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Science Literacy and Popular Culture: Forensic Anthropology in Application and Fiction

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Abstract

This exploratory research examines the discussion of "race" in popular cultural media in a forensic anthropological context. The TV series *Bones* was used as a sample site for a cultural comparative analysis. This research critically compares popular culture understandings of "race" or ancestral heritage as depicted in *Bones* with a specific, newly developed method that forensic anthropologists apply in actual lab procedures in combination with other methods to determine ancestral heritage as depicted in textbooks. This research project has two phases. The first phase is a media analysis of discussions and depictions of ancestral heritage in episodes of *Bones*; the second phase uses osteology lab work with biological specimens in the Portland State University and Portland Community College Sylvania Campus osteology collections. People may acquire science literacy through popular culture and social media sources, and inaccurate depictions and misapprehensions may adversely affect people's understanding of human biological diversity

and ancestral heritage. This study contributes to the ongoing effort in biological anthropology to undo the concept of biological “race” and to portray accurate information about how human variation occurs on gradients or clines by examining possible influences in the public’s understanding of science from popular media representations to create better overall science literacy concerning human variation.

Science Literacy and Popular Culture: Forensic Anthropology in Application and Fiction

This study inquires if popular media presentations of forensic anthropology depict accurate human biological science. The information depicted may influence how people understand the biological realities of human ancestral origin or “race.” Studies have shown that bias or misinformation in TV programming, whether accidental or intentional, influences the behavior and opinions of the consumer audience (Ellingsen and Hernæs 2018; Jensen and Oster 2009). Science literacy concerning “race” in a forensic context is important for the general public because incorrect assumptions about the biological nature of human variation garnered from media representations are a part of the larger socio-cultural framework of racialism and racism (Kondo 2018, 25-34).

The United States National Center for Education Statistics (1996, 22) defines science literacy as "the knowledge and understanding of scientific concepts and processes required for personal decision making, participation in civic and cultural affairs, and economic productivity." This conception of science literacy is fundamentally influenced in the general public by sources such as television, film, and social media (Hall 2011, 81-84). My research has focused on observing some of the lab methods for assessing ancestral heritage that are portrayed on the TV crime drama *Bones* and evaluating those sampled methods against similar forensic anthropological lab methods to evaluate them for validity.

The purpose of this study is to explore if the TV series *Bones* paints an accurate portrayal of forensic anthropological assessments of "race" or ancestral heritage. *Bones,* a popular TV crime drama inspired by novels written by actual forensic anthropologist Kathy Reichs, depicts a forensic anthropologist working in the field and the lab with other forensic pathologists, scientists, and representatives from other branches of law enforcement (Flatow and Reichs 2012). Much of the understanding that people have about forensic anthropology's methods, capabilities, and practices may come from TV and film depictions on late night "true crime" reenactments and procedural police dramas (Alduraywish, *et al*. 2022). In this research I have reproduced the methodological approaches depicted in *Bones* to the best of my present capabilities as a graduate student and then tested them by using a real-world discipline specific method and dataset that most closely correspond to the fictional one to compare the analysis techniques for creating ancestral heritage estimations in biological profiles. I focus my research on human skulls.

Misrepresentation of specialized scientific procedures may influence opinions in the public and judicial arenas such as in murder cases, wherein there might be an expectation of instantaneous identification, DNA results, or other pathological evidence. This may be based upon misinformation about what is possible or realistic for crime lab processing as seen in *CSI* or *Bones* type crime drama television programs (Kruse 2010; Lawson 2009; Shelton, *et al*. 2009; Smith, *et al*. 2011). Possible misapprehensions gained from pop-media fictions may contribute to science illiteracy which may influence socially and culturally dysfunctional outcomes, particularly in marginalized populations.

This study focused on the sampled depictions of forensic anthropological methods relating to ascertaining the ancestral heritage of human remains on the TV crime series *Bones.* However, *Bones* sometimes depicts non-existent "technology" such as using advanced computer holograms to conjure the image of the victim instantly or make casual use of existing technology, such as DNA processing, that is too expensive for many real-world crime labs (University of Nebraska Medical Center 2022). Directors and screenwriters might use these types of fictions to allow the show to fit in a brief timeslot and to make the drama of the show the focus for the audience. This dramatization may cut out vital methodological processes and procedural approaches, so that what is depicted can unintentionally misguide the viewer about what is possible or practical in a forensic anthropological context (Taylor and Jaeger 2022, 31-36).

Literature Review

The general public's comprehension concerning scientific processes and methods may be attributed to a combination of a fundamental lack of science literacy and popular media, including social media spreading disinformation or, conversely, valid information that is possibly missing enough context to be misleading (Salmon *et.al.* 2015; Zarocostas 2020).

In my analysis of popular culture, I have used audience theory to examine the content of the TV portrayals of forensic anthropological methodologies (Ruddock 2006). Audience theory seeks to understand if the audience is a passive or active observer in the narrative and worldbuilding, and if the audience is addressed as an individual or as a part of a larger population. I observed if there is an inherent implication that the audience is addressed singularly, *en masse*, or if the narrative itself is the target of the information (Ruddock 2006). In my analysis of *Bones*, I have found that the viewer is being addressed as an active participant rather than a passive population or individual. In other words, I believe the writers may expect the audience to be an engaged agent with the program they are watching rather than having the program playing in a public venue as a backdrop, like an advertisement (Taylor and Jaeger 2022, 131-135).

