A new take on the 19th-century skull collection of Samuel Morton

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In the 1830s and 1840s, American craniologist Samuel Morton collected and measured hundreds of human skulls in what he described as an attempt to compare the brain size of five human racial groups. At nearly the same time, across the world, German anatomist Friedrich Tiedemann was conducting similar research.

The scientists produced nearly equivalent results, but what they inferred from those findings differed drastically: Tiedemann used his to fight for equality and the abolition of slavery, and against the idea that different races were created separately. Morton's research was used to maintain the status quo in the United States, which, at that time, meant racial division, hierarchy, and slavery.

Though the work happened almost 180 years ago, it still elicits debate, particularly over the concept of scientific racism and bias. A paper published in *PLOS Biology* from University of Pennsylvania doctoral candidate Paul Wolff Mitchell adds to the conversation, through analysis of never-before analyzed, handwritten cranial measurements he unearthed in Morton's archives.

Mitchell determined that while Morton's data-collection methods produced accurate numbers and were likely not intentionally biased, the scientist's conclusions—that Caucasians had the largest skull size and therefore, the highest intelligence and that Africans had the smallest skull size and lowest intelligence—blatantly were. They also point to the importance of scientific interpretation.

"Morton and Tiedemann both thought the bigger and more complex the brain, the more superior the individual or species," Mitchell says. It was a belief held by many scientists at the time, although one that modern science has disproven. "Beyond that, more than just the data were informing their scientific positions," he adds. "Political and ethical considerations were, too."

"It's a complex story," Mitchell says, one that requires walking through Morton's process and what followed to fully grasp its intricacy.

Morton's scientific path

Morton, a native Philadelphian, physician, and naturalist, recognized as the first physical anthropologist, began collecting human skulls in the early 1800s. Though he didn't travel much himself, his role as president of the Academy of Natural Sciences afforded him the opportunity to correspond with scientists around the world to secure samples.

He aimed to gather sufficient numbers from each of the five racial groups he recognized: Ethiopian (or African), Native American, Caucasian, Malay, and Mongolian. In total, he amassed around 900 skulls, the largest academic collection at the time, and one that remained so for half a century after his death. Today, the Morton Collection is stored and curated in the Physical Anthropology Section of the Penn Museum.

Initially, Morton measured the size of 256 skulls by pouring white pepper seed into each cavity, then gauging in cubic inches the volume of seed needed to fill a sample. From that work, he published Crania America in 1839, which reported statistics from every Native American skull and averages for the other groups. The next year, he published the first of three skull catalogues, and then a book called Crania Aegpytiaca and the second catalogue came in 1844.

In trying to replicate his seed measurements, Morton had difficulty so he switched to lead shot and went through the measurement process again, now with 672 skulls. "He came to basically the same conclusion as before," Mitchell explains, "with Caucasians having the biggest brain size and Africans the smallest." In 1849, Morton published a third and final catalogue with cranial data based on the lead-shot measurements of every individual skull.

He died just two years later, at the time considered a preeminent expert in his field. Until, that is, Charles Darwin published On the Origin of Species and the United States fought the Civil War.

Seeing something new

For more than a century following those two events, Morton's science fell into obscurity, his methods modernized and surpassed, his theories debunked. Then in 1978, American scientist Stephen Jay Gould wrote several texts about scientific racism, the idea that scientific findings might justify continued discrimination and intolerance. He used Morton's skull studies as a prime example.

"Gould notices that the average for the Africans between the seed measurements and shot measurements increases a lot, but the average for the measurements of the Caucasians only increases a little, about the same amount that the measures for the Native Americans do," Mitchell says. "This leads Gould to conclude that Morton was unconsciously underestimating brain size for the Africans."

Because of the seeds' compressible nature, Gould suggested skulls could be inadvertently overstuffed or lightly packed, producing inaccurate numbers. Morton had unconsciously done so, Gould surmised, packing seeds into Caucasian skulls and only lightly filling African skulls, leading to systematic underestimations of African cranial capacity.

Unbeknownst to Gould, however, he didn't have all the facts, namely the full seed data Morton never published—data that Mitchell rediscovered in the scientist's archives at the Academy of Natural Sciences.

"I was looking through Morton's old catalogue of skulls. He had printed three copies throughout his life to advertise to other scientists and collectors what he had in his collection," says Mitchell. "He also kept personal copies, which he signed and dated. The first copy was from 1840."

That first edition didn't include printed brain size like the latter two did, but in Morton's personal copy, Mitchell noticed handwritten measurements accompanying many entries, some scratched out and rewritten. He also realized that the brain measurements from the 1840 and 1849 catalogues differed, leading him to conclude that those jotted down represented previously unseen seed measurements.

Having worked with the Morton skulls since 2010, under the tutelage of Janet Monge, curator in charge of the Penn Museum's Physical Anthropology section and a Penn adjunct professor of anthropology, Mitchell had an intimate relationship with the collection. "I know those skulls well," he says. "When I looked at what Morton had written down, I said, 'Something's not right here. That's not the measurement he gives later.' It was due to a great deal of familiarity with the skulls that I could see something new in these documents."

What does it all mean?

For Mitchell, viewing the entries for the original seed measurements rather than the averages for four out of the five of Morton's racial classifications shifts the conversation about these skulls. Mitchell's analysis confirmed that Morton's measurements were accurate; the seed and shot measurement averages differed because of different overall

sample sizes.

But, he points out, that finding almost doesn't matter.

"Just because Morton's data were not biased doesn't mean his science wasn't," Mitchell says. "He can measure skulls very accurately but also be a biased scientist." Simply look at Tiedemann, he says. "The German scientist basically does the same thing Morton does but comes to a dramatically different conclusion."

Through his work, Tiedemann noticed a range of skull sizes among all humans. Morton, on the other hand, focused on brain-size averages of different races. Although Morton's numbers overlap across races, and although taking the averages of Tiedemann's data—which he himself never did—reveal an almost perfect match to Morton's, the interpretive differences of the two scientists supported their divergent conclusions.

With respect to today's science, the biggest fault in Morton's research may lie in that he didn't collect data on body size, Mitchell says. Brain size correlates to body size, and brain and body size are well known adaptions to the climate in which people live. That means from an evolutionary perspective, there's no reason to suppose a link between cranial size and intelligence.

"If you just collect heads from all over the globe and you don't take body size into account, there is no meaningful way to compare your data," Mitchell says. "People with bigger bodies have bigger brains."

The other issue with Morton's research, he notes, is that the racial categories he supposes have no biological basis. Which all leads Mitchell to question what, in the end, Morton's data can really teach.

"When dealing with moral and political questions, interpretation is a key

part of how the science gets done," Mitchell concludes. "That will always have an element of bias. The only way to get around it is to have the open presentation of data, scrutiny of scientific work, and a diverse community of people working on and thinking about these issues."

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