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The aerial panopticon and the ethics of archaeological remote sensing in sacred cultural spaces

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Abstract

Remote sensing technology has become a standard tool for archaeological prospecting. Yet the ethical guidelines associated with the use of these technologies are not well established and are even less-often discussed in published literature. With a nearly unobstructed view of large geographic spaces, aerial and spaceborne remote sensing technology creates an asymmetrical power dynamic between observers and the observed. Here, we explore the power dynamics involved with aerial and spaceborne remote sensing, using Foucault's notion of power and the panopticon. In many other areas of archaeological practice, such power imbalances have been actively confronted by collaborative approaches and community engagement, but remote sensing archaeology has been largely absent from such interventions. We discuss how aerial and spaceborne imagery is perceived by local communities in southwest Madagascar and advocate for a more collaborative approach to remote sensing archaeology that includes local stakeholders and researchers in all levels of data acquisition, analysis, and dissemination.

KEYWORDS
community archaeology, ethics, Madagascar, remote sensing, surveillance

1 | INTRODUCTION

Within archaeological remote sensing, the ethics of aerial photography are often overlooked, especially when areas of interest involve local, Indigenous and descendant (LID) communities. While surveillance has been highlighted within the context of aerial and spaceborne remote sensing archaeology (Myers, 2010), the literature on this topic is scarce. The ethical quandary surrounding surveillance parallels dilemmas of 'who controls the past' (Colwell, 2016), specifically in terms of who is permitted to 'collect, retain, and use' large-scale datasets derived from aerial and spaceborne sensors (Cohen et al., 2020). Image data, in particular, has reinforced colonialist agendas and has had severely negative consequences in many instances for LID groups around the world (e.g., Gordon, 1997; Hartmann et al., 1999; Ranger, 2001). With the creation of larger remote sensing datasets with extremely fine spatio-temporal resolutions and virtually unlimited spatial coverage, issues of power and surveillance must be confronted head-on to ensure that future research is equitable and avoids repeating the many injustices of colonial era research.

A primary issue to address is the epistemological dissonance between remotely sensed and other classes of data (see Millican, 2012; Thomas, 1995, 2008). Knowledge produced by remote sensing instruments is often viewed as fundamentally different from other sources of archaeological and anthropological data, such as ethnohistoric information, because they are collected from the sky and are thus assumed to be disconnected from and less impactful to communities on the ground (see Hacıgüzeller, 2012). This creates a disconnect between local community views of space and place and the viewpoint of the aerial surveyor (Ingold, 1993; Mark & Turk, 2003; Rennell, 2012; Thomas, 1993) and serves to deny sovereignty of LID communities over the acquisition and use of remotely sensed data. The disparity in the treatment of different classes of information augments an already uneven power structure between archaeologists and LID communities. This power dynamic is critically dependent upon LID representation in scientific research, and a collaborative approach can help balance existing power structures by providing more sovereignty to LID communities.

In combination with other classes of data, remote sensing can be used to enhance archaeological and historical interpretation. For example, Wadsworth (2020) underscores how different techniques can create complementary narratives about landscapes and their history and that researchers can combine different data sources (like remote sensing and local histories) to produce interpretations that are more meaningful for researchers and LID communities. Douglass, Walz, et al. (2019) emphasize that such integration of multiple data sources is, in fact, necessary to minimize the risk of inaccurate or biased interpretations of how people and landscapes co-evolve. Nonetheless, remote sensing archaeology does not always take an integrative and collaborative approach. Unequal power dynamics between the observer(s) and the observed remain deeply entrenched (Eubanks, 2017), and this is particularly significant when observed parties have deep histories of connection to the places that they live (i.e., LID communities).

The uses of remotely sensed imagery in archaeology have a broad range, encompassing small-scale, localized studies of specific sites and locations, broader regional surveys and landscape-scale assessments of at risk cultural heritage with agendas quite distinct from other academic initiatives. As such, in what follows, our discussion is primarily targeted towards those uses of remotely sensed data that target traditional homelands of LID communities with long histories associated with the landscape under investigation and particularly the use of high-resolution datasets where culturally significant features can be directly identified and recorded. Nevertheless, our reflections on the ethics of remote sensing archaeology are certainly relevant to broader scale investigations and studies using lower resolution data. Our aim is not to present a 'one size fits all' solution, as different research programs will have different ethical dilemmas to face. Rather our paper seeks to spark a conversation about how archaeologists wield significant power and influence through their use of remote sensing technologies and that this power has the potential to have real and devastating consequences on LID communities. Thus, regardless of scale or scope of the research agenda, we must confront these power dynamics to ensure that communities are not negatively impacted by our work.

Certainly, in many heritage management projects rooted in large-scale surveys, the scale of the analyses and level of detail are not always great enough to constitute a violation of privacy, per se. Massive archaeological undertakings of landscape mapping have advanced scholarly understandings of many regions around the world (e.g., Bewley et al., 2016; Casana, 2014; Hobson, 2019; Menze & Ur, 2012). Nevertheless, even where such work has lower data resolutions and less direct contact with individual sites and cultural features, ethical considerations with regard to local communities remain imperative. In the context of large heritage management surveys, previous community and participatory mapping and education initiatives demonstrate some of the ways that researchers are beginning to engage local communities within landscape-scale projects (e.g., Casana, 2020; Fisher et al., 2021; Parcak, 2019; Yates, 2018; also see community archaeology projects like The Chiltrns AONB [https://www.chilternsaonb.org/], Whiteadder [https://whiteadder.aocarchaeology.com/], among others). Additionally, these large-scale initiatives can also increase local or regional representation on project boards so that local concerns can be more consistently acknowledged and addressed.

Recently, a number of researchers have begun to address ethical issues surrounding remote sensing archaeology (e.g., Chase et al., 2020; Cohen et al., 2020; Gupta et al., 2020), but attention remains limited, particularly considering the scope of the ethical issues at stake in the use of remote sensing technologies. In addition to an ethical consideration of power imbalances resulting from aerial or spaceborne sensing, there are also legal considerations. While the proliferation of drone technology into the private and commercial sectors has been met with legal regulations on their use in some areas, laws governing aerial and spaceborne remote sensing are largely ambiguous or entirely unrelated to issues of privacy (Oduntan, 2011). International aviation laws claim that nations are entitled to 'complete and exclusive sovereignty' of airspace above their territorial boundaries (Haney, 2015), but space law is not as concrete. Furthermore, despite the clarity of aviation laws, disputes over jurisdiction still arise. For example, Native American nations view airspace and land as part of the same continuous territory and thus claim jurisdiction over both, while US aviation regulations run counter to this sovereignty claim (Haney, 2015; Reddix-Smalls, 2014). International law, therefore, does not create a legal panacea that solves all issues of legality and ethics. There are even regions of the world where legal policies are limited, or non-existent, regarding safety and privacy of citizens in relation to aerial technologies, or how such data are used (Oduntan, 2019). Because remote sensing technology has opened vast amounts of space to exploration by archaeologists, the question posed here is whether the collection and analysis of remote sensing data from locations where data collected at the ground level would otherwise be 'off-limits' are ethically justifiable.