I have also assessed if there is an assumed level of science literacy that the target audience has. To determine this, I have considered the framing, knowledge-gap, and cultivation theories under the audience parent theory, which has allowed me to observe that *Bones* may be depicting a culturally influenced selective view of reality which might allow the observed media to influence social reality (Taylor and Jaeger 2022, 131-135). Depictions of an inaccurate interpretation of social or scientific reality may allow the consumer media to influence social beliefs concerning marginalized groups and science literacy (Gerbner and Gross 1976; Webster and Ksiazek 2012).

Human variation that manifests in superficial or phenotypic characteristics has been the basis for racist ideologies about human categorization since the eighteenth-century, when Swedish naturalist Carl Linnaeus first proposed a classification system for modern humans that included four distinct categories (i.e., races): *Homo sapiens americanus*, *asiaticus*, *africanus*, and *europaeus*, representing Indigenous Americans, Asians, Africans, and Europeans respectively. Harvard professor Earnest Hooten (1887-1954) later reframed these cranial morphological trait categories into three major racial groups: Negroid, Mongoloid, and Caucasoid (Christensen, Passalacqua, and Bartelink 2019, 274-277). This racial classification was pivotal in the cultural proliferation of scientific racism or racial essentialism that fostered the idea that character traits such as intellect or morality were biologically based on morphological characteristics

(Christensen, Passalacqua, and Bartelink 2019, 274-277; Müller-Wille 2014, 597-606). These superficial morphological differences have been propagandized in visual pop-culture since the beginning of film media in the US as a tool for marginalization of othered or outsider populations (Taylor and Jaeger 2022, 131-135).

Due to advances in DNA technology, we now know that ~90% of human genetic variation can be found in a single population from Europe, Asia, or Africa, and only ~15% would be contributed if the other mentioned populations were added (Foster and Sharp 2022). This means that humans vary less genetically than other primates. It is now genetically proven that the proportion of human genetic material that is variable is consistent across populations and that if we add India then the percentage shrinks to ~10% (Jorde and Wooding 2004). This informs us that humans only vary slightly on the genetic level due to a recent common ancestor, and that only a minimal portion of this variation is continental population specific (Foster and Sharp 2022; Jorde and Wooding 2004). Biologically, humans have more genetic diversity within a population than between populations. "Race" doesn't exist biologically; it is a socio-cultural and political ideology used to colonize, exploit, and marginalize people based on superficial differences in appearance by those in positions of systematically constructed privilege and power (Chou 2017).

Today, many biological anthropologists think of human morphological variation in terms of clinal variation rather than "race." Biologist Julian Huxley conceptualized clinal variation to describe gradual and continual morphological variation in a species across a broadly dispersed area. In contrast, the concept of "race" describes a population geographically isolated from its parent species long enough to develop significantly distinct characteristics (Christensen, Passalacqua, and Bartelink 2019, 274-277). Biologically and anthropologically, many scholars now recognize that “race” does not exist in the human species outside of socio-cultural identities (Fujimura, *et al.* 2014). The concept of easily categorized racial groups is based on the colonial ideology that ancestral heritage can be assessed by a few macromorphological traits that can be quickly and simply observed owing to extreme human variations in ancestral populations. This construct discounts the dynamic and constantly shifting cultural, ethnic, and social realities that form the basis of what is perceived as race in western ideology. Human variation occurs on clines or gradients and is based on geography and environment and do not meet the biological criteria for race (Bethard and DiGangi 2021; Yosso 2020, 5-13; Christensen, Passalacqua, and Bartelink 2019, 274-277).

The causal effect of a misinformed science literacy might manifest as a socially shared cognitive bias that may disallow a person or group to believe accurate information because their shared ideology may have been initially rooted in bad information (Spalding 2020). This form of possible cognitive bias may also manifest indirectly when an individual or population is represented in a scene by a character’s mention, but not by on-screen presence for example, when a character in a position of authority mentions the population as a plot device when referencing a decedent. This may place the passive or theoretical population in an outsider category and might simultaneously allow the majority audience to relate further to the authority or insider representation (Kondo 2018, 25-34).

Social and cultural models of information exchange exist within a paradigm that may put the individual and their identity first and the environment within which the information exists as secondary. This can manifest as an individual’s demographic information being conflated with their identity, which may remove context from personal circumstances. This may allow the media consumer to experience the media from an impersonal perspective that centers the narrative over its relationship to reality, but which may have detrimental effects on marginalized populations by lacking accurate representation. In *Bones*, the forensic scientists possibly represent pillars of the scientific community. They may represent authority through their specialization and expertise, and that authority may make the information they reveal seem trustworthy to the audience, even if the populations represented only exist within the environment as a narrative device (Siebers 2019, 39-47).

The prospect of this study is to contribute to the ongoing effort in biological anthropology to undo the cultural concept of biological "race" and to portray accurate information about how human variation occurs on gradients or clines by examining possible influences in the public's understanding of science from popular media representations in order to create better overall science literacy concerning human variation (Jorde and Wooding 2004). Using pop-cultural representations of forensic anthropology procedures as a test-site, I examine how pop-cultural depictions in *Bones* may present racist bias in the form of scientific bioessentialism (Dirkmaat et al. 2008, 33-52; Soylu Yalcinkaya, Estrada-Villalta, and Adams 2017).

Methodology

This research critically assesses if pop media may expose the viewing audience to possible misinformation of biological science by portraying inaccurate or incomplete ideas of human skeletal variation in an authoritative manner. In my research design, I have evaluated a sample of pop-media forensic anthropology from *Bones* for the validity of the methods depicted. To achieve this goal, I have examined human skeletal variation and cranial indicators associated with ancestral heritage while utilizing discipline standard practices of applied forensic anthropology (Christensen and Passalacqua 2018; Byers 2018, 131-50; Christensen and Passalacqua 2018, 127-30).

