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Assessing the Accuracy of ForDisc: Identification of Spaniard Remains and What It Means to be Hispanic in Anthropology

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ASSESSING THE ACCURACY OF FORDISC; IDENTIFICATION OF SPANIARD REMAINS AND WHAT IT MEANS TO BE HISPANIC IN ANTHROPOLOGY

By

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This thesis is dedicated to Bobs Burgers, which got me through the first half of my thesis, and Harrys House by Harry Styles which got me through the second half.

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ABSTRACT

This study analyzes the classification of Spaniard remains in Fordisc 3.1. This analysis is a broader comment on how anthropologists and the public define the term "Hispanic." It was hypothesized that the Spaniard remains will classify primarily as white since they are European though culturally, they may align more with the term Hispanic. 31 females and 30 males from the Wamba Ossuary were analyzed in Fordisc 3.1. The primary classification outcome was White, followed by Hispanic with a relatively high rate of Black and Japanese classifications. Spaniards functioned as a parental population to Latin America, therefore they do not have the admixture seen in other Hispanic populations. The Japanese and Black misclassification rates of this study are comparable to those seen in other Hispanic populations, putting into question the current explanations behind these rates which are predicated on high admixture rates.

CHAPTER 1

INTRODUCTION

The use of discrete racial classifications in forensic death investigations and Fordisc has long been a point of contention among biological anthropologists. The modern view of race as a social construction and not a strict biologically definable phenomenon is reinforced through the various numbers and definitions of racial groups seen around the world. The more accurate concept adopted by anthropologists in the recent half-century establishes identity through geographic ancestry based on genetic frequencies and continuous variables found primarily through cranial variation of different populations. The assessment of geographic ancestry is then translated into cultural categories of race and ethnicity in a forensic context for the express purpose of gaining assistance from law enforcement and the public. Forensic anthropologists use many methods to determine the ancestry of an individual, and software such as Fordisc 3.1, has made this task easier. After the age of exploration and colonization, increasing globalization has caused populations to become less isolated and more biologically homogeneous. Making ancestral determination especially difficult in cases where the individual's ancestry is a mixture of various traditional "races." This puts the usefulness of geographic ancestry, particularly mixed-ancestry in a medico-legal context, into question.

Individuals of Hispanic identity have proven especially difficult for anthropologists to identify from remains alone. Hispanic is an ethnicity used to describe individuals that come from Spanish-speaking countries and therefore is made up of various ancestral backgrounds. 62.1 million people in the U.S. identify as Hispanic (Lopez, 2021). It is too broad to be a descriptor on its own, yet Fordisc 3.1 uses it as one of its population categories. The use of Hispanic, an ethnic categorization, as a biologically based racial classifier in Fordisc 3.1 contrasts with the modern definitions of ancestry and race in the field of anthropology. The use of this classification in medico-legal cases could hinder the identification of Hispanic individuals while minimizing variation and erasing cultural identity.

To assess these inconsistencies, this study will use individuals of Spanish ancestry as a case study by analyzing them in Fordisc 3.1 software. Fordisc 3.1 is limited by its reference populations, and thus it is hypothesized that anthropologists cannot accurately identify individuals of Spaniard descent using Fordisc 3.1. This paper attempts to critically analyze how anthropologists categorize Hispanic people through a case study of one Hispanic group, Spaniards, and the usefulness of these classifications in a medico-legal context. Theoretically, Spaniards should classify as ancestrally European, yet culturally and legally Spanish-speaking individuals are classified as Hispanic. Individuals tracing their heritage to Latin America (as is the case with most Hispanic identifying populations) have mixed Spanish, African, and Indigenous ancestry in varying proportions. The classification of Spaniards in Fordisc 3.1 with its White and Hispanic categorizations yields multiple outcomes with important implications for each group.

CHAPTER 2

BACKGROUND

Defining Race Ethnicity and Ancestry

Anthropologists generally agree that biological race does not exist (Wagner, 2016). Race is a cultural construct used to categorize groups of people based on perceived variation in physical differences as well as shared cultural and linguistic traits (Haviland, 2007). Racial categories are culture-specific and can be fluid or rigid in form. Historically and currently, race is most associated with skin color and group affiliation by the public in the U.S. (Haviland, 2007). The modern idea of race came about when certain western European countries, most notably Great Britain, began colonial expansion in the 16th century and encountered populations relatively distinct from themselves (Smedley & Smedley, 2011). In humans there has always been a concept of otherness, but not separate races based on skin color. The British ideals of race spread to other colonizing nations, such as Spain, in varying degrees. This expansion led to a form of slavery unique to the modern age, one based on a racial social system stemming from skin color, a system whose remnants are still seen today (Smedley & Smedley, 2011).

The U.S. Census Bureau defines race as “a person’s self-identification with one or more social groups” (n.d.) Outside of academia, the term race still holds biological connotations and is associated with certain physical traits, most notably skin color, and culturally learned behaviors (Jurmain et al., 2012). These are the traits most individuals base their racial identity on; therefore, the same traits governmental organizations use to define race since they are primarily self-report based.

Ethnicity is a group identity based on shared culture (Munasinghe 2018). It is a clear cultural categorization without the spotted history of the term race. Ethnicity was first used in anthropology in the 1950s to avoid the use of the controversial term “race” (Jurmain et al., 2012). Ethnicity is therefore a bit easier to define but still quite broad in interpretation. The U.S. Census Bureau defines ethnicity only as determining “whether a person is of Hispanic origin or not.” (n.d.). Ethnicity is plainly much more than that and applies to groups outside of Hispanics. This statement reflects how the U.S. government deals with individuals who identify as Hispanic because they do not fit neatly into their traditional racial classifications.

The previous two cultural concepts are interrelated to the geographic ancestry traditionally associated with those groups, which is the origin of their continued biological connotations. Geographic ancestry refers to biologically based skeletal and genetic differences due to parental population isolation and distribution (Algee-Hewitt, 2016). The traditional parental reference populations are African, European, and Asian/Indigenous. These terms are translated to Black, White, Native American, etc. when working with law enforcement because these are terms familiar to them and the public (Algee-Hewitt, 2016).

Some anthropologists do not give much credence to race, ethnicity, and ancestry because there is far more variation within groups than between them (Jurmain et al., 2012). Still, the cultural and social implications associated with these concepts of identification are vital to understanding the individual and the way they are perceived by society. Forensic anthropologists must take ancestry into account not only for physical traits but for their cultural implications and group affiliations that could aid in identification.

Hispanic generally refers to individuals who come from Spanish-speaking countries, which includes most Latin American countries (excluding Brazil) and Spain (Lopez et al., 2021).

Many government organizations have stretched this definition to include Brazil and other Portuguese-speaking countries, assimilating the term Latino into Hispanic (U. C. Bureau, 2021). Due to colonization and the transatlantic slave trade, the geographically isolated Indigenous groups of the Americas mixed with two other discrete groups (Algee-Hewitt, 2016). This resulted in all three main ancestral groups, African, European, and Indigenous, being represented in various ratios throughout the Americas. The resulting admixture is what makes identifying "Hispanic" difficult with traditional ancestry methods since all traditional ancestral groups are present in these populations in varying percentages.

The number of people who identify as "Hispanic" in the U.S. is increasing every year. In 2020, 61.2 million people identified as Hispanic/Latino in the U.S. census, a 23 percent population increase from 2010 (U.S C. Bureau, 2021). 18.7 percent of the U.S. population identifies as Hispanic making it increasingly vital that we can accurately identify these individuals in a forensic context (U. S. C. Bureau, 2021-a).

Forensic Anthropology and Law Enforcement

A primary focus of forensic anthropology is to provide law enforcement with enough identifying information gleaned from the remains to match the individual with a missing person. They do this by building a biological profile, with the most important demographics being ancestry, biological sex, stature, and age at death (Byers, 2015). There are two methods used by forensic anthropologists to ascertain ancestry, anthroposcopy and osteometry (Byers, 2015). Anthroposcopic traits are non-metric observations of differences between ancestral groups, which are discrete and subjective in nature (Byers, 2015). Osteometry are metric methods used to quantify some anthroposcopic traits (though not all can be quantified) which is the method used by Fordisc. Anthroposcopic techniques are subjective and ambiguous, leaving their accuracy in the hands of the examiner but have proven fairly accurate when performed by experts (Byers, 2015). Metric methods can be deceptive in their accuracy. This is because the measurements can sometimes be ambiguous since they are based on inexplicit anthroposcopic observations, and the metrics are reliant on their reference samples for accuracy (Byers, 2015).

As the Hispanic population grows in the U.S. so does their estimated place in the collective missing person file. It is difficult to gauge how many Hispanic people go missing every year for two reasons, one being that the FBI (and other law enforcement agencies) combine Hispanic and White into one racial category, and the second is that an unknown number of undocumented Hispanic immigrants go missing every year but are not reported (2020 NCIC Missing Person and Unidentified Person Statistics, 2021). Border crossing itself is a perilous trek that leaves many dead along the way; in 2020 alone 250 immigrants were found dead at the U.S./Mexico border (Corchado, 2021). The group that most frequently makes this trek are individuals from Mexico who tend to demonstrate about 50/50 Native American and European (Spanish) ancestry (Dudzik & Jantz, 2016).

It is reasonable to assume that Hispanic individuals make a significant dent in the missing persons file given they make up 19 percent of the U.S. population and are more likely to be victims of violent crime (U. S. C. Bureau, 2021-a; Morgan & Truman, 2020). For this reason, it is vital that forensic anthropologists have a firm grasp on what it means to be Hispanic and how to accurately identify their remains.

Fordisc

Fordisc 3.1 is a software program that uses discriminant function analysis to classify individuals into sex and racial/ethnic groups using reference samples from the Forensic Data Bank (FDB) (Ubelaker, 2002). The program uses two procedures based on Linear Discriminant

Function (LDF) depending on how many reference groups are included in the comparison (Forensic Anthropology Center, 2005). With two groups, a linear combination of the individual's measurements (known as the Mahalanobis distance) are converted to LDF scores. The unknown's LDF score is compared to the average LDF score for each reference group, the unknown is classified into whichever group most closely matches its mean score. If there are more than two groups, multiple LDF scores are calculated and analyzed on differing dimensions (known as Canonical Variates Analysis) to discriminate between groups. The mean scores are called centroids since they exist on multiple dimensions. The unknown is classified into the group with the shortest distance from the centroid (Forensic Anthropology Center, 2005).

Fordisc 3.1 has been criticized for being only as useful as its reference samples (Ubelaker, 2002). Yet it is still the leading software for ancestry identification. The program places racial and ethnic identifications in the same category, which is problematic for many groups but especially problematic for Hispanics which is an ethnic category that includes multiple racial categories in Fordisc 3.1.

The terms "Black, White, Hispanic" used by the FDB represent racial and ethnic categorizations that are cultural in nature, not traditional ancestral classifications that are associated with biologically based identifications. This is because the FDB gets its reference population from forensic cases, where their identity is described by a peer, the attending physician, self-identification, documents, or from the medico-legal investigation (Algee-Hewitt, 2016). Because of this, identity is described in cultural terms, but it is inferred that the cranial metrics relate more to their parental ancestral groups because race has no biological basis. In defense of their cultural classifications for biological based discriminations the Fordisc 3.1 official manual states:

> It is extremely practical to proceed with forensic identification using a social race label, which need not be objective, but merely be correlated with some biological criteria in order to be useful; FORDISC does not define, redefine, or justify any racial classifications, but merely tests the relationship between these cultural categories and metric variation. (Forensic Anthropology Center, 2005, PG. 74-75).

Winburn & Algee-Hewitt (2021) argue that forensic anthropologists are moving towards population affinity identifications, which are more fine-tuned socially relevant groups of interest that show regional variation. These groups share populations histories, and more closely and specifically fit how modern individuals identify. This is especially relevant for the majority of Hispanics, who prefer to identity by country of origin first (Lopez et al., 2020). Fordisc 3.1 goes beyond traditional continental-based classification, which is evident in their use of population-specific categories like "Japanese, Chinese, Guatemalan" indicating the software is moving in that direction as well.

Hispanic Misclassification in Fordisc 3.1

Fordisc 3.1's Hispanic reference sample comes from the FDB and consists of 334 individuals, mostly of Mexican descent (Dudzik & Jantz, 2016). A small percentage of individuals come from El Salvador, Guatemala, Nicaragua, and Panama (Dudzik & Jantz, 2016). This is clearly not a representative sample of the various groups that personally identify and would be classified by others as Hispanic. Due to this undiversified reference sample, multiple studies have demonstrated that individuals of various Hispanic backgrounds are misclassified in Fordisc. Most often they are categorized as White or Native American, but there is a surprisingly high frequency of misclassification into Asian populations, specifically Japanese (Dudzik & Jantz, 2016). The misclassification trends are dependent on which group is being analyzed.

Hughes et al. found that 35% of their Pima County Medical Examiner sample, which consisted primarily of individuals from Mexico, were misclassified as Asian (2018). Only 21% of individuals from this sample were classified as Hispanic despite coming from the population that encompasses most of Fordisc 3.1's reference sample (Hughes et al., 2018).

When an individual presents features of two or more ancestral groups, it is standard practice to assign them to the minority groups, because in life, this is likely how they would have been classified by others (Byers, 2015). This is not how Fordisc 3.1 classifies, for it does not have the capacity to be this nuanced in its categorizations and instead places the individual in whichever group they most closely match since the classification comes down simply to statistical analysis. This is one downfall of the software, especially when dealing with individuals with considerable amounts of admixture.

Spaniard Identification

This study's focus is on Spaniards due to ease of access to collections, their importance in Floridian and Southeastern archaeology, and their influence on all other Hispanic groups due to colonialism. Spaniards are a unique population because historically, they functioned as a parental ancestral group to the Hispanic ethnicity, but modernly they straddle the line between Hispanic and White. As a parent population, they should have far less admixture and serve as a point of comparison for studies on other Hispanic populations.