In previous work on Madagascar, several of the authors of this paper utilized satellite remote sensing to identify archaeological sites (Davis, Andriankaja, et al., 2020). Our work on this project inspired the current paper and deeper probing of the ethics of remote sensing research, especially when it involves the investigation of sacred cultural spaces and communities with deep historical ties to the landscapes under study. Here, we thus primarily consider a case study from Southwest Madagascar, where diverse communities have lived for hundreds to thousands of years and where there are strict taboos (*fady* or *faly*) governing access to parts of the landscape, especially with regard to *vahiny*—people outside of the endogamous community (Cinner, 2008). Remote sensing, however, allows outsiders to have unrestricted aerial access to these locations, and Malagasy law only requires a permit for the use of certain technologies (e.g., drones) but does not require permission from local communities for the use of remotely sensed data. Regardless of legality, we ask whether it is *ethical* for researchers to conduct geospatial analyses of the SW Malagasy landscape without the consent and collaboration of LID peoples? We suggest that the answer ultimately lies in who benefits from the sensing of these spaces and the research that comes from this action (see Cohen et al., 2020). Furthermore, we argue that the use of remotely sensed data should not adversely impact any party, especially LID communities in the region under study.

In fact, with collaborative remote sensing approaches, archaeologists have the capacity to engage with communities that have often been excluded from many past investigations because of highly mobile and transient lifeways that make the study of their connections to landscapes more difficult. Such research agendas could help empower highly vulnerable populations who have been victims of displacement and disenfranchisement. Furthermore, geospatial technologies more broadly have been leveraged in powerful ways to revision and centre the histories and agency of Black, Indigenous and people of colour (Dunnavant, 2020), as these are inscribed in land and seascapes.

We advocate approaches to the use of remote sensing technologies that engage LID communities in active collaboration and knowledge exchange. This includes discussing how remote sensing technologies work, understanding local opinions about these methods, developing research plans in consultation with LID community members and land owners prior to any aerial survey taking place, involving community members in the survey process and maintaining transparency about the use of remotely sensed data throughout the research project. Transparency is at the heart of collaborative archaeological practice and is central to co-producing science in a just manner (Atalay, 2012; Douglass, Morales, et al., 2019; Lyons, 2013; Wadsworth, 2020). As Gupta et al. (2020, p. S47) state: 'greater attention to community-driven intellectual efforts can enhance the bonds of trust between Indigenous and non-Indigenous peoples, a situation that can meaningfully address colonial practices in archaeology'.

In what follows, we outline the power imbalance that can result from aerial and spaceborne sensing in the form of a panopticon dynamic (sensu Foucault, 1995 [1975]). Next, we discuss these issues within the context of Southwest Madagascar. Our objective in the article is to critically evaluate the ways in which remote sensing archaeology can create or accentuate unequal power dynamics between local communities and researchers and their institutions. To this end, we evaluate the opinions of LID communities in Velondriake, Madagascar, about the use of remote sensing instruments (specifically drones and satellites) for documenting culturally significant places. We draw on our experiences in working with local communities in this area to challenge currently accepted assumptions about power dynamics within remote sensing archaeology. In such a discussion, we acknowledge that some may be uncomfortable with the framing of our discussion, as we are ultimately suggesting that power must be more equitably shared between researchers and stakeholder communities—put more bluntly, we are implying that power must be ceded by researchers who have hitherto held it. At the same time, we stress that this article should not be seen as an attack on particular individuals or practices but rather as a critical self-reflection about how to increase the equity of our research practices.

2 | SURVEILLANCE AND POWER: FOUCAULDIAN DYNAMICS

In his book, *Discipline and Punish*, Michael Foucault (1995 [1975]) outlines the role of surveillance in the construction of a power structure between members of society. In particular, Foucault focuses on the panopticon (Benthem, 1791), an architectural style employed in many European prisons wherein guards watch inmates from an elevated central tower. The guards' presence or absence in the tower is unknown to prisoners. Prisoners must, therefore, assume that guards are always present.

Much like the panopticon, remote sensing offers a 'birds-eye' view of entire regions with unfettered access and visibility and limited indication to people on the ground of when the landscape is being surveilled. Many remote sensing technologies (like aerial photography) became prominent through their military applications, including the survey of battlefields and enemy territories (Parrington, 1983). RADAR technology, which has gained popularity in archaeological remote sensing (e.g., Chen et al., 2017), saw its largest development during WWII, when it was extensively used to look for enemy submarines and aircraft (Parrington, 1983). Furthermore, while satellite imagery was first proposed as a step forward for scientific research, it was an essential tool used by Russian and American agencies in the space race during the Cold War. In fact, the US Navy's Bureau of Aeronautics was intimately involved in the creation and launch of the first satellites (Rosenthal, 1968).

The development of remote sensing techniques for military purposes may explain the lag in ethics concerns regarding these methods (Pollock, 2016), as the early intent of much of this technology was espionage, which by definition does not involve consent (Gogarty & Hagger, 2008). Personal property and 'private' spaces are inherently revealed, and all restrictions are ignored. While archaeologists may not think of their work as surveillance or espionage, the potential ramifications of using aerial or spaceborne imaging systems to photograph people's homes and property do require careful thought, especially when the bounds of an investigation involve culturally sensitive areas or communities that have historically been exploited by colonialist/imperialist agendas. Applications of remote sensing can be positive, negative or both, but regardless, these tools result in a shift of power towards the observer(s) and away from the observed. Therefore, practitioners need to be conscious and intentional about how they are engaging communities in the gathering and application of remotely sensed datasets.

