What is *Homo sapiens*?

Chris Stringer, The Natural History Museum, London
What is a ‘Homo sapiens’??

Spencer Wells: I’d like to suggest that we re-welcome Neanderthals into our own species and tear down the wall we’ve built between us and them since their discovery over 150 years ago....

Chris Stringer: There’s no ‘one size fits all’ for Nea vs sapiens species status. My separation on morphology has to acknowledge they could interbreed, Spencer’s merging from behaviour has to acknowledge the resultant species has variation in pelvic + ear bone shape beyond any extant ape species.....
Our complex ‘modern’ behaviour...

Complex technology

Complex societies

Language

Complex treatment of the dead

Art, Music, Spirituality
Today there is only one human species: *Homo sapiens* - also known as ‘modern humans’
The diagram illustrates the timeline of human evolution, focusing on the relationships between different hominin species from the present day back to 1 million years ago (1 MA).

Key points:
- **Present**: Later modern and early/modern Homo sapiens.
- **100 ka**: Possible gene flow from early/Archaic Homo sapiens to later Homo neanderthalensis.
- **200 ka**: Early Archaic Homo sapiens and early Homo heidelbergensis.
- **300 ka**: Early Homo neanderthalensis.
- **400 ka**: Early Homo heidelbergensis and early Homo neanderthalensis.
- **500 ka**: Early Homo erectus, early Homo floresiensis, and early Homo luzonensis.
- **600 ka**: Early Homo erectus and early Homo floresiensis.
- **700 ka**: Early Homo erectus.
- **800 ka**: H. antecessor.
- **900 ka**: H. antecessor.
- **1 MA**: Possible gene flow from early Homo heidelbergensis to later Homo sapiens.

The diagram highlights the timeline and potential gene flow between these hominin species, indicating the complexity of human evolutionary history.
There were still at least 5 kinds of humans ~70,000 years ago....
One, two, three or four *Homo sapiens* crania?
Anatomically modern *H. sapiens* (Howells) includes *heidelbergensis*, Neas? (Bräuer) +archaic *H. sapiens* (Stringer) + *H. sapiens* (Wolpoff) includes *erectus* (Wolpoff)
Which is the type of *Homo sapiens*?
David Nottton and Chris Stringer (2010)

There was, however, no single person recognised as the type until 1959, when Professor William Stearn, in a passing remark in a paper on Linnaeus’ contributions to nomenclature and systematics wrote that 'Linnaeus himself must stand as the type of his *Homo sapiens*'. This was enough to designate Linnaeus as a lectotype (Article 74.5), the single name-bearing type specimen for the species *Homo sapiens*....
Morphology and function of Neandertal and modern human ear ossicles

Alexander Stoessel\textsuperscript{a,1}, Romain David\textsuperscript{a}, Philipp Gunz\textsuperscript{a}, Tobias Schmidt\textsuperscript{b}, Fred Spoor\textsuperscript{a,c}, and Jean-Jacques Hublin\textsuperscript{a}
Neandertal Introgression Sheds Light on Modern Human Endocranial Globularity

Philipp Gunz,1,20*, Amanda K. Tilot,2,20 Katharina Wittfeld,3,4 Alexander Teumer,5 Chin Yang Shapland,2

~6500 modern humans

Figure 2. Globularity Scores of CT and MRI Scans
(A) Principal component analysis of endocranial shape. 99% confidence ellipses are shown for modern human CT scans from Europe (blue; n = 19), MRI scans of present-day humans (yellow; n = 6,575), and Neandertal CT scans (red; n = 7); two Homo heidelbergensis individuals are plotted in black.
(B) Frequency plot of globularity scores computed for data shown in (A). This globularity score quantifies overall endocranial shape by projecting each individual onto the vector between the elongated average shape of Neandertals and the globular average shape of present-day humans. Inset shows example MRI scans associated with low (left) and high (right) globularity scores among present-day humans. See also Figure S1.
The evolution of modern human brain shape

Simon Neubauer,* Jean-Jacques Hublin, Philipp Gunz

Fig. 1. Differences in brain shape between a present-day human (left, in blue) and a Neandertal from La Chapelle-aux-Saints (right, in red). Endocasts are shown together with the triangulated landmark set used in this study and CT scan renderings of the crania.

