

## Neanderthal genome gives UCSC researcher a glimpse into humans

By Megha Satyanarayana Santa Cruz Sentinel

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SANTA CRUZ -- Our ancestors likely mated with Neanderthals, according to a study led by a UC Santa Cruz research comparing the genes of humans and Neanderthals.

Scientists say the findings will help define what it means to be human.

UCSC researcher Richard Green, assistant professor of biomedical engineering, led an international team of scientists that fished crumbly DNA from three 40,000-year-old Neanderthal bones found in Croatia, separated the tiny Neanderthal amount from the abundant DNA of scavenging bacteria and read the 4 billion pieces of Neanderthal chemical sequence.

Then, by comparing the DNA to human and chimpanzee DNA, to which it is mostly indistinguishable, the team was able to find tiny differences in genes related to complex thought, metabolism and body shape, among others.

Subtle genetic changes in cognitive genes may have given humans our social selves, with the ability to respond to emotions, facial expressions, body language and behavior.

"We thought we'd get a list of these boring things," Green said. "But brain function and behavior -- it felt like we really hit a home run."

One of the genes the researchers discovered is associated with diabetes and others with autism, which Green said may be related to the ability to socialize.

Neanderthals are humanoid beings that came into the fossil record about 400,000 years ago, whereas humans date back to about 200,000 years. Both likely evolved from chimpanzees between 5 million and 7 million years ago.

Neanderthals are structurally different from humans, said Adrienne Zihlman, UCSC professor of anthropology, although they used tools.

Common theory is that Neanderthals were mostly in Europe and Western Asia, and humans were found in Africa, fueling the debate as to whether Neanderthals were their own species or a subspecies of Homo sapiens, she said. Evidence suggests humans and Neanderthals split off the family tree some 350,000 years ago, and researchers believe humans and Neanderthals crossed paths in the Middle East about 80,000 years ago.

This crossing of paths may have led to a small amount of interbreeding, as Green found Neanderthal sequences in the DNA of modern humans from China and Papua New Guinea, even though it's likely Neanderthals never lived in either place. Green also found up to 4 percent of Eurasian individuals have stretches of DNA more related to Neanderthals than other humans. And the research team found no human stretches of DNA in Neanderthals, suggesting that the flow of genetic information went forward, from Neanderthals to humans, and not vice versa.

His is one of two Neanderthal studies published Thursday in Science.

Zihlman lauded the research as a possible gold mine of information.

"The profession is very excited about the work. It's a new adventure and a new frontier," she said. "It's just given us a whole different way of looking at things."

She said the genetic information will bolster interpretations about Neanderthal life, and what was unique about it. It may even help answer how Neanderthals died, whether it was fast or slow, or whether they just blended in with humans over the years.

But the frontier isn't just genetics, said David DeGusta, assistant professor of anthropology at Stanford University.

He said the genome analysis was exciting, but Green's work, coupled with continued fossil and geological research, will paint a better picture of culture -- how Neanderthals interacted with themselves and with humans. He said the goal is to define the "finishing touches, the last steps to being us."

"Genetics doesn't give the whole story. Behavior, what they did with their biology -- it's the fossils and tools which help answer the question of who we are," he said.

What is a neanderthal?

Neanderthals are humanoids that lived between 400,000 and 30,000 years ago, and overlapped with Homo sapiens, leading some researchers to believe the two interbred.

Both humans and Neanderthals are related to a common ancestor that split off from chimpanzees some 5 million to 7 million years ago.

The first Neanderthal skulls were discovered in the early 19th century in Belgium. Subsequent study of skeletons found Neanderthals were likely about the same size as humans, but stronger, with a sloped forehead, and their children may have developed faster than human children. Some scientists believe a long childhood lent itself to learning language and other skills that may have helped humans survive.

One of the big questions is how Neanderthals became extinct. Theories include being outcompeted by humans or blending in with humans.