

Assessing UK Undergraduate Students' Understanding of Genetic Ancestry Claims in the Media

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Abstract:

Genetic ancestry is a field that never fails to catch public attention. Consequently, many for-profit companies, such as direct-to-consumer testing companies, the news and media often exploit this, sometimes in exchange for scientific accuracy and validity, whether intentional or not (Kennett et al., 2018). This ranges from over-simplistic genetic interpretations to completely outlandish and false claims, sometimes reflecting more sinister political agendas (Jobling et al., 2015). This is concerning because readers often lack the background, time, and resources to filter out inaccurate claims. Despite the significance of this issue, little research has so far been conducted on understanding of genetic ancestry, with the vast majority focused either on their understanding of basic genetic concepts or on unreliable genetic media claims. In my research project, I aim to bridge this gap through a qualitative survey methodology to explore where the understanding of undergraduate students in the UK lies in genetic ancestry, and identify potential common trends, therefore highlighting how science communicators, journalists, for-profit companies, and the layperson can work together to better shape public understanding and discourse on good science. The results of the survey overall demonstrate that while most respondents had some basic understanding of genetic ancestry, this was not always sufficient to fully grasp the media claims presented. Furthermore, there was much more nuance in the responses than just whether they conformed to the hypothesised misconceptions. While it may be premature to state the implications of these findings, they represent an important starting point for possible future research on the wider public's understanding of genetic ancestry.

Methodology: The Survey

Firstly, through reviewing past media claims on genetic ancestry and identifying common themes, I formulated 5 main misconceptions surrounding genetic ancestry: that genetic ancestry testing can identify ethnic and racial identities accurately; that genealogical records can identify individuals directly descended from historical figures; that Neanderthals and humans are only weakly genetically related; that humans across the world are only weakly genetically related; and that all humans are descended from two individuals around 100,000 to 200,000 years ago.

I then formulated open-ended questions around these misconceptions using real examples of claims in the media, ranging from newspaper headlines to video clips. To avoid any bias, I removed the respective news sources, so the respondents are only presented with the bare claims. This qualitative survey was designed on the platform Qualtrics and was advertised on University College London's internal Moodle sites. The survey was open to undergraduate

students from all disciplines and faculties, with the only requirements being that they were aged 18 and above and studying in the UK. 75 students responded to the survey, and 29 completed it in full. The age range was 18 to 23 and respondents came from a range of degree courses.

Methodology: Analysis of responses

For each question, I categorized each response under 1 of 3 levels of conformity, i.e. how much it conformed to the question's corresponding hypothesised misconception. Next, for a deeper thematic analysis, I identified common themes from responses and recorded these as well as their number of mentions to pick out any patterns and trends. The following discussion integrates this raw data with the corresponding misconception. All numbers quoted from the analysis are out of a sample of 29 responses. The full analysis can be found in the supplementary materials.

Hypothesized misconception 1:

Genetic ancestry testing can tell me about my true ethnic and racial identity

Question 1

Read the testimonial below taken from a direct-to-consumer genetic ancestry testing company's website:

"I am very, very impressed." Liz Rawlings is an avid genealogist - and has been since she was 14 years old. She became interested in DNA testing as part of a community effort to explore the Flemish roots of her small village in Wales. What she discovered surprised her - instead of the French & German ancestry that she expected, she had a greater percentage of British & Irish ancestry. She even has a dash of Viking DNA, which she thinks might be the source of her daughter's red hair!

Do you think genetic ancestry testing companies are able to accurately assess whether Liz's daughter has Viking DNA? Why do you think this?

Question 2

Read the newspaper headline below:

One million Brits 'descended from Romans' One million British men may be directly descended from the Roman legions which came, saw, and conquered England and Wales almost two thousand years ago, a DNA study suggests.

In a few sentences, could you, in your own words, explain what is meant by one million Brits having descended from Romans? Genetic terminology is not required, and you can choose whether to agree or disagree with the statement, or to what extent.

People are naturally keen to learn more about their identities, particularly their ethnic and racial backgrounds. Consequently, the results and interpretations of genetic ancestry tests can often deeply impact test-takers. Unfortunately, while direct-to-consumer testing companies offering these services acknowledge the limitations of their test reports, lay consumers often do not keep these in mind and take ancestry percentages at face value, leading to sometimes exaggerated or even incorrect conclusions of one's ethnic or racial history (Bolnick et al., 2007). This is evidenced by the fact that only 2 responses to question 1 acknowledged that the claim may have been exaggerated for commercial purposes.

