Scientists revise timeline of human origins

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Between 2.1 and 1.8 million years ago, the oldest known species of the human genus, Homo, exhibited diverse traits. These species include the 1470 Group and the 1813 Group, based on the Kenyan fossils KNM-ER 1470 (left) and KNM-ER 1813 (second from left), respectively. By 1.8 to 1.9 million years ago, the species Homo erectus had evolved in Africa and started to spread to Eurasia. Early populations of this long-lived species are represented by the Kenyan fossil KNMER 3733 (right) and the Georgian fossil Dmanisi Skull 5 (second from right). The three lineages -- the 1470 group, the 1813 group, and Homo erectus -- overlapped in time for several hundred thousand years. The Kenyan fossils, from the site of Koobi Fora in the Lake Turkana region of Kenya, are housed in the National Museums of Kenya. Fossils from Dmanisi are housed in the

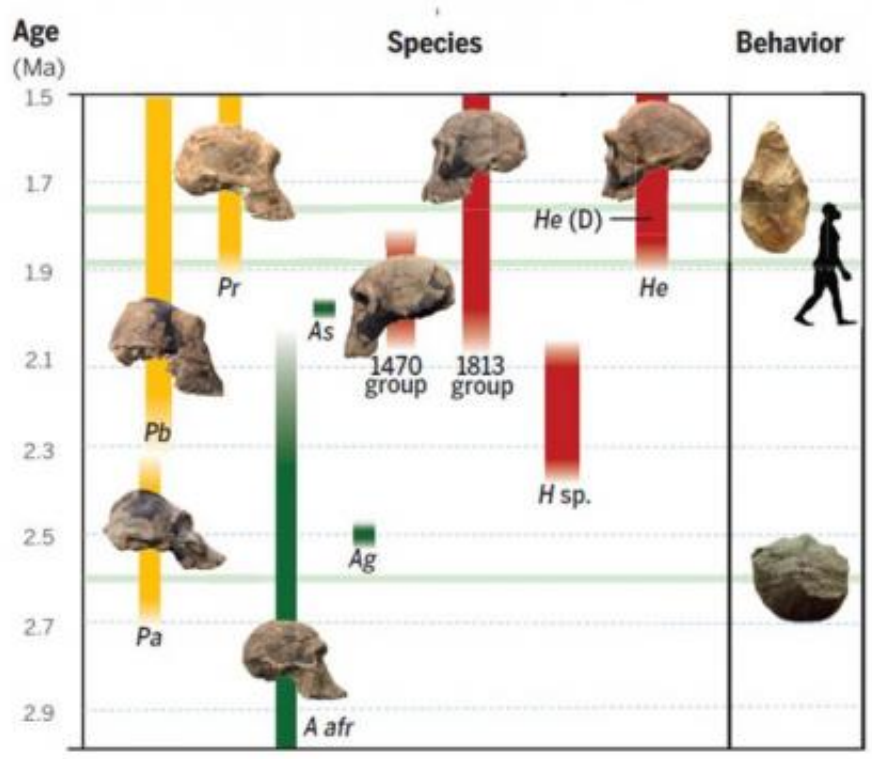
Georgian National Museum. Credit: Kenyan fossil casts – Chip Clark, Smithsonian Human Origins Program; Dmanisi Skull 5 – Guram Bumbiashvili, Georgian National Museum

Many traits unique to humans were long thought to have originated in the genus *Homo* between 2.4 and 1.8 million years ago in Africa. Although scientists have recognized these characteristics for decades, they are reconsidering the true evolutionary factors that drove them.

A large brain, long legs, the ability to craft tools and prolonged maturation periods were all thought to have evolved together at the start of the *Homo* lineage as African grasslands expanded and Earth's climate became cooler and drier. However, new climate and fossil evidence analyzed by a team of researchers, including Smithsonian paleoanthropologist Richard Potts, Susan Antón, professor of anthropology at New York University, and Leslie Aiello, president of the Wenner-Gren Foundation for Anthropological Research, suggests that these traits did not arise as a single package. Rather, several key ingredients once thought to define *Homo* evolved in earlier Australopithecus ancestors between 3 and 4 million years ago, while others emerged significantly later.

The team's research takes an innovative approach to integrating paleoclimate data, new fossils and understandings of the genus *Homo*, archaeological remains and biological studies of a wide range of mammals (including humans). The synthesis of these data led the team to conclude that the ability of early humans to adjust to changing conditions ultimately enabled the earliest species of *Homo* to vary, survive and begin spreading from Africa to Eurasia 1.85 million years ago. Additional information about this study is available in the July 4 issue of *Science*.

Potts developed a new climate framework for East African human evolution that depicts most of the era from 2.5 million to 1.5 million years ago as a time of strong climate instability and shifting intensity of annual wet and dry seasons. This framework, which is based on Earth's astronomical cycles, provides the basis for some of the paper's key findings, and it suggests that multiple coexisting species of *Homo* that overlapped geographically emerged in highly changing environments.



