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# Origins of Modern Humans: Multiregional or Out of Africa?

Donald Johanson

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## articlehighlights

There are two theories about the origin of modern humans: 1) they arose in one place — Africa and 2) pre-modern humans migrated from Africa to become modern humans in other parts of the world. Most evidence points to the first theory because:

- fossils of modern-like humans are found in Africa
- stone tools and other artifacts support African origin
- DNA studies suggest a founding population in Africa
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Around 30,000 years ago humans were anatomically and behaviorally similar throughout the world.



Lucy is the common name of an *Australopithecus afarensis* specimen discovered in 1974 in Ethiopia. Lucy is estimated to have lived 3.2 million years ago. Cleveland Natural History Museum, photo by Andrew.

One of the most hotly debated issues in paleoanthropology (the study of human origins) focuses on the origins of modern humans, *Homo sapiens*.<sup>9,10,3,6,13,15,14</sup> Roughly 100,000 years ago, the Old World was occupied by a morphologically diverse group of hominids. In Africa and the Middle East there was *Homo sapiens*; in Asia, *Homo erectus*; and in Europe, *Homo neanderthalensis*. However, by 30,000 years ago this taxonomic diversity vanished and humans everywhere had evolved into the anatomically and behaviorally modern form. The nature of this transformation is the focus of great deliberation between two schools of thought: one that stresses multiregional continuity and the other that suggests a single origin for modern humans.

## Understanding the issue

Multiregional theory: *homo erectus* left Africa 2 mya to become *homo sapiens* in different parts of the world.

The **Multiregional Continuity Model**<sup>15</sup> contends that after *Homo erectus* left Africa and dispersed into other portions of the Old World, regional populations slowly evolved into modern humans. This model contains the following components:

- some level of gene flow between geographically separated populations prevented speciation, after the dispersal
- all living humans derive from the species *Homo erectus* that left Africa nearly two million-years-ago
- natural selection in regional populations, ever since their original dispersal, is responsible for the regional variants (sometimes called races) we see today

- the emergence of *Homo sapiens* was not restricted to any one area, but was a phenomenon that occurred throughout the entire geographic range where humans lived

In contrast, the **Out of Africa Model**<sup>13</sup> asserts that modern humans evolved relatively recently in Africa, migrated into Eurasia and replaced all populations which had descended from *Homo erectus*. Critical to this model are the following tenets:

Out of Africa theory: homo sapiens arose in Africa and migrated to other parts of the world to replace other hominid species, including homo erectus.

- after *Homo erectus* migrated out of Africa the different populations became reproductively isolated, evolving independently, and in some cases like the Neanderthals, into separate species
- *Homo sapiens* arose in one place, probably Africa (geographically this includes the Middle East)
- *Homo sapiens* ultimately migrated out of Africa and replaced all other human populations, without interbreeding
- modern human variation is a relatively recent phenomenon

The multiregional view posits that genes from all human populations of the Old World flowed between different regions and by mixing together, contributed to what we see today as fully modern humans. The replacement hypothesis suggests that the genes in fully modern humans all came out of Africa. As these peoples migrated they replaced all other human populations with little or no interbreeding.

To understand this controversy, the anatomical, archaeological, and genetic evidence needs to be evaluated.

## **Anatomical evidence**

Sometime prior to 1 million years ago early hominids, sometimes referred to as *Homo ergaster*, exited Africa and dispersed into other parts of the Old World. Living in disparate geographical areas their morphology became diversified through the processes of genetic drift and natural selection.

- In Asia these hominids evolved into Peking Man and Java Man, collectively referred to as *Homo erectus*.
- In Europe and western Asia they evolved into the Neanderthals.