Spaniards in Spain do not generally use the term "Hispanic" and instead refer to themselves as "Spanish" (Soto-Márquez, 2018). However, when first generation Spanish immigrants come over to the U.S., they switch between the terms White and Hispanic depending on the situation. American peers see them as Hispanic, despite most preferring to be grouped into the White racial category because they are European, and the term Hispanic can carry negative job prospects and connotations in certain social situations (Soto-Márquez, 2018). Still there is a shared language and culture with Latin American groups which further bifurcates the identity of Spanish Americans. As of 2017 an estimated 810,000 individuals of Spanish ancestry personally identify as Hispanic in the U.S. and this number increases every year (Noe-Bustamante et al., 2019).

How Fordisc 3.1 and forensic anthropologists identify Spaniards not only affects their personal identity but affects the identity of every population they colonized, especially those with a higher percentage of Spanish ancestry. Spaniards present a unique position where they are more distinct ancestrally since they hail from Europe, yet because of their colonization, Spaniard ancestry can be seen in nearly all Latin American populations. Hispanic individuals that would be considered "white-passing" or identify as White Hispanic presumably owe this to European, specifically Spaniard, ancestry. These groups are more likely to have a strong Hispanic identity but may not fall under the "Hispanic" category in Fordisc 3.1 because they do not align with the reference sample. This mismatch between ancestry determination and ethnic identity could hinder investigations. This is especially true when software like Fordisc 3.1 includes Hispanic as a possibility, but the individual is placed in a different category than what they primarily identify as.

A few other studies have analyzed Fordisc 3.1's accuracy in identifying Spaniard remains. Ubelaker et al. (2002) ran 98 individuals of Spanish ancestry from the 16-17th century through Fordisc 2.0. There are two notable findings of that study, the first being that Fordisc's sex classification disagreed with the author's estimations. Because Spanish males are relatively smaller than other populations, 52-57% of the author estimated males were classified as females (Ubelaker et al., 2002). The software can only rely on metric analysis; the non-metric features that the authors observed account for this inaccuracy on Fordisc's end. Using the FDB, only 9 percent of the individuals were classified as Hispanic, 44 percent were classified as White, and 35 percent as Black. When accounting for the authors' sex estimations using the "Known Sex" categories only, a majority of the individuals were classified as Black (Ubelaker et al., 2002). These results are not unifying and the high rate of classification as Black brings up a lot of questions for this European sample. Only 9 percent of Spaniards were classified as Hispanic, the identity that many Spanish Americans align with today.

It is evident that Spaniards are an inherently variable group. The collection being used dates to the end of the Middle Ages, a time of co-mingling between the Spanish and Islamic groups primarily from north Africa (Smedley & Smedley, 2011). Still, such disparity in classification results is partly due to a poor reference sample, as evidenced by the classifications of some individuals into groups that have no historical ties to the Spanish samples such as Chinese and Vietnamese (Ubelaker et al., 2002).

CHAPTER 3

METHODS AND MATERIALS

A collection of known geographic ancestry was used to evaluate the effectiveness of Fordisc 3.1 software. Cranial metrics of 61 adult individuals from the Church of Santa Maria Wamba Ossuary in Spain were analyzed. The remains from this ossuary came from medieval villagers in the town of Wamba. At the time Wamba was a small agricultural community which showed gendered division of labor (López-Bueis, 1999). These remains date to the 15th century onward. The sample is composed of 30 males and 31 females, the sample skews slightly female purely based on availability of cranial metrics. This converses the FDB reference samples being tested against which are heavily dominated by male individuals. The FDB reference groups for Black Females and American Indian Females are smaller in number than the number of females from the Wamba sample. Through this is not ideal, it is not unusual given how small the FDB reference populations are, nor is it particularly problematic since each female is being tested one at a time.

The collection is bioarcheological in context, not forensic. Bioarcheological remains can often give reliable ancestry because, in addition to osteological methods, archaeologists have a historical context to work with. While the period between when these individuals lived and modern Spaniards may allow for some microevolution, it is not enough time for significant cranial morphological shifts making these remains still relevant (Brickley et al., 2004). Although there are no such thing as “pure” ethnic groups, populations from this period demonstrate less admixture than modern groups, which theoretically should lead to more accurate and conclusive ancestry estimations (Smedley & Smedley, 2011).

16 cranial metrics were chosen based on availability from the sample and effectiveness at discriminating between groups for the reference samples being used. To keep consistency and limit confounding variables that could arise if variable metrics were used, individuals from the Wamba sample were chosen if they had at least 14 out of the 16 metrics. A majority of the sample had all 16 metrics, a minority were missing the ZYB, EKB, or ECM metric. Table 1 lists the metrics used. Figures H1 and H2 in the appendix visually show the cranial measurements.

Table 1

Measurements used and abbreviations

Measurements	Abbreviations
Maximum Cranial Length	GOL
Maximum Alveolar Breadth	MAB
Maximum Cranial Breadth	XCB
Bizygomatic Breadth	ZYB
Basion-Bregma Height	BBH
Cranial Base Length	BNL
Basion-Prosthion Length	BPL
Minimum Frontal Breadth	WFB
Biorbital Breadth	EKB
Frontal Cord	FRC
Parietal Cord	PAC
Occipital Cord	OCC
Mastiod Height	MDH
Biasterionic Breadth	ASB
Zygomaxillary Breadth	ZMB
Foramen Magnum Length	FOL

Note- Typical cranial measurements with abbreviations specifically used in Fordisc 3.1.

The cranial metric data was collected and provided by Rolando Gonzalez-José. Rolando González-José is a principal researcher at Conicet and has many publications on Latino ancestry and cranial morphology (Google Scholar, 2022). Some measurements such as the prosthion, nasion, and the left asterion were measured twice so the averages of those measurements were used for this study. This data was collected in three dimensions, therefore, to use it with Fordisc software, the data needed to be translated to two-dimensional specs. This was done by using the 3D distance formula; length = sqrt[(x1-x2) ^2 + (y1-y2) ^2 +(z1-z2) ^2] which gave the distance between two points for each of the 16 parameters. The formula was used for each individual's metrics and the output was then entered into Fordisc 3.1.

The individuals were run through the forensic data bank with most classifications included in the analysis to closely gauge the software's accuracy when the individual is of completely unknown origin. The reference populations being tested were Hispanic, White, Black, American Indian, and Japanese. These are the racial terms Fordisc 3.1 uses therefore these terms will be used when referencing the program and results. These reference groups were chosen based on their ancestral association with the term Hispanic and misclassification trends from other studies, which will be discussed further in the discussion section. The measurements used change the sample size for reference groups, Table 2 gives the sample sizes for the conditions in this study.

Table 2

FD3 Reference sample sizes

FD3 Reference Samples	Male	Female
White (WM, WF)	197	97
Black (BM, BF)	51	29
Hispanic (HM, HF)	155	30
American Indian (AM, AF)	48	24
Japanese (JM, JF)	183	115

Note- Sample sizes for the cranial metrics used

Each individual from the sample was tested four times to maximize information and aid in understanding the driving causes behind Hispanic classification when presented with varying options. The first round included each unknown Spaniard being compared to all five categories (White, Black, Hispanic, American Indian, and Japanese) at once. Following that, the unknown Spaniard was compared to one group at a time, with Hispanic being the consistent option and the comparison groups run one at a time.

Each individual was run through these parameters twice, the first time with sex being unknown, the second with the estimated sex accounted for, similar to the way Ubelaker et al. tested their sample (2002). Sex has already been estimated for these individuals by Rolando Gonzalez-José through standard nonmetric assessment of sexual dimorphism in the crania. Metric measures are used by Fordisc to estimate sex.

As stated previously, Fordisc 3.1 primarily uses discriminate function analysis to classify unknowns based on the relationship between their measurements and the measurements of known reference groups. The condition with just two classification options (Hispanic and the comparison group of known sex) produced a two-way discriminate function analysis. The condition with two classification options where known sex was not accounted for produced a multigroup classification matrix with four possible options. The all-possibilities condition with estimated sex accounted for produced a multigroup classification matrix with five possible outcomes. When sex is unaccounted for this jumps to ten possible outcomes.

In the above conditions with two classification options, the Mahalanobis Distance is used to calculate LDF scores, classifying the unknown into the classification with the closest mean LDF score. In all conditions where there are more than two classification options, Fordisc 3.1

uses canonical variate analysis to calculate LDF scores and the unknown is classified into the reference group with the shortest distance from its centroid.

The primary statistic being analyzed is the distance from the centroid/mean for each classification option in each condition. Additional probabilities are also calculated for each condition including F, R, P, Chi, and posterior probabilities. though these probabilities are not directly analyzed for this study, they are checked for each individual to gauge possible data errors and outliers. Fordisc 3.1 uses leave-one-out-cross-validation (LOOCV) to analyze the classification accuracy of the chosen cranial metrics for the reference groups (Forensic Anthropology center, 2005). The classification accuracy was checked for each condition to verify that it was higher than random chance.

The results from Fordisc 3.1 were then consolidated for each individual and separated by condition, descriptive statistics were used to analyze the output. The mean of each condition was calculated numerically as well as the mean classification rates. Statistics for each sex were ran separately then combined. The primary trends being measured were overall classification rates, sex misclassification, and change in racial classification when sex is unknown.

CHAPTER 4

RESULTS

The results are broken down by condition. In each condition the classification accuracy is given, followed by the centroid means, then the overall classification rates. The changes between conditions are given after the 4-way and 10-way sections. The results are separated by sex.

2-way Discriminate function

In the 2-way discriminate function condition, individuals were tested one at a time against two groups of the same sex as them, one being Hispanic and the other being one of the other four comparison groups. Table 3 below shows the cross-validated classification accuracies for every condition in this section. Random chance would be 50% therefore the classification accuracy is well above that for every condition in this section.

Table 3

2-way classification accuracy

	H/W	**H/B**	**H/A**	**H/J**
Male	88.60%	85%	86.20%	80.80%
Female	89%	76.30%	79.60%	84.80%

Note- Cross validated classification accuracy for each condition

Table B in the appendix shows the distance from the mean for each individual in every comparison condition. Tables 4 and 5 below show the average of those means, separated by sex. For males, the overall smallest average distance from the mean was for White males at 21.59, the largest was Hispanic males in the same condition (when isolating HM and WM) at 35.26. For females, the smallest average distance from the mean was White females at 20.7, the largest was for American Indian at 34.29.

Table 4

2-way Mean Distance from Centroid- Male

	H/W	H/B	H/A	H/J
Hispanic	35.260	23.024	23.364	24.796
Comp	21.592	27.364	26.924	25.824

Note- Mean for all males in the sample for each condition

Table 5

2-way Mean Distance from Centroid- Female

	H/W	H/B	H/A	H/J
Hispanic	25.314	30.407	29.460	27.089
Comp	20.696	28.134	34.293	26.489

Note- Mean for all females in the sample for each condition

Five individuals 141, 284, 288, 161, and 142 were found to be too dissimilar in all conditions of the 2-way discriminate function condition. Therefore, these individuals had no impact on the means listed above. They were not excluded from the study because they do classify in other conditions. Other outliers were not excluded because their exclusion did not significantly impact the means.

The overall classification results for each individual are listed in Table B2 in Appendix B. In tables 6 and 7 below the aggregated number of classifications into each category for every condition are listed, separated by sex. Each column represents a 2-way discriminate function condition based on differing comparison groups, the graph should be read column by column not row by row.

Table 6

Mean 2-way Classification Results- Male

	H/W	H/B	H/A	H/J	Total %
Hispanic	9	22	19	14	
% of Sample	30.00%	73.33%	63.33%	46.67%	53.33%
Comparison	16	3	6	10	
% of Sample	53.33%	10.00%	20.00%	33.33%	29.17%
Dissimilar	5	5	5	6	
% of Sample	16.67%	16.67%	16.67%	20.00%	17.50%

Note- Each column represents a different condition, percentages in each column add up to 100%

For males, 55.3% classified as White in the Hispanic v. White condition and only 30% classified as Hispanic, with 16.7% classifying as neither. For females, 64.5% classified as White and 25.8% as Hispanic, and 9.7% as neither. However, with the other comparison groups, Hispanic has the highest classification rate for males, and overall, 53.3% of the sample classified as Hispanic.

Table 7

Mean 2-way Classification Results- Female

	H/W	H/B	H/A	H/J	Total %
Hispanic	8	9	25	11	
% of Sample	25.81%	29.03%	80.65%	35.48%	42.74%
Comparison	20	20	5	16	
% of Sample	64.52%	64.52%	16.13%	51.61%	49.19%
Dissimilar	3	2	1	4	
% of Sample	9.68%	6.45%	3.23%	12.90%	8.06%

Note- Each column represents a different condition, percentages in each column add up to 100%

For females, the classification rates varied more widely. In the Hispanic v. Black condition, a majority, 64.5%, of the sample classified as Black. In the Japanese v. Hispanic condition again, a majority classified as the comparison group, with 51.6% classifying as Japanese. Only in the Hispanic v. American Indian condition did a majority of females classify as Hispanic, with 80.6%, the highest rate among males and females in all conditions for the 2-group comparison. Overall, 42.7% of the female sample classified as Hispanic, with 49.2% of the sample classifying into one of the comparison groups.

Table 8

2-way Combined Classification Results

	H/W	**H/B**	**H/A**	**H/J**
Comparison	59.02%	37.70%	18.03%	42.62%
Hispanic	27.87%	50.82%	72.13%	40.98%
Dissimilar	13.11%	11.48%	9.84%	16.39%

Table 8 above shows the combined sex results for each racial category in the 2-way condition. In the Hispanic v. White condition, 59% of the sample classified as white. In the Hispanic v American Indian condition 18% of the sample classified as American Indian.

4-way Discriminate Function

In the 4-way discriminate function analysis, each individual was still compared against two groups simultaneously, with Hispanic being the constant. However, sex is not accounted for, so the analysis includes male and female reference populations for each racial group. Table 8 below shows the cross-validated classification accuracies for every condition in this section. While lower than the two-way condition, random chance would be 25% in this condition, therefore the classification accuracies are still considerably higher than chance in every condition.