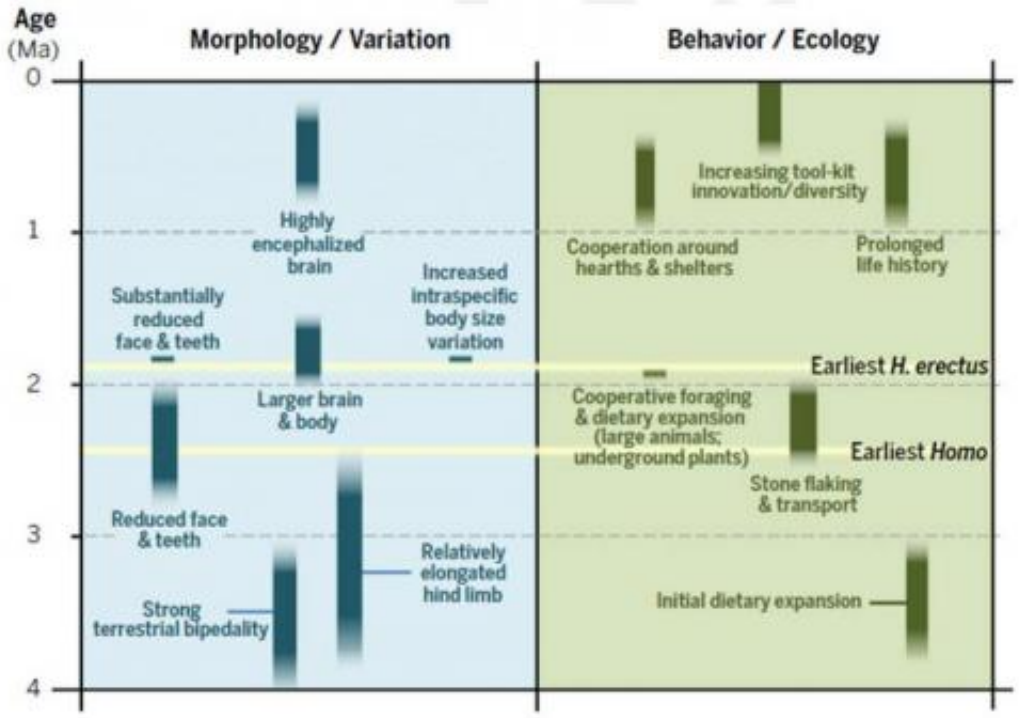
Hominin evolution from 3.0 to 1.5 Ma. Green: Australopithecus, Yellow: Paranthropus, Red: Homo. The icons indicate from the bottom the first appearance of stone tools at ~2.6 Ma, the dispersal of Homo to Eurasia at ~1.85 Ma, and the appearance of the Acheulean technology at ~1.76 Ma. The number of contemporaneous hominin taxa during this period reflects different strategies of adaptation to habitat variability. The cultural milestones do not correlate with the known first appearances of any of the currently recognized Homo taxa. Credit: Antón et al., *Science*, 2014

"Unstable climate conditions favored the evolution of the roots of human flexibility in our ancestors," said Potts, curator of anthropology and director of the Human Origins Program at the Smithsonian's National Museum of Natural History. "The narrative of human evolution that arises from our analyses stresses the importance of adaptability to changing environments, rather than adaptation to any one environment, in the early success of the genus *Homo*."

The team reviewed the entire body of fossil evidence relevant to the origin of *Homo* to better understand how the human genus evolved. For example, five skulls about 1.8 million years old from the site of Dmanisi, Republic of Georgia, show variations in traits typically seen in African *H. erectus* but differ from defining traits of other species of early *Homo* known only in Africa. Recently discovered skeletons of Australopithecus sediba (about 1.98 million years old) from Malapa, South Africa, also include some *Homo*-like features in its teeth and hands, while displaying unique, non-*Homo* traits in its skull and feet. Comparison of these fossils with the rich fossil record of East Africa indicates that the early diversification of the genus *Homo* was a period of morphological experimentation. Multiple species of *Homo* lived concurrently.

"We can tell the species apart based on differences in the shape of their skulls, especially their face and jaws, but not on the basis of size," said Antón. "The differences in their skulls suggest early *Homo* divvied up the environment, each utilizing a slightly different strategy to survive."

Even though all of the *Homo* species had overlapping body, brain and tooth sizes, they also had larger brains and bodies than their likely ancestors, Australopithecus. According to the study, these differences and similarities show that the human package of traits evolved separately and at different times in the past rather than all together.



Evolutionary timeline of important anatomical, behavioral and life history characteristics that were once thought to be associated with the origin of the genus Homo or earliest H. erectus. Credit: Antón et al., *Science* 2014

In addition to studying climate and fossil data, the team also reviewed evidence from ancient stone tools, isotopes found in teeth and cut marks found on animal bones in East Africa.

"Taken together, these data suggest that species of early *Homo* were more flexible in their dietary choices than other species," said Aiello. "Their flexible diet—probably containing meat—was aided by stone tool-assisted foraging that allowed our ancestors to exploit a range of resources."

The team concluded that this flexibility likely enhanced the ability of human ancestors to successfully adapt to unstable environments and disperse from Africa. This flexibility continues to be a hallmark of human biology today, and one that ultimately underpins the ability to occupy diverse habitats throughout the world. Future research on new fossil and archaeological finds will need to focus on identifying specific adaptive features that originated with early *Homo*, which will yield a deeper understanding of human evolution.

More information: Evolution of early Homo: an integrated biological perspective, by S.C. Antón et al. *Science*, 2014. www.sciencemag.org/lookup/doi/ … 1126/science.1236828

Provided by Smithsonian