Neanderthals lived in quasi isolation in Europe during a long, relatively cool period that even included glaciations. Neanderthals are distinguished by a unique set of anatomical features, including:

- a large, long, low cranial vault with a well-developed double-arched browridge
- a massive facial skeleton with a very projecting mid-face, backward sloping cheeks, and large nasal aperture, with large nasal sinuses

- an oddly shaped occipital region of the skull with a bulge or bun
- molars with enlarged pulp chambers, and large, often very heavily worn incisors
- a mandible lacking a chin and possessing a large gap behind the last molar
- a massive thorax, and relatively short forearms and lower legs
- although short in stature they possessed robustly built skeletons with thick walled limb bones
- long clavicles and very wide scapulas

*Homo sapiens* is a separate species from Neanderthals and other hominids

By 130,000 years ago, following a prolonged period of independent evolution in Europe, Neanderthals were so anatomically distinct that they are best classified as a separate species — *Homo neanderthalensis*. This is a classic example of geographic isolation leading to a speciation event.

In contrast, at roughly the same time, in Africa, a body plan essentially like our own had appeared. While these early *Homo sapiens* were anatomically modern they were not behaviorally modern. It is significant that modern anatomy evolved prior to modern behavior. These early *sapiens* were characterized by:

- a cranial vault with a vertical forehead, rounded occipital and reduced brow ridge
- a reduced facial skeleton lacking a projecting mid-face
- a lower jaw sporting a chin
- a more modern, less robustly built skeleton

Hence, the anatomical and paleogeographic evidence suggests that Neanderthals and early modern humans had been isolated from one another and were evolving separately into two distinct species.

## **Archaeological evidence**

Very interestingly, while Neanderthals and early *Homo sapiens* were distinguished from one another by a suite of obvious anatomical features, archaeologically they were very similar. Hominids of the Middle Stone Age of Africa (*H. sapiens*) and their contemporary Middle Paleolithic Neanderthals of Europe had artifact assemblages characterized as follows:

- little variation in stone tool types, with a preponderance of flake tools that are difficult to sort into discrete categories
- over long periods of time and wide geographical distances there was general similarity in tool kits
- a virtual lack of tools fashioned out of bone, antler or ivory
- burials lacked grave goods and signs of ritual or ceremony
- hunting was usually limited to less dangerous species and evidence for fishing is absent
- population densities were apparently low
- no evidence of living structures exist and fireplaces are rudimentary

Homo sapiens exhibited technological skills around 50,000 years ago.

- evidence for art or decoration is also lacking

The archaeological picture changed dramatically around 40-50,000 years ago with the appearance of behaviorally modern humans. This was an abrupt and dramatic change in subsistence patterns, tools and symbolic expression. The stunning change in cultural adaptation was not merely a quantitative one, but one that represented a significant departure from all earlier human behavior, reflecting a major qualitative transformation. It was literally a “creative explosion” which exhibited the “technological ingenuity, social formations, and ideological complexity of historic hunter-gatherers.”<sup>7</sup> This human revolution is precisely what made us who we are today.

The appearance of fully modern behavior apparently occurred in Africa earlier than anywhere else in the Old World, but spread very quickly, due to population movements into other geographical regions. The Upper Paleolithic lifestyle, as it was called, was based essentially on hunting and gathering. So successful was this cultural adaptation that until roughly 11,000 years ago, hominids worldwide were subsisting essentially as hunter-gatherers.

In the Upper Paleolithic of Eurasia, or the Late Stone Age as it is called in Africa, the archaeological signature stands in strong contrast to that of the Middle Paleolithic/Middle Stone Age. It was characterized by significant innovation:

- a remarkable diversity in stone tool types
- tool types showed significant change over time and space
- artifacts were regularly fashioned out of bone, antler and ivory, in addition to stone
- stone artifacts were made primarily on blades and were easily classified into discrete categories, presumably reflecting specialized use
- burials were accompanied by ritual or ceremony and contained a rich diversity of grave goods
- living structures and well-designed fireplaces were constructed
- hunting of dangerous animal species and fishing occurred regularly higher population densities
- abundant and elaborate art as well as items of personal adornment were widespread
- raw materials such as flint and shells were traded over some distances

*Homo sapiens* of the Upper Paleolithic/Late Stone Age was quintessentially modern in appearance and behavior. Precisely how this transformation occurred is not well understood, but it apparently was restricted to *Homo sapiens* and did not occur in Neanderthals. Some archaeologists invoke a behavioral explanation for the change. For example, Soffer<sup>11</sup> suggests that changes in social relations, such as development of the nuclear family, played a key role in bringing about the transformation.

