep fake of Lewis Binford singing *Cococabana* created by archaeologists using an app. Does approximating past people, places and things through digital technology thrill us through a sense of power and control of these things, or is it the frisson of recognition, entering what I’ve characterised as an “interstitial space” where digital present and digital past dwell in commensurate space (Morgan 2019)? Graham characterises this as “practical digital necromancy” wherein archaeologists are creating “zombies,” resurrected partial people “animated by a limited set of appetites and urges and responding to its wider environment in limited or particular ways” (Graham 2020, 11; cf Hertz and Parikka 2012). He is speaking particularly about agent-based modelling which he specifies is “not to try to justify stories of the past, but to generate new stories” (2020, 14). Tringham notes elements of the surreal in her work with prehistoric speech and ASMR in the “spirit of playfulness, subversion, and participatory exploration” (2019, X). Mol discusses “dark phenomenology” in her exploration of animism in Roman cults and virtual reality with the *Iseum Campense Virtual Histories Project* (2020). I have written more broadly about the digital “monsters” created by archaeological interventions, in that they “should not be a seamless, transhuman integration of machine and body to transmit ideas about the past, but should invoke a monstrous disruption, interfering with both our understanding of the past and current sense of self” (Morgan 2019). Digital monsters are created by synaesthetic interventions, and failure that begets creativity (sensu Graham et al. 2019; Ireland and Bell 2021).

Ethics, Politics, and Accessibility

Digital archaeology has long been the domain of white men, though like the early histories of both computing and archaeology, there have been significant and unrecognised contributions from others. More recently the field has greater participation and attending critique from white women but has a long way to go before being able to serve as a more inclusive subdiscipline in archaeology. Digital archaeology and computational archaeology are viewed as more objective and scientific, with masculinist overtones, whereas digital heritage is associated with outreach, museums, and arguably feminized. Boundary-keeping regarding who is a digital practitioner within archaeology can be divisive; there are those who are specifically skilled in certain technologies or visual production, and those who can creatively rethink or critique the use of these technologies, but these qualities are rarely imbued in the

same people and are often subject to differing rewards (Perry 2017). With the burgeoning pace of innovation, even those who were once skilled can be rapidly left behind.

Digital technologies and online access are still unequally distributed across the world, and there are growing indications that digital tools contribute to intensive resource exploitation and degradation, climate change, and adverse mental health outcomes. Structural inequalities and white privilege and power that are still central in archaeology can be compounded through practices in digital archaeology such as unequal access to digital resources, the choice of subjects to digitize, and the retention and maintenance of digital archaeological data. Rico discusses the many drawbacks that come with the adoption of digital technologies, noting that increased adoption of technology “contributes to the perpetuation of a culture of expertise that is embedded in the dominant heritage paradigm” (2017, 218). Bonacchi et al. (2018) reveal how depictions of the past on social media directly contribute to the construction of political identities. The COVID-19 Pandemic has shown us how useful it is to have access to digital archives, artefacts, even entire sites. There are immense digital archives of cultural materials, but these are far from universal or secure. Which materials are deemed important enough to digitize, to make available and to maintain in perpetuity? Which parts of our past are thus made obscure, inessential, invisible? It is therefore welcome that there is a growing attention to harm reduction and accessibility within digital archaeology, which I discuss in terms of ethics and politics.

There has been some work in developing ethical frameworks for digital archaeology and heritage; a relatively early intervention by Colley (2015) outlined many of the pertinent issues including uneven distribution and exclusion, deceptive claims of democratisation, data standards, authenticity and authority in 3D audiovisual simulations, privacy standards and social media, and indigenous critiques. Richardson (2018) expands this discussion to examine ethical standards around digital public archaeology and data collection from digital media. Graham (2020 see also Dennis 2016; Khunti 2018) situates ethics in archaeology as applicable in archaeogaming, also making a parallel argument to Brazelton’s (2020) examination of Minecraft as operating within a settler-colonial framework. The most nuanced case studies are identified by bioarchaeologists who have discussed the particular ethical problems of the display of human remains on websites and sharing osteoarchaeological digital data (Hassett 2018; Huffer et al. 2019; Ulguim 2018). Finally, Dennis (2020) discusses the “failures” in ethics in digital archaeology with regard to codes of conduct, with a lack of institutional oversight combined with a lack of “consensus-led ethical guidelines” (2020). These concerns are mirrored in the 2018 Computer Applications and Quantitative Methods (CAA) statement on ethics (Brughmans et al. 2018).