Table 9

4-way Classification Accuracy

H/W	H/B	H/I	H/J
78.50%	70.20%	68.10%	69.80%

Note- Cross validated classification accuracy for each condition

Tables C1 and C2 in the appendix shows the average distance from the centroid for each individual in every comparison condition. Tables 10 and 11 below show the average of those distances, separated by sex. For males, the classification with the lowest average distance from the centroid was White female at 22.09, with White male and American Indian female coming in second, nearly tying at 22.91 and 22.90 respectively. The classification furthest from the centroid for males was American Indian male at 29.53.

Table 10

4-way Mean Distance from Centroid- Male

	H/W	H/B	H/A	H/J
Hispanic Male	24.867	24.444	25.682	25.848
Hispanic female	25.256	23.856	24.325	26.364
Comp. Male	22.911	28.893	29.532	26.404
Comp. Female	22.093	24.993	22.904	24.576

Note- Each column represents a separate condition. Known sex is male, tested against all sex conditions.

For females, the classification with the lowest average distance from the centroid was White female at 18.39, with Hispanic female coming in second at 18.50 in the Black v. Hispanic condition. The classification furthest from the centroid was American Indian Male at 36.12. Again, in this condition, the female samples show a wider range of variation in means and classification rates.

Table 11

4-way Mean Distance from Centroid- Female

	H/W	H/B	H/A	H/J
Hispanic Male	26.253	25.421	26.493	25.866
Hispanic female	20.250	18.503	19.386	21.293
Comp. Male	27.770	30.714	36.124	28.590
Comp. Female	18.393	20.055	23.597	20.766

Note- Each column represents a separate condition. Known sex is female, tested against all sex conditions.

Individuals 288, and 142 were too dissimilar to be classified in all conditions, therefore they were excluded from computing the means. As stated previously, outliers were not removed from the sample because their removal did not significantly alter the results.

The overall classification results for each individual are listed in Table C3 in Appendix. In tables 12 and 13 below the aggregated number of classifications into each category for every condition are listed, separated by sex. Each column represents a 4-way discriminate function condition based on differing comparison groups, the graph should be read column by column not row by row.

Table 12

4-way Mean Classification Results- Male

	H/W	H/B	H/A	H/J	Totals	Total %
Hispanic Male	5	9	6	7	27	
Sample %	16.67%	30.00%	20.00%	23.33%		22.50%
Hispanic Female	4	10	9	5	28	
Sample %	13.33%	33.33%	30.00%	16.67%		23.33%
Comparison Male	7	5	0	4	16	
Sample %	23.33%	16.67%	0.00%	13.33%		13.33%

Comparison female	11	3	13	9	36	
Sample %	36.67%	10.00%	43.33%	30.00%		30.00%
Dissimilar	3	3	2	5	13	
Sample %	10.00%	10.00%	6.67%	16.67%		10.83%

Note- Each column represents a different condition. Known sex is male, tested against all sex conditions.

55.3% of the male sample misclassified as female, with 23.3% classifying as a Hispanic female and the remaining 30% classifying as a female from one of the comparison groups. The highest rate of classification for the entire male sample was the American Indian female group for the Hispanic v. American Indian condition at 44.3%. Conversely, 0% of the male sample classified into the American Indian male group in that same condition. Across conditions, 45.85% of the male sample classified as Hispanic, either male or female.

Table 13

4-way Mean Classification Results- Female

	H/W	H/B	H/A	H/J	Totals	Total %
Hispanic Female	10	19	23	13	65	
Sample %	32.26%	61.29%	74.19%	41.94%		52.42%
Hispanic Male	3	2	2	1	8	
Sample %	9.68%	6.45%	6.45%	3.23%		6.45%
Comparison Female	16	8	4	14	42	
Sample %	51.61%	25.81%	12.90%	45.16%		33.87%
Comparison Male	1	0	0	1	2	
Sample %	3.23%	0.00%	0.00%	3.23%		1.61%
Dissimilar	1	2	2	2	7	
Sample %	3.23%	6.45%	6.45%	6.45%		5.65%

Note- Each column represents a different condition. Known sex is female, tested against all sex conditions.

8.06% of the female sample was misclassified as male, with a majority of that coming from misclassifications as a Hispanic male. The highest rate of classification for the entire female sample was the Hispanic female group for the Hispanic v. American Indian condition at 74.19%.

Table 14 below shows the combined sex classification rates for each racial condition. The highest classification rate was Hispanic in the Hispanic v. Black and Hispanic v. American Indian conditions. The lowest was Black in the Hispanic v. Black condition.

Table 14

4-way Classification Combined Totals

	H/W	H/B	H/A	H/J
Comparison	57.38%	26.23%	27.87%	45.90%
Hispanic	36.07%	65.57%	65.57%	42.62%
Dissimilar	6.56%	8.20%	6.56%	11.48%

Note- each column represents a condition

Sex and racial changes between 2 conditions

Between the 2-way and 4-way conditions the same individuals and same racial categories are tested but estimated sex is unaccounted for in the second condition. In addition to the sex misclassifications mentioned previously, 13.1-31.2% of the sample changed racial classifications, depending on which comparison group was being tested.

` Tables D1-4 in the appendix lists all individuals that changed racial classification in each condition as well as their sex classifications.

In the Hispanic v. White condition 8 individuals changed racial classification, 6 of which changed to Hispanic when sex was unknown. Of these 8 individuals, 3 also changed sex classification from male to female.

In the Hispanic v. Black condition, 19 individuals, 31.2% of the sample changed racial classification. 63.2% of these individuals changed from Black to Hispanic when sex was unaccounted for. Of these 19, 6 changed sex classification 5 from male to female and 1 from female to male.

In the American Indian v. Hispanic condition, 13 individuals, 21.31% of the sample changed racial classification. 53.9% of these changes were from Hispanic to American Indian. 8 of the 13 individuals changed sex classification, all male to female. A majority of the Hispanic to American Indian group also changed sex from male to female.

In the Japanese v. Hispanic condition, 15 individuals, or 24.6% of the sample changed racial classifications. It was a nearly even split between Japanese and Hispanic changes when sex is unknown. 8 of these individuals changed sex, 7 male to female and 1 female to male. 5 out of the 7 male to female classification changes also changed to Japanese.

5-way analysis

In the 5-way analysis the individuals were compared to all 5 reference groups at once, with known sex accounted for. The cross-validated classification accuracy for males in this condition was 69.90% and 74.20% for females. The classification accuracies are comparable to that of the 4-way function, which is high considering random chance would be 20% in this condition.

Table E1 in the appendix shows the average distance from the centroid for each individual. Tables 15 and 16 below show the average of those distances, separated by sex. For the male sample, the smallest average distance from the mean is the White classification at 22.79. The largest centroid distance is American Indian at 27.84.

Table 15

5-way Mean Distance from Centroid- Male

White	Black	American Indian	Japanese	Hispanic
22.789	26.393	27.843	25.596	23.986

For the females, White is also the smallest distance from the centroid at 20.94. American Indian is also the largest distance at 31.57. The 5-way function result follows the general trend seen in the previous two conditions.

Table 16

5-way Mean Distance from Centroid- Female

White	Black	American Indian	Japanese	Hispanic
20.936	23.929	31.571	24.968	24.204

Individuals 288, 155, 161, 231, and 142 did not classify into any categories and therefore had no impact on the above averages. As with the previous conditions, outliers had no significant impact on means therefore were not removed.

The overall classification results for each individual are listed in Table E2 in Appendix E. In tables 17 and 18 below the aggregated number of classifications into each category for every condition are listed, separated by sex. Table 19 shows the combined racial classifications regardless of sex.

Table 17

5-way Classification Results- Male

White	Black	American Indian	Japanese	Hispanic	Too Dissimilar	Total
14	1	1	3	9	2	30
46.67%	3.33%	3.33%	10.00%	30.00%	6.67%	100%

When sex is accounted for, 46.7% of the male sample classifies as White and 30% classify as Hispanic. The other three reference groups have much lower rates, with Japanese at 10% and both Black and American Indian at 3.3%. 6.7% of the male sample did not classify into any of the racial options.

Table 18

5-way Classification Results- Male

White	Black	American Indian	Japanese	Hispanic	Too Dissimilar	Total
14	5	1	5	3	3	31
45.16%	16.13%	3.23%	16.13%	9.68%	9.68%	100%

When sex is accounted for 45.16% of the female sample classifies as White, similar to the male rates. However, as seen with previous conditions the classification rates are more diversified for the other racial groups. Black and Japanese came in second, tying at classification rates of 16.13%, Hispanic is 9.7% and American Indian is the least likely at 3.23%. 9.7% of the female sample did not classify into any of the available groups.

Table 19

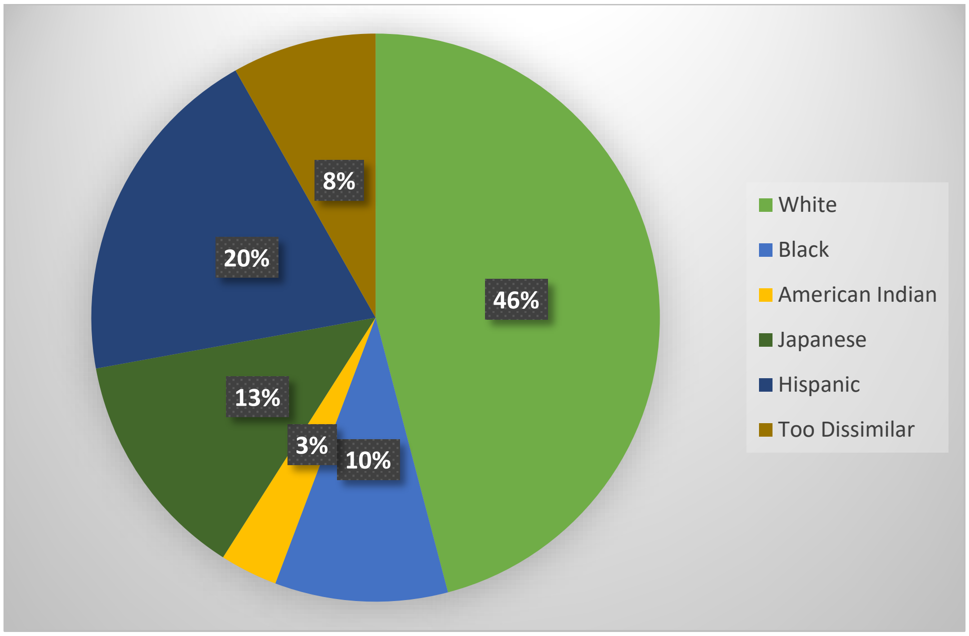
5-way Combined Classification Results

White	Black	American Indian	Japanese	Hispanic	Too Dissimilar	Total
28	6	2	8	12	5	61
45.90%	9.84%	3.28%	13.11%	19.67%	8.20%	100%

Overall, 45.9% of the sample classified as White, 19.67% as Hispanic, 13.11% as Japanese, 9.84% as Black and 3.28% as American Indian. In this condition, 8.2% of the sample was too dissimilar to all racial groups available and did not classify into any. Figure 1 below visualizes the data presented in Table 19.

Figure 1

5-way Combined Sex Racial Classification Pie Chart



10-way analysis

In the 10-way analysis condition, each individual was tested against all racial categories at once, but estimated sex was not accounted for. The classification accuracy was 61.80% which is slightly lower than the previous conditions but significantly higher than random chance which would be 10% in this condition.

Table F1 in the appendix shows the average distance from the centroid for each individual. Tables 20 and 21 below show the average of those distances, separated by sex. For the male sample, the smallest average distance from the centroid is White female at 22.06. The furthest average distance from centroid is American Indian male at 29.62.

Table 20

10-way Mean Distance from Centroid- Male

	White	Black	American Indian	Japanese	Hispanic
Male	23.932	28.089	29.618	26.814	25.079
Female	22.064	25.682	24.886	24.929	25.696

For females, the shortest average distance from the centroid was also White female at 18.82. Except for American Indian female at 25.62, the other female categorizations were all in the 20 range. American Indian male was also the furthest from centroid for the female samples.

Table 21

10-way Mean Distance from Centroid- Female

	White	Black	American Indian	Japanese	Hispanic
Male	28.083	30.043	35.997	29.570	25.393
Female	18.823	20.983	25.620	20.603	20.450

Individuals 288, 161, and 142 were all too dissimilar from the available racial categories and therefore were not categorized into any of them.

The overall classification results for each individual are listed in Table F2 in Appendix F. In tables 22 and 23 below the aggregated number of classifications into each category for every condition are listed, separated by sex. Table 24 shows the combined racial classifications regardless of sex.

Table 22

10-way Classification Results- Male

	White	Black	American Indian	Japanese	Hispanic	Dissimilar	Sample %
Male	5	0	1	1	3	2	
Sample %	16.67%	0.00%	3.33%	3.33%	10.00%	6.67%	33.33%
Female	10	1	3	2	2		
Sample %	33.33%	3.33%	10.00%	6.67%	6.67%		60.00%
Combined %	50.00%	3.33%	13.33%	10.00%	16.67%	6.67%	

Note- Known sex is male, with all racial and sex possibilities tested for. Dissimilar is included in the male row for ease, but that is the rate for the entire male sample.

With the male sample the highest classification rate was into the White female group at 33.3%, which is equal to the entire portion of the male sample that classified as male. Of the males that were classified as male, White male was the highest at 16.7% and Black male was the lowest at 0%. 10% of males are classified as American Indian female. Only 33.3% of the male sample classified as male, with 60% classifying as female and 6.7% undetermined. Overall, 50% of the male sample was classified as White and 16.7% as Hispanic, regardless of sex.

Table 23

10-way Classification Results Female

	White	Black	American Indian	Japanese	Hispanic	Dissimilar	Sample %
Female	9	7	0	5	5	1	
Sample %	29.03%	22.58%	0.00%	16.13%	16.13%	3.23%	83.87%
Male	1	0	0	1	2		
Sample %	3.23%	0.00%	0.00%	3.23%	6.45%		12.90%
Combined %	32.26%	22.58%	0.00%	19.35%	22.58%	3.23%	

Note- Known sex is female, with all racial and sex possibilities tested for. Dissimilar is included in the female row for ease, but that is the rate for the entire female sample.