Social or biological changes may account for “smarter” hominids.

Klein<sup>7</sup>, on the other hand, proffers the notion that it was probably a biological change brought about by mutations that played the key role in the emergence of behaviorally modern humans. His biologically based explanation implies that a major neural reorganization of the brain resulted in a significant enhancement in the manner in which the brain processed information. This is a difficult hypothesis to test since brains do not fossilize. But it is significant that no changes are seen in the shape of the skulls between earlier and later *Homo sapiens*. It can only be surmised from the archaeological record, which contains abundant evidence for ritual and art, that these Upper Paleolithic/Late Stone Age peoples possessed language abilities equivalent to our own. For many anthropologists this represents the final evolutionary leap to full modernity.

Shortly after fully modern humans entered Europe, roughly 40,000 years ago, the Neanderthals began a fairly rapid decline, culminating in their disappearance roughly 30,000 years ago. Neanderthals were apparently no match for the technologically advanced fully modern humans who invaded Europe and evidence for interbreeding of these two types of hominids is equivocal.

## Genetic evidence

Investigation of the patterns of genetic variation in modern human populations supports the view that the origin of *Homo sapiens* is the result of a recent event that is consistent with the Out of Africa Model.

- Studies of contemporary DNA, especially mitochondrial DNA (mtDNA) which occurs only in the cellular organelles called mitochondria, reveal that humans are astonishingly homogeneous, with relatively little genetic variation.<sup>1,5</sup>
- The high degree of similarity between human populations stands in strong contrast to the condition seen in our closest living relatives, the chimpanzees.<sup>2</sup> In fact, there is significantly more genetic variation between two individual chimpanzees drawn from the same population than there is between two humans drawn randomly from a single population. Furthermore, genetic variation between populations of chimpanzees is enormously greater than differences between European, Asian and African human populations.

Africans display higher genetic variation than other populations, supporting the idea that they were the first modern humans.

- In support of an African origin for *Homo sapiens* the work of Cann and Wilson<sup>1</sup> has demonstrated that the highest level of genetic variation in mtDNA occurs in African populations. This implies that *Homo sapiens* arose first in Africa and has therefore had a longer period of time to accumulate genetic diversity. Using the genetic distance between African populations and others as a measure of time, they furthermore suggested that *Homo sapiens* arose between 100,000 and 400,000 years ago in Africa.
- The low amount of genetic variation in modern human populations suggests that our origins may reflect a relatively small founding population for *Homo sapiens*. Analysis of mtDNA by Rogers and Harpending<sup>12</sup> supports the view that a small population of *Homo sapiens*, numbering perhaps only 10,000 to 50,000 people, left Africa somewhere between 50,000 and 100,000 years ago.

- Scientists recently succeeded in extracting DNA from several Neanderthal skeletons.<sup>8</sup> After careful analysis of particularly the mtDNA, but now also some nuclear DNA, it is apparent that Neanderthal DNA is very distinct from our own. In assessing the degree of difference between DNA in Neanderthals and modern humans, the authors suggest that these two lineages have been separated for more than 400,000 years.

Although in its infancy, such genetic studies support the view that Neanderthals did not interbreed with *Homo sapiens* who migrated into Europe. It is, therefore, highly likely that modern humans do not carry Neanderthal genes in their DNA.

### **Additional considerations**

The chronology in the Middle East does not support the Multiregional Model where Neanderthals and anatomically modern humans overlapped for a long period of time.