The research design has two parts. First, I observed the ways in which *Bones* depicts possible ancestral biological profiles and evaluated how accurate those methods are in practice. I gathered comparative data by watching episodes of the series *Bones.* I selected episodes for critical analysis using synopses provided on the websites IMDb and Wikipedia (IMDb 2005; Wikipedia 2022). I selected episodes with the keywords “race,” “ancestral estimation,” ”biological profile,” “ancestral origin,” or “racial identity” to locate scenes that depict ancestral estimation in biological profiles using discipline-accepted assessment techniques (Christensen and Passalacqua 2018, 127-30). My search using those terms garnered 23 episodes, of which I discuss 3 in detail in this essay. I worked during the summer of 2022 to locate 10 scenes with these procedures depicted in my sample. I chose these 10 scenes at random from the 23 that came from my search results. I watched the 10 random scenes and chose 3 to analyze because they had more information about how the forensic anthropologist reached their conclusion about the decedent's ancestral heritage. I have used critical theory and narrative analysis to analyze these episodes by looking for patterns in how the script and actors address biological profile estimation (Bernard 2011; Christensen 2018, 35-41, 101-09, 127-130; Ruddock 2006; Webster and Ksiazek 2012; White, Black and Folkens 2012, 379-426).

Second, I made the estimation that the closest approximation to the macroscopic visual observations gathered from scenes in *Bones* in my sample set would be Optimized Summed Scoring Attributes (OSSA) method (Christensen and Passalacqua 2018, 127-36). I used the OSSA categorization method to evaluate crania in the teaching collections at Portland State University and Portland Community College-Sylvania. The OSSA method allowed me to score specific locations on the skull by visual assessment to estimate likely ancestral heritage. The OSSA method scores cranial features on a scale that, when totaled, gives an approximation of ancestral heritage. I then compared this analytic technique to the macroscopic assessment techniques portrayed in my samples of *Bones* episodes. I compared how long the analysis took, how difficult it was to perform, and how accurately the techniques could predict ancestral heritage. Specifically, I performed macroscopic, morphoscopic analysis using the OSSA method to estimate the ancestral heritage of the available samples (Christensen and Passalacqua 2018, 127-36). I decided not to use craniometric estimation techniques because these were not common in my observed samples of the show and I do not have the training necessary to complete this method of assessment accurately without expert supervision.

I assessed the inferior nasal aperture (INA), interorbital breadth (IOB), nasal aperture width (NAW), nasal bone structure (NBS) (Figure 1), anterior nasal spine (ANS), and post-bregmatic depression (PBD) (Figure 2.) In each assessment, I compared the size and shape of each landmark to examples given in forensic anthropology lab manuals on a scale. A certain topological configuration would earn the landmark a number on a scale and each number was then assessed according to the OSSA chart. Each of these scores were then weighed to extrapolate if the decedent was presumed to be either "American Black" or "American White." Each estimation gave me a number that was then scored according to the OSSA scaling methodology that gave me an estimation of the ancestral heritage of samples.

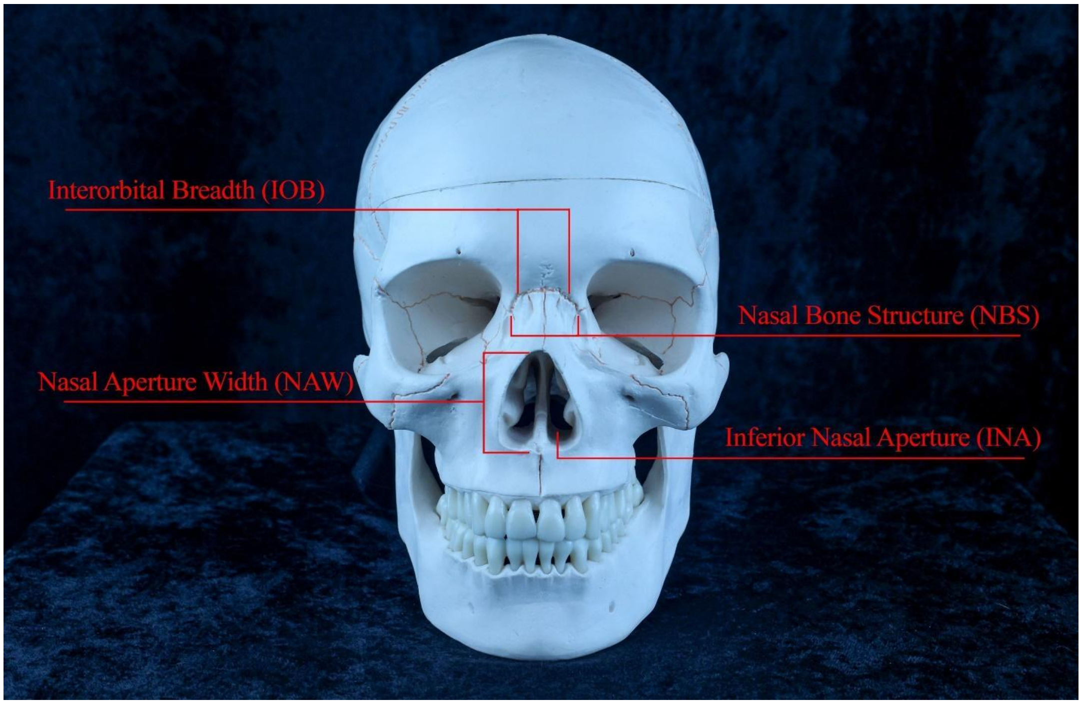

Figure 1: Figure 1 depicts a front facing human cranial analog with visual indicators of OSSA locations: interorbital breadth, nasal bone structure, nasal aperture width, inferior nasal aperture. Photo credit: William Brown 2022