Following the previous trend, the female sample was more diversified but White female still had the highest classification rate at 29%. Black female was second at 22.58%, Japanese and Hispanic female tied at 16.1%, and 0% of the sample classified as American Indian female. 12.9% of the female sample misclassified as male, with Hispanic male being the highest at 6.5%. Overall, 32.3% of the sample classified as White and 22.6% classified as Hispanic regardless of sex. Additionally, 22.6% classified as Black and 19.4% classified as Japanese representing a fairly even distribution among the 4 racial categories, with 0% of the sample classifying as American Indian.

Table 24

Combined 10-way Classification Results

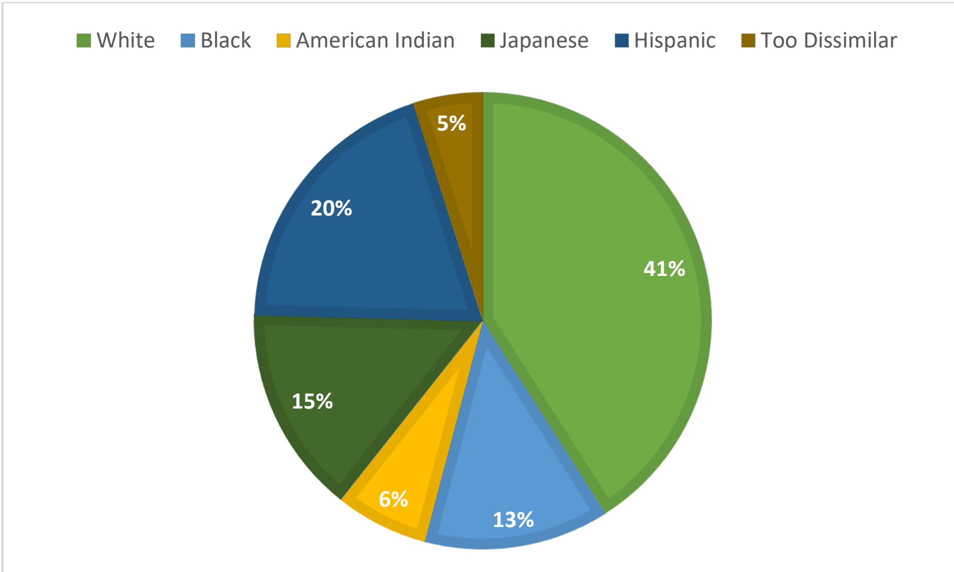
White	Black	American Indian	Japanese	Hispanic	Dissimilar	Total
25	8	4	9	12	3	61
40.98%	13.11%	6.56%	14.75%	19.67%	4.92%	100.00%

Note- First row is number that classified into that racial category regardless of sex, below is percent of total sample.

Overall, 41% of the sample classified as White, 19.7% as Hispanic, 14.8% as Japanese, 13.1% as Black and 6.6% as American Indian. 4.9% of the sample was too dissimilar from all groups. Figure 2 below visualizes the data in table 24.

Figure 2

10-way Combined Sex Classification Results Pie Chart



Change in race between the two

Between the 5-way and 10-way conditions the same individuals and same racial categories are tested at once, but estimated sex is unaccounted for in the second condition. In addition to the sex misclassifications mentioned previously, 26.23% changed racial classifications.

` Table G1 in the appendix lists all individuals that changed racial classification as well as their sex classifications. Table 25 below shows the breakdown of the changes in racial classification. It is a fairly even distribution, with the largest change being 3 individuals changing from White to Black when sex is unaccounted for, and every other group having 1-2 individuals change classifications.

Table 25

Change in Racial Classification- 5-way to 10-way

Class. Change	# of Ind.
American Indian to Japanese	1
Black to American Indian	1
Black to Hispanic	1
Hispanic to American Indian	2
Hispanic to Black	1
Hispanic to Japanese	1
Hispanic to White	1
Japanese to Hispanic	1
Too Dissimilar to Other	2
White to Black	3
White to Hispanic	2
Total	16

Note- All racial classification changes between the two conditions

CHAPTER 5

DISCUSSION

The discussion section is broken down by racial categories to discuss the results and implications for each. Overall, the results show that the dominant classification for Spaniards is White, at about 43% of the sample. However, these numbers are not an overwhelming majority, with about 20% of the sample classifying as Hispanic and the remining split between the other three racial classifications. About 14% of the sample classified as Japanese, 11.5% as Black, and 5% as American Indian. About 6.5% of the sample did not classify into any category and was deemed by Fordisc too dissimilar from all.

Black

Black was included in this study because of the high classification rate of Hispanic groups as Black in previous studies, and the importance of African ancestry in most Hispanic populations but the lack thereof in Spaniards. Of the male portion of the sample, very few classified as a Black male, this categorization was the lowest along with American Indian male. This is likely due to the substantial size differences between this sample, which is on average smaller in stature than other medieval Spanish samples, and the African American reference population.

However, a sizable portion of the females classified as Black female, as did a few males when sex was unaccounted for. In the 2-way condition Black v. Hispanic, 64.5% of the female sample classified as Black, the same proportion that classified as White in the White v. Hispanic test in the same condition. In the 5-way and 10-way conditions Black tied for the second-highest classification rate for females at 16.1% and 22.58% respectively, with the male sample Black was the lowest classification rate in those conditions, with only 3.33% in each. As stated in the background section, other studies have found much higher classification rates as Black for known Hispanic populations.

Some may instinctually hypothesize that this classification is due to the Moorish population in Spain, which occupied most of the Iberian Peninsula during the time this sample came from. The Moors came almost exclusively from North Africa, and DNA studies have proven that southern Europeans do show some North African ancestry (Ghose, 2013). However, the Black reference sample in Fordisc 3.1 come from African Americans who trace their ancestry to primarily West Africa, southwestern Africa, and west-central Africa (Salas et al., 2005). African Americans show no significant genetic contribution from North African groups, in fact, most studies find that north African groups contribute the least to African American ancestry compared to any other region in Africa (Salas et al., 2005). Africa is the most genetically diverse continent, the fact that these groups show African ancestry means little when they come from different regions. Additionally, the high sex differences in Black classification rates for this sample indicate that these classifications do not stem from African ancestry in the sample but misclassification due to dimorphism.

Native American

Native American was included in this study because it is one of the three parental ancestral groups to Latin Americans. Its inclusion is to serve more as a comparison point in the conversation due to its higher misclassification rates with other Hispanic population studies. This sample represents pre-contact Spaniards, who do not know that Native Americans exist yet therefore there was no admixture between the two groups. It would be expected that little to none of the sample would classify as Native American, which for the most part was accurate.

In nearly every condition American Indian Male had the lowest classification rate regardless of sex, with 0% classifying in multiple conditions. American Indian male also had the furthest distance from the centroid in every condition except for the 2-way where it was second furthest, indicating it was consistently quite dissimilar from the Spaniard population. However, when sex is unaccounted for there was a significant portion of males who classified into the American Indian Female groups. In the 4-way Hispanic v. American Indian condition 43.3% of the male sample classified as American Indian female, this was the highest classification rate for males in all tests in this condition. In the 10-way condition 10% of the male sample classified as American Indian female. Among the female portion of the sample, American Indian female was the lowest classification rate across all conditions.

The large sex differences in classification aside, it is impossible that these classifications are due to some Native American ancestry in the sample. These misclassification rates are due to Spaniards not fitting well with Fordisc 3.1 reference populations. This sample is particularly small in stature and given most American Indian classifications happen when the males in this sample are misclassified as female, it is inferred that dimorphism is the driving cause.

Japanese

Japanese was included in this analysis because previous studies on Hispanic groups demonstrated high classification rates into reference populations from Asia. Other Asian groups such as Chinese and Vietnamese were not included in this study because Fordisc 3.1. only has male samples for these groups. A surprisingly high rate of the sample classified as Japanese across the various conditions, with 33.3% of the male sample and 51.6% of the female sample classifying as Japanese in the 2-way condition. Japanese was consistently the second to third highest classification rate in all conditions regardless of sex. When all racial categories were assessed at once, 13.1% of the sample classified as Japanese when sex was known and 14.8% when sex was unknown. The likelihood of classifying as Japanese was similar whether sex was known or unknown, though when sex was unknown males were twice as likely to classify as Japanese females than Japanese males.

It has been proposed that these results are due to shared parental ancestry between east Asians and Native Americans who are significant contributors to Latino heritage (Dudzik, B., & Jantz, R. L. 2016). However, this explanation does not hold up with this sample because Spaniards have no Native American ancestry, as discussed previously this population does not yet know of their existence. Additionally, this sample group is about 50 years older than the first European contact with Japan and therefore has no possible admixture with them either (Victoria and Albert Museum, 2022). An alternative explanation must be proposed for this high misclassification rate as the Japanese have no shared ancestral parental population with Spaniards. This puts into question that explanation for Asian misclassification rates with other Hispanic groups. Given there was no significant difference when sex was known and unknown, and there were comparable rates of male and female classification, dimorphism alone is not a justifiable explanation for this high misclassification rate.

Hispanic and White

The primary focus of this study was to ascertain whether Spaniards would classify as Hispanic or White given Spanish individuals lead a bifurcated existence and encompass both identities fluidly. From a biological anthropologist perspective, Spaniards would classify as White since they are European, and that appeared to be the case with a little less than half of the sample. Across all but one condition, White had the smallest average distance from centroid/mean, regardless of sex. When all possibilities are tested, 45.9% of the sample classifies as White when sex is known and 40.98% when sex is unknown.

From an ethnic and public perspective, Spaniards would classify as Hispanic. In the White v. Hispanic condition, 59% classify as White and 27.9% classify as Hispanic when sex is known. When sex is unknown, 57.38% classify as White and 36% classify as Hispanic. White is the dominant classification still, but roughly a third of the sample classifies as Hispanic when the two are compared. Hispanic is the dominant outcome with Black and American Indian conditions with 51-72% classification rates. In the Hispanic v. Japanese conditions, they are about equal, with Japanese coming out a few percentage points ahead in both conditions.

Fordisc 3.1 claims not to rely on traditional ancestral groups or biologically based ancestry for their programs, instead simply correlates skeletal metrics with self and peer identifications which are cultural in nature. Following that logic, it is postulated that the sample would classify as Hispanic over White, which was not true for a majority of the sample. Hispanic was the second highest classification in both the 5-way and 10-way conditions with 19.7% of the sample classifying in both. The most probable explanation for the classification rate is that the Hispanic reference population has some individuals higher in Spaniard ancestry. This is supported by much of the reference population being Mexican who are typically about 50/50 Native American and Spanish ancestry.

Forensic Implications

As discussed previously, Spaniard Americans live a dichotomized existence. As such they often identify as White and/or Hispanic depending on the situation, being classified as White may not be as detrimental to the identity of some as it would others. However, Spaniards classifying as White has far reaching implications, specifically across all of Latin America.

Spaniards serve as a parental population for Latin American populations in varying degrees. Populations such as Argentineans, Costa Ricans, and Uruguayans have European genetic contributions in rates from 62-92% (Cabeza de Baca et al., 2020; Parolin et al., 2019; Sans et al., 1997). The results of this study imply that individuals descending from these populations would classify as White, despite likely having a strong Hispanic identity.

These populations may also identify as White, since most Latin Americans have separate racial and ethnic identities that do not necessarily fit with U.S. concepts. But in the U.S. these groups are much more likely to identify as Hispanic over White, though most Hispanic populations in the U.S. prefer to identify as their country of origin above all else (Lopez et al., 2020). This form of identification is not yet part of Fordisc software but is currently gaining traction in biological anthropology though the use of population affinities over traditional ancestral identifications. Pushing for software that allows for bifurcated identities or moving towards population affinity models would be highly beneficial in forensic contexts where the individual does not fit into our traditional racial classes.

A significant portion of the sample misclassified into Japanese, Black, or American Indian groups which are not representative in the sample and are clear examples of pure misclassification. When sex was known 26% of the sample classified into one of these groups and 34% classified when sex was unknown. In addition to the complicated bifurcated identity issue, the high rate of misclassification into unrelated groups is extremely problematic in forensic contexts. As stated previously, this high misclassification rate is not unique to this study or this group but seen in multiple studies of various Hispanic groups. The misclassification of Hispanic individuals into one of these groups means a major part of their biological profile is grossly misrepresented and therefore their likelihood of identification decreases significantly. The reality of these misclassifications is that someone will go unidentified, and families will not get closure for their loved ones.

Sex and sexual dimorphism

It is evident that Fordisc 3.1 has a high misclassification rate when it comes to men of smaller stature. With crania, sex determination is made entirely based on dimorphism and does not have the nuance of differing characteristics that other bones have, such as the pelvis. As discussed earlier, Fordisc 3.1 can only use metric measurements and cannot account for sex differences which are observable but not measured. This is highly problematic when sex is unknown, and the individual is especially small or large in stature. As evidenced by this study, when an entire population is outside the normal distribution for stature at least one sex cannot be accurately sexed by Fordisc 3.1.

Between the 2-way to 4-way conditions, 13.1-31.2% of sample changed racial classifications when sex was unknown. In the White v. Hispanic and Japanese v. Hispanic condition there was not a significant pattern in the classification changes. In the Black v. Hispanic condition, 12 individuals changed from Black to Hispanic when sex was unknown. In the Hispanic v. American Indian condition, 7 individuals changed from Hispanic to American Indian and 5 of these individuals changed sex from male to female. Between the 5-way and 10-way conditions 26.23% of the sample changed racial classifications when sex was unknown but there was not a significant pattern in racial changes.

Since sex is fairly easy for biological anthropologists to ascertain based of off nonmetric observations, sex should be estimated whenever possible instead of relying on Fordisc 3.1 to do so. This will aid in much more accurate sex identification but also more accurate race identification, especially in two group comparisons.

Limitations and future studies

The biggest limitation of this study is the age of the remains. These remains are unique in that they have less admixture than later populations, especially with Native American groups since this population lies on the cusp of the age of exploration. Using a collection from this time period adds depth to the conversation, future studies should expand on these questions and with more modern Spanish samples for a well-rounded look into Spanish identity.