Fig. 2. bgPCA of endocranial shape. * erectus, triangles and orange convex hull; Neandertals, squares and red convex hull; * heidelbergensis/rhodesiensis, light blue convex hull; * sapiens fossils, circles and dark blue convex hulls for geologic age groups 1 to 3. Evolutionary trends of shape in modern individuals are shown as regressions on geologic age (arrows) (see fig. S2 for labels of fossil individuals).
Last common ancestor ~600 ka?
For me, *Homo sapiens* = everything on our lineage after we diverged from the Neanderthal (and Denisovan) lineage.
H. neanderthalensis

H. sapiens

Evolutionary change

Atapuerca (Sima)

Jebel Irhoud

Last common ancestor ~600 ka?
Last common ancestor ~600 ka?

'Early H. n.'

'H. neanderthalensis'

'H. sapiens lineage'

'Archaic H. s.'

'Archaic' and 'modern' H. s. may have co-existed (Iho Eleru)

'Archaic H. s.'

'Late H. n.'

'Early H. n.'

'Modern H. s.'
Ideas about the place of origin of *Homo sapiens* [~1970]

- Multiregional/Neanderthal phase/spectrum models
- Neanderthal model
- Generalised Neanderthal model
- Single origin model
  - Location unknown
1971: my PhD trip around Europe

The Jebel Irhoud skull from Morocco: an African ‘Neanderthal’ 40,000 years old?
Cranial changes primarily in:-

Vault shape
- face size

Vault size
- face shape

Upper Palaeolithics

H. sapiens

Skhul Qafzeh

H. neanderthalensis

Asian Neanderthals

European Neanderthals

African archaic sapiens

archaic vault
large flat face

H. heidelbergensis

H. sapiens lineage

Phenogram Stringer 1978/1994
New fossils from Jebel Irhoud, Morocco and the pan-African origin of *Homo sapiens*

Jean-Jacques Hublin, Abdelouahed Ben-Ncer, Shara E. Bailey, Sarah E. Freidline, Simon Neubauer, Matthew M. Skinner, Inga Bergmann, Adeline Le Cabec, Stefano Benazzi, Katerina Harvati, & Philipp Gunz

Luminescence + ESR dating ~315 ka...
Ancient faces from Spain and China – the ‘modern’ face is actually primitive?

Gran Dolina (Atapuerca) *(H. antecessor)*
~850ka

Nanjing (Hulu Cave)
~600 ka
Homo heidelbergensis: its place in evolution in question?
The African story gets more complex…

…our fossils come from less than 10% of the area of Africa
Irhoud ?sapiens

Africa at about 300,000 years: at least 3 species?

Broken Hill
heidelbergensis

H. naledi
Omo Kibish 1 (Ethiopia) is currently the oldest known fossil that can fairly confidently be assigned to ‘modern’ *H. sapiens* (found 2001).

Thus, the Omo I fossils have an age of at least 172 ka and, given the depositional environment of Kibish Member 1, probably closer to 196 ka. Omo I is therefore the oldest securely dated fossil evidence of anatomically modern humans.

The Omo-Kibish I pelvis (found 2001)

Ashley S. Hammond a,*, Danielle F. Royer b, John G. Fleagle c

In conclusion, the Omo I hipbone is modern human in appearance. It has modern human apomorphies, including a reduced iliac tubercle (and therefore, reduced iliac pillar) and an ilium that does not appear as widely laterally flaring as earlier *Homo*. The hipbone is within the range of recent human variation for a number of features.
Again, evidence that “archaic” and “modern” anatomies overlapped in Africa - found only a few km apart, these crania have both been dated to ~195ka and are very different in cranial shape…
DNA: our species’ history is written in our own body cells.
Deep divisions in early *H. sapiens* in Africa?
‘Humans did not stem from a single ancestral population in one region of Africa, as is often claimed. Instead, our African ancestors were diverse in form and culture, and scattered across the entire continent’
One or more early exits of modern humans from Africa?
Initial Upper Palaeolithic *Homo sapiens* from Bacho Kiro Cave, Bulgaria

~45,000 years old

Jean-Jacques Hublin¹,², Nikolay Sirakov³, Vera Aldeias⁴, Shara Bailey⁵, Edouard Bard⁶, Vincent Delvigne⁷,⁸, Elena Endarova⁹, Yoann Fagault⁹, Helen Fewlass¹, Mateja Hajdijak¹⁰, Bernd Kromer¹, Ivaylo Krumov¹¹, João Marreiros¹²,¹³, Naomi L. Martisius¹³, Lindsey Paskulin¹⁴, Virginie Sinet-Mathiot¹, Matthias Meyer¹⁰, Svante Pääbo¹⁰, Vasili Popov¹⁵, Zeljko Rezek¹⁶, Svoboda Sirakova³, Matthew M. Skinner¹⁷, Geoff M. Smith¹, Rosen Spasov¹⁸, Sahra Talamo¹⁹, Thibaut Tuna⁶, Lukas Wacker²⁰, Frido Welker¹²,¹ⁱ, Arndt Wilcke²², Nikolay Zahariev²³, Shannon P. McPherron¹ & Tsenka Tsanova¹

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Check for updates
Apidima Cave fossils provide earliest evidence of *Homo sapiens* in Eurasia

>200,000 years old?

