

BABAO recommendations on the ethical issues surrounding 2D and 3D digital imaging of human remains

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1.0 Preamble

As its name implies, the British Association of Biological Anthropology and Osteoarchaeology (BABAO), is concerned with the disciplines of biological anthropology and osteoarchaeology. BABAO seeks to advance our understanding of human and non-human primates past and present¹, and views the generation, dissemination, and use of this knowledge as a valuable goal that should be undertaken in an ethical manner.

Since the study of biological anthropology and osteoarchaeology is multidisciplinary by its very nature (Turner 2004), BABAO members have interests and backgrounds that range broadly within the natural and social sciences. The researchers, teachers, and practitioners that make-up the BABAO membership are often members of many different communities, each with its own moral rules or codes of ethics, and BABAO members often have moral obligations as members of these other groups (e.g. family, religion, and community) as well as to the profession.

In an area of such complex relationships and responsibilities, it is unavoidable that misunderstandings, conflicts, and the need to make choices among apparently incompatible values will arise. It is a BABAO member's responsibility to deal with such challenges and explore avenues to resolve them. The codes will provide BABAO members with tools to engage in developing and maintaining an ethical framework for their work.

Members should recognise that the activities they engage in may be subject to more than one code of professional activity (e.g. Chartered Institute for Archaeologists (CIfA)), and they should aim to familiarise themselves with those affecting their particular working practices. Although the BABAO membership encompasses scientists from many countries, this document is primarily intended for the UK, although some points can indeed be used in other countries. The purpose of this Code is to foster discussion and provide guidance for conducting work in an ethical and professional manner. BABAO does not and will not adjudicate claims for unethical or unprofessional behaviour.

2.0 Introduction

In recent years there has been an increase in the use of digital imaging in the documentation, recovery and analysis of human remains,² such as 2 dimensional (2D) photography, computerized axial tomographic (CT) scanning, 3 dimensional (3D) laser scanning and

¹ BABAO recognizes that the professional activity of its members also extends to fossil and forensic remains

² Please note, that the Human Tissue Act does not cover images. The Human Tissue Authority Codes of Practice (which apply to licensed institutions, but are not statutory) require that licensed institutions ensure 'appropriate use' of images: "The making and displaying of images (including photographs, films and electronic images) falls outside the scope of the HT Act. However, the HTA requires Designated Individuals (DIs) to put systems in place to ensure suitable practices are carried out" (2006, 17. Point 73).
https://www.hta.gov.uk/sites/default/files/HTA%20Code%20A_1.pdf

photogrammetry. These have increasingly been used to: document human remains prior to destructive or invasive sampling or reburial, to help with the diagnosis of disease, use in public engagement, to minimise handling of the actual remains, and for sharing data. We fully expect that these methods and their uses will continue to develop in future years.

Image research has found that living communities and individuals with connections to certain human remains or cemetery populations may have strong beliefs and feelings against imaging and display (see, Harries et al., 2018; TRACES project). Conversely, human remains displayed in museums and used in television programmes typically receive a favorable response from the viewing public, and help to engage the audience in science and archaeology³. This means that a careful assessment of the rationale for display of ‘images’ in their broadest sense is required, from images in the public domain to images used in scholarship and teaching.

The exponential development, and democratisation of a range of 3D imaging technology is having an increasing impact on the study of human skeletal remains (Kuzminsky and Gardiner 2012; Sumner and Riddle 2009). The value of 3D digital data in human remains excavation and analysis has been demonstrated across archaeology, anthropology, and the forensic sciences. For example, computerized axial tomography (CT) scanning can capture bone density (Lam et al., 1998), anthroposcopic measurements (Robinson et al., 2008) and internal structures (Ynnerman et al., 2016). 3D photogrammetry has been demonstrated as effective for trauma analysis (Urbanová et al., 2015), and mass grave documentation (Baier and Rando 2016). Laser scanning has been used to capture 3D morphology, and facilitate geometric morphometric (GMM) analysis of skeletal variation across populations (Bigoni et al., 2010; Cardillo 2010; Franklin et al., 2006; Gonzalez et al., 2009; Rando et al., 2014). These methods provide new means to visualize human remains both as 3D digital models, but also increasingly 3D digital models are being 3D printed to create physical replicas of human remains (Seguchi and Dudzik, 2019). The literature demonstrates that this use of 3D imaging and printing across these disciplines has now extended beyond the novelty of a new technology (e.g. Carew and Errickson 2019).