The sample size of this study is not particularly big, especially when compared to other studies, but given the small sample sizes of the reference collection this is not seen as a limitation. Larger sample sizes should be used in future studies, but the reference samples sizes need to expand to accommodate. Numerous studies have pointed out, and this study concurs, that more diverse reference populations need to be added to Fordisc software to make it more applicable on a broad scale. Not only that but the current reference samples need to be expanded, especially the female reference samples which are currently dwarfed by the available male data.

CHAPTER 6

CONCLUSION

Fordisc has proven repeatedly to only be as good as its reference samples, but it does not appear to be leaving the forefront of the biological profile any time soon, therefore it is evident that we need more reference samples. The results of this study were mixed, about 43% of the sample categorized as White, which was the highest classification rate, demonstrating just how diversified the results were. This is not due to a flaw in the program itself but because Spaniards fit into two of the possible classifications, therefore they fit well into none of them. A conscious effort must be made to expand the reference collection to make this tool worth using on more than a few specific groups. As it currently stands, Fordisc 3.1 is not able to accurately identify Spaniards, and the results further question how anthropologists discriminate between Hispanic groups as a whole.

Fordisc is programmed to be mutually exclusive, which is at the core of why the term "Hispanic" is problematic when "White, Black" and "American Indian" are also classifications. These terms are not mutually exclusive but used in tandem. In a forensic context, this disconnect could lead to the misclassification of Hispanic remains due to the narrow reference population in Fordisc 3.1. White Hispanics should not have half of their identity erased because this program cannot accommodate them. Though Fordisc gives one classification for each individual, the results from this study showed many individuals with very close centroid scores for multiple classifications, indicating the individuals did not fit well into one category. When reviewing similar results, it should be investigated if the individual is of mixed ancestry.

The high misclassification rates into unaffiliated groups is even more concerning within a forensic context. If an individual is labeled as a social race completely different from what they identified as, their likelihood of identification by peers would drastically decrease. Identification of remains is the core purpose of the biological profile and software such as Fordisc 3.1. High misclassification rates and confusion about terminology are not acceptable when its purpose is to give a voice to the dead, who's recognition depends on accuracy.

An effort must be made on the part of anthropologists to re-examine our use of ethnic, racial, and ancestry terms and how these terms are used by the public and government which they work with and for. Fordisc is a conglomerate of input from anthropologists and the public alike, but at its core it is a program built by anthropologists for anthropologists, therefore it is imperative that it stands up to scientific scrutiny and anthropological ethics. The terminology used in the program should be re-examined to ensure its inclusivity and clarity. The term "Hispanic" should not be used if they really mean Latino, yet still the term Latino should not be used if they simply mean Mexican, as that is the main reference sample for the Hispanic classification. This move is not impossible with the program standards as evident by their use of "Chinese, Vietnamese, and Japanese" reference populations with no umbrella term such as "Asian." Still, among individuals of Hispanic descent about half do not prefer to identify themselves as such, but first identify themselves as their country of origin (Lopez et al., 2021). Given the heterogeneity of the Hispanic ethnicity and evidenced by recent work by Algee-Hewitt (2018, 2020), this region-specific identity may be the future of forensic anthropology. A future that is more specific, accurate, and narrows the bridge between cultural identity and biological markers.

APPENDIX A

KEY AND INDIVIDUAL DATA

Table A1

Sample Age and Sex

Ind #	Sex	Age
13	F	Adult
113	M	Adult
123	F	Adult
124	F	Adult
127	F	Adult
128	F	Adult
130	M	Adult
133	M	Adult
135	F	Adult
139	F	Adult
140	M	Adult
141	M	Adult
145	M	Adult
146	F	Adult
147	M	Adult
149	M	Adult
151	F	Adult
152	F	Adult
164	F	Adult
165	F	Adult
166	F	Adult
178	M	Adult
182	M	Adult
190	F	Adult
192	M	Adult
239	F	Adult
246	F	Adult
184	F	Adult
197	M	Adult
215	F	Adult
235	M	Adult
238	F	Adult
240	M	Adult

Table A2

Key for Tables and Figures

Term	Abbreviation
Hispanic v White conditions	H/W
Hispanic v Black Condition	H/B
Hispanic v American Indian condition	H/A
Hispanic v Japanese Condition	H/J
Comparison group	Comp
Male	M
Female	F
Hispanic	H
White	W
Black	B
American Indian	A
Japanese	J
Individual	Ind

262	F	Adult
267	F	Adult
270	M	Adult
273	F	Adult
278BIS	M	Adult
279	M	Adult
281	M	Adult
282	F	Adult
284	M	Adult
288	M	Adult
293	F	Adult
314	M	Adult
347	F	Adult
252	F	Adult
155	F	Adult
161	M	Adult
114	M	Adult
150	M	Adult
245	M	Adult
249	M	Adult
181	M	Adult
18	M	Adult
144	F	Adult
175	M	Adult
177	F	Adult
187	M	Adult
231	F	Adult
142	F	Adult

APPENDIX B

2-WAY DISCRIMINANT FUNCTION INDIVIDUAL DATA

Table B1

2-way Discriminate Function- Centroid distance

Ind #	Sex	H	W	H	B	H	A	H	J
13	F	17.1	13.5	15.6	17.5	17.9	29	15	21.1
113	M	20.3	24.2	20.1	31.9	22	30.9	22.6	19.6
123	F	21.1	26.9	27.1	38.2	29.4	28.5	28	24.9
124	F	26.6	20.7	29.7	24.2	26.2	33.1	26.6	20.3
127	F	12	3.8	13.7	15.2	15.6	23.8	13.7	19.2
128	F	20.6	29.6	29.9	28.6	23.2	23.4	22.2	16.9
130	M	23.6	21.8	22.7	27	24	23.9	24.8	25.3
133	M	29.8	23.8	29.4	32.4	34.3	36.4	36.6	31.4
135	F	28.9	29.9	36.4	38.8	28.2	34	27.9	28.4
139	F	40	26.9	52.9	47	54.3	57.7	Dissimilar	Dissimilar
140	M	20	13.6	19.3	20.9	19.3	15.5	19.9	18.6
141	M	Dissimilar	Dissimilar	Dissimilar	Dissimilar	Dissimilar	Dissimilar	Dissimilar	Dissimilar
145	M	19.8	19.2	20.9	26.7	18.6	33.5	16.3	21.1
146	F	38.3	25.9	47	39.5	40.2	40.5	42	37.2
147	M	22.4	19.7	23.5	30.4	20.3	26	21.3	27.3
149	M	23.8	25.5	25	35.9	24.2	32	27.8	30.2
151	F	19.8	22.9	22.9	19.1	20.8	22.8	19.4	14.7
152	F	27.2	22.4	21.6	17.7	26.6	42.6	25.5	31
164	F	14.5	6.5	17.7	16.9	15.9	26.9	18.3	25.3
165	F	14.1	22.9	20	30.7	22.8	25.5	22.5	23
166	F	Dissimilar	Dissimilar	45.9	52.9	45.2	46.5	43	33.5
178	M	7	14.3	7	12.5	6.8	12.9	7.2	13.4
182	M	23.8	26.9	24.5	26.6	21.4	32	24.8	27.6
190	F	31.1	20.3	29	23.6	28.5	41	28.7	27.3
192	M	20.4	20.1	18.7	29.7	21.2	25.9	20.3	19.3
239	F	26.1	13.8	27.9	25	33.2	35.2	34	27.6
246	F	31.1	18.6	31	20.3	27.4	42.3	33.4	33
184	F	15.9	20.6	24.6	33.6	17.4	33.4	17	24.9
197	M	23.1	20	24.3	25.1	26.8	29.3	25	28.5

215	F	17.4	14.7	22.8	16.4	22.5	28	19.5	24
235	M	15.6	12.7	15.8	19.6	17.5	20.9	17.2	17.7
238	F	25.9	20.5	37.8	37.5	23.6	28	28.1	31.6
240	M	24.7	28.1	24.7	31	22.2	25.3	26.8	28.6
262	F	21.1	15.4	28.7	17.6	19	20.9	27.8	25
267	F	29.7	18.6	40.3	27.2	33.2	33.6	36.4	30.1
270	M	19.9	16.3	18.4	22.3	20.3	26	23.4	26.7
273	F	34.6	28	37.2	25.6	27.1	29.7	35.6	42.1
278BIS	M	29.1	31.5	26.6	38	28.6	33.9	30.3	34.6
279	M	27.7	21.9	28.5	27.6	27.7	28.2	31.9	28.8
281	M	27.3	25.9	27.4	32.3	31.3	33.2	28.1	29.3
282	F	20.9	17.8	22.7	20.1	26.3	29.6	25.6	27.6
284	M	Dissimilar	Dissimilar	Dissimilar	Dissimilar	Dissimilar	Dissimilar	Dissimilar	Dissimilar
288	M	Dissimilar	Dissimilar	Dissimilar	Dissimilar	Dissimilar	Dissimilar	Dissimilar	Dissimilar
293	F	16	18.4	32.2	34.2	12.4	16.6	21.4	16.1
314	M	34.8	31.6	34.8	35.6	33.6	26.7	37.6	39.4
347	F	23.7	23.1	20.6	21.4	24.1	33.2	24.5	27.1
252	F	37.6	29.1	43.1	41.8	45.9	40.4	46.1	37.5
155	F	Dissimilar	Dissimilar	49.8	43.4	58.7	58.4	Dissimilar	Dissimilar
161	M	Dissimilar	Dissimilar	Dissimilar	Dissimilar	Dissimilar	Dissimilar	Dissimilar	Dissimilar
114	M	9.9	10.2	9.3	15.1	9.8	11.4	11.1	10.7
150	M	31.9	19.5	30.1	25.5	36.8	34.2	36.9	34.2
245	M	31.6	25.7	34.1	33.8	Dissimilar	Dissimilar	38.1	33.5
249	M	341	31.2	31.6	32.2	30.6	27.9	33.6	38.9
181	M	10.9	9.9	11.2	16.7	11.1	17.5	12.1	15.4
18	M	Dissimilar	Dissimilar	Dissimilar	Dissimilar	32.6	45.3	Dissimilar	Dissimilar
144	F	35.7	21.8	39.6	30.7	44.8	49.9	34.8	32
175	M	27.8	28.2	33	39.2	29.4	28.7	28	30.3
177	F	13.4	13.5	14.1	11.2	13.8	15.8	14.4	13.8
187	M	15.3	18	14.7	16.1	13.7	15.6	18.2	15.2
231	F	48.4	33.4	Dissimilar	Dissimilar	59.6	58.5	Dissimilar	Dissimilar
142	F	Dissimilar	Dissimilar	Dissimilar	Dissimilar	Dissimilar	Dissimilar	Dissimilar	Dissimilar

Note- Individual data for 2-way condition. The alternating grey and black headings are to give visual separation to conditions.

Table B2

2-way Discriminate Function Classification Results

Ind #	Sex	H/W	H/B	H/A	H/J
13	F	WF	HF	HF	HF
113	M	HM	HM	HM	JM
123	F	HF	HF	AF	JF
124	F	WF	BF	HF	JF
127	F	WF	HF	HF	HF
128	F	HF	BF	HF	JF
130	M	WM	HM	AM	HM
133	M	WM	HM	HM	JM
135	F	HF	HF	HF	HF
139	F	WF	BF	HF	Dissimilar
140	M	WM	HM	AM	JM
141	M	Dissimilar	Dissimilar	Dissimilar	Dissimilar
145	M	WM	HM	HM	HM
146	F	WF	BF	HF	JF
147	M	WM	HM	HM	JM
149	M	HM	HM	HM	HM
151	F	HF	BF	HF	JF
152	F	WF	BF	HF	HF
164	F	WF	BF	HF	HF
165	F	HF	HF	HF	HF
166	F	Dissimilar	HF	HF	JF
178	M	HM	HM	HM	HM

182	M	HM	HM	HM	HM
190	F	WF	BF	HF	JF
192	M	WM	HM	HM	JM
239	F	WF	BF	HF	JF
246	F	WF	BF	HF	JF
184	F	HF	HF	HF	HF
197	M	WM	HM	HM	HM
215	F	WF	BF	HF	HF
235	M	WM	HM	HM	HM
238	F	WF	BF	HF	HF
240	M	HM	HM	HM	HM
262	F	WF	BF	HF	JF
267	F	WF	BF	HF	JF
270	M	WM	HM	HM	HM
273	F	WF	BF	HF	JF
278BIS	M	HM	HM	HM	HM
279	M	WM	BM	HM	JM
281	M	WM	HM	HM	HM
282	F	WF	BF	HF	HF
284	M	Dissimilar	Dissimilar	Dissimilar	Dissimilar
288	M	Dissimilar	Dissimilar	Dissimilar	Dissimilar
293	F	HF	HF	AF	JF
314	M	WM	HM	AM	Dissimilar
347	F	WF	HF	HF	HF
252	F	WF	BF	AF	JF
155	F	Dissimilar	BF	AF	Dissimilar
161	M	Dissimilar	Dissimilar	Dissimilar	Dissimilar
114	M	HM	HM	HM	JM
150	M	WM	BM	AM	JM

245	M	WM	BM	Too Dissimilar	JM
249	M	WM	HM	AM	HM
181	M	WM	HM	HM	HM
18	M	Dissimilar	Dissimilar	HM	Dissimilar
144	F	WF	BF	HF	JF
175	M	HM	HM	AM	HM
177	F	HF	BF	HF	JF
187	M	HM	HM	HM	JM
231	F	WF	Dissimilar	AF	Dissimilar
142	F	Dissimilar	Dissimilar	Dissimilar	Dissimilar

Note- Individual data for 2-way condition. Classification for each condition is given, columns represent separate conditions, and individuals are separated by row.