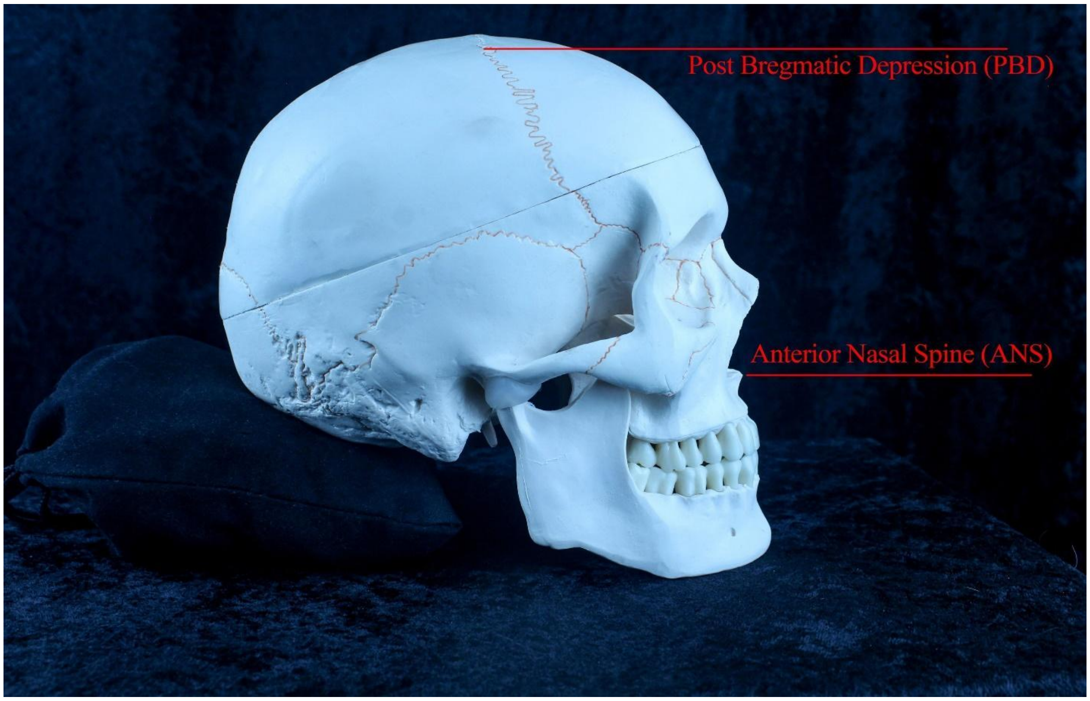

Figure 2: Figure 2 depicts a side facing human cranial analog with visual indicators of OSSA locations: post bregmatic depression, anterior nasal spine. Photo credit: William Brown 2022

Binary Transformation of OSSA Scores:

Trait	Character expression and OSSA scores				
Anterior nasal spine (ANS)	Slight 1 =0	Intermediate 2=1	Marked 3=1		
Inferior nasal aperture (INA)	Pronounced slope 1=0	Moderate slope 2=0	Straight 3=0	Partial Sill 4=1	Sill 5=1
Interorbital breadth (IOB)	Narrow 1=1	Intermediate 2=1	Wide 3=0		
Nasal Aperture width (NAW)	Narrow 1=1	Medium 2=1	Broad 3=0		
Nasal Bone Structure (NBS)	Low/Round 0=0	Oval 1=0	Marked Plateau 2=1	Narrow Plateau 3=1	Triangular 4=1
Post-Bregmatic depression (PBD)	Absent 0=1	Present 1=0			

OSSA Sum of 0-3= “American Black” Sum of 4+= “American White”

Table 1: Table 1 depicts the OSSA binary transformation scoring method wherein a decedent’s ancestral origin is estimated based on cranial topographical morphological features (Christensen and Passalacqua 2018, 127-36).

I recorded how long it took to do each of these assessments three times per sample, a standard forensic protocol when performing such analysis. I also recorded how long it took to take documentary photographs and follow lab safety protocols (Christensen and Passalacqua 2018, 127-36). In my analysis of the cranial human remains at the Portland State University human osteology lab and the Portland Community College Sylvania biology lab, I was able to perform the first steps in a macroscopic ancestral heritage estimation according to standard forensic anthropology identification procedures. I am aware of the possibly problematic nature of working in a post-colonial osteological collection of unknown proveniences in an institutional setting, and I have taken special care to be respectful and conscientious of the human remains I have examined at Portland State University and Portland Community College Sylvania campus during this stage of my research. My comparison of the *Bones* methods and my assessment methods are outlined in the data section of this study.

Data

Bones Episodes

The following information includes my observations of scenes depicting ancestral estimation in *Bones* episodes. The ancestral heritage estimations are performed by a forensic anthropologist, a forensic anthropology graduate student, and a forensic artist, with contributions from other scientists depending upon the scene. I have analyzed the following three scenes from the ten sample episodes I watched for this study, but I hope to examine more episodes in further depth in future studies.

Example 1: Season 1 episode 1: Pilot

Scene at 14:35

*Team of scientists and an artist looking at 3D hologram in the Jeffersonian lab. *

Angela: "Brennan reassembled the skull and applied tissue markers."

Dr. Brennan: "Her skull was badly damaged, but racial indicators, cheek bone dimensions, nasal arch, occipital measurements, suggest African American."

Hologram populates

Dr. Brennan: "Rerun the program substituting Caucasian values."

Hologram populates

Dr. Brennan: "Split the difference. Mixed race."

Angie: "Lenny Kravits or Vanessa Williams?"