Genetic ancestry tests use the assumption that specific alleles or haplotypes are diagnostic of an ethnic group because they are the most common in that population. However, there is no clear connection between one's DNA and their racial or ethnic group. This is because there is high genetic diversity within human populations and gene flow between different groups, meaning that specific alleles may have been inherited from a population where it is less common (Bostanci, 2011). As expected, such nuanced understanding is rare, as shown by the fact that only 4 responses mentioned that modern-day Scandinavian DNA markers do not equate to that of Vikings and that Viking DNA is a vague term. 8 responses provided some form of genetic explanation, albeit inaccurate; however, these all conformed to the misconception, demonstrating that while respondents may have some basic understanding of genetic ancestry when applied to understanding claims in the media, this is insufficient.

Furthermore, the racial or ethnic categories used in these tests are based on present-day population labels, which likely do not coincide with historical groupings. Cultural, tribal, and national barriers are a recent phenomenon that would not have prevented groups from mixing and migrating throughout history. The relationships between race, ethnicity and geography are complex, and no genetic ancestry test can offer a comprehensive identity report. Unfortunately, as shown by the 16 responses which fully conformed to the misconception, this fact is not widely known.

As this misconception was hypothesised to be the most common, question 2 was included to provide nuance to complement the findings of question 1. 18 responses conformed to the misconception, with 7 either paraphrasing or repeating the media claim and 11 with some scientific detail. As with question 1, a minority acknowledged that the Romans as an ethnic group is vague (3); and a slightly larger number noted that 'directly descended' is likewise ambiguous (5). Possibly because this question provided more scope to display basic genetic understanding, a significant number of responses (9) used terminology such as DNA sequences/markers and single nucleotide polymorphisms/SNPs.

Overall, although in both questions 1 and 2, more than half the respondents conformed to the misconception, this thematic analysis shows that respondents do have some basic understanding of genetic ancestry. The issue, it seems, is in applying it to new situations such as those presented in these media claims.

Hypothesized misconception 2:

Based on genealogical records, I am related to this historical figure!

Question 3

Read the headline below:

Taking the Genghis Khan test

Sitting in front of a packed restaurant as someone stuck what looked like a micro toilet brush in my mouth was the undignified way I began to find out if I was related to the evil conqueror Genghis Khan. While the blood-thirsty Mongol emperor was rampaging across Central Asia and the Middle East, I was just a passing genetic thought in one of my ancestor's DNA. But that DNA could determine if I am one of the world's 17 million people that a recent study suggests are descended from the infamous Khan and his tribe. I have about six weeks before the results arrive from Oxford Ancestors, which provides DNA-based services for ancestry research. The tests are part of the burgeoning field of bioarchaeology, which uses genetics to learn about our ancient ancestors...

Imagine you are explaining this headline to someone. What would you say to them?

Claims of being a direct descendant from a notable historical figure such as a member of royalty unsurprisingly excite everyone. However, the issue is not that they are incorrect; instead, everyone else too is most likely directly descended from these individuals. For instance, any two modern Europeans have many common ancestors who lived 1000 years ago (Callaway, 2013).

The reason for this is based merely on numbers and doubling. Each generation backwards, an individual doubles their ancestors (2 parents, 4 grandparents, 8 great-grandparents, etc.). This quickly reaches the point where the number exceeds the number of humans alive at the time. This is resolved by the concept of inbreeding, where the same individual can fill multiple positions on the family tree.

If a particular individual, such as Charlemagne, Socrates or Nefertiti, was alive a sufficiently long time ago, all humans alive today will be direct descendants of them, a point called the genetic isopoint. However, the inverse is also true; all humans alive today are also directly related to many unnamed and forgotten individuals in history but nevertheless contributed to our ancestors' DNA.

As shown by the many responses conforming to the misconception (23), such knowledge is not widely known. For example, 3 responses expressed some doubt about the claim but could not

support this with any explanation, and only 1 response provided an explanation, albeit an inaccurate one. Overall, this question was answered poorly compared to the others, indicating that this misconception may also be more commonly held than hypothesised.

Hypothesized misconception 3:

Neanderthals and humans are only weakly genetically related

Question 4

Watch this video: <https://youtu.be/-soaBmX-6mo>

Do you agree or disagree, and to what extent, with what was said in the video?
Please write a few sentences explaining your thoughts.

The previously held view in the media was that Neanderthals were brutish dim savages. This largely changed, however, in 2014 when a study confirmed that all populations outside of sub-Saharan Africa inherited 1-3% of the Neanderthal genome as people realised we are much more closely related to them than previously thought. Inevitably, however, much of the public still believe our species to be genetically distant or unrelated to Neanderthals (McClusky, 2016). Genomic studies, however, have repeatedly shown that we have distinct Neanderthal ancestry coded in our DNA at specific loci (Sankararaman, 2014).