APPENDIX C

4-WAY DISCRIMINANT FUNCTION INDIVIDUAL DATA

Table C1

4-way Discriminate Function Centroid Distance White and Black Conditions

		Hispanic v. White Condition				Hispanic v. Black Condition			
Ind #	**Known Sex**	**HM**	**WM**	**HF**	**WF**	**HM2**	**BM**	**HF2**	**BF**
13	F	25.3	29.5	11.6	12.5	26.6	34.4	10.9	16.6
113	M	21.8	25.6	20.8	21.8	21.5	33.4	19.2	23.3
123	F	27.4	32.4	18.7	25.7	32	45.4	20.5	33.4
124	F	33.1	36	20.7	17.4	30.1	32.8	18.4	18.7
127	F	13	8.3	8.6	3.1	13.5	20.1	7.8	10.4
128	F	19.8	31.1	15.7	21.4	18.1	27.6	15.5	16.5
130	M	23.5	21.1	22.3	19.6	22.1	25.7	19.5	21.6
133	M	31.8	25	33.5	23.4	29.2	32.5	31.6	28.6
135	F	28.6	32.6	22.3	23.3	26.2	30	20.2	23.1
139	F	37	35.4	29.9	22.3	34.3	39.5	27.2	28.4
140	M	21.2	13.7	28	27.2	20.7	21.4	25.7	28.8
141	M	43.4	36	32.7	20.2	40.4	46.6	28.5	31.3
145	M	20.2	19.3	9.5	5	20.3	26.2	8.3	10.1
146	F	27.7	26	27.5	20.6	27.6	34.1	25.4	25.7
147	M	22.6	19.5	17.4	11.7	21.7	28.7	16	18.6
149	M	23.5	25.3	26.5	26.2	26.6	37.7	26.4	29.6
151	F	27	34.4	15.8	19.5	26.5	30.6	14.3	16.6
152	F	27.9	30.9	19.4	18.2	27.9	28.8	17.5	15.8
164	F	22.7	17	12.2	5.5	22.7	27.1	11.6	13.5
165	F	12.8	22.6	13.2	21	15.3	31.8	14.1	21.7
166	F	33.2	37.3	31.2	31.3	31.8	47.5	29.9	39.2
178	M	6.9	14.3	8.9	14.4	7	12.5	8.5	8.8

182	M	22.9	25.6	22	23	24.8	26.5	21	19.4
190	F	27.3	25.9	20.6	15.2	25.5	28.5	17.6	16.1
192	M	22.1	21.3	23.9	16.4	20.1	31.2	20.9	24
239	F	20.2	16.2	19.4	11.1	17.1	22.8	16.3	16.8
246	F	35.3	28.6	23.5	14.4	35.4	30.6	23.1	17.5
184	F	34.5	42.4	15.3	20.3	39.9	53.4	17.7	27.8
197	M	23.8	19.5	18.5	17.6	22.8	23	17.2	19.6
215	F	20.5	22.7	13.9	10.9	18.9	23	12.5	10.2
235	M	16.8	13.6	17.4	13.5	16.5	19.9	17.3	16.1
238	F	20	16.2	18.7	17.5	21.6	21.7	19.2	21.2
240	M	24.9	27.6	27.6	32.5	23.7	29.8	26.2	30.1
262	F	20.1	17.1	18.6	13.4	18.9	16.8	18.6	12.4
267	F	24.9	23	26	18.7	21.6	19.7	23.3	16.7
270	M	20.9	16.5	27.3	17.6	19.2	23.5	24.6	21
273	F	31.2	30.8	27	21.7	28.8	25.3	25.6	19.3
278BIS	M	30.3	32.5	33.3	28.4	27.7	39.5	28.7	30.2
279	M	28.3	21.4	37.5	35.7	28.1	27.1	39.4	36.6
281	M	26.9	25.8	24.4	20.2	27	31.2	23.2	23.9
282	F	15.8	20.4	12.3	13.4	14.6	19.5	10.6	11.3
284	M	Dissimilar	Dissimilar	Dissimilar	Dissimilar	Dissimilar	Dissimilar	Dissimilar	Dissimilar
288	M	Dissimilar	Dissimilar	Dissimilar	Dissimilar	Dissimilar	Dissimilar	Dissimilar	Dissimilar
293	F	8.3	11.1	12.4	15.3	8.3	13.1	13.4	15.4
314	M	36.6	32.6	42.9	39.4	35.4	34.9	39.4	38.7
347	F	35	38.1	19.2	20.8	38.4	42.6	20.7	24.6
252	F	33.9	30.3	27	23.3	34.3	41.1	25.2	31.4
155	F	44.8	58.9	32	38.2	44.8	51.4	30.2	32.2
161	M	Dissimilar	Dissimilar	Dissimilar	Dissimilar	Dissimilar	Dissimilar	Dissimilar	Dissimilar
114	M	10.3	10.4	13.8	11.9	9.8	15.7	13.7	14
150	M	34.4	20.5	38.5	23.6	31.6	25.7	35.7	30.3

245	M	34.5	27.1	36.4	26.4	35.2	34	36.8	36.7
249	M	36.2	33.3	38.9	37.4	32.5	32.1	34.8	34.1
181	M	11	10.3	14.3	15.7	11.4	16.7	14.9	17.3
18	M	32.4	33.7	18	20.2	36.4	50.3	19.6	31.1
144	F	31.8	27.2	24.8	15.9	28.5	34.4	20.3	19.6
175	M	27.9	27.8	25.2	25.9	32.9	37.6	26	32.5
177	F	8.1	15	9.5	9.8	8	17.1	9	9.5
187	M	16.3	19.3	22.4	21.6	15.4	16.7	21	18.5
231	F	40.4	35.7	40.5	30.1	Dissimilar	Dissimilar	Dissimilar	Dissimilar
142	F	Dissimilar	Dissimilar	Dissimilar	Dissimilar	Dissimilar	Dissimilar	Dissimilar	Dissimilar

Note- Individual centroid distance data for 4-way condition. Grey and black headings are included to visually separate conditions. Conditions are split between two tables for space purposes only.

Table C2

4-way Discriminate Function Centroid Distance American Indian and Japanese Conditions

		Hispanic v. American Indian Condition				Hispanic v. Japanese Condition			
Ind #	**Known Sex**	**HM3**	**AM**	**HF3**	**AF**	**HM4**	**JM**	**HF4**	**JF**
13	F	26.1	37.8	11.6	21.7	23	29.5	10.9	16.8
113	M	23.2	31.6	20.9	23.7	23.4	19.8	22.6	19.6
123	F	29.5	34.7	19.9	22.9	28.9	25.7	19.2	20.7
124	F	35.3	45.3	21.3	27	31.2	29.7	21.8	16
127	F	12.7	23.8	7.9	14.1	13	19	10	14.7
128	F	21.3	33.2	16.3	19.4	20.7	22.5	16.7	13.3
130	M	23	24	20.2	17	25.6	26.5	25.1	21.7
133	M	33.6	37.1	33.7	32.1	37.9	32.7	42.7	32.3

135	F	27.4	34.3	21.2	25.5	29.8	32.7	23.2	22.9
139	F	40	51	31.7	34.1	40.5	43.9	35.4	30.3
140	M	19.3	16.5	23.6	16.2	21.1	19.5	27.3	27.7
141	M	44.1	52.9	33.6	37.6	41	37.1	33.9	25.9
145	M	19.1	34.5	8.7	20	16.2	21.9	8.4	12.4
146	F	27.2	33.6	26.1	26.2	29.1	31.4	29.7	26.7
147	M	20	26.5	14.8	19.9	21.6	28.3	17.9	22
149	M	25.1	32.8	26.1	25.7	27.2	29.6	31.3	31.2
151	F	28	36	15.8	19.7	26	25.1	15.9	13
152	F	27	44.7	18.8	30.7	23.8	32.4	18.5	23.4
164	F	23.3	36.3	12	19.6	21.8	27.9	13.6	18.5
165	F	13.7	23.3	14.6	20.3	15	17	14.5	17.6
166	F	36.1	34.9	32.4	29	37.8	36.1	38	30.7
178	M	6.7	12.7	8.5	11.5	7.4	14.6	8.9	13.1
182	M	21.9	31.9	21.8	24.5	25.2	28.5	25.1	24.3
190	F	25.5	39.8	19.1	27.4	23.1	27.3	20.3	20.5
192	M	22.6	27.6	22.1	23.6	22	21.5	25.3	21
239	F	21.1	27.8	18	18.6	22.9	22.7	24.7	18.7
246	F	36.2	55.9	24.3	34.3	32.3	36.1	25.7	24.5
184	F	33.9	53.4	15.3	30.1	32.9	38.9	15.3	22.7
197	M	26.3	29.8	17.8	19.2	24.7	28.9	20	24.7
215	F	21.8	35.1	14.2	19.8	18.9	28.3	14.4	17.2
235	M	17.7	21.9	16	16.2	17.4	18.2	18.9	19.5
238	F	19.6	22.7	18	19.3	22.8	25.3	21.2	23.1
240	M	22.9	25.2	23.9	19.1	27.4	28.6	28.3	27.9
262	F	19.9	30.5	17.6	19.8	21.8	25	21.5	19.7
267	F	25	30.8	25.5	24	25.6	28.4	28.9	21.7
270	M	21	26.8	26.1	26.5	24.4	28.5	33.6	30.1
273	F	32.7	40.2	26.2	26.6	32.6	24.6	32.4	25
278BIS	M	30.4	35.4	32.3	29.7	32.5	36.8	38.1	34

279	M	28.3	28.6	37.3	32.1	33	29.7	39.6	36.5
281	M	29.3	33	24.2	19.7	28.8	30.6	28.3	22.9
282	F	16.9	26.8	11.4	16.2	15.8	23	13.8	16
284	M	43.4	45.5	37.1	32	44.8	35	39.4	32.5
288	M	Dissimilar	Dissimilar	Dissimilar	Dissimilar	Dissimilar	Dissimilar	Dissimilar	Dissimilar
293	F	8.8	9.9	11.6	8.4	11.1	8.1	13.7	9.4
314	M	32.6	26.6	35.2	24.2	Dissimilar	Dissimilar	Dissimilar	Dissimilar
347	F	36.2	54.7	19.9	30.9	35.7	40.1	21.8	25.6
252	F	34.3	38.7	24.9	22.9	35.1	32.8	29.2	26.5
155	F	49.2	56.4	33.5	36.3	43.3	50.4	33.2	33.2
161	M	46.3	43.9	45.3	33.1	Dissimilar	Dissimilar	Dissimilar	Dissimilar
114	M	10.3	12.1	11.9	10.8	11.7	11.6	15.5	13.5
150	M	34.3	33.6	34.6	28	Dissimilar	Dissimilar	Dissimilar	Dissimilar
245	M	Dissimilar	Dissimilar	Dissimilar	Dissimilar	39.4	35.5	43.9	33.2
249	M	31.7	29.6	32.3	23.5	Dissimilar	Dissimilar	Dissimilar	Dissimilar
181	M	11.7	18.3	13.9	14.5	12.5	15.8	14.4	17.8
18	M	31.4	45.2	16.9	25.3	32.3	33.6	18.7	22.2
144	F	31.2	44.2	23.5	28.7	27.8	32.7	24.2	24.2
175	M	28.5	28.4	23.6	22.6	29.7	31.7	27.1	30.4
177	F	8.4	11.8	9.6	10.8	7.8	12.5	9.8	9.6
187	M	14.4	14.9	18.7	13	19	15.6	24.8	18
231	F	Dissimilar	Dissimilar	Dissimilar	Dissimilar	Dissimilar	Dissimilar	Dissimilar	Dissimilar
142	F	Dissimilar	Dissimilar	Dissimilar	Dissimilar	Dissimilar	Dissimilar	Dissimilar	Dissimilar

Note- Individual centroid distance data for 4-way condition. Grey and black headings are included to visually separate conditions.

Table C3

4 way discriminate function-Classification

Ind #	Known Sex	H/W	H/B	H/A	H/J
13	F	HF	HF	HF	HF
113	M	HF	HF	HF	JF
123	F	HF	HF	HF	HF
124	F	WF	HF	HF	JF
127	F	WF	HF	HF	HF
128	F	HF	HF	HF	JF
130	M	WF	HF	AF	JF
133	M	WF	BF	AF	JF
135	F	HF	HF	HF	JF
139	F	WF	HF	HF	JF
140	M	WM	HM	AF	JM
141	M	WF	HF	HF	JF
145	M	WF	HF	HF	HF
146	F	WF	HF	HF	JF
147	M	WF	HF	HF	HF
149	M	HM	HF	HM	HM
151	F	HF	HF	HF	JF
152	F	WF	BF	HF	HF
164	F	WF	HF	HF	HF
165	F	HM	HF	HM	HF
166	F	HF	HF	AF	JF
178	M	HM	HM	HM	HM
182	M	HF	BF	HF	JF
190	F	WF	BF	HF	HF
192	M	WF	HM	HF	JF
239	F	WF	HF	HF	JF
246	F	WF	BF	HF	JF
184	F	HF	HF	HF	HF
197	M	WF	HF	HF	HF
215	F	WF	BF	HF	HF
235	M	WF	BF	HF	HM
238	F	WM	HF	HF	HF
240	M	HM	HM	AF	HM
262	F	WF	BF	HF	JF

267	F	WF	BF	AF	JF
270	M	WM	HM	HM	HM
273	F	WF	BF	HF	JF
278BIS	M	WF	HM	AF	HM
279	M	WM	BM	HM	JM
281	M	WF	HF	AF	JF
282	F	HF	HF	HF	HF
284	M	Dissimilar	Dissimilar	AF	JF
288	M	Dissimilar	Dissimilar	Dissimilar	Dissimilar
293	F	HM	HM	AF	JM
314	M	WM	BM	AF	Dissimilar
347	F	HF	HF	HF	HF
252	F	WF	HF	AF	JF
155	F	HF	HF	HF	HF
161	M	Dissimilar	Dissimilar	AF	Dissimilar
114	M	HM	HM	HM	JM
150	M	WM	BM	AF	Dissimilar
245	M	WF	BM	Dissimilar	JF
249	M	WM	BM	AF	Dissimilar
181	M	WM	HM	HM	HM
18	M	HF	HF	HF	HF
144	F	WF	BF	HF	JF
175	M	HF	HF	AF	HF
177	F	HM	HM	HM	HM
187	M	HM	HM	AF	JM
231	F	WF	Dissimilar	Dissimilar	Dissimilar
142	F	Dissimilar	Dissimilar	Dissimilar	Dissimilar

Note- Individual classification data for 4-way condition. Each column represents a condition, individuals are separated by row.