The scene implies that some craniometric analysis may have been performed off camera, but there is no way to determine which methods were performed (Hanson, Hart 2005). Zygomatic (cheek) bones and the zygomatic suture placements are more similar in Caucasian and African populations than dissimilar to other ancestral populations. There are multiple specific nasal landmarks that can be used in determining a biological profile, but "nasal arch" is an unknown and inaccurate term (Christensen, Passalacqua and Bartelink 2019, 271-304). "Occipital measurements" implies that some type of craniometric analysis may have been performed off screen, but there is no indication as to what methods were used.

Example 2: Season 6 Episode 6: The Shallow in the Deep

Scene at 3:40

Scientists are working simultaneously in the Jeffersonian lab on bodies from a slave shipwreck with many decedents. Skeletal remains from the shipwreck's mass marine grave are being set on examination tables. The forensic artist holds a slave ship's manifesto that lists the names and descriptions of possible decedents

Dr. Brennan *Approaches examination table. Camera pans up the skeletal remains to show that much of the craniofacial features are obscured by marine mussels*: "Male child under 10 years old. One hundred and thirty centimeters. The marine mussels compromised the bone, *Points to face* but the skull shows a mix of Negroid and Caucasoid characteristics suggesting he'd be listed as Mulatto."

Angela: "Got it. Polidore Nelson."

Graduate student *At another examination table examining another decedent. Points to intact pelvis*: "Symphyseal rim well defined. *Points to cranium* Partial ectocranial suture closure. Female, 40's, five feet tall."

The scene implies that decedents from a recently discovered slave shipwreck, which housed a mass marine grave, are being brought to the lab and assessed immediately after retrieval, inferring that the viewer is witnessing the entire biological profile analysis process, without any anthropometric measurements happening off screen (Kettner 2010). Contrary to what *Bones* portrays in the case of Polidore Nelson, subadult skeletal remains are difficult to sex, and most methods used on adults are not considered reliable on juveniles until after 14 years of age. One method that is employed for sexing subadult skeletons with 81%-90% accuracy is metric analysis of radiographs, which was not performed here. Determining ancestral origin in a subadult decedent by visual assessment alone and without anthropometric evaluation may not be a reliable method of determining ancestral heritage in subadult individuals, especially in admixed populations (Christensen, Passalacqua and Bartelink 2019, 256-259).

The pubic symphysis is a good feature to examine for aging skeletal remains, however, the graduate student in this scene estimated the age by expressing there is a well-defined rim, that she couldn't have seen in an intact pelvis (Brooks and Suchey 1990, 227-238). The ectocranial suture isn't used as an aging landmark in people under 50-60 years of age because the suture does not fully close until approximately 80 years of age (Meindl and Lovejoy 1985, 57-66; Ruengdit, Case, and Mahakkanukrauh 2020, 1-11). The biological profiles given in this scene are determined by macroscopic assessments within moments of visual examination (Kettner 2010), which would not be possible or procedurally acceptable in real life.

Example 3: Season 10 Episode 6: The Lost Love in the Foreign Land.

Scene at 2:28

*Forensic Pathologist, forensic entomologist, and forensic anthropologist are examining human remains in a pasture. They approach a mostly fleshed, though skinless decedent. *

Dr. Brennan *Holds hand in a size gauging gesture near the decedent's hip joint*: I'm judging by the length of the hip axis the decedent was female of Mongoloid descent."

Dr. Brennan *Moves hand to decedent's mouth and runs gloved fingers over the mandibular arcade*: "The wear on the mandibular teeth suggest she was in her late 20's."

Without defleshing the decedent and without using calipers for metric analysis, there is no reasonable explanation for how Dr. Brennan can accurately gauge measurements of the hip axis in millimeters. Dr. Brennan would be required after metric analysis to perform statistical analysis using a database like Fordisc to come to an accurate ancestral estimation using hip axis metrics (Meeusen, Christensen, and Hefner 2015, 1300-1304). The use of femoral neck axis length to approximate sex in a forensic anthropological context is a method shown to be approximately 86% effective in determination when anthropometric measurements with slide calipers are used on skeletal remains then compared to forensic discipline sex specific datasets. However, it is considered limited due to significant intra-population variation in ancestral estimations and may not be applied in a forensic anthropological context when other more valid skeletal landmarks are available (Attia et al 2022; Meeusen, Christensen, and Hefner 2015, 1300-1304).

Although there are methods of determining the approximate age at death of a decedent from tooth wear, these methods rely heavily upon visual inspection and may also include metric analysis, neither of which Dr. Brennan performed (Alayan, Aldossary and Santini 2018, 18-21). The validity of this method of determining approximate age at death is influenced by diet, pathology, dental malocclusion, and other factors, and as such may not be used when other valid methods are available (Miles 2001, 973-982).

At a crime scene, a forensic anthropologist may be present to help locate human remains, determine if the skeletal remains are intact, identify and differentiate human skeletal remains from animal remains, or to work in a mobile lab to process evidence. However, most of the individuation of human remains happens in the lab after the bones have been cleaned and the chain of custody observed per judicial procedures (Stanojevich 2016). Dr. Brennan would not have been able to give expert witness testimony as to the biological profile of this decedent ethically had she estimated age, sex, and ancestry in this manner (Christensen, Passalacqua and Bartelink 2019, 256-259; Manthey and Jantz 2020, 275–87; Stanojevich 2016).