- Cave sites in Israel, most notably Qafzeh and Skhul date to nearly 100,000 years and contain skeletons of anatomically modern humans. Furthermore, Neanderthal remains are known from sites such as the 110,000-year-old Tabun cave, which predates the earliest *Homo sapiens* by about 10,000 years in the region.

Neanderthals and modern humans coexisted in some parts of the world for thousands of years.

- The presence of Neanderthals at two other caves in Israel, Amud and Kebara, dated to roughly 55,000 years means that Neanderthals and *Homo sapiens* overlapped in this region for at least 55,000 years. Therefore, if *Homo sapiens* were in this region for some 55,000 years prior to the disappearance of the Neanderthals, there is no reason to assume that Neanderthals evolved into modern humans.
- Archaeological evidence from Europe suggests that Neanderthals may have survived in the Iberian Peninsula until perhaps as recently as 30,000 to 35,000 years ago. Fully modern humans first appear in Europe at around 35,000-40,000 years ago, bringing with them an Upper Paleolithic tool tradition referred to as the Aurignacian. Hence, Neanderthals and fully modern humans may have overlapped for as much as 10,000 years in Europe. Again, with fully modern humans on the scene, it is not necessary to have Neanderthals evolve into modern humans, further bolstering the view that humans replaced Neanderthals.

Neanderthals probably did not breed with modern humans but they borrowed some of their tools and skills

- The situation in southern France is, however, not quite as clear. Here, at several sites, dating to roughly 40,000 years there is evidence of an archaeological industry called the Châtelperronian that contains elements of Middle and Upper Paleolithic artifacts. Hominids from these sites are clearly Neanderthals, sparking speculation that the Châtelperronian is an example of Neanderthals mimicking the culture of modern humans. The lack of anatomical intermediates at these sites, suggests that if Neanderthals did encounter and borrow some technology from *Homo sapiens*, they did not interbreed.

- A potential 24,500-year-old Neanderthal/*sapiens* hybrid was announced from the site of Lagar Velho, Portugal.<sup>4</sup> This 4-year-old has a short, squat body like a Neanderthal, but possesses an anatomically modern skull. There are a number of problems with interpreting this find as a Neanderthal/*sapiens* hybrid.<sup>14</sup> First of all, as a hybrid it should have a mixture of traits throughout its body and not possess the body of a Neanderthal and skull of a modern human. For example, if we look at hybrids of lions and tigers they do not possess the head of one species and the body of the other, but exhibit a morphological mixture of the two species. Secondly, and more importantly, acceptance of this specimen as a hybrid would suggest that Neanderthal traits had been retained for some 6,000 to 10,000 years after Neanderthals went extinct, which is highly unlikely. This is theoretically unlikely since Neanderthal traits would have been genetically swamped by the *Homo sapiens* genes over such a protracted period of time.
- Proponents of the Multiregional Model, such as Milford Wolpoff, cite evidence in Asia of regional continuity. They see an evolutionary link between ancient *Homo erectus* in Java right through to Australian aborigines. A possible problem with this view is that recent dating of late surviving *Homo erectus* in Indonesia suggests that they survived here until 50,000 years ago, which is potentially when fully modern humans may have arrived in the region from Africa.
- China may contain the best evidence for supporting the Multiregional Model. Here there are discoveries of a couple of skulls dated to roughly 100,000 years ago that seem to possess a mixture of classic *Homo erectus* and *Homo sapiens* traits. Better geological dating and more complete specimens are needed to more fully assess this possibility.

## Conclusion

For the moment, the majority of anatomical, archaeological and genetic evidence gives credence to the view that fully modern humans are a relatively recent evolutionary phenomenon. The current best explanation for the beginning of modern humans is the Out of Africa Model that postulates a single, African origin for *Homo sapiens*. The major neurological and cultural innovations that characterized the appearance of fully modern humans has proven to be remarkably successful, culminating in our dominance of the planet at the expense of all earlier hominid populations.