APPENDIX D

2-WAY TO 4-WAY RACIAL CLASSIFICATION CHANGES

Table D1

2-way to 4-way Change in Racial Classification- White v. Hispanic Condition

2-Way		4-Way		
Ind #	**Known sex**	**Race est**	**Est sex**	**Est Race**
13	F	W	F	H
141	M	Dissimilar	F	W
166	F	Dissimilar	F	H
278BIS	M	H	F	W
282	F	W	F	H
347	F	W	F	H
155	F	Dissimilar	F	H
18	M	Dissimilar	F	H

Note- All individuals who changed racial classifications between conditions are included. Highlighted individuals also changed sex. Light pink highlight indicates a change from Male to Female between conditions.

Table D2

2-way to 4-way Change in Racial Classification- Black v. Hispanic Condition

2-way		4-way		
Ind #	**Known sex**	**Race est**	**Est sex**	**Est Race**
124	F	B	F	H
128	F	B	F	H
133	M	H	F	B
139	F	B	F	H
141	M	Dissimilar	F	H
146	F	B	F	H
151	F	B	F	H

164	F	B	F	H
182	M	H	F	B
239	F	B	F	H
235	M	H	F	B
238	F	B	F	H
282	F	B	F	H
314	M	H	M	B
252	F	B	F	H
155	F	B	F	H
249	M	H	M	B
18	M	Dissimilar	F	H
177	F	B	M	H

Note- All individuals who changed racial classifications between conditions are included. Highlighted individuals also changed sex. Light pink highlight indicates a change from Male to Female between conditions and light blue indicates a change from Female to Male.

Table D3

Change in Racial Classification- American Indian v. Hispanic Condition

	2-way		4-way	
Ind #	**Known sex**	**Race est**	**Est sex**	**Est Race**
123	F	A	F	H
133	M	H	F	A
141	M	Dissimilar	F	H
166	F	H	F	A
240	M	H	F	A
267	F	H	F	A
278BIS	M	H	F	A
281	M	H	F	A
284	M	Dissimilar	F	A
155	F	A	F	H
161	M	Dissimilar	F	A
187	M	H	F	A

231	F	A	Dissimilar

Note- All individuals who changed racial classifications between conditions are included. Highlighted individuals also changed sex. Light pink highlight indicates a change from Male to Female between conditions.

Table D4

Change in Racial Classification- Japanese v. Hispanic Condition

2-way			4-way	
Ind #	**Known sex**	**Race est**	**Est sex**	**Est Race**
123	F	J	F	H
130	M	H	F	J
135	F	H	F	J
139	F	Dissimilar	F	J
141	M	Dissimilar	F	J
147	M	J	F	H
182	M	H	F	J
190	F	J	F	H
281	M	H	F	J
284	M	Dissimilar	F	J
155	F	Dissimilar	F	H
150	M	J		Dissimilar
249	M	H		Dissimilar
18	M	Dissimilar	F	H
177	F	J	M	H

Note- All individuals who changed racial classifications between conditions are included. Highlighted individuals also changed sex. Light pink highlight indicates a change from Male to Female between conditions and light blue indicates a change from Female to Male.

APPENDIX E
5-WAY DISCRIMINANT FUCNTION INDIVIDUAL DATA

Table E1

5-way Discriminate Function Distance from Centroid

Ind #	Known Sex	W	B	A	J	H
13	F	14.8	17	30	21.6	15.7
113	M	24.5	20.7	29.2	18.3	20.7
123	F	30.4	34.9	25.5	21.6	23
124	F	20.4	23	33.8	20.3	24
127	F	4	13.1	19	22.5	12.6
128	F	28.4	23.3	22.2	15.8	19.2
130	M	21.1	25	23.6	24	21.7
133	M	22.9	30.7	31.8	26.7	29.4
135	F	30.2	30.2	38.4	28.2	28.2
139	F	29.6	42	48.4	40.1	41.8
140	M	12.8	20.5	17.3	18.7	19.5
141	M	31.8	40.3	46.9	35.2	37
145	M	16.3	19.1	32.3	22.5	16.4
146	F	25.3	32.3	39.4	34.6	36
147	M	18.4	23.2	27.8	27.4	20.5
149	M	26.5	34.7	31.5	27.6	24.7
151	F	25.1	19.9	26.6	16	19.4
152	F	20.6	17.8	42.1	29.5	23.8
164	F	7	16.4	26.3	22.1	14.6
165	F	24.4	23.8	21.6	17.8	16.1
166	F	39	48.2	34.2	31.8	37.8
178	M	14.7	11.7	13.9	13.3	6.9
182	M	26.8	23.8	24.1	26.4	23.3
190	F	17.6	18.8	40	27.1	25.8
192	M	19.3	28.6	24	19.8	19.4
239	F	13.1	25.8	28.8	24.2	26.3
246	F	17.5	20.5	48.7	31.5	29.7
184	F	23.4	25.8	36.2	22.9	16
197	M	20.4	23.9	26.2	28.7	23.6
215	F	14.1	13.7	25.9	22	17.2
235	M	12.7	17.5	19	17	15.9

238	F	21	26.1	32.4	29.5	25.9
240	M	27.4	28.9	27.1	26.5	23.8
262	F	15.4	13.9	27.8	21.7	22.1
267	F	19.5	20.8	35.2	26.8	30.4
270	M	16.4	21.7	26.6	25.8	21.1
273	F	24.4	23	36.7	27.5	31.3
278BIS	M	32.6	36.2	34.2	35	29.8
279	M	20.7	28.1	29.8	25.9	28.1
281	M	25.4	29	28	28.7	24.7
282	F	17.5	18.1	28	25.8	21.5
284	M	38.9	39.8	44.1	31.8	40.1
288	M	Dissimilar	Dissimilar	Dissimilar	Dissimilar	Dissimilar
293	F	18.6	21.8	13.2	14.1	16.9
314	M	31.5	32	28.1	37.3	34.3
347	F	23	24.7	37.8	26.7	23
252	F	30.4	40.1	31.8	33.5	36.8
155	F	Dissimilar	Dissimilar	Dissimilar	Dissimilar	Dissimilar
161	M	Dissimilar	Dissimilar	Dissimilar	Dissimilar	Dissimilar
114	M	9.9	15	10.8	10	9.7
150	M	18.6	24.8	30.4	31.8	31.5
245	M	26.6	30.2	31.8	29.9	31.6
249	M	31.9	29.9	30.9	38	33
181	M	10.1	15.2	19.1	15.2	11.7
18	M	32.2	41.2	46.9	33.2	30.3
144	F	18.6	24.5	39	31.6	30.8
175	M	28.8	29.8	28.7	29.3	27.4
177	F	12.9	10.5	15	12.3	11.8
187	M	18.9	17.5	15.5	12.7	15.5
231	F	Dissimilar	Dissimilar	Dissimilar	Dissimilar	Dissimilar
142	F	Dissimilar	Dissimilar	Dissimilar	Dissimilar	Dissimilar

Note- Individual centroid distance data for 5-way condition. Each row represents one individual and one test as all classifications were tested at once. Only groups matching the known sex were included

Table E2

5-way Classification Results

Ind #	Known Sex	Classification
13	F	WF
113	M	JM
123	F	JF
124	F	JF
127	F	WF
128	F	JF
130	M	WM
133	M	WM
135	F	HF
139	F	WF
140	M	WM
141	M	WM
145	M	WM
146	F	WF
147	M	WM
149	M	HM
151	F	JF
152	F	BF
164	F	WF
165	F	HF
166	F	JF
178	M	HM
182	M	HM
190	F	WF
192	M	WM
239	F	WF
246	F	WF
184	F	HF
197	M	WM
215	F	BF
235	M	WM
238	F	WF
240	M	HM
262	F	BF

267	F	WF
270	M	WM
273	F	BF
278BIS	M	HM
279	M	WM
281	M	HM
282	F	WF
284	M	JM
288	M	Dissimilar
293	F	AF
314	M	AM
347	F	WF
252	F	WF
155	F	Dissimilar
161	M	Dissimilar
114	M	HM
150	M	WM
245	M	WM
249	M	BM
181	M	WM
18	M	HM
144	F	WF
175	M	HM
177	F	BF
187	M	JM
231	F	Dissimilar
142	F	Dissimilar

Note- Individual classification data for 5-way function

APPENDIX F

10-WAY DISCRIMINANT FUCNTION INDIVIDUAL DATA

Table F1

10-way Discriminant Function- Distance from Centroid

Ind #	Known Sex	WM	WF	BM	BF	AM	AF	JM	JF	HM	HF
13	F	29.2	13.3	28.6	14.7	36.5	23	30.8	17	23.2	11.5
113	M	26	22.1	32.6	24.6	30.8	23.6	19.2	19	22.2	21.3
123	F	33.9	25.5	39.9	30.2	34	23	23.6	19.2	27	18.5
124	F	35.5	17.8	33.1	19.5	41	26.4	31.1	15.9	30	19.4
127	F	8.3	3.3	17.5	10.8	25.3	16.8	19.6	14.6	12.8	9.6
128	F	33.3	22.4	30.6	18.4	32.3	18.9	23.3	13.2	20	15.8
130	M	21.2	18	25.7	22.2	24.8	19.8	24.8	19.6	22.3	21.2
133	M	24.4	22.9	32.9	29.6	34.2	31.3	28.4	26.7	31	33.5
135	F	34.9	24.3	33.2	25.1	38.8	30.1	32.6	22.5	28.6	22.7
139	F	36.9	24	42.8	32.4	50	35.6	43.7	28.9	36.8	30.9
140	M	13.5	24.1	22.1	30.6	18.7	19.5	20	29.1	21.2	27.5
141	M	33.5	19.4	42.6	30.5	49.9	36.9	37.3	24.7	38.7	30.3
145	M	16.9	4.7	20	8.1	34.4	22.1	23.8	13.1	17.1	8.9
146	F	26.6	20.9	31.6	25.5	35.4	29.4	30.9	25.6	27.5	27.7
147	M	19.2	12.2	24.2	17.4	29.1	24.4	28.8	21.7	21.2	17.7
149	M	26.8	26	35.4	29.9	31.9	25	27.7	28.4	24.8	27.4
151	F	36.4	21.1	30.5	17.2	35.6	21.3	26.6	13.5	26.2	15.8
152	F	21.8	17.3	23.2	13.9	43.9	32.1	33.7	23	24.2	18.5
164	F	16.8	5.9	25.8	14.4	35.3	20	29.2	18.5	21.4	12.4
165	F	23.4	20.7	27.5	20.1	23.9	20	14.4	15.3	13.2	13.8
166	F	40	33.6	47.2	41.3	32.3	29.6	34.2	27.6	33.1	32.3
178	M	15.2	13.9	11.9	8.8	14.8	13.9	14.2	12.5	7.2	9
182	M	26.5	23.1	23.5	18.6	36	28.3	26.6	21.8	23.2	22.8
190	F	23.3	14.7	22.3	14.6	39.9	30.1	29.3	20.9	24	20.3
192	M	21.1	16.2	31.3	26.2	26.6	25.5	22.7	21.8	21.8	24.1
239	F	16.5	11	25.8	20.5	26.9	21.1	22.1	17	20	20
246	F	26.1	14.1	26.5	16.1	54.3	35.3	38.3	24.4	32.2	23.3
184	F	42.4	21.3	45.6	24	54	30.5	39.2	21.6	32.1	14.8
197	M	23.7	17.2	24.1	22.3	26.5	19.4	29.1	26.4	23.7	19.2
215	F	22.9	11.1	22.8	10.9	32.6	19.4	30	17.1	19.2	13.6
235	M	13.8	13.2	18.8	16.4	20.1	16.8	18.2	19.2	16.8	17.7

238	F	17.6	18	20.9	21.5	27.2	24.3	22.9	22.5	20.9	19.9
240	M	28.3	30.6	30.3	30.7	27.7	22.2	27.1	27	24.9	27.1
262	F	18	13.9	17.7	12.7	32.4	22.9	25.1	18.9	20.7	19.7
267	F	22.3	17.7	20.5	17.4	30.8	26.5	28.1	20.2	23.1	24.9
270	M	17.3	18.5	23	23	28.3	30.1	27.9	28.1	22.3	29.8
273	F	30.8	21.3	27.1	20.1	37.5	27.8	34.3	22.4	29.5	26.4
278 BIS	M	34.5	30	38.3	32.7	35.7	33.2	37.1	32.6	31.5	35.5
279	M	21.4	32.9	29.6	36.5	31.2	33.1	27.1	35.4	29.4	37.3
281	M	26.2	19.1	29.9	23.1	29.1	17.9	29.3	19.9	25	22.5
282	F	21.5	14.1	20	13	27	19.7	24.8	16.8	16.4	14
284	M	40.9	37.9	41.5	38.4	45.7	32.8	31.9	29.6	41.5	36.3
288	M	Dissimilar	Dissimilar	Dissimilar	Dissimilar	Dissimilar	Dissimilar	Dissimilar	Dissimilar	Dissimilar	Dissimilar
293	F	12.8	14.6	15.7	16.4	11.6	10.3	7.3	9.5	9.3	12.5
314	M	33.2	37.3	33.9	38.6	28.9	29.4	39	40.4	36	41.9
347	F	38.3	21.5	37.9	22.3	54.2	32	39.5	23.9	33.7	19.9
252	F	31.6	23.4	39.1	31.2	37	24.4	32.8	25.9	33.6	27.3
155	F	62.9	41.5	51.5	33.7	51	35.4	53	33.2	44.7	32.7
161	M	Dissimilar	Dissimilar	Dissimilar	Dissimilar	Dissimilar	Dissimilar	Dissimilar	Dissimilar	Dissimilar	Dissimilar
114	M	11	11	16.3	14.2	11.6	11.5	11.1	12.7	10.5	13.6
150	M	19.8	22.6	27.1	32.3	33.4	32.8	34.9	35	34.1	39.2
245	M	27.9	26.5	32.5	35.6	34.9	34.2	32.6	29.9	33.8	36.9
249	M	33.8	35.6	31.7	35.1	31.5	28.1	39.5	38.4	34.2	37.3
181	M	10.7	15.3	15.8	17.3	19.7	15.1	15.5	18	11.9	15
18	M	33	20.2	41.8	27.5	47.9	27.7	32.9	21.4	30.3	17.6
144	F	25.2	15.4	30.1	19.8	42.6	30.4	35	24.9	28.9	24.3
175	M	29.6	26.6	30.3	28.9	29.6	26.8	30.2	29	28.7	26.6
177	F	16.2	10.1	15.1	8.2	11.9	11.4	13.3	9.3	7.9	9.3
187	M	20.7	20.7	19.4	20	16.3	15.4	13.9	16.6	16.9	22.3
231	F	37.1	30.9	51.2	43.6	44.7	40.9	38.4	34.8	41.6	41.7
142	F	Dissimilar	Dissimilar	Dissimilar	Dissimilar	Dissimilar	Dissimilar	Dissimilar	Dissimilar	Dissimilar	Dissimilar

Note- Individual centroid distance data for 10-way condition. Each row represents one individual and one test as all classifications were tested at once.