While the panopticon can be viewed negatively, there are also positive elements of such surveillance mechanisms. Advances in science and medicine require surveillance mechanisms to address important questions on a range of topics, and such hierarchical observation can also help to counter dominant power structures (Galič et al., 2017, p. 23). For example, a 'constitutional panopticon' flips the roles of observers and observed to oversee governmental officials and those in places of power (Brunon-Ernst, 2013). Therefore, the concept of a panopticon is neutral (see Haggerty, 2006) but can make positive or negative impacts depending upon how such power dynamics are exploited.

Unlimited access to remotely sensed data can therefore come at a cost: it can exert power over those living in investigated spaces (see Myers, 2010). For example, local perceptions of being surveilled can induce behavioural change through fear and can limit the ability of local communities to make managerial decisions about their land and resources. Gupta et al. (2020) illustrate this issue in Canada, where legal statutes limit the authority and capacity of First Nations communities to access archaeological information compiled from 'big data' sources like satellites and aerial surveys. This creates a power imbalance resembling Jeremy Benthem's (1791; also see Foucault, 1995 [1975]) panopticon, wherein researchers and government employees are given total control of datasets in most instances, leaving indigenous peoples without any authority to control/manage their own cultural heritage or how this information is used. This threatens sovereignty and local rights over data access and privacy (see Myers, 2010). To use these data without consulting with stakeholder communities is a breach of trust, confidentiality, and establishes an all-too-familiar power structure in which the academic elite dominates the histories and heritage of LID communities.

On Madagascar, for example, the French colonial administration undertook widespread cartographic projects in the 19th and 20th centuries which often undermined LID communities and served to solidify colonial control of land and resources (Amelot, 2017). In order to protect places from surveillance, local informants sometimes deliberately left important places out of official records (Figures 1 and 2). With increasing availability of mapping technology (i.e., satellites and GIS), mapping these locations becomes easier, but to add such locations to new maps would be a transgression of local wishes. Not only does mapping culturally significant locations become easier, but it also becomes possible without ever consulting local communities, thereby creating a top-down power structure where the foreigner can be perceived as ever-present, always watching, and the surveilled may have little authority to object (sensu Foucault, 1995 [1975]).

Of course the nature of surveillance and the ethical issues that arise depend, to one degree or another, on the nature of the surveillance instrument, the region and people under watch (and their ability to object to surveillance activities), the degree of privacy that may be infringed upon by such investigations and the plans for interpretation and use of remotely acquired data. For example, coarse-grained satellite imagery cannot detect individuals or features smaller than dozens of meters in diameter with any clarity, and thus, individual privacy will likely not be in question if research only utilizes these

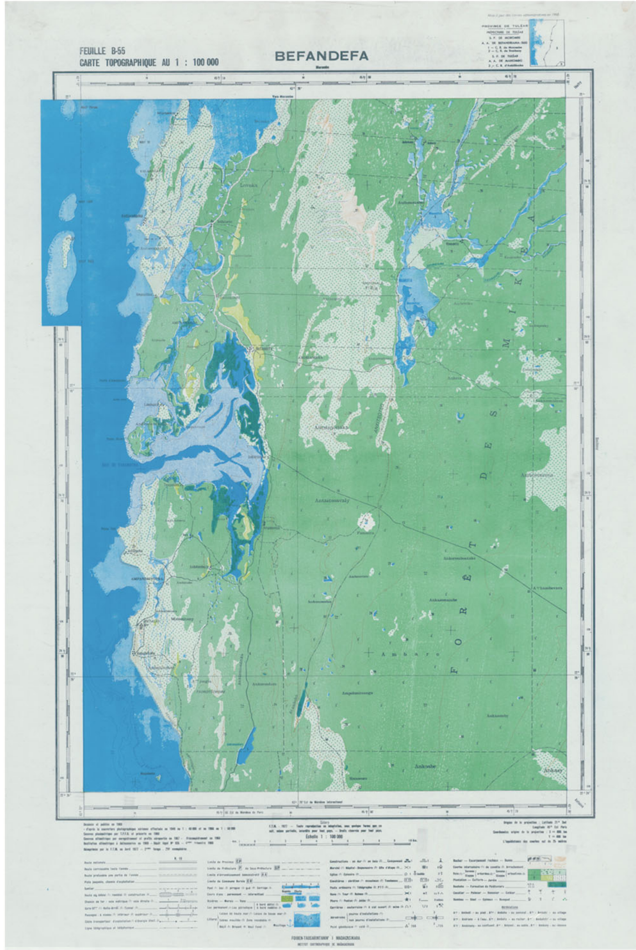

FIGURE 1 A map of the commune of Befandefa (which now also includes the Velondriake Marine Protected Area) created by the French colonial administration. Notably, the map does not include many important landscape features like caves and rock shelters in this area. This was a conscious effort by local informants to keep these locations (many of which are sacred or places of hiding from outside interference) secret (credit: Foiben-Taosarintanin'i Madagasikara [FTM]) [Colour figure can be viewed at wileyonlinelibrary.com]

lower resolution datasets. In contrast, if drones are used, you can identify people, license plates and even coins on the ground; this can certainly violate privacy. But, even in cases where individual privacy may not be infringed upon, decisions may be made based on remote sensed data that affect the autonomy and ability of communities and individuals to use and manage the landscapes they inhabit. Foucauldian power dynamics thus still operate at coarse resolutions where the degree of personal privacy infringement is low. Remote sensing archaeology should therefore strive to increase engagement with LID communities, regardless of project scope and data resolution. In what follows, we focus particularly on ethical issues as they pertain to the most significant potential breaches of local community privacy rights in the context of culturally sacred spaces. As such, while all researchers should bear in mind the arguments and problems put forth here, the degree to which our specific recommendations will be relevant will entirely depend upon the scale of the analysis taking

FIGURE 2 Examples of caves and rock shelters in Velondriake, most of which do not appear on official maps, like the one in Figure 1. Many caves and shelters are sacred to local, Indigenous and descendant (LID) communities (credit: K. Douglass) [Colour figure can be viewed at wileyonlinelibrary.com]

place, the types of data employed and the status of local communities in the region of focus.

The issues of privacy and confidentiality that arise with the use of geospatial technologies like high-resolution aerial/satellite imagery are well established by geographers. The American Association of Geographers (AAG, 2009) specifically states in their code of ethics that '[d]ecisions about the collection, ownership, and analysis of geospatial data should be made with a view toward affording individuals and communities that bear the burdens of geospatial research the opportunity also to share in its benefits'. The AAG continues, stating that field-based projects should return all results and findings back to local communities and local collaborators should be included as authors on publications deriving from that research (AAG, 2009).