Although the excavation, analysis, display, publication and curation of human remains have been subject to ethical debates for many years, ethical issues surrounding the use of images of human remains is a more recent phenomenon. This document explores these issues in relation to the display of images in the public domain and use of 3D imaging of human remains, and seeks to highlight some recommendations.

2.1 Initial Considerations

The requirement for justification and recommendation for consultation, where appropriate, are just as applicable to the creation and sharing of imagery of human remains in a virtual

³ The display of human remains is supported by public surveys (see, <https://historicengland.org.uk/content/docs/research/opinion-survey-results-pdf/>)

setting. Furthermore, contextualising the data presented through an image or 3D model is a key factor in mitigating ethical issues of display (Perry 2011; Williams and Atkin 2015). Justification, the results of consultation, and key meta- and para-data should therefore be provided for the image on display (Antoine 2014) or linked to the remains in virtual, digital spaces (Ulguim 2017).

Digital and physical 2D and 3D images (including photographs, radiographs, 3D polygons and voxels) are widely disseminated in the public domain, frequently without warning, and sometimes out of context. Once published, these may be edited and manipulated in unforeseen ways outside of the intended context. This can compromise the dignity and respect with which human remains should be treated. The BABAO code of ethics state that the analysis of human remains ‘is a privilege and not a right ...and... should always be treated with dignity and respect’ (BABAO 2019, 3). This respect should be maintained when handling the data of the human remains and before any data are collected, and a scientifically robust reason or research question must be explored⁴.

It is important to highlight that our definition of image display requires reflection, as ultimately images and 3D models of bones are visual representations of data which may be displayed or sensed in different ways. We often prioritize the ‘visual’ over other senses due to bias which characterises ‘vision’ as the primary sense. Digital imagery, in the form of 2D and 3D data of the human remains, in itself contains data on colour, size, condition, and shape, and it may also take the form of images from radiographic or microscopic.

Making replicas of real human remains is not a new occurrence, but 3D printing like 3D digitisation should never be carried out without scientific reason, and physical replication should be only utilised in cases where research, education or public knowledge can be enhanced, such as the creation of handling collections in universities for example.

3.0 Preservation

One of the key benefits of utilising 3D technologies for the study of human remains is preservation. A digital copy of the remains can be made and kept for future study, teaching, and/or display. Human remains from forensic contexts have additional legal and ethical implications, for instance any evidence involved in a current case is tightly controlled to maintain chain of custody, and security and privacy. In addition to this, while public interest in forensic anthropology has markedly increased in recent years, the perception of using modern human remains in research has faced some resistance. However, the overall aim is the same: to prevent damage, degradation, and/or destruction of the skeletal material (Fletcher et al., 2014; Kuzminsky and Gardiner 2012). In both archaeological and forensic settings, digitisations can be used as a proxy for the original human remains, limiting any

⁴ Permission should also be sought from the curating institution, and to work with them to contact descendants where appropriate (see DCMS 2005, 20, 26). These arrangements are often best managed with a memorandum of understanding to govern use, permissions etc...

contact with and movement of the original remains, thus minimizing ‘use-damage’ and any ‘emotional damage’ the real remains may have on communities and families (Gilissen 2009; Roberts and Mays 2011).

4.0 Analysis

The second benefit is that 3D imaging methods offer powerful analytical tools for the study of morphological-based changes to human remains. Across scientific disciplines, innovative imaging methods are being developed to transform the ways in which we visualise information and enhance the resolution. The 3D nature of bone means that these imaging methods are more suitable than traditional 2D methods, such as linear measurements or outline analysis, where the full geometry of the remains is lost. 3D imaging methods capture the multiple geometric faces of the object in a single model (Thali et al., 2005). Additionally, they provide image enhancement through features such as magnification (Bocaege et al., 2010), light-based feature highlighting (Newman 2015), and mathematical image enhancement (Mudge et al., 2006). Furthermore, with the available calibration and scaling used in these methods, metrical data can also be extracted from the models produced. For example, shape analysis using a 3D Gaussian Mixture Model (GMM) to investigate evolutionary changes (Bruner 2004; Lawing and Polly 2010), sexual dimorphism (Janin 2017; Velemínská et al., 2012), and toolmarks on bone (Maté-González et al., 2016), has already been empirically demonstrated. It should also be noted that there are also limitations to the use of 3D imaging (please refer to Errickson et al., 2017).

