

Distant Cousins: Why We Are All Royals, and Why It Means Absolutely Nothing

BY JAMES HOWE

At icebreaker activities, there is one specific piece of trivia that I like to use whenever I have to give an interesting fact about myself: My full name is actually James Howe VI. To this day, I have never met anyone else who was also 'the sixth' or higher. James Howe I had a very interesting life: he was a two-time Congressman representing Queens and director of multiple banks in New York, and personally knew Theodore Roosevelt.

Does this have any bearing on my life? Could someone sequence my genome and show me that he had a significant genetic influence on me? For much of human history, many people might have answered: "yes." From antiquity up until the Renaissance, noble families had pedigrees to show descent from notable sources, such as gods, legendary heroes, conquerors, or Roman patrician families, which they used to glorify themselves and add legitimacy to their rule (1). British inheritance laws also allow titles to be inherited by male-line descendants eight generations removed over any other more distantly related or female claimants (2). The 1896 Supreme Court case *Plessy v. Ferguson*, which established Jim Crow laws, revolved around an octo-noon, or someone who is 7/8 white, man who was considered African-American (3).

Modern genetics has challenged these sorts of assumptions regarding the importance of one's ancestry. Each person has two sets of chromosomes, one inherited from each

parent. Knowing this, it can be estimated that an individual shares roughly half of its genes with each parent. There are other factors at play, like random mutation, but they do not have a large effect on the overall genome. In 1922, Sewall Wright, a researcher at the USDA, formalized and extrapolated this relationship by developing a measure known as the coefficient of relationship, commonly known as r (unrelated to the correlation coefficient) (4). The value of r is equal to the fraction of the genome that is similar to the family member of interest. It is a very simple calculation, where n equals the degrees of kinship separating the two related individuals (4). For example, parents are one generation apart from offspring, so the coefficient of relationship is $2^{-1} = 0.5$, matching the observed phenomenon. Grandparents and great grandparents have r -values of 0.25 and 0.125, respectively (4). To answer my own question in the introduction, the r for between James Howe I and myself is 0.03125 (3.13% similarity,) so we are probably not very genetically similar at all.

As generations become more distant in time, the genetic similarity between members shrinks very quickly. In fact, when sperm banks do background checks on future donors to ensure that they carry no inherited diseases, the most stringent require medical history goes back only three generations, suggesting that any more distant individual genetic contribution is considered to be negligible (5). In fact, at

Art by André Thevet (1500-1590). Available at <http://commons.wikimedia.org/wk/Fi/Motzuma.jpg>

Figure 1: European imagining of Moctezuma II (1466-1520), last Emperor of the Aztecs. Despite having over 100 children, only two were brought back to Spain. Both children married into Spanish nobility. Today, all Spanish nobility is descended in some way from him (21).



some point a person's genetic contribution to humanity actually becomes zero. At a separation of approximately 32 generations, an individual and its direct descendant of will have an r of 2.328×10^{-10} . The human genome is approximately 3 billion base pairs long (6). The product of these two numbers is less than one, meaning that such a distant ancestor is responsible for less than one base pair in its descendant's genome, which is essentially equal to no contribution at all (7). In the United States, the average generation length is 25.2 years. Assuming that stays constant for the next 32 generations, it will take approximately 800 years for an individual to lose all impact in the gene pool (8).

Identity by Descent

However, while those living today may not have any discernable impact on the genes of anyone living in the year 2814, an individual's genetic footprint remains enormous. Just as quickly as individual genetic contribution drops, the overall number of descendants rises, assuming these descendants all reproduce. To establish genetic distance between two living individuals, researchers use a method known as Identity By Descent (IBD). IBD relies on crossing over, an event during gamete formation where paternal and maternal homologous chromosomes exchange segments, creating recombinant chromosomes and, in effect, new gene profiles. To estimate genetic distance, geneticists search for sequences shared by two individuals at certain loci, known as the IBD block, inherited from a common ancestor (9). As the length of these sequences decreases, genetic distance increases, as more crossing over events have occurred (9).

Using this method, researchers at UC Davis were able to estimate the genetic distances between populations in European nations. Unsurprisingly, they found that people within nations were more closely related to each other than to individuals from other countries (10). They also found that Europeans had more distant cousins in close nations than in their own (10). For example, a German is most likely more closely related to a randomly selected German than to a randomly selected Greek, but he likely has more distant cousins living in Poland than in Germany (10). Interestingly, the group found that the common ancestor of all Europeans is much more recent than previously thought. Based on trends in decreasing IBD block length, they found that every single European shares a common ancestor who lived approximately 1,000 years ago, meaning every person of even partial European ancestry is a descendant of any European living before that time, including many of the first noble houses, such as the

Carolingians (Charlemagne's dynasty) and the Habsburgs (10,11). However, genealogists cannot conclusively determine deeper lineage at a more distant point in time. After the fall of the Roman Empire, the pedigrees of almost all notable Roman families ceased to be updated, and the Germanic tribes that took power in most of the former Western Roman Empire did not keep detailed records of ancestry (12).