Professional organizations in archaeology and anthropology, however, have not demonstrated a unified approach. As Dennis (2020) notes, digital archaeology (encompassing all research conducted via computer-based approaches) exists almost entirely without well-formulated ethical oversight. For example, the Society for American Archaeology (SAA) has no specific requirements or ethics mandate for community engagement, stating that 'archaeologists *should* reach out to, and participate in cooperative efforts' (SAA, 2016, emphasis added). In contrast the American Anthropological Association (AAA) has an explicit guideline that '[a]nthropologists have an obligation to ensure that research participants have freely granted consent, and must avoid conducting research in circumstances in which consent may not be truly voluntary or informed' (AAA Ethics Forum, 2012). Similarly, the Code of Ethics for the Computer Applications and Quantitative Methods in Archaeology (CAA) specifically acknowledges that their work can impact local communities and the general public. As such, the CAA 'is committed to engagement and consultation with groups and individuals impacted by archaeological work carried out by CAA members, with the aim of building relationships that are respectful and mutually beneficial' (CAA International, 2018). There is a growing consensus among archaeologists and anthropologists that local engagement is needed, but ethical guidelines are not uniform between regions or organizations, especially when it relates to digital research practices like remote sensing.

This inconsistency extends to the classification of human-subject research (HSR) by institutional review boards (IRBs). Geographical and geospatial technologies that record or contain potentially sensitive geographic information (i.e., GPS coordinates and personal identification records) are heavily scrutinized during IRB processes (Appendix A). However, remote sensing data, which inherently contains geographic information and photographic documentation of cultural locations, are not always explicitly mentioned.

While the use of drones and other aerial imaging systems can monitor and record people and their activities, aerial images are only classified as HSR by the US government if an investigator obtains information from a 'living individual', either directly or via means that would be considered private (Resnik & Elliott, 2019). For archaeological remote sensing research looking at historical, landscape-scale patterns of land use, the absence of identifiable information about living individuals is usually interpreted as non-HSR, and therefore, an IRB is not deemed necessary. As such, IRB forms (e.g., Appendix A, section 22.9) that require information about photographing or videoing 'subjects' refer to people themselves, not necessarily cultural landscape features. However, landscapes are inherently cultural, and in some cases, landscape features have been granted personhood status (e.g., those connected with ancestors), with all the rights that people have (e.g., Roy, 2017; Safi, n.d.; Warne, 2019).

It is important to emphasize that landscapes are conditioned by and condition how individuals and communities use particular spaces. Therefore, they are places infused with human values which are embodied within that place (sensu Basso, 1996; de Certeau, 1984; Ingold, 1993; Lepofsky et al., 2017). Landscapes and humans are inseparable. Thus, surveilling landscapes—regardless of whether individuals are present on the landscape at the time of data collection—should be thought of in critical terms that adhere to ethical standards related to cultural research. Researchers making use of aerial imagery should consider that the study of cultural landscapes and features can have the same implications as HSR and may need to be included as such in proposals for IRB approval (see Resnik & Elliott, 2019; also see AAG, 2009). As mentioned earlier, some datasets simply do not have the quality to precisely locate specific cultural features, and in such instances, the connection with HSR may be unnecessary; nonetheless, it is vital that remote sensing archaeologists collaborate with local communities to ensure that local perceptions of place are understood and respected.

3 | CASE STUDY: MADAGASCAR

Madagascar is the fourth largest island in the world and sits at the crossroads of the Indian Ocean, connecting the cultural spheres of the African continent and Persian Gulf to those of South and East Asia and Indonesia (Radimilahy & Crossland, 2015). The peoples of Madagascar have diverse cultural practices, beliefs and norms, which include a range of taboos (*fady* or *faly*). *Fady* are often tied to specific locations. For example, visiting certain locations can be *fady*, especially for a *vazaha* or *vahiny* (outsider) to the community (Cinner, 2008; Fritz-Vietta et al., 2017; Langley, 2006; Pearson & Regnier, 2018). *Fady* locations are often associated with privileged or sacred knowledge and with the rights of *razana* (ancestors; Cinner, 2008). Despite strong prescriptions governing access to and use of sacred spaces, drones and satellites can scan these areas without consent from local leaders, completely disregarding and contravening the wishes of LID communities. In this sense, the Foucauldian power dynamics inherent to remote sensing make it possible to scan these areas without community consent.

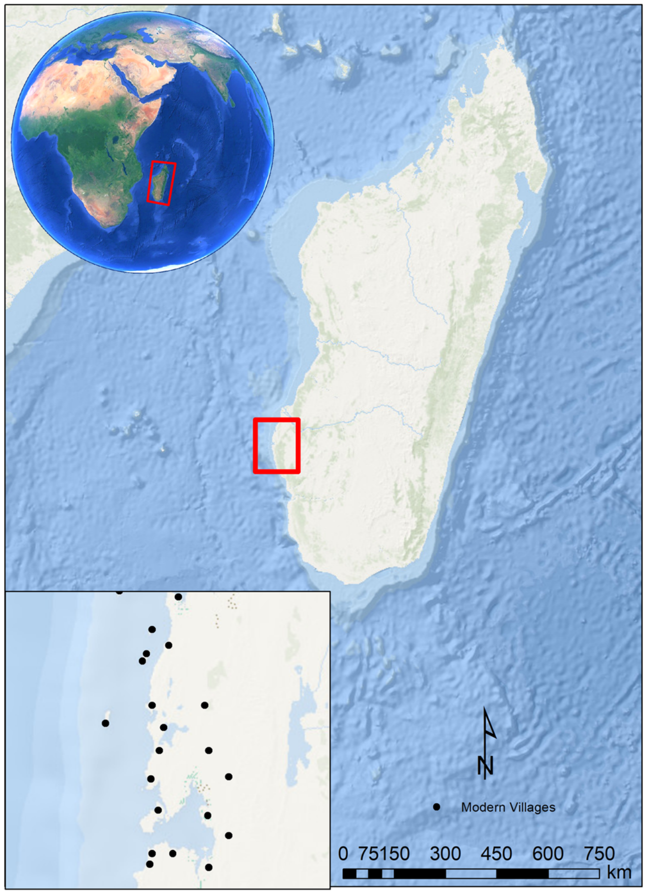

FIGURE 3 Location of study region in Southwest Madagascar. Inset map shows the Velondriake Marine Protected Area and modern day villages (black dots) located within this region. Service layer credits: ESRI, Garmin, GEBCO, NOAA NDGC and other contributors. Inset map credits: Google [Colour figure can be viewed at wileyonlinelibrary.com]