5.0 Sharing

Digital data opens more doors for sharing and collaborative work. Developments in cloud storage and internet speeds make this a logistically and economically viable tool for research and practitioner work. Both archaeology and the forensic sciences suffer from tight budgetary controls that can limit the efficacy and scope of work (Tully 2016). The creation of high-quality 3D models opens up opportunities for global collaboration and the reasons for this are four-fold: 1) reduction in costs of accessing human remains anywhere in the world; 2) it provides access to data that have high-quality geometry, colour, and texture reconstructions, all essential for morphological studies; 3) it reduces the heavy burden on institutions to maintain continual access to physical skeletal collections; (4) collaboration between different groups of people. It is important to note that digitisations of human remains act as proxies only, it is accepted that these will never operate as absolute replacements of original material, and there will be limitations for studies concerned with multiple collections which may have differing levels of digitisation. However, as outlined above, there are significant benefits granted by the use of 3D technology, as well as opportunities for solely digital studies, such as those conducted by Digitised Diseases (n.d.)⁵. This opportunity is particularly valuable where the original remains and the analyst cannot be physically connected. Access to a high quality digital version is inevitably more beneficial than no access at all.

⁵ <http://www.digitiseddiseases.org/alpha/>

Individuals may encounter instances of unethical sharing and image display via different platforms and media. We recommend contacting the BBAO Committee, who has experience in resolving these situations.

6.0 Display and Handling

The final primary benefit of 3D models is their role as valuable demonstrative tools for communicating with the public. Media interest in forensic and biological anthropology has stoked the public interest (Blau 2018). For example, the last few years has seen increasing numbers of outreach events in these fields⁶. Virtual and 3D printed models allow people to interact with these objects without any contact with the original human remains. Furthermore, interactive displays can be built around this technology with great success, such as the British Museum's digital Gebelein Man (Ynnerman et al., 2016), and the 3D printed Jericho Skull exhibitions (Hirst 2017). Additionally, these models can be shared publicly on web-platforms to encourage education and outreach around the study of human skeletal remains (Meyers and Killgrove 2015).

When assessing whether to display human remains either via 2D or 3D imagery, the individual responsible needs to review a series of variables which will affect their response in design and the final output for display. These variables can be broadly categorized into two categories and form an 'ethical decision making' matrix as described by Ulguim (2018) for sharing imagery of human remains. The first category relates to *situational* conditions and the second to the nature of the *individual* on display. Within *situational* variables the requirements resulting from consultation, legislation, and the wider context (which takes into account local sensitivities and historical information) can be assessed. *Individual* variables relate to the identification or association with living groups (and in particular the expressed wishes of the deceased), the condition of the remains, the circumstances of death (i.e. genocide may not lend support to sharing the imagery), and time since death (as there may be further sensitivities surrounding this).

The combination of the variables described above will influence aspects of the display, such as the final decision on whether to actually display the image. Communication and exposure should be carefully managed so not to develop sensationalist reporting, and the extent to which the human remains are directly accessed should be considered, perhaps requiring the user to click on a warning message to view the image directly. The inclusion of contextual information is vital, including in potentially ethically compromising situations, and should note the justification for sharing. This allows transparency in virtual skeletal collections by providing important information about provenance and funerary context. Finally, these

⁶ Museum of London 'Close to the Bone' (<https://www.archaeology.co.uk/articles/specials/museum-of-london-docklands-close-to-the-bone-workshops.htm>); Natural History Museum 'Crime Scene Live' (<http://www.nhm.ac.uk/events/crime-scene-live.html>); 'Being Human Festival', in collaboration with BBAO (<https://www.ljmu.ac.uk/conferences/babao/being-human-festival>)

variables will influence how accessible the imagery should be, and what permissions and licensing should be applied.