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Paleoanthropologist **Donald C. Johanson**, is professor of anthropology and Director of the Institute of Human Origins at Arizona State University. He is best known for his discovery of “Lucy”, a 3.2 million-year old Australopithecus afarensis skeleton he found in 1974 in Ethiopia. His books include *Lucy: The Beginnings of Humankind* and, most recently, *From Lucy to Language*. Dr. Johanson hosted the Emmy-nominated NOVA television series *In Search of Human Origins*.

[http://www.mnsu.edu/emuseum/information/biography/fghij/johanson\\_donald.html](http://www.mnsu.edu/emuseum/information/biography/fghij/johanson_donald.html)





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The Institute of Human Origins' web site is a comprehensive site on human origins and has a special segment on the emergence of modern humans.

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<http://www.bioanth.org/>

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The BBC challenges you to put your skills to the test in their interactive quiz or play the seven stages of evolution (click on the “cavemen challenge” to begin). Also check out the in-depth information in the side-bar menu (e.g., family tree) or click on a time period near top of page.

<http://www.bbc.co.uk/science/cavemen/>

## Smithsonian Institution

Its Human Origins Program covers all aspects of evolutionary science, with a Hall of Human Ancestors, a family tree, and What's Hot! in Paleoanthropology which looks at recent findings. [www.mnh.si.edu/anthro/humanorigins](http://www.mnh.si.edu/anthro/humanorigins)

### Read a book

- » *From Lucy to Language* by D.C. Johanson and B. Edgar (Simon and Schuster, 1996).
- » *The Fossil Trail: How We Know What We Think We Know about Human Evolution* by I. Tattersall (Oxford University Press, 1995).
- » *Extinct Humans* by I. Tattersall and J. H. Schwartz (Westview Press, 2000).

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## author glossary

**Gene flow** - the flow of genes from one population to another.

**Genetic drift** - the change of gene frequency from one generation to another caused by the cumulative effects of random fluctuations, rather than by natural selection.

**Mitochondrial DNA** - the DNA found only in the mitochondria (the powerhouses of the cell) and inherited only from the mother.

**Morphology** - the scientific study of the form and structure of organisms.

**Paleoanthropology** - the study of human origins, the study of the fossil and cultural remains of extinct human ancestors.

**Taxonomy** - the classification of organisms into groups according to their relationships and the ordering of these groups into a hierarchical arrangement.

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### ActionBioscience.org original lesson

This lesson has been written by a science educator to specifically accompany the above article. It includes article content and extension questions, as well as activity handouts for different grade levels.

**Lesson Title:** *Roots: The Ancestry of Modern People*

**Levels:** high school - undergraduate

**Summary:** This lesson examines the two main models of the origin of modern humans. Students can map the movements of early humans, consider what it takes to be a paleoanthropologist, write a news flash about Lucy's discovery, chart a book plot about the adventures of an early hominid, create a sketchbook of hominid fossils... and more!

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### Useful links for educators

In addition to the links in the "learn more" section above:

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The official site of one of the foundations established by Dr. Louis Leakey, one of the world's best known paleoanthropologists. You may want your students to listen to the audio archives of scientists and their fossil discoveries.  
<http://www.leakeyfoundation.org/>

### Useful links for student research

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- » Human Evolution: A Look at Our Ancestors  
Pre-human and human species are presented here, based on the the fossil record and by physical characteristics.  
<http://www.humboldt.edu/~mrc1/main.shtml>
- » A Look at Modern Human Origins  
This site details some of the available evidence of human ancestors.  
<http://www.modernhumanorigins.com/>

- » Anthropology in the News  
A site for professional or student anthropologists. All the latest anthropologically-related news can be found here on a daily basis.  
<http://www.tamu.edu/anthropology/news.html>
- » The Cradle of Humankind  
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This site lists many of the hominid fossils, who discovered them & when, and basic information.  
<http://www.msu.edu/~heslipst/contents/ANP440/index.htm>
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