Recently, several authors of this paper were involved in a remote sensing survey in the Velondriake Marine Protected Area in southwest Madagascar (Davis, Andriankaja, et al., 2020) (Figure 3). During ground surveys, to test the accuracy of a predictive model of archaeological site locations derived from satellite images (Davis, Andriankaja, et al., 2020; Davis, DiNapoli, & Douglass, 2020), there were several instances in which the sampling protocol called for ground-truthing *fady* locations, such as ancestral tombs. Upon discovery of the inclusion of these sites in the survey plan, ground investigation was suspended or rerouted to avoid trespassing on restricted grounds. Because LID communities were consulted and our research team consists of local archaeologists and community members, we were cognizant of the potential for our geospatial methodology and tools to transgress local *fady* and carefully avoided trespassing on sacred spaces. Our work on this project inspired the current paper and deeper probing of the ethics of remote sensing research. We ask whether *fady* locations should even be visible on freely available datasets (which are oftentimes produced by foreign nations or agencies).

On Madagascar, legal statutes regulating satellite imagery do not restrict access or require consultation with LID communities in any form. Drones, in contrast, are more heavily regulated. For example, the conditions of use for drones, detailed in the 'Instruction N°01 ACM/DRG/17 relative aux conditions d'exploitation des aéronefs télépilotés' (http://www.acm.mg/spip.php?article35) lays out clear and specific regulations for how and where drones can fly and record images or video.

Article 2 of this code, for example, specifies that no drone can be flown within 100 m of a person unless prior consent has been given to the drone pilot from the people in question. Furthermore, the drone pilot must identify and take all necessary measures to avoid flying over property limits of the land that they are flying above, and if private land will be flown over, consultation with the land owner must be acquired. Article 3 of this code further specifies that drones are prohibited from encroaching upon prohibited areas. Anecdotally, however, we know these stipulations are often ignored by drone pilots where we work in Madagascar.

With respect to spaceborne remote sensing (i.e., satellites), Madagascar has ratified several treaties relating to space exploration and space telecommunication systems (Oduntan, 2019). However, Madagascar has not signed or ratified treaties related to liability (LIAB 1972) or object registration (REG 1975; see Oduntan, 2019). Thus, in contrast to drones, the use of spaceborne data is essentially unregulated, apart from treaties deeming that data collected by such means should be shared with governments of states who are impacted. Even in these treaties, however, issues of privacy go unmentioned (e.g., The Space Treaty. 18 UST 2410, 610 UNTS 205). In fact, several UN resolutions on space activities do not require prior consent of countries targeted by satellites, which leaves many concerns regarding privacy rights of nations and individuals (Oduntan, 2011). Therefore, remotely sensed information has the power to control without local consent and needs to be closely considered by data users (observers) in order to avoid enforcing unequal power dynamics and/or further disempowering the observed.

3.1 | Local opinions on aerial imagery

The Morombe Archaeological Project (MAP), based in SW Madagascar, was established in 2011 and is grounded in collaborative and co-produced research on the co-evolution of people and landscapes. The project is guided by the fundamental principle that science is enriched and made just through collaborative and inclusive approaches (Douglass, Morales, et al., 2019). The MAP team comprises over 25 members, predominantly from the communities of Velondriake. Several MAP team members are authors on this paper. Geospatial tools and data, including drones, handheld GPS devices, total stations and satellite imagery, are central to MAP work, particularly in reconstructing landscape-level phenomena related to human mobility and resource use (Figure 4).

The suite of geospatial tools used by MAP serve a variety of aims, all of which have the potential to yield sensitive information. For example, total stations produce detailed maps of individual sites, topography and landscape features. Handheld GPS units are used to record geographic coordinates of sites and artefact locations. These data are then used to make maps that include locations that are potentially sacred to the communities of Velondriake. On a larger scale, satellite imagery is used by the MAP to document settlement patterns and drivers of landscape change, while drones are used for aerial photography and videography.

Given the widespread use of geospatial technologies—especially remote sensing instruments that produce sensitive information, it is imperative to the MAP's foundation that we engage the ethics of using these tools and data. To that end, the team has gathered information regarding local opinions about the use of drones, in particular, as drones are a newer addition to the suite of tools the project relies on. We consider this to be an important first step in establishing best practices and a collaboratively produced ethics of geospatial technologies in Malagasy archaeology.

To evaluate the opinions of LID communities in Velondriake about the use of remote sensing instruments for documenting culturally significant places, we draw on our work experiences and the work done by the MAP team. Specifically, we focus on local opinions on drone imagery because of the highly visible nature of drones and their ability to record detailed photographs of culturally significant places.

We developed a series of questions to guide a critical discussion between MAP team members on the best practices for archaeologists using remote sensing technologies: (1) do team members feel that drone photography violates local customs and privacy? (2) Are people aware of what drones can see? And (3) is there interest among community members in how the technology works? Understanding local perceptions can help to avoid unequal power dynamics by modifying remote sensing activities in accordance with local norms instead of generating discomfort or fear (and invading privacy) through detached surveillance. Thus, our critical self-reflection and discussion led to a series of clear revelations that will be central in developing a set of best practices and future efforts to generate collaborative work with geospatial technologies in Velondriake and elsewhere. Future development of best practices will involve formal interviews with LID community members beyond the MAP team and workshops to increase community familiarity with these technologies.

Based on our critical discussions, when using drones to take aerial photographs, local views on privacy appear largely dependent upon

FIGURE 4 Morombe Archaeological Project (MAP) team member George Manahira assisting with Total Station mapping of karst topography around archaeological sites in Velondriake (credit: K. Douglass) [Colour figure can be viewed at wileyonlinelibrary.com]

the places drones are flown. If a particular area is *fady* for people to visit or photograph in general, then drones are not an exception. As such, the photography of graves and burial sites via drone is almost never allowed, unless express permission has been granted by community leaders.

Apart from *fady* areas, there does not seem to be great concern about privacy with respect to remote sensing via drones. However, part of the reason for this likely stems from the transparent research design of MAP projects. For all projects, the MAP team meets with local community leaders to discuss the nature of all archaeological research projects. Thus, before photographs are taken or surveys are conducted, community leaders are made aware, and any concerns over any aspect of the research are addressed before work proceeds.