Cranial Assessment Data

Before I could analyze the crania using the OSSA method, I needed to take a number of steps to gain permissions to access the bones through institutional authorities. I spent months emailing and networking to get permissions. Once I had permission to use osteological collections, I also spent time traveling, signing paperwork for the care and handling of the space, materials and human remains, getting lab key permissions, setting out lab pads to protect the crania, and washing hands before and after handling human remains. These preparatory steps preceded the in-lab process of carefully handling the crania, photographing them from multiple angles, writing down each observation, then doing it twice more on different days to recheck for accuracy. I spent approximately 40 minutes assessing each cranium, including the time I spent taking notes. In actual forensic lab situations, there are many factors that take time, including chain of custody procedures, ongoing judicial processes, court permissions, cleaning the remains, and performing multiple analysis techniques to get the most accurate and valid information for individuation as possible (Stanojevich 2016). The *Bones* episodes I observed did not portray these steps and protocols. Due to the OSSA method only allowing for a categorical approximation of ancestry of either “American black” or “American white,” accuracy in my ancestral estimations will not be entirely known. I did not perform biological profiles including age or sex because these factors fall outside of the scope of this study. Further refinement of ancestral estimation could be performed through methods such as craniometric measurements in concert with database comparisons such as Fordisc. Fordisc is a database used by biological anthropologists to statistically analyze human remains for biological profile approximations concerning ancestry, sex and stature (Manthey and Jantz 2020, 275–87). The Decision Tree Modeling (DTM) method, which uses the categorization information found from OSSA assessments to further narrow the possible ancestral origins of decedents based on cranial features, could also be used to add one further dimension to OSSA. However, I did not have access to these resources or sufficient training in these techniques to make valid assessments using them at the time of this study.

In my assessments, I use the term "wormians" in place of "supernumerary sutural bones," or "extra numerary sutural ossifications," which are bones that form because of extra ossification centers along cranial suture lines in utero from a variety of causes (Pickett and Montes 2019).

The cranial data presented is in two designations. Crania with an "A" designation came from the Portland State University osteology lab and are listed first, crania with a "P" designation came from the Portland Community College-Sylvania biology lab and are listed second. There is no particular order outside of these designations.

Cranium A54: Notes: Nasal aperture damaged, anterior nasal spine missing, inferior nasal aperture damaged. Examination and documentation lasted 45 minutes.

OSSA Trait

OSSA Trait	Character/Score	OSSA Score
ANS	Inconclusive	-
INA	Inconclusive	-
IOB	2	1
NAW	2	1
NBS	4	1
PBD	Present	0
Sum	Incomplete assessment	undetermined

Table 2: Table 2 displays the morphological scores assessed from the cranium "A54" located in PSU's osteology collection as they apply to the morphoscopic OSSA ancestry estimation assessment.

Visual macroscopic observations: Features absent or present:

Supraorbital ridge	absent
Extra occipital protuberance	robust
Extra sutural bones	absent
Mastoid process	present
Staining	Not significantly
Fractures	Left temporal bone fractured. Left zygomatic bone fractured.

Table 3: Table 3 displays the morphological traits assessed from the cranium “A54” located in PSU’s osteology collection as they apply to the morphoscopic OSSA ancestry estimation assessment.

Cranium A30: Notes: Incisors, bicuspids, and canines damaged. Presumed female with masculinized features. Bone porosity possibly due to iron deficiency, wormians present. Examination and documentation lasted 55 minutes.

OSSA Trait	Character/Score	OSSA Score
ANS	2	1
INA	4	1
IOB	1	1
NAW	2	1
NBS	1	1
PBD	Absent	0
Sum	10	5 Possible American “white”

Table 4: Table 4 displays the morphological scores assessed from the cranium “A30” located in PSU’s osteology collection as they apply to the morphoscopic OSSA ancestry estimation assessment.

Visual macroscopic observations: Features absent or present:

Supraorbital ridge	slight
Extra occipital protuberance	absent
Extra sutural bones	wormians present but otherwise simple sutural structure
Mastoid process	present, small
Staining	minimal
Fractures	Present, front dentition fractured, postmortem fractures due to handling

Table 5: Table 5 displays the morphological traits assessed from the cranium “A30” located in PSU’s osteology collection as they apply to the morphoscopic OSSA ancestry estimation assessment.

Cranium A43: Examination and documentation lasted 45 minutes.

OSSA Trait	Character/Score	OSSA Score
ANS	3	1
INA	3	0
IOB	2	1
NAW	2	1
NBS	1	0
PBD	Absent	0
Sum	11	3 Possible American “white”

Table 6: Table 6 displays the morphological scores assessed from the cranium “A43” located in PSU’s osteology collection as they apply to the morphoscopic OSSA ancestry estimation assessment.

Visual macroscopic observations: Features absent or present:

Supraorbital ridge	minimal
Extra occipital protuberance	present
Extra sutural bones	present
Mastoid process	present, gracile
Staining	minimal
Fractures	left styloid process absent, teeth fractured, anterior nasal spine fractured

Table 7: Table 7 displays the morphological traits assessed from the cranium "A43" located in PSU's osteology collection as they apply to the morphoscopic OSSA ancestry estimation assessment.

Cranium A50: Examination and documentation lasted 45 minutes.

OSSA Trait	Character/Score	OSSA Score
ANS	2	1
INA	2	0
IOB	3	0
NAW	3	0
NBS	0	0
PBD	Present	1
Sum	10	2- Possible American "black"

Table 8: Table 8 displays the morphological scores assessed from the cranium "A50" located in PSU's osteology collection as they apply to the morphoscopic OSSA ancestry estimation assessment.

Visual macroscopic observations: Features absent or present:

Supraorbital ridge	absent
Extra occipital protuberance	present
Extra sutural bones	wormians present
Mastoid process	Present, gracile
Staining	moderate
Fractures	Front dentition, mandibular angle broken off, multiple postmortem fractures due to handling

Table 9: Table 9 displays the morphological traits assessed from the cranium "A50" located in PSU's osteology collection as they apply to the morphoscopic OSSA ancestry estimation assessment.