Two fossilized human crania (Apidima 1 and Apidima 2) from Apidima Cave, southern Greece, were discovered in the late 1970s but have remained enigmatic owing to their incomplete nature, taphonomic distortion and lack of archaeological context and chronology. Here we virtually reconstruct both crania, provide detailed comparative descriptions and analyses, and date them using U-series radiometric methods. Apidima 2 dates to more than 170 thousand years ago and has a Neanderthal-like morphological pattern. By contrast, Apidima 1 dates to more than 210 thousand years ago and presents a mixture of modern human and primitive features. These results suggest that two late Middle Pleistocene human groups were present at this site—an early *Homo sapiens* population, followed by a Neanderthal population. Our findings support multiple dispersals of early modern humans out of Africa, and highlight the complex demographic processes that characterized Pleistocene human evolution and modern human presence in southeast Europe.
The evolutionary history of Neanderthal and Denisovan Y chromosomes

Martin Petr†, Mateja Hajdinjak†, Qiaomei Fu†, Elena Essel†, Hélène Rougier†, Isabelle Crevecoeur†, Patrick Semal†, Liubov V. Golovanova†, Vladimir B. Doronichev†, Carles Lalueza-Fox†, Marco de la Rasilla†, Antonio Rosas†, Michael V. Shunkov†, Maxim B. Kozlikin†, Anatoli P. Derevianko†, Benjamin Vernot†, Matthias Meyer†, Janet Kelso†

The last pieces of a puzzling early meeting
Y chromosomes transferred from Homo sapiens to Neanderthals between 350,000 to 150,000 years ago

By Mikkel Heide Schierup
Will Asia Rewrite Human History?

The earliest unequivocally modern humans in southern China

An early modern human presence in Sumatra 73,000–63,000 years ago

Daoxian (Fuyan) Cave
80 ka+?

Lida Ajer Cave, Sumatra
Human occupation of northern Australia by 65,000 years ago

Chris Clarkson¹, Zenobia Jacobs²,³, Ben Marwick³,⁴, Richard Fullagar³, Lynley Wallis⁵, Mike Smith⁶, Richard G. Roberts²,³,

Madjedbebe rockshelter
[Or could the genetic calibrations of events be wrong (too young)?]
The complete genome sequence of a Neanderthal from the Altai Mountains

Kay Prüfer¹, Fernando Racimo², Nick Patterson³, Flora Jay², Sriram Sankararaman³,⁴, Susanna Sawyer¹, Anja Heinze¹,

The genomic landscape of Neanderthal ancestry in present-day humans

Sriram Sankararaman¹,², Swapan Mallick¹,², Michael Dannemann³, Kay Prüfer³, Janet Kelso³, Svante Pääbo³, Nick Patterson¹,² & David Reich¹,²,⁴

Patterns of coding variation in the complete exomes of three Neandertals

Sergi Castellano⁴,¹, Genís Parra⁴,², Federico A. Sánchez-Quinto⁴,², Fernando Racimo⁴,³,², Martin Kuhlwilm⁴,²,
Interbreeding?

Contact?

If there was any interbreeding it was thought that it was on such a small scale we would find no trace of it today.
Close Encounters Of the Prehistoric Kind

As a result, many people living outside Africa have inherited a small but significant amount of DNA from these extinct humans.

The long-awaited sequence of the Neandertal genome suggests that modern humans and Neandertals interbred tens of thousands of years ago, perhaps in the Middle East.

**Fig. 6.** Four possible scenarios of genetic mixture between Neandertals and modern humans.
The owner of the Oase 1 mandible (~40 ka Romania) had a very recent Neanderthal ancestor....

Genetic Analysis Detects Neanderthal Ancestor

Wednesday, May 13, 2015

BOSTON, MASSACHUSETTS—Genetic testing of a 40,000-year-old mandible with modern human and Neanderthal traits has revealed that the Oase man’s genome was between five and 11 percent Neanderthal, including large chunks of several chromosomes. Palaeogenomicist Qiaomei Fu of Harvard Medical School and her colleagues analyzed how lengths of DNA inherited from an ancestor shorten with each generation. They estimate that this individual’s Neanderthal ancestor was introduced in the previous four to six generations. The jawbone and one other human bone were discovered among bear remains in a Romanian
Neanderthal DNA is selected away...