Table F2

10-way Classification Results

Ind #	Known Sex	Classification
13	F	HF
113	M	JF
123	F	HF
124	F	JF
127	F	WF
128	F	JF
130	M	WF
133	M	WF
135	F	JF
139	F	WF
140	M	WM
141	M	WF
145	M	WF
146	F	WF
147	M	WF
149	M	HM
151	F	JF
152	F	BF
164	F	WF
165	F	HM
166	F	JF
178	M	HM
182	M	BF
190	F	BF
192	M	WF
239	F	WF
246	F	WF
184	F	HF
197	M	WF
215	F	BF
235	M	WF
238	F	WM
240	M	AF
262	F	BF

267	F	BF
270	M	WM
273	F	BF
278BIS	M	WF
279	M	WM
281	M	AF
282	F	BF
284	M	JF
288	M	Dissimilar
293	F	JM
314	M	AM
347	F	HF
252	F	WF
155	F	HF
161	M	Dissimilar
114	M	HM
150	M	WM
245	M	WF
249	M	AF
181	M	WM
18	M	HF
144	F	WF
175	M	HF
177	F	HM
187	M	JM
231	F	WF
142	F	Dissimilar

Note- Individual classification data for 10-way function

APPENDIX G

5-WAY TO 10-WAY RACIAL CLASSIFICATION CHANGES

Table G1

Individual Change in Racial Classification 5-way to 10-way Conditions

5-way			10-way	
Ind #	**Known Sex**	**Est Race**	**Sex Est.**	**Est. Race2**
13	F	White	F	Hispanic
123	F	Japanese	F	Hispanic
135	F	Hispanic	F	Japanese
155	F	Dissimilar	F	Hispanic
177	F	Black	M	Hispanic
182	M	Hispanic	F	Black
190	F	White	F	Black
231	F	Dissimilar	F	White
240	M	Hispanic	F	American Indian
249	M	Black	F	American Indian
281	M	Hispanic	F	American Indian
267	F	White	F	Black
282	F	White	F	Black
293	F	American Indian	M	Japanese
347	F	White	F	Hispanic
278BIS	M	Hispanic	F	White

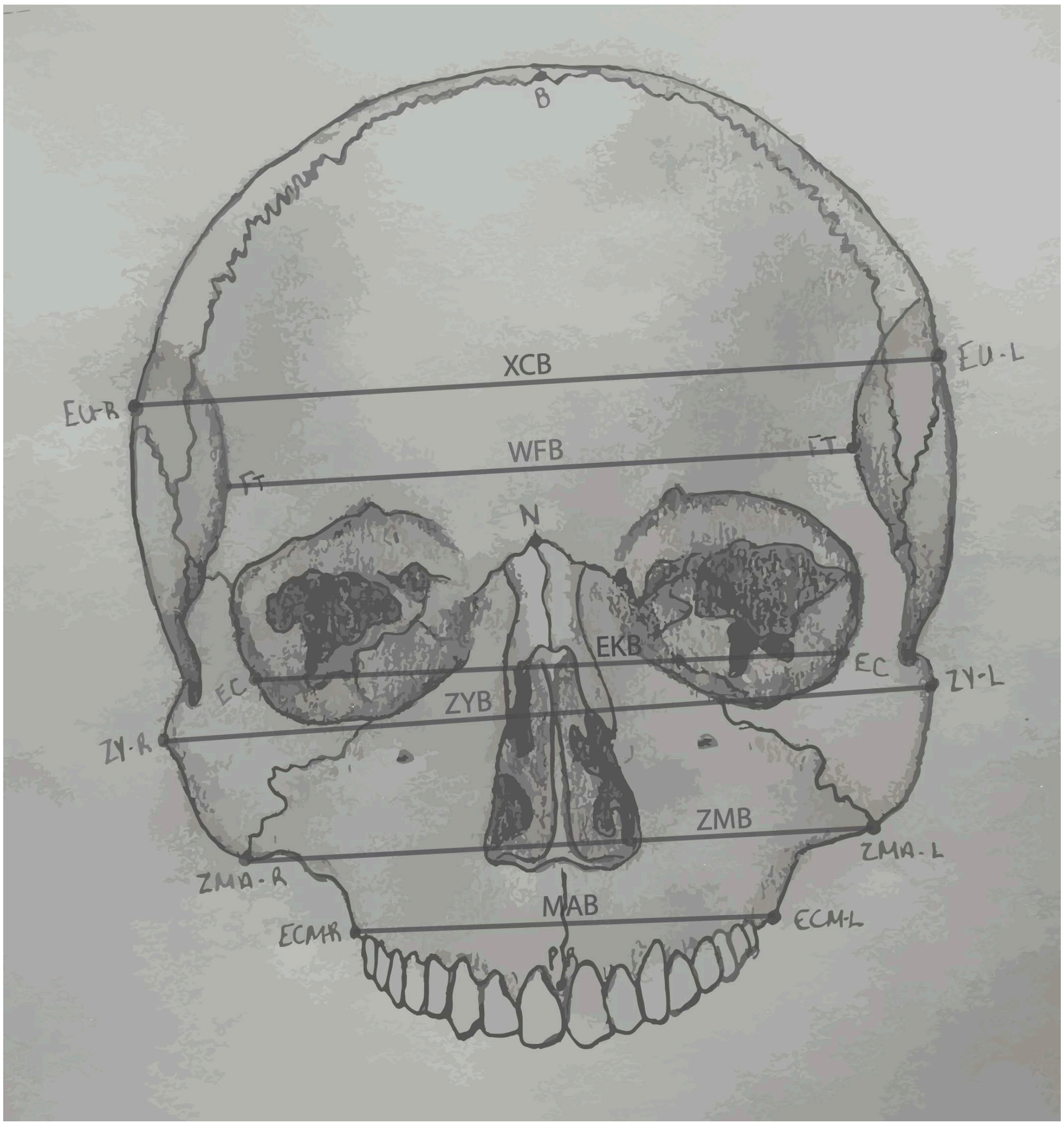
Note- 5-way racial classification listed first, then 10-way classification. Highlighted individuals also changed sex. The light blue highlighted individuals changed from Female to Male and the light pink changed from Male to Female.

APPENDIX H

CRANIAL MEASUREMENT DIAGRAMS

Figure H1

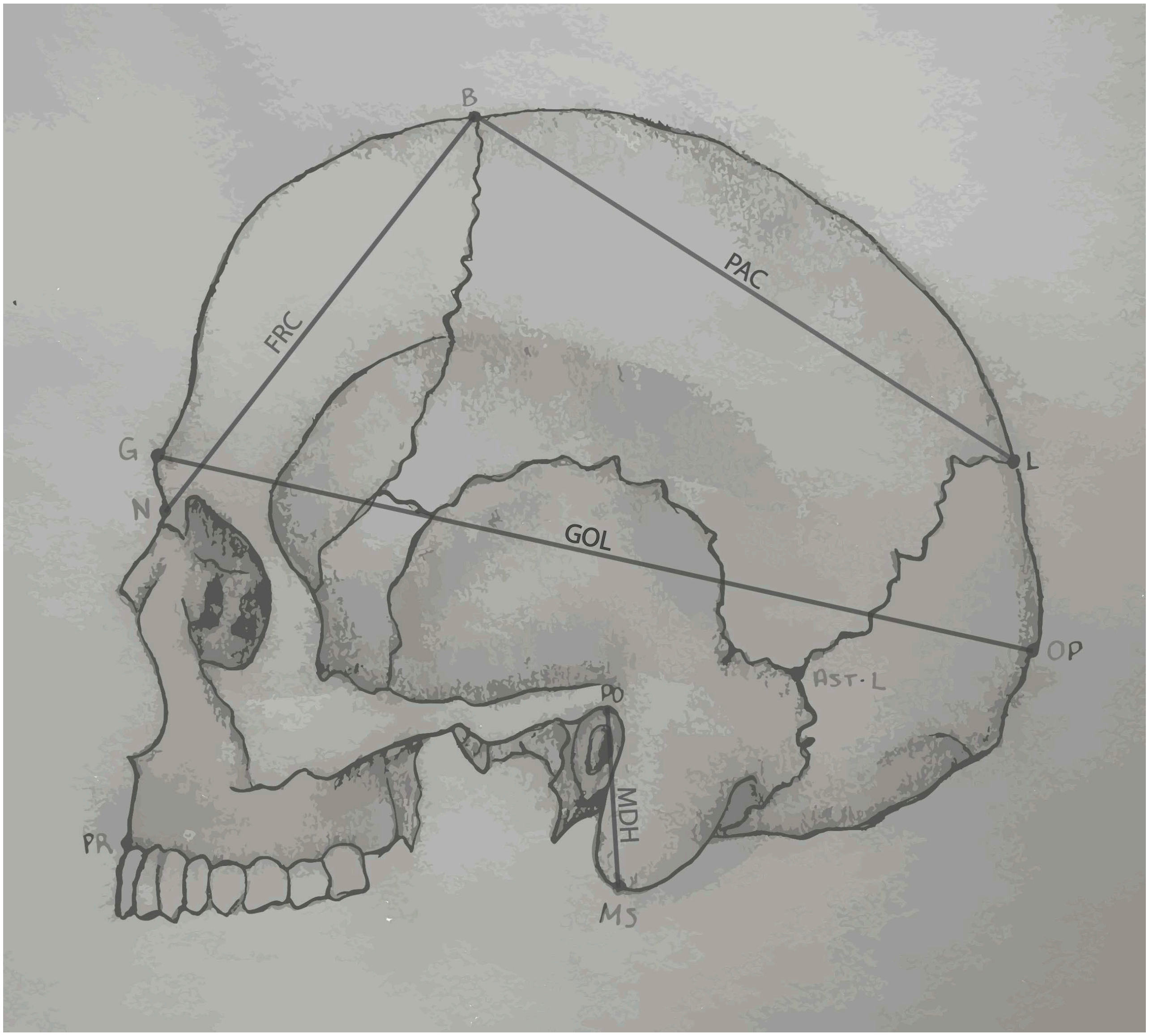
Diagram of Cranial Metrics Used- Anterior View



Note- Cranial metrics XCB, WFB, EKB, ZYB, ZMB, and MAB shown.
Illustration by me, reference material from Forensic Anthropology Center, 2005, Fordisc Help file version 1.53.

Table H2

Diagram of Cranial Metrics Used- Lateral View



Note- PAC, FRC, GOL, and MDH shown. Metrics O and BA are on the inferior portion of the skull on the foramen magnum, therefore the measurements involving those points can not be shown in 2D.

Illustration by me, reference material from Forensic Anthropology Center, 2005, Fordisc Help file version 1.53.

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BIOGRAPHICAL SKETCH

Arizona Maki

Education

Florida State University- 3.9 Cumulative, 4.0 Major GPA Expected Graduation- July 2022

Latin Honors- Summa Cum Laude

Dual Degree- B.S. in Psychology, B.S. in Anthropology

Minors- Law Enforcement Operations and Public Administration

EMHS Certificate- U.S. Intelligence Studies Track Fall 2022

Honors and Awards

Honors in the Major Program Graduate- 2022

- Graduation with honors in the major upon completion of this thesis

Bess H. Ward Honors Conference Attendance Award- 2022

- Grant for honors students, awarded for attending the SAA 87th annual conference

Bright Futures Scholarship- 2018-2022

- Merit-based scholarship through the state of Florida

Godbold Scholarship- 2018-2022

- Merit-based scholarship from private organization

First Generation Matching Grant- 2018-2022

- Need-based grant for 1st generation college students.

Academic Experience

Southeast Archeological Center- NCPE Intern April 2021-Current

- The main duties include washing, photographing, analyzing, cataloging, and writing reports and on artifacts. Phase I, II, and III field work.
- Most sites are native American, historic, and colonial in context.
- Primary specializations are human and animal osteology, prehistoric and colonial pottery, and mariculture.

Field School- Funerary Archaeology in Pompeii July-August 2021

- Excavated a mausoleum at Porto Sarno in Pompeii. In the mausoleum, discovered an inhumation, multiple urns, funerary artifacts, a stela, and inscriptions.
- Gained experience in the entire archaeology process, from excavating to photographing and mapping the site, to analyzing in the lab. Learned how to excavate and analyze both inhumations and cremated remains.

    - Learned how to properly excavate structures, urns, tombs, inscriptions, and stelas.
- Featured in Lost Treasures of Rome National Geographic documentary, and Archeologia VIVA magazine.

Psychology Research Assistant January 2021- May 2022

- Assisted in evolutionary-focused psychology lab conducted by Ph.D. candidates. Assisted in experiment design, experiment procedure, and data collection. Research specifically pertains to life-history strategies and leadership styles.

C.J. Ford P.I.- Wrongful Convictions Intern August 2020-August 2021

- Screen potential clients by conducting a preliminary investigation to determine if they had been wrongfully convicted, then decide whether we would take on their case.
    - Interviewed clients, used open-source information to investigate cases, wrote progress report letters to clients, and created the screening questionnaire.

Directed Individual Research- Skeletal Analysis July 2019

- Six-week DIS on human remains held by the FSU anthropology department. Identified and cataloged remains from excavated sites.

Involvement/Activities

- **Phi Beta Kappa-** Inducted Spring 2022
- **Lambda Alpha National Anthropology Honor Society-** Inducted Summer 2022
- **Anthropology Society at FSU-** Member