Cranium A63: Examination and documentation lasted 45 minutes.

OSSA Trait	Character/Score	OSSA Score
ANS	2	1
INA	2	0
IOB	2	1
NAW	2	1
NBS	0	0
PBD	Present	0
Sum	8	3 Possible American "black"

Table 10: Table 10 displays the morphological scores assessed from the cranium "A63" located in PSU's osteology collection as they apply to the morphoscopic OSSA ancestry estimation assessment.

Visual macroscopic observations: Features absent or present:

Supraorbital ridge	absent
Extra occipital protuberance	present
Extra sutural bones	wormians present
Mastoid process	present but slight
Staining	minimal
Fractures	maxilla dentition

Table 11: Table 11 displays the morphological traits assessed from the cranium “A63” as they apply to the morphoscopic OSSA ancestry estimation assessment.

Cranium A52: Examination and documentation lasted 40 minutes.

OSSA Trait	Character/Score	OSSA Score
ANS	3	1
INA	5	1
IOB	1	1
NAW	1	1
NBS	4	1
PBD	Absent	1
Sum	14	6- Possible American “White”

Table 12: Table 12 displays the morphological scores assessed from the cranium “A52” located in PSU’s osteology collection as they apply to the morphoscopic OSSA ancestry estimation assessment.

Visual macroscopic observations: Features absent or present:

Supraorbital ridge	absent
Extra occipital protuberance	present
Extra sutural bones	small wormian present
Mastoid process	present
Staining	absent
Fractures	absent

Table 13: Table 13 displays the morphological traits assessed from the cranium “A52” as they apply to the morphoscopic OSSA ancestry estimation assessment.

Cranium P1: Notes: Cranium is partially covered in white paint, handling damage, elderly individual, parietal foramina present, glabellar foramen present, multiple foramina in lateral lesser wing of sphenoid bone. Examination and documentation lasted 50 minutes.

OSSA Trait	Character/Score	OSSA Score
ANS	2	1
INA	3	0
IOB	2	1
NAW	2	1
NBS	1	1
PBD	Present	0
Sum	9	4 Possible American “white”

Table 14: Table 14 displays the morphological scores assessed from the cranium “P1” located in PCC’s osteology collection as they apply to the morphoscopic OSSA ancestry estimation assessment.

Visual macroscopic observations: Features absent or present:

Supraorbital ridge	minimal

Extra occipital protuberance	absent
Extra sutural bones	obliterated
Mastoid process	absent
Staining	absent
Fractures	Multiple postmortem fractures in many locations likely due to handling

Table 15: Table 15 displays the morphological traits assessed from the cranium “P1” located in PCC’s osteology collection as they apply to the morphoscopic OSSA ancestry estimation assessment.

Cranium P2: Notes: Nasal aperture damaged, maxillary teeth damaged, glue along coronal and sagittal sutures. Examination and documentation lasted 40 minutes.

OSSA Trait	Character/Score	OSSA Score
ANS	2	1
INA	4	1
IOB	2	1
NAW	2	1
NBS	3	1
PBD	Absent	1
Sum	13	6 Possible American “white”

Table 16: Table 16 displays the morphological scores assessed from the cranium “P2” located in PCC’s osteology collection as they apply to the morphoscopic OSSA ancestry estimation assessment.

Visual macroscopic observations: Features absent or present:

Supraorbital ridge	minimal
Extra occipital protuberance	present
Extra sutural bones	absent
Mastoid process	robust
Staining	absent
Fractures	Fractures to nasion and maxilla due to handling postmortem

Table 17: Table 17 displays the morphological traits assessed from the cranium “P2” located in PCC’s osteology collection as they apply to the morphoscopic OSSA ancestry estimation assessment.

Cranium P3:

Notes: Nasal aperture damaged, Maxillary and mandibular anterior dentition damaged, glue along coronal suture, older individual. Examination and documentation lasted 40 minutes.

OSSA Trait	Character/Score	OSSA Score
ANS	3	1
INA	5	1
IOB	1	1
NAW	2	1
NBS	4	1
PBD	Absent	1
Sum	15	6 Possible American “white”

Table 18: Table 18 displays the morphological scores assessed from the cranium “P3” located in PCC’s osteology collection as they apply to the morphoscopic OSSA ancestry estimation assessment.

Visual macroscopic observations: Features absent or present:

Supraorbital ridge	present
Extra occipital protuberance	present
Extra sutural bones	absent
Mastoid process	robust
Staining	absent
Fractures	Some due to handling postmortem

Table 19: Table 19 displays the morphological traits assessed from the cranium “P3” located in PCC’s osteology collection as they apply to the morphoscopic OSSA ancestry estimation assessment.

Discussion

In my analysis of the scenes depicting the ancestral estimations in biological profiles on *Bones*, I noticed that the estimations shown to the viewer were macromorphoscopic, meaning that the fictional scientists took a large-scale look at the features of the skull without using metric measurements. There was mention of craniometric analysis done in Example 1 when Dr. Brennan mentions “occipital measurements,” but without mention of a specific testing procedure, there is no way to know which method was utilized (Hanson and Hart 2005). This means that the viewer is only shown subjective, typological, macroscopic cranial analysis for ancestral heritage estimation in these examples. Without the craniometric analysis of a decedent compared to a statistical dataset like Fordisc, the forensic anthropologist doing ancestral estimation may run the risk of providing an inaccurate biological profile based on confirmation bias while working from a list of typological macroscopic traits (Christensen, Passalacqua, and Bartelink 2019, 274-277; Nakhaeizadeh, Dror, and Morgan 2014, 208–14).