In the forensic sciences, initial research is being conducted to assess the suitability of 3D digitisations and prints as probative forensic evidence. Evidence may be required to be presented for the benefit of the jury; however, there are restrictions on showing physical evidence that is considered upsetting or unacceptably graphic as this can bias the decision making of the jury (Thompson 2015). Errickson and colleagues (2014) discussed the use of various 3D digitisations of skeletal evidence for this purpose, concluding that these methods provide a 'logical extension' to submitting photographs of skeletal remains to the court jurors. However, the authors also acknowledged the lack of standard procedures for this process, without which this approach cannot yet be validated.

Ultimately, in the endeavour to reconstruct physical and contextual information from human remains, a balance must be struck between preservation and advancing knowledge. Intensive and repeated study and sampling often leads to human remains becoming compromised, but 3D data offers the next best method of accessing the remains. Additionally, 3D models can be printed out in circumstances when actual physical use of the remains would be beneficial, such as for teaching or outreach activities (Niven and Richards, 2017), and even for display. Likewise, if a skeleton is to undergo destructive sampling, documentation by digitisation and printing may be achieved (APABE 2013). Likewise, if remains are to be repatriated and/or reburied, although consideration needs to be given to who owns the data, and to whom they can be shared with. While 3D prints may provide a proxy for human remains, they should not be considered a replacement (see Roberts 2018).

7.0 Further Data Considerations

It is important to maintain digital storage to avoid data loss (see, Paradigm Project⁷). The curating institution should hold data ownership to avoid data silos, but with the allowance for the person's plan for analysis of data⁸. Consideration of how long to retain the data should also be sought, and accurate metadata should be included alongside the 3D data following advice published by the Archaeology Data Service.⁹ A formal agreement should be made prior to 3D printing, with the appropriate research questions and permissions in place. The guiding principle regarding printing human remains is that the permission of the curating institution should always be sought.¹⁰ A recent World Archaeology Congress Resolution (Hassett et al., 2016) recommended a tiered model for the licensing of digital bioarchaeological data, which respects the rights and wishes of the individual and their

⁷ <http://www.paradigm.ac.uk/>

⁸ This should be managed with a memorandum of understanding, and a standard term of exclusivity is generally considered to be three years

⁹ https://guides.archaeologydataservice.ac.uk/g2gp/CreateData_1-2

¹⁰ Also, any known descendants, as per DCMS (2005, 26). Managing these projects is greatly assisted by having a memorandum of understanding, one which details restrictions and fair usage. Any changes to the agreement must be made with the curating institution.

descendants, as well as the creator of the data. This is important, because community requirements must be met, but data creators often operate within and on behalf of institutions or in partnership with them.

The inability to make or obtain copies of human remains continues to be an issue within our discipline, with the Digitised Diseases project a notable exception.¹¹ To encourage good practice, where imagery and data on human remains are shared physically or digitally, an ethical statement on data sharing should be added to forward facing publications with reference to relevant guidelines.

8.0 Conclusions

Overall, there is a marked increase in the use of 3D imaging methods for analytical purposes, such as the visualisation of trauma, but there is yet to be a widespread uptake and sharing of digitised of skeletal collections, although some are available, for example: ‘Digitised Diseases’, The Mary Rose Virtual Tudors Project (n.d.), and the Smithsonian Human Origins 3D collection (n.d.). The broad issues discussed in this document can act as a guide for researchers and practitioners when in choosing suitable 3D imaging methods for projects, and key considerations for managing that data.

8.1 Summary highlights

- We all have an ethical responsibility when dealing with images of human remains
- Digital imaging can offer a recording mechanism that can be non-contact and non-destructive
- There is an advantage to imaging human remains; however there must always be a justified value to this form of documentation. This value must be for education and/or research; it also serves to create a record the human remains
- 3D images or prints can be used to minimise access and handling of remains, avoid public exhibition of the original remains, and can be used for teaching and for public events, however we must consider context and permission to establish whether they should be used in this context
- Taking and using images (especially in the public domain such as on social media) with no good valid reason is not justifiable
- To be mindful of copyright laws and the policies governing curating institutions
- Imaging and 3D printing should not be considered a substitute for the original remains, but imaging can be used prior to destructive analysis as part of record keeping

¹¹ <http://www.digitiseddiseases.org/fairuse.php>

- We need to be mindful of who owns the data, how long can the data be stored, and whether permissions to use the images are in place prior presentation.

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