With respect to overall interest in drones and remote sensing technologies, we have observed that there are many community members who are curious about drones when they are used for taking photographs. Recently, the MAP incorporated a Phantom IV drone and DJI Digital FPB goggles into its project toolkit (Figure 5). These goggles provide the user with a live feed of the imagery being recorded by the drone and the feeling of flying over the landscape. Team members and LID community members who attended training sessions for the use of the drone and goggles all took turns wearing the goggles and viewing this live feed. All reported a feeling of initial disorientation followed by awe at the extent of the drone's view and the clarity of the image. Older members of the community, in particular, found the technology disorienting, particularly as it allows the user to see themselves from above. The MAP team agreed that hands-on experiences with the technology afforded by the goggles significantly altered users' understanding of the power of these tools. This highlights the need not only to discuss the nature and capabilities of geospatial tools but also to create opportunities for community members to have hands-on experiences that enhance their understanding of their scope and resolution. Without an understanding of how these tools work, the collection of imagery with informed consent is difficult, if not impossible.

FIGURE 5 Community member in SW Madagascar wearing goggles and viewing live feed from drone [Colour figure can be viewed at wileyonlinelibrary.com]

In recent work, the MAP team used satellite images to remotely identify and survey archaeological sites in Velondriake (Davis, Andriankaja, et al., 2020). Due to the volume of satellite imagery available, our project investigated over 1000 km^2 of the Velondriake area, which inevitably includes sacred spaces. According to local community members, there are approximately 54 *fady* places throughout the Velondriake area, and every village within this region has at least three *fady* locations. When planning each survey, team members would instantly recognize specific locations in the imagery (e.g., nearby towns, villages and cities). Likewise, many could identify locations of prior archaeological work or where *fady* sites were located. In multiple instances, areas detected in satellite images overlapped with *fady* areas and required changes in survey plans. In these instances, the team's collaborative discussion of the satellite data was crucial to ensuring that the research plans would avoid sacred spaces. At the same time, it highlighted an important issue with aerial and spaceborne sensors: these practically unregulated sources of data can locate sensitive cultural information that, in all other instances, would be off-limits to outsiders (Figure 6). This inevitably tips the scales of power towards the outside observer and away from local communities. As such, our critical reflection of this project provides important lessons for future remote sensing archaeological work, namely, that *collaboration with LID communities is imperative to ethical research practice*.

4 | DISCUSSION

The use of remote sensing technologies has been historically dominated by institutions and scholars in the Global North, with most publications coming from Europe, Asia and North America (Agapiou & Lysandrou, 2015; Cohen et al., 2020; Davis, 2020). This places scholars and communities in other regions of the world at a disadvantage in terms of training to utilize remote sensing instruments to improve knowledge of the past, despite the fact that many datasets exist with global coverage (Davis & Douglass, 2020). Furthermore, it can create an imbalance of power with respect to archaeologists and local communities in areas where knowledge of such technologies is limited (Figure 7a), wherein outside researchers have the ability to record people and landscapes without local knowledge or consent (sensu Foucault, 1995 [1975]).

For example, within North America, Gupta et al. (2020) show how significant portions of indigenous historical and archaeological data are 'owned' by the Canadian government. This leaves many First Nations communities without any control over how these data are used or disseminated. Akin to Foucault's (1995 [1975]) notions of power, LID communities are placed at the mercy of foreign powers to monitor and protect their cultural heritage, and their sacred places are left in a perpetual state of surveillance by those who should not necessarily have access to those places, remotely or otherwise. Gupta et al. (2020) also state that there is growing interest among First Nations communities in this area in controlling geospatial information related to their cultural heritage. As our experience shows, local

FIGURE 6 (a) Drone image of cultivation areas in the Mikea territories east of Velondriake (credit: G. Cripps). (b) PlanetView (Planet Team, 2020) satellite image of cultivation areas in the Mikea territories (credit: Imagery © Planet Inc. 2020). These show examples of cultural features that can easily be recorded using aerial and spaceborne imaging systems [Colour figure can be viewed at wileyonlinelibrary.com]

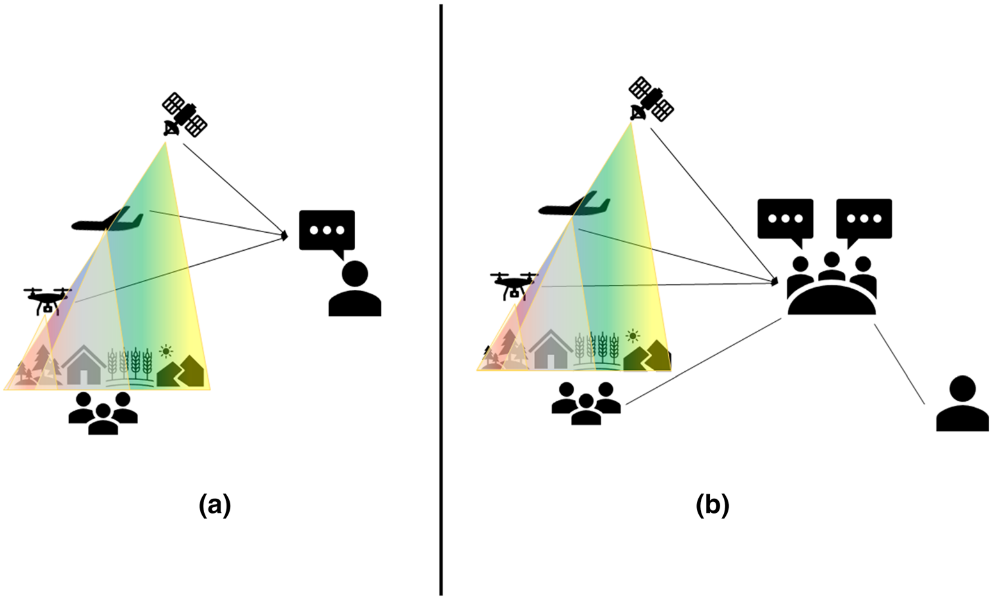

FIGURE 7 (a) Standard means by which remote sensing archaeology is conducted. The academic acquires aerial/spaceborne datasets, develops a research agenda and analyses that data without consent from or collaboration with local, Indigenous and descendant (LID) communities. (b) Proposed establishment of best practices in remote sensing archaeology centred on community collaboration and consent. The academic consults with local communities and analyses aerial/spaceborne datasets collectively within the scope of a mutually agreed upon research agenda [Colour figure can be viewed at wileyonlinelibrary.com]

communities in Madagascar are also expressing interest in archaeology and the geospatial technologies being used to collect this information.