As I based my cranial analysis methodology on what I was able to see in the episodes I sampled, I used the OSSA method which is limited to a binary choice for ancestral estimation, i.e., “American Black,” or “American White.” The DTM method that works with the OSSA method would have added “Hispanic” to the list of possible ancestral origins had I used it, however, these three categories do not give a clear biological profile to most decedents and are based on cultural and social ideas about race rather than clinal realities (Christensen, Passalacqua, and Bartelink 2019, 274-277).

Although a discussion of skeletal and dental variation that occurs within and between populations is beyond the scope of this paper, there are superficial morphologic features that vary in shape and size observed in craniofacial and postcranial remains across populations. These skeletal and dental features have traditionally been assessed using topographical methods to assign race to skeletonized remains (White, Black and Folkens 2012, 379-426). However, race is a social construct and ancestry represents relatedness, thus race and ancestry are not the same thing. When the global distribution of human variation is considered, a gradual shift over geographic space in trait prevalence or phenotype is best explained through clines (Christensen and Passalacqua 2018, 127-30). Due to population histories, cultural factors, migration, and an increase in global travel, populations that were once disparate are now in contact, which renders datasets describing or characterizing skeletal or dental variation by population antiquated and inaccurate (Christensen and Passalacqua 2018, 127-30; Christensen, Passalacqua and Bartelink 2019, 274-277, White, Black and Folkens 2012, 379-426).

My estimations for the 9 crania I examined were 1 undetermined, 2 possible “American black,” and 6 possible “American white” according to the OSSA method which took me approximately 45 minutes per cranium to assess (Christensen, Passalacqua and Bartelink 2019, 274-277). *Bones* had a 100% individuation accuracy rate instantaneously in the episodes I observed in this study.

Conclusion

Comparative analysis of data:

Item	Bones	Me
Who performed analysis	Forensic anthropologist, graduate students	Novice Graduate student
Method used in analysis sample	Undefined macromorphoscopic methods	Macromorphoscopic OSSA method
Time to perform analysis	Instantaneous – Apx. 3 minutes	Apx. 40 minutes per each sample
Outcome: Ancestral estimation	Simple, without error, immediate.	Complicated, many overlapping features due to admixture, cranial damage, and typical human variation. Unable to accurately determine ancestral heritage.

Table 20: Table 20 compares the methods viewed in the samples of *Bones* against real life lab methods to compare time to perform and accuracy of ancestral estimation using macromorphoscopic procedures**.**

A forensic anthropologist is a specialist in a discipline that requires as accurate a biological profile as possible for judicial and ethical concerns. Law enforcement in the United States relies on accurate and valid decedent individuation, including socially relevant ancestral heritage estimation due to culturally influenced reporting and procedure advancement (Dirkmaat *et al.* 2008, 33-52). Accurate ancestral heritage estimations allow law enforcement to better investigate missing persons. Due to the inaccuracy of the testing method I applied, based on the samples of *Bones* I observed, I would not be able to make precise or accurate ancestry estimations on any of the crania I analyzed in a judicial or professional context (Christensen, Passalacqua, and Bartelink 2019, 274-277; Manthey and Jantz 2020, 275–87).

I have observed that *Bones* may have streamlined forensic procedures, possibly excluding depictions of necessary paperwork, with time for procedures. In addition, *Bones* makes a protagonist fill several roles, such as crime scene investigator, forensic pathologist, and homicide detective. This kind of blending of roles in TV and film media may mislead the general public about these specialized professions (Christensen, Passalacqua, Bartelink 2019, 3-22; Kruse 2010, 79-91; Scheufele and Krause 2019).

I have found that *Bones* presents forensic science that uses jargon and represents reality closely enough that it may be believable for the lay audience, but that might leave out enough detail that it may be misleading concerning ancestral estimation without contextual science literacy. The fictional forensic scientists in my samples appear to be able to neatly categorize a victim into a "race" while possibly using methods that may fall outside of forensic anthropology standards (Christensen, Passalacqua, and Bartelink 2019, 274-277; Kruse 2010, 79-91).

For over a hundred years, film has been influencing public perceptions of everything from politics, to consumer brand identity, to gender expression, to "race" (Snow 2003, 22). In the case of *Bones* and shows like it, if a fictional forensic anthropologist can visually inspect human remains and instantly recognize the ancestral heritage of an individual, it may tell the viewer that there are such intrinsic and substantial biological differences in human ancestral groups that a trained specialist would easily be able to classify the victim into culturally recognized racial categories. In reality, there is a process of assessment that allows an expert to make an estimation of ancestral heritage. These biological profile techniques do not account for cultural identity, complexion, ethnicity, personal expression, or several other variables, but are important factors in individuating a decedent for identification purposes. (Christensen, Passalacqua and Bartelink 2019, 271-304; Kruse 2010, 79-91).

This research is significant because it operates in a multi-disciplinary way that invokes both cultural and biological anthropology and may contribute a broader socio-cultural and biological understanding regarding where the general public may be influenced in their conceptualizations about the biological nature of race. This is important during our moment of national self-examination regarding racialism and racism (Dirkmaat et al. 2008, 33-52; Kondo 2018, 25-34; Jensen and Oster 2009, 1057–94).

This preliminary research serves as an exploratory study and will provide the basepoint in future research projects and studies using a similar framework to examine implications concerning the dominant cultural ideologies surrounding popular media depictions of marginalized demographics and their portrayal in medical and biological science situations, e.g., disabled, impaired, ethnic and ancestral minority, LGBTQ+, and elderly populations (Ellingsen and Hernæs 2018; Kondo 2018, 25-34; Jensen and Oster 2009, 1057–94; National Center for Health Statistics 2015).

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