In this discussion of ethics it is worthwhile to revisit the discussion of deontological codes, ethics and politics set forth by Gonzalez-Ruibal (2018). In his review, Gonzalez-Ruibal notes that *ethics* and its association with “morals, virtuous behaviour and policy” is in contrast to *politics* which invokes “equality, enfranchisement, conflict, power asymmetries, social justice, political economy, and capitalism” (2018, 346). In my previous work I have emphasised a political and ethical engagement with digital archaeology rooted in feminist epistemology and emancipatory archaeology (Morgan 2012) and formed an early intervention in the documentation and display of digital archaeological data captured from human remains (Boutin and Morgan 2009). This early intervention relied on ethical codes that were formed through state or institutional power, so could come under critique as another set of ethical principles without particular engagement with political action. In the process of forming ethical principles for the Other Eyes project, we used a consensus process based on

anarchist principles, with advocacy for the dead, and participation of representative stakeholders (Morgan et al. forthcoming).

Though ethical discussions in digital archaeology are ongoing, political engagements are only beginning to proliferate. There has hereto been relatively little engagement with the greater political ramifications of digital archaeology, including questions such as the privileging of state societies or institutional power through the continual reconstruction of churches and castles or the potential for the use of digital archaeology for prefiguration of more egalitarian futures. There are excellent projects that address accessibility and decolonisation within digital archaeology, particularly within virtual reality and 3D reconstruction. Ongoing research and work by Edward Gonzalez-Tennant (2013) in the Virtual Rosewood Research Project has demonstrated the ability for 3D reconstruction and virtual reality to create impactful interventions for social justice (Figure 1). Katherine Cook created “Built on Bones” an augmented reality skeletal overlay for architecture, revealing buildings that are related to colonial legacies (2017). Perhaps the most fully realized collaborative project is *Nunalleq, Stories from the Village of Our Ancestors* a digital educational resource for children in the Yukon-Kuskokwim region on Alaska’s Bering Sea coast (Figure 2; Watterson and Hillerdal 2020). The project is codesigned between academic researchers and a wide consortium of indigenous community members and combines archaeological data with contemporary indigenous knowledge to create an interactive resource to empower children to “take ownership of their history and heritage” (Watterson and Hillerdal 2020, 222).

Interventions are not always limited to 3D reconstruction within digital archaeology. There is an insightful issue on mapping and historical archaeology in the *International Journal of Historical Archaeology* that features GIS used to map power and resistance, including the 1733 St. Jan Slave Rebellion in the Danish West Indies (Norton 2020) experiences of suffering and death surrounding undocumented migration (Gokee et al. 2020), and indigenous uses of space through radical placemaking (Townsend et al. 2020). Also notable is the Mukurtu content management system that “empowers communities to manage, share, narrate and exchange their digital heritage in culturally relevant and ethically-minded ways” (Mukurtu 2022; Christen 2011). These are a few examples of projects that show the potential for restorative justice work with digital technologies in archaeology.

Perhaps the most controversial political intervention with subsequent discussions surround Oxford’s Institute for Digital Archaeology 3D modelling and reconstruction of the triumphal arch from Palmyra. The arch was met with general plaudits from popular media and condemnation from archaeologists who were concerned with the funding, symbolism, lack of stakeholder consultation, and disconnect from critical heritage discourse by the creators of the model (Khunti 2018; Stobiecka 2020; Rico 2020). In particular Yazdi and Massoudi note, “there are no traces of blood stains in the reconstruction site” (2017, 451). Kamash (2017) led an intervention that productively queried the model by conducting place-based research while the model was located in Trafalgar Square. She and a team of students invited responses on postcards from visitors from the site; these responses highlighted the alienation of the model to colonial surroundings and positioning of the uprooted arch.

3D printing has also been explored by others as a way to more widely distribute artefacts and skeletal remains, for replacement after repatriation, and for interpretive displays. 3D printed objects are archaeological artefacts themselves, of course, and archaeologists have been exploring how they evoke emotional responses as interpretive materials (Di Giuseppantonio Di Franco et al. 2018; Galeazzi 2018). Digital reproductions and 3D printing have been used

by artists to protest colonialism in what is known as the “Nefertiti Hack” wherein a 3D scan of the iconic Nefertiti bust held in the Neues Museum in Berlin was purportedly clandestinely created and then used to print a 3D copy (Geismar 2018, 111). It was later understood that this “hack” was actually a leak of an existing 3D scan. Isaac (2015) discusses indigenous repatriation of artefacts and the power that 3D reproductions can have to transform relationships through co-production. Through consultation with clan members, the National Museum of Natural History created a 3D replica of a Tlingit Dakl’awewidi clan Killer Whale crest hat or *Kéet S’aaxw*. This replica then became an important site of cultural and clan memory (Hollinger et al. 2013) and demonstrates digital archaeological practice in service to restorative justice principles. Isaac further notes that “through the creation of these digital/object/beings these projects have given the Tlingit more agency in formalizing their expectations about the responsible or moral treatment for these, as well as for their ‘kin’ or other related object/beings in museums” (2021).