The work conducted by the MAP team over the past several years has increasingly utilized drones and other remote sensing technologies in fieldwork. What is clear from field observations and discussions with LID community members in Madagascar is that photography, of any kind, requires mutual consent. While many aspects of privacy do not appear to be a major concern (i.e., photographing modern villages and houses), the scanning of sacred locales (i.e., ancestral tombs and burials, sacred caves, and spaces of ritual—like the practice of *tromba* [trance]) is taboo and in violation of the wishes of LID communities. This largely coincides with the legal statutes in place within Madagascar pertaining to drone operation, where permission is needed before operating a drone within certain spaces.

Within the MAP surveys in southwest Madagascar, the level of comfort with drones is likely, in large part, due to the transparent nature of MAP practices (see Douglass, Walz, et al., 2019). Local community leaders are consulted prior to any archaeological field project and any use of drones or other methods are explicitly discussed before any work commences. By engaging with local community members before any analysis even begins, research is guided by the interests and concerns of LID communities and researchers (Figure 7b). This helps to restructure the power dynamics involved with remote sensing technologies and avoid a panopticon-esque organization with outside researchers controlling all aspects of data collection and analysis.

This notion of mutual benefit is central to many participatory mapping approaches in geography and anthropology (e.g., Álvarez Larrain et al., 2020; Colloredo-Mansfeld et al., 2020; Dunn, 2007; King, 2002; Ramirez-Gomez et al., 2015). By involving local communities in mapping projects that utilize GIS and remote sensing, research is inherently on track to adhere to many ethical standards such as providing benefits to local communities (Álvarez Larrain et al., 2020; Ehrman-Solberg et al., 2020; Larrain & McCall, 2019; Sanchez et al., 2021). For example, participatory mapping has alleviated conflicts among groups over resources (e.g., Kwaku Kyem, 2004). Issues still persist in the use of participatory mapping, particularly the eurocentric cartographic representation that is standard in GIS (see Larrain & McCall, 2019). Such views of the world do not always align with LID knowledge, and participatory projects must be careful not to force certain viewpoints onto others via eurocentric cartographic representations of the world (Larrain & McCall, 2019; also see Dunn, 2007), as this also perpetuates asymmetries of power.

As our discussions above and previous research emphasize for Madagascar (see Evers & Seagle, 2012), landscapes are cultural phenomena that are inseparable from people (also see Basso, 1996; de Certeau, 1984; Morton, 2013). As such, when using technologies to record information about landscapes, this work will inevitably have impacts on communities living in these places. While some geospatial technologies like drones can have a very invasive effect because of the high resolution of the data and the visible presence of the instrument, satellites, in contrast, are not visible to local communities but are achieving comparable image quality that can record sacred spaces at submeter resolution (Figure 6). While individuals may not be visible in such imagery, sacred places are and can be documented in great detail. The distance placed between many geospatial datasets and HSR have ultimately created a false dichotomy between what constitutes 'human-subject' research, as some geospatial data (like GPS points) are scrutinized by IRB protocols while others (aerial and spaceborne images) are alarmingly absent (Appendix A). As such, archaeologists must be careful about what data they use and how they share this information. Ultimately, the dissemination of potentially sensitive information acquired from aerial reconnaissance should be an open dialogue with LID communities to ensure both the protection of cultural heritage and ensuring local autonomy in managing their heritage.

5 | CONCLUSION

In this article, we detail how the concept of the panopticon, central in Foucauldian theories of power, applies to archaeological remote sensing. We then provide context on how we have addressed these power dynamics during fieldwork in SW Madagascar as a means of raising critical awareness about ethical issues inherent to remote sensing research. While there is ample access to global remote sensing datasets, archaeologists should be reserved in their ambitions to use these without first grappling with the ethical issues discussed here. Researchers must ask themselves is this: 'Do the places I am investigating potentially contain actively sensitive or sacred sites? And if so, would I want a stranger recording places that are significant to me without my knowledge or consent?' Most likely, if the answer to the first question is 'yes', the answer to the second will not be as straightforward (or will result in 'no'). Thus, there is a need to communicate with communities to ensure that consent and knowledge of research activities are established before using these powerful technologies.

While some datasets (i.e., satellite imagery) are widely (and in some cases freely) available, the use of such data with high resolutions that have the capacity to directly detect culturally important structures should be in consultation with local stakeholders (Figure 7). In the case of newly commissioned remote sensing datasets (e.g., drone imagery and aerial remote sensing [e.g., LiDAR]), conversations should take place between local communities and researchers before data collection to discuss: (1) the extent of data collection, (2) how the data can be used and (3) who should have access to that information.

In sum, we argue that the ethical implications of archaeological prospection efforts using remote sensing revolve most heavily around power dynamics. To alleviate such issues, a collaborative approach to archaeological remote sensing is needed to ensure that research agendas do not violate local communities' respect for privacy and traditional customs. In order to more broadly represent community concerns regarding use of these technologies, all archaeological projects using geospatial technologies should engage in a structured discussion with LID communities prior to and throughout research projects that involves a clear set of steps: (1) create shared understanding of the scope, nature, scale, resolution of the technology or dataset in question; (2) provide hands-on experience of how different technologies operate; (3) generate a plan for the use and dissemination of these tools and data that respects LID wishes and (4) make data acquired from that tool available to LID community members. Only by making the status of external researchers and local communities equal in all elements of research can we avoid power imbalances and the ethical pitfalls that accompany such dichotomies.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

DATA AVAILABILITY STATEMENT

Data sharing is not applicable to this article as no datasets were generated or analysed during the current study.

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APPENDIX A: IRB FORM FROM PENN STATE UNIVERSITY

22.1 Which of the following identifiers will be recorded for the research project? Check all that apply. If none of the following identifiers will be recorded, do not check any of the boxes.