An encouraging 16 responses did not conform to the misconception, with a number supporting their answers with detailed explanations that mentioned terminology such as admixture, interbreeding, selection, and environmental pressures (5). This indicates that the derogatory views towards Neanderthals and distancing are largely outdated. However, as this question did not ask respondents to name a percentage of genetic similarity, this fact remains speculative.

Hypothesized misconception 4:

People across the world are only weakly genetically related

Question 5

Read the headline below:

Humans Are All More Closely Related Than We Commonly Think Humanity's most recent common ancestor and so-called genetic isopoint illustrate the surprising connections among our family trees.

How genetically similar do you believe you are to another person on the other side of the world? Can you estimate a percentage genetic similarity?

Different populations across the world look, behave and speak differently. Since antiquity, humans have been divided into groups of shared language, culture, and geographic area. Consequently, it seems counterintuitive that people worldwide are extremely genetically similar, 99.9% (Crow, 2002).

However, realising how genetically closely related we all are may have important implications on how we group and view each other, particularly concerning different forms of discrimination such as racism.

Just as when explaining genealogy and ancestry claims to notable historical figures, humanity's high genetic relatedness is due to inbreeding. Because the same individual occupies multiple positions in a family tree, the more generations you go back, the more likely you will have ancestors you share with anyone else alive today. As this global genetic isopoint occurred so (relatively) recently in history, no one comes from a pure lineage; we all carry sections of our DNA that can be traced to distant groups and eventually to everyone else alive today.

While 11 responses stated the figure as 99 to 99.9%, and 6 stated it to be 90 to 98%, a surprisingly large number assumed it to be 30 to 80% (9), and even one response said it to be 5 to 10%. Overall, however, it is evident that most respondents are aware of the high genetic similarity between humans but slightly underestimate this when asked to quote exact figures.

Hypothesized misconception 5:

All humans descended from two individuals 100,000 to 200,000 years ago

Question 6

Read the headline below:

All humans may be descended from just TWO people and a catastrophic event almost wiped out ALL species 100,000 years ago, study suggests

- Genetic 'bar codes' of five million animals from different species were surveyed •
- Research prompted speculation humans and animals sprang from single pair
- This may have happened after a catastrophic event after the last ice age
- The study has been misunderstood by some religious parties who interpreted it as challenging evolutionary theory, which has been denied by the authors

In a few sentences, could you, in your own words, explain what you think is meant by all humans being descended from just two individuals? Genetic terminology is not required and you can choose whether to agree or disagree with the statement, or to what extent.

Whether interpreted as Adam and Eve or not, the belief that all humans descended from two people between 100,000 and 200,000 years ago has been commonly held for centuries. A popular explanation for this is a population bottleneck, or a series of events that significantly reduce a species' population size, for example, natural disasters, disease, or competition from other species. In this case, it would have needed to be an extreme bottleneck to reduce the entire human species to just two individuals as the founding pair for the forthcoming population.

Unfortunately, this is extremely unlikely. The method used, DNA barcoding, relies on mitochondrial DNA, which is different to nuclear DNA. However, as mitochondrial DNA is only passed matrilineally, it misses out on potential insights gained from nuclear DNA (Stoeckle and Thaler, 2018).

Furthermore, a 100,000-year timespan is an extensive period to pinpoint a founding pair. The original study's authors also acknowledge that the same finding could have been due to a founding population of at least a thousand individuals that remained stable for tens of thousands of years. Still, genomic data cannot distinguish such events yet, so while the human population at the time would have been tiny, it is improbable to have been just two individuals (Stoeckle and Thaler, 2014).

Although many responses paraphrased or repeated the media claim (10), a large number did not conform to the misconception. For example, 3 expressed doubts about the claim but offered no explanation, 7 supported their doubts although inaccurately, and 5 did this accurately. Noteworthy was the surprising minority that mentioned religion (4). Over half of the respondents did not conform to the misconception, demonstrating that although the reasoning may be flawed, the general views are on the right lines.

Conclusion:

Genetic ancestry remains a topic of interest for the public and, consequently, the media. It is thus important how such science is communicated. As evidenced by the responses, there is much more nuance to the issue than just whether respondents conform to the hypothesised misconception in question. For instance, although questions 5 and 6 had the highest number of non-conforming responses (19), the answers to question 4 demonstrated a deeper understanding of genetics by mentioning specific terminology, which responses to the other questions lacked. Furthermore, the 5 misconceptions represent only a small sample of potential topics to investigate within genetic ancestry.

While the findings only represent the views of UK undergraduate students and a small sample size, this study is important in igniting the conversation in this otherwise overlooked area of science communication and journalism. Genetic ancestry can sometimes be a sensitive topic, the interpretations of which can potentially impact on many social and political issues, especially those concerning identity; therefore, it is a long overdue conversation worth having.

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