

Modern humans are the evolutionary product of different ancestral populations

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Recently published research is calling into question our current understanding of the pattern of human evolution. Accumulating data, including a growing sample of ancient DNA, is increasingly revealing that a small but not negligible amount of gene flow between regionally dispersed ancient human populations. These, including anatomically modern humans from Africa, Neanderthals in Europe and west Asia and Denisovans in east Asia, had previously been interpreted as distinct species within the genus *Homo*, based on comparisons of physical characteristics of fossilized, often fragmentary bones.

The new data indicates they now appear to represent regionally diverse populations which, although physically somewhat distinct, nevertheless remained members of a single species and, therefore, members of different groups were able to mate with each other and produce viable, reproductively capable offspring, based on the persistence of genetic markers from distinct ancestral populations in the modern genome.

The previously dominant interpretation of human evolution viewed it as roughly resembling a tree, with many branches spreading out from a single trunk, that being the Australopithecines. According to this model, most of the branches were dead ends, eventually going extinct, either through failure to adapt to their local environments or being “outcompeted” by more advanced populations due to superior technology and/or social organization. According to this theory, only one branch, originating in Africa, ultimately evolved into modern *Homo sapiens*. A key basis of this model rested on the classical definition of what constitutes as species—genetic isolation.

Members of different species are genetically incompatible. Some can mate with each other but cannot produce sexually viable offspring. A classic example is the mule—the product of a mating between a horse and a donkey. The resulting individual can grow to adulthood

but is incapable of reproduction. Therefore, there is no gene flow between horses and donkeys and the two species progress along separate evolutionary trajectories, adapting to distinct selective pressures, possibly resulting in extinction.

There is no way to conclusively determine whether fossilized remains represent members of a single species or not. Paleontologists and paleoanthropologists must rely on the physical characteristics of the available sample of fossils. When the differences are pronounced, the interpretations are relatively clear. However, when dealing with fossils similar in appearance, the distinction between closely related species becomes more difficult, especially when the remains are few and fragmentary. For example, some species are extremely sexually dimorphic—males and females have distinctly differing body sizes and builds. Without the ability to examine living individuals, differentiating between the sexes may be difficult.

A similar difficulty arises from the inability to gauge the range of physical variation within a species regarding size and robustness of either sex. Recovered fossilized remains represent only a small proportion of the individual members of a species at any given time and even more so when a time scale of thousands of years is involved. The available sample may be too small to support robust interpretation.

The ability to recover and analyze DNA from some fossils provides another tool in assessing the relationships among the growing yet still quite limited available sample of human fossils. Fossilized remains of ancient *Homo sapiens* are relatively abundant, that of other groups less so. Newly recovered physical and genetic material is providing an increasingly detailed view of human evolution (see “Scientific study sheds new light on human evolution”). Several distinct populations, some of which are not known from the fossil record, appear to have

contributed to the modern human genome.

Discovery of the fingerbone of a tiny hominin (members of the genus *Homo* and its ancestors) during excavations in 2008 at Denisova Cave in southern Siberia, Russia, when subjected to DNA analysis, revealed that it contained some material not closely related to any known human group, including Neanderthals and *Homo sapiens*. This newly identified group was given the name “Denisovans.” Subsequent investigations have shed more light on this previously unknown hominin lineage.

Most recently, an article in the scientific journal *Nature* (“Who were the Denisovans? Rich trove of fossils and tools paints new picture” Dyani Lewis, September 9, 2026) adds important new knowledge about their culture and geographic distribution.

The data comes from excavations in an abandoned quarry in southwestern China. This study reports that Denisovans were accomplished hunters. The investigation found that Denisovans produced bone tools similar to those of Neanderthals as well as several kinds of stone tools, including scrapers and choppers. Animal bones found at the site show evidence of butchery and marrow extraction. The site was occupied by Denisovans for at least 30,000 years and possibly as long as 120,000 years.

Furthermore, it was discovered that:

present-day people living on the islands of New Guinea and Bougainville in the southwestern Pacific Ocean have inherited 4–6% of their DNA from Denisovans, despite the fact that these islands are roughly 8,500 kilometres from Denisova Cave.

Denisovan DNA is now known to be widespread in people from southeast Asia, including Papua New Guinea. A 2014 genetic study found that modern Tibetans have inherited a Denisovan genetic variant that helps them cope with the low oxygen levels found at high elevations.

It has also been recently revealed that a small percentage of Neanderthal genetic material is found in contemporary world populations outside of Africa due to matings between members of these two groups. Far from being the brutish dullards characterized in early research due to their more robust bodies, as compared to the modern humans who migrated from Africa, archaeological investigations have demonstrated that Neanderthals had a sophisticated culture, not markedly inferior that of the African immigrants.

The interbreeding among several related prehistoric populations now encompassed under the genus *Homo* is now extensively documented. A study published in 2018 reported that a sliver of bone found in the Denisova cave

came from a first-generation girl resulting from a mating between a Neanderthal mother and a Denisovan father.

The picture emerging from an accumulating body of data indicates that, rather than being “tree-like,” with many separating branches, human evolution has more closely resembled a network of geographically dispersed populations repeatedly splitting and reconnecting over hundreds of thousands of years. The key to this pattern is found in humans’ increasing reliance on cultural rather than purely physical methods of adaptation.

In non-human animals, plants and other living creatures, geographic separation means two things—reduced gene flow between different populations of a species and a differing environment which produces distinct selective pressures. Over time, differences mount, ultimately leading to speciation—a condition in which the geographically separate populations become so genetically distinct that they can no longer mate and produce offspring that are unable in turn to mate and produce sexually functional progeny.

Over time humans and their ancestors came increasingly to rely on cultural rather than purely physical adaptation to the selective pressures of differing natural environments. That is knowledge transferable intellectually rather than by genetics, thus reducing the tendency toward speciation and permitting increasing genetic continuity even over significant temporal and spatial separation. As a result, when members of long-separated human groups once more came into contact with each other, successful mating and therefore gene flow was possible.

Over time, the exchange of cultural traditions, evolved in different environments and social contexts, have melded and thereby enhanced our ability to deal with changing conditions.



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