**Q&A: Where did the Neanderthals go?**

Kelley Harris and Rasmus Nielsen

**Fig. 1.** The decline of Neanderthal DNA in humans due to selection. The curve shows the expected decline in the proportion of Neanderthal DNA in modern humans due to natural selection based on the simulations in Harris and Nielsen [6]. The chromosomes depicted also illustrate the fact that not only is the Neanderthal DNA proportion decreasing through time, it is also distributed in smaller and smaller segments due to the effect of recombination.
The introgressed variants remaining in modern Europeans are depleted of heritability for most traits.

However, we discover that they are enriched for heritability of several traits with potential relevance to human adaptation to non-African environments, including hair and skin traits, autoimmunity, chronotype, bone density, lung capacity, and menopause age.

Quantifying the contribution of Neanderthal introgression to the heritability of complex traits
Evonne McArthur, David Rinker, John A. Capra
So we \((Homo\ sapiens)\) are not more or less 100% Recent African Origin, as I would have said 15 years ago.

Our DNA shows that we are \(>90\%\) Recent African Origin

So we are ‘Mostly Out of Africa’
Homo sapiens
Neanderthals
Homo floresiensis
Denisovans
Homo luzonensis

Why were we the only kind of human left by ~30,000 years ago?
End of Neanderthals linked to flip of Earth's magnetic poles, study suggests

Event 42,000 years ago combined with fall in solar activity potentially cataclysmic, researchers say

When the poles switch, Earth's magnetic field weakens dramatically, exposing the planet to cosmic radiation. Photograph: ElenI11/Getty Images/iStockphoto

The flipping of the Earth’s magnetic poles together with a drop in solar activity 42,000 years ago could have generated an apocalyptic environment that may have played a role in a major events ranging from the extinction of megafauna to the end of the Neanderthals, researchers say.
The secret(s) of our success?

Homo sapiens WERE to blame for Neanderthal extinction because they were better hunters and out-competed them for food, computer model shows

- Experts have long been divided on the reason for the extinction of Neanderthals
- They lived in Eurasia for 300,000 years and went extinct 40,000 years ago
- This coincided with the introduction of Homo sapiens into their territory
- Supercomputer has found the most likely cause of Neanderthal extinction is that Homo sapiens were better hunters and out-competed them for food

A new theory claims Homo sapiens beat out Neanderthals because of art

Science News

Homo sapiens developed a new ecological niche that separated it from other hominins

Date: July 30, 2018

Source: Max Planck Institute for the Science of Human History

Summary: A new study argues that the greatest defining feature of our species is not 'symbolism' or dramatic cognitive change but rather its unique ecological position as a global 'generalist specialist'.

SHARP EXIT Humans replaced Neanderthals because we had bows and arrows and they didn’t, study suggests

PRIMITIVE cavemen may have been wiped out by man’s early ancestors armed with bows and arrows, a study suggests.

Scientists in Italy have found evidence that early homo sapiens were using spears, arrows and darts at least 40,000 years ago — 20,000 years earlier than previously thought.
As humans became friendlier, we were able make the shift from living in small bands of ten to fifteen individuals to living in larger groups of a hundred or more. Even without larger brains, our larger, better-coordinated groups easily outcompeted other groups of humans. Our sensitivity to others allowed us to cooperate and communicate in increasingly complex ways that put our cultural abilities on a new trajectory. We could innovate and share those innovations more rapidly than anyone else.
Our success was down to a combination of factors?

In summary, we succeeded in colonising all parts of Asia and eliminating rival species such as Neandertals because we were more numerous, had a more diverse diet that increased the survival rates of mothers and infants, and combined a longer period of childhood development with a re-organised brain that was cognitively more powerful in inventive, imaginative and ingenuous at colonising new environments.
State of the Science

Aspects of human physical and behavioural evolution during the last 1 million years

JULIA GALWAY-WITHAM,1 JAMES COLE2 and CHRIS STRINGER1

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Review

Origins of modern human ancestry

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New finds in the palaeoanthropological and genomic records have changed our view of the origins of modern human ancestry. Here we review our current understanding.
Thanks for listening and thanks to the Natural History Museum London The Calleva Foundation and Human Origins Research Fund and all my sources of data and illustrations..

Centre for Human Evolution Research (NHM)

@ChrisStringer65
Adapted from P. Gunz, using about 1000 cranial landmarks and semi-landmarks.