	Hard Copy Data	Electronic Stored Data
Names and/or initials (including on signed consent documents)	☐	☐
All geographic subdivisions smaller than a State, including street address, city, county, precinct, zip code, and their equivalent geocodes,	☐	☐
All elements of dates (except year) for dates directly related to an individual, including birth date, admission date, discharge date, date of death; and all ages over 89 and all elements of dates (including year) indicative of such age, except that such ages and elements may be aggregated into a single category of age 90 or older	☐	☐
Telephone numbers	☐	☐
Fax numbers	☐	☐
Electronic mail addresses	☐	☐
Social security numbers	☐	☐
Medical record numbers	☐	☐
Health plan beneficiary numbers	☐	☐
Account numbers	☐	☐
Certificate/license numbers	☐	☐
Vehicle identifiers and serial numbers, including license plate numbers	☐	☐
Device identifiers and serial numbers	☐	☐
Web Universal Resource Locators (URLs)	☐	☐
Internet Protocol (IP) address numbers	☐	☐
Biometric identifiers, including finger and voice prints	☐	☐
Full face photographic images and any comparable images	☐	☐
Any other unique identifying number, characteristic, or code (such as the pathology number)	☐	☐
Study code number with linking list	☐	☐
Genomic sequence data	☐	☐
State ID numbers	☐	☐
Passport numbers	☐	☐
Driver's license numbers	☐	☐

22.2 If storing paper records of research data, answer the following questions:

22.2.1 Where will the paper records, including copies of signed consent forms, associated with this research study will be stored?

22.2.2 How will the paper records be secured?

22.2.3 How will access to the paper records be restricted to authorized project personnel?

22.3 If storing electronic records of research data, indicate where the electronic data associated with this research study will be stored. Check all that apply.

☐ Penn State-provided database application. Check which of the following database applications are being used (check all that apply):

- ☐ Penn State REDCap
- ☐ Other – Specify - provided and approved database application:
- ☐ Penn State, College, or Department IT file server
- ☐ Box.psu.edu (Apply for a Box NPA here: https://box.psu.edu/non-person-account/)
- ☐ Web-based system provided by the sponsor or cooperative group - Specify URL and contact information:
- ☐ Other – Specify the database application or server:

Provide details about the data security features or attach security documentation provided by sponsor or group:

> If there is a list/key that links indirect identifiers (code numbers, participant IDs, etc.) to direct identifiers, that list must not be comingled (i.e., stored in the same location) as the identifiable data, including copies of signed informed consent forms. Additionally, access to that list/key must be restricted to authorized project personnel.

22.4 Is there a list/key that links code numbers to identifiers?

☐ Yes - explain how the list that links the code to identifiers is stored separately from coded data:

☐ Not applicable, there is no list that links code numbers to identifiers. Skip to section 22.6.

22.5 Is there a list of people who have access to the list/key?

☐ Yes – explain how access to that list is restricted and why certain persons require access.

☐ No – explain why not:

22.6 Describe the mechanism in place to ensure only approved research personnel have access to the stored research data (electronic and paper).

☐ Password-protected files
☐ Role-based security
☐ Specify all other mechanisms used to ensure only permitted users have access to the stored research data.

> he use of mobile devices or wireless activity trackers to collect identifiable research data must be approved by the)ffice of Information Security. Before completing this section, please contact security@psu.edu to confirm approval.

22.7 **Will any research data (such as survey data) be collected on a mobile device, such as an electronic tablet, cell phone, or wireless activity tracker?**

☐ No
☐ Yes - answer the following questions:

22.7.1 **Specify the provider of the mobile devices(s)**

☐ Supplied by the sponsor
☐ Penn State owned device
☐ A personal device
☐ Other – Please specify source:

22.7.2 **Specify the type(s) of mobile device(s) that will be used to capture data and all identifiers captured on the mobile device(s). Please list all devices, and if more than one, the identifiers to be collected on each.**

22.7.3 **Specify the type of data collected on the mobile devices(s).**

22.7.4 **Specify the application or website used to collect the data from the mobile device, if applicable.**

22.7.5 **Describe the measures taken to protect the confidentiality of the data collected on mobile device(s). Please address physical security of the device(s), electronic security, and secure transfer of data from device(s) to the previously indicated data/file storage location provided in section 22.3.**

The use of online survey tools and email to collect or send research data containing identifiers that represent more than minimal risk to subjects must be approved by the Office of Information Security. Before completing this section, please contact security@psu.edu.

22.8 **Will any research data be directly entered/sent by subjects over the internet or via email (e.g., data capture using on-line surveys/questionnaires, surveys via email, observation of chat rooms or blogs)?**

☐ No
☐ Yes - answer the following questions:

22.8.1 **Specify the identifiers collected over the internet or via email (Including IP addresses if IP addresses will be collected).**

22.8.2 **Specify the type of data collected over the internet or via email.**

22.8.3 **Describe the measures taken to protect the confidentiality of the data collected?**

22.8.4 **Describe how the research team will access the data once data collection is complete.**

22.8.5 If the research involves online surveys, list the name(s) of the service provider(s) that will be used for the survey(s) (e.g., REDCap, Penn State licensed Qualtrics, Survey Monkey, Zoomerang)? (Note: The IRB strongly recommends the use of REDCap for online surveys that obtain sensitive identifiable human subjects data.)

☐ Penn State REDCap
☐ Penn State Qualtrics (de-identified data only)
☐ Other - Please specify:
Application:
URL (If applicable):

22.8.6 If the answer above is "Other" contact security@psu.edu for approval of an alternative data capture method

Depending on the nature of the subject matter involved, certain security requirements must be in place for the audio and/or video recording or photographing of subjects. If the subject matter presents more than minimal risk to the subjects, then, before completing the section below, please contact the Office of Information Security at security@psu.edu to confirm whether these requirements are required.

22.9 Will any type of recordings (e.g., audio or video) or photographs of the subjects be made during this study?

☐ No - skip to section 22.10
☐ Yes - answer the following questions:

22.9.1 What will be used to capture the audio/video/images? Give a brief description of content.

☐ Audio – Describe the intended content of the audio recording:

☐ Video – Describe the intended content of the video recording:

☐ Photographs of the subjects – Describe the intended content of the photographs:

☐ 3-D Images – Describe the intended content of the of 3-D images:

☐ Other - Specify:

22.9.2 How will the recordings/photographs/images be stored (electronically or physically)?

22.9.3 Where will the recordings/photographs/images be stored?

22.9.4 Who will have access to the recordings/photographs/images?

22.9.5 Will any of the recordings be transcribed?

☐ Not applicable
☐ No
☐ Yes – indicate who will be doing the transcribing?

22.9.6 Will the recordings/photographs be used for purposes other than this research study?

☐ No
☐ Yes - specify purpose(s) (e.g., publication, presentations, educational training, future undetermined research):