Conclusions

Though digital archaeology has been primarily a method and is emerging as theory, it has been discussed as a continual process of *becoming* (sensu Lock 2003, xiii). Technological vanguardism is celebrated within the community of digital archaeologists as we continue to experiment with digital methods to investigate the past. These methods are then absorbed into general practice, or set aside as they prove to be too unwieldy or outmoded. Some have argued that to “stop talking about digital archaeology” in order to “to continue doing archaeology digitally” (Costopoulos 2016, 1), and much technologically-aided practice is tedious, menial, and does not necessarily contribute to furthering the discipline at large.

Some digital methods increase divides in practice and contribute to deskilling and reduce the legibility and sustainability of the archive (Morgan et al. 2021). As such, I have tried to select the transformative aspects of digital archaeology, ones that broaden our metaphors, change our objects of investigation, and reveal our practices of knowledge production. In bringing together this work I offer a moment of reflection in the fast-paced and often near-future seeking subdiscipline of digital archaeology. There is incredible joy and creativity to be found in working with digital technology in archaeology; to shape this use into the service of prefiguration and the imagining of better futures is key and should inform all current and future practice.

Recently Huggett et al. (2018) considered several potential futures for digital archaeological knowledge. Through a scenario analysis they identified change as being driven by relative openness, innovation, centrality, and state/institutional affiliation and encourage building a “high-level digital disciplinary architecture—a consensus model of what archaeology does as a whole” to determine areas of innovation and deficiencies to address (2018, 51). There is relatively little reflexivity within this particular exercise; that the path has been primarily determined by established, white British men working with a few others in Europe is not acknowledged as a significant detriment, though the authors have made significant contributions toward increased diversity in other contexts. To contrast with this scenario analysis, the most intriguing work that pushes the discipline lies at its intersections, when digital archaeology allies with political interventions such as decolonisation and in playful conversation with analog methods, as demonstrated within this review. Prefigurative, collaborative practice-based research animates digital archaeology and mobilizes it to critically engage with contemporary, political issues in the field (cf Rabinowitz 2016).

There is a further productive parallel development in anthropology with the recent reframing of “Visual Anthropology” to “Multimodal Anthropology.” This move acknowledges the broadening of media practice within anthropology and in collaboration with communities with which they work, emphasising a field “encapsulated within the numerous visual, aural, and tactile media that anthropologists produce, post, and share” (Collins et al. 2017, 142). An excellent example of this practice is in Danis’ (2019) discussion of her collaboration with students and indigenous people as creating ‘casual cyborgs’ who move freely between ‘real’ and virtual’ (2019). She found that using digital recording in archaeology freed up time, allowing “a new form of local, intergenerational knowledge production between myself, Abiquiú youth interns, and their families” as they created analog collages and zines alongside digital records of archaeological remains (2019, 388). Multimodality also has resonance with practice-based research and the continual discussions regarding technologies and creative practice (Beale and Reilly 2017) and in co-creation (Di Giuseppantonio Di Franco et al. 2019) and enchantment (Perry 2019); as such archaeologists could join what is already a vibrant discussion in Anthropology.

Archaeology is the collective, deep chronological documentation of the capacity of humans to imagine different ways to live. Digital archaeology, so often cast as seductively simple, as normative, as deskilling and automating, should instead encourage joyful practice and animate the wild splendour, diverse and outright strange ways people have lived in the past. The International Workers of the World, an international labor union, have a commitment to “forming the structure of the new society within the shell of the old.” A prefigurative digital archaeology means that we must stop building empty 3D castles and temples and focus on the labor of the people who built them. We must understand the waste generated by mining for materials to create digital infrastructure and the exploitative practices of tech companies who create our tools. We must engage with Bill Caraher's “slow archaeology” which queries the methods that we use to record archaeology at the cost of skilled craftspersonship and the acceleration strategies of late capitalism. We must rethink intellectual property and museum practice to address structural oppression and colonialism. Digital work within archaeology must move beyond skeuomorphic submission and replication of previous structural inequalities to foment new archaeological imaginaries.

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