Royal Blood

The establishment of European descent from antiquity, linking the earliest medieval nobles to Roman patrician families, is an important focus of genealogy today. By establishing a clear, verified line of descent between the two time periods, genealogists would be able to establish much longer pedigrees by combining records from the two time periods. The falsification of noble pedigrees in an attempt to enhance prestige has made this task significantly more difficult. Only a few individuals have been investigated thus far, and no families have been conclusively linked to anyone living before 800 CE (12). Europe is not unique in this regard. Most other parts of the world have similar difficulties establishing long lines of descent. Few genealogists have even attempted to create an African or Native American descent from antiquity, largely because of the destruction, loss, or lack of genealogy records in these regions. There are a select few families in the world that have produced a verified record of their descent from antiquity, with the most prominent three in Asia. The Yamato Dynasty, the Imperial House of Japan, can trace its roots back to the first historical Emperor of Japan, who reigned circa 300 CE (13). There is some debate over whether he was real or legend, however. While the Yamato Dynasty claims a fairly detailed pedigree, the longest verified pedigree belongs to the male-line descendants of Confucius. It stretches 79 generations to Confucius (551-479 BCE) and even continues further past the first king of the Shang Dynasty (b. circa 1700 BCE) (14, 15).

Another intriguing group includes the descendants of Muhammad. Detailed records of the lineage of some of his descendants exist, and numerous clans and royal houses in the Arab World claim descent from Muhammad (16). However, the claimants vastly outnumber the actual descendant due to the special place afforded to Muhammad's descendants in society, where they are given the title of 'Sayyid.' This title affords them a number of privileges in Muslim society, such as prestige, specially colored turbans, and exemptions from various taxes (16). At one point, almost all of the Ottoman aristocracy claimed to be Sayyids to capitalize



Image available at http://upload.wikimedia.org/wikipedia/commons/4/46/Stammtafel_der_Karolinger.jpg

Figure 2: Carolingian family tree, found in a Bavarian monastery. Pedigrees were very important to medieval nobility, because they literally gave people the right to rule land, inherit it from others, and even allowed them to declare war to gain land that they could realistically claim as birthright.

on the myriad benefits that accompanied this lineage (16). Without genetic evidence, which members of most descendants from Muhammad are hesitant to provide, it is impossible to verify the ancestry of the millions of claimed “Sayyids” in the Arab world. Not all descendants of Muhammad are Arab, or even Muslim. In fact, there are 700 million in Europe alone. By 1000 CE, there were dozens of verified descendants of Muhammad living in Spain who interacted with the common population, which, returning to the IBD studies from before, makes them common ancestors of all Europeans (17).

However, Muhammad’s descendants are not special in this regard. This phenomenon applies to almost every historical figure from the distant past. Most distantly historical figures have numerous descendants. For example, Genghis Khan, who almost every ruler in Asia traced descent from in order to gain legitimacy, had a known mutation on one of his Y-chromosomes that 8 percent of all men of Asian descent carry today (18). However, if women and female-line descendants had a similar marker, the number would be even higher. According to Joseph Chang, Professor of Statistics at Yale University, the most recent common ancestor of all of humanity, barring completely isolated populations, is thought to have existed around 3,000 years ago, also making every single human a descendant of any ancient figure living before 1000 BCE (assuming they had offspring whose lineage survived to the present day) (19). When two people are separated by more than four degrees of kinship horizontally, they are generally considered dissimilar enough not to be related. Ancestors are still considered a part of a person’s family, but four degrees of kinship away from your ancestors is the same degree of genetic similarity to four degrees of kinship away from cousins. It is truly odd that some people will take pride in and be given some social advantages based on the actions of their great-great-grandparent (who, based on genetic similarity, they do not resemble at all), but not their third cousin, who is just as closely related. When talking about a person, it can be said that his distant lineage has absolutely no effect on him on a personal level. 

CONTACT JAMES HOWE AT JAMES.R.HOWE.VI.17@
DARTMOUTH.EDU

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Figure 3: A group of Bene Israel businessmen meeting. The Bene Israel are a community of Jews who have lived in Southern India for hundreds of years, claiming descent from a lost Tribe of Israel (20). Most Jews doubted their claims of descent, but the Bene Israel’s ancestry was eventually confirmed to be Jewish via IBD studies (20). Since their ancestry has been confirmed, many have moved to Israel.