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Faculty of Philosophy
General Linguistics

Language Evolution WiSe 2023/2024

Lecture 3: Human Evolution II
Human Morphology

31/10/2023, Christian Bentz

Overview

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Section 1: Recap

Hominids

'Hominids' (lat. hominidae) refer to all species after our LCA (last common ancestor) with orangutans, gorillas, and chimpanzees.

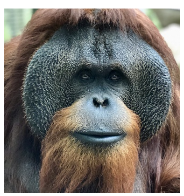
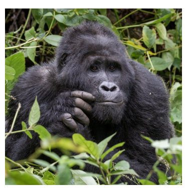
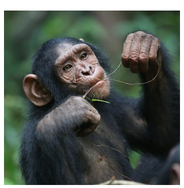
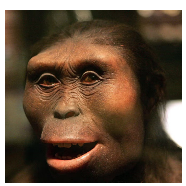





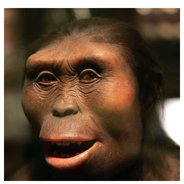

Table 1. *a. A taxonomy of the living higher primates that recognises the close genetic links between* Pan *and* Homo

Superfamily Hominoidea ('hominoids')
- Family Hylobatidae
  - Genus *Hylobates*
- Family Hominidae ('hominids')
  - Subfamily Ponginae
    - Genus *Pongo* ('pongines')
  - Subfamily Gorillinae
    - Genus *Gorilla* ('gorillines')
  - Subfamily Homininae ('hominines')
    - Tribe Panini
      - Genus *Pan* ('panins')
    - Tribe Hominini ('hominins')
      - **Subtribe Australopithecina ('australopiths')**
        - **Genus *Ardipithecus***
        - **Genus *Australopithecus***
        - **Genus *Paranthropus***
      - Subtribe Hominina ('hominans')
        - Genus *Homo*

Wood & Richmond (2000), p. 21.

Hominins

'Hominins' (lat. hominini) refer to all species after our LCA (last common ancestor) with chimpanzees (**excluding** chimpanzees).

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          - Genus *Homo*

Wood & Richmond (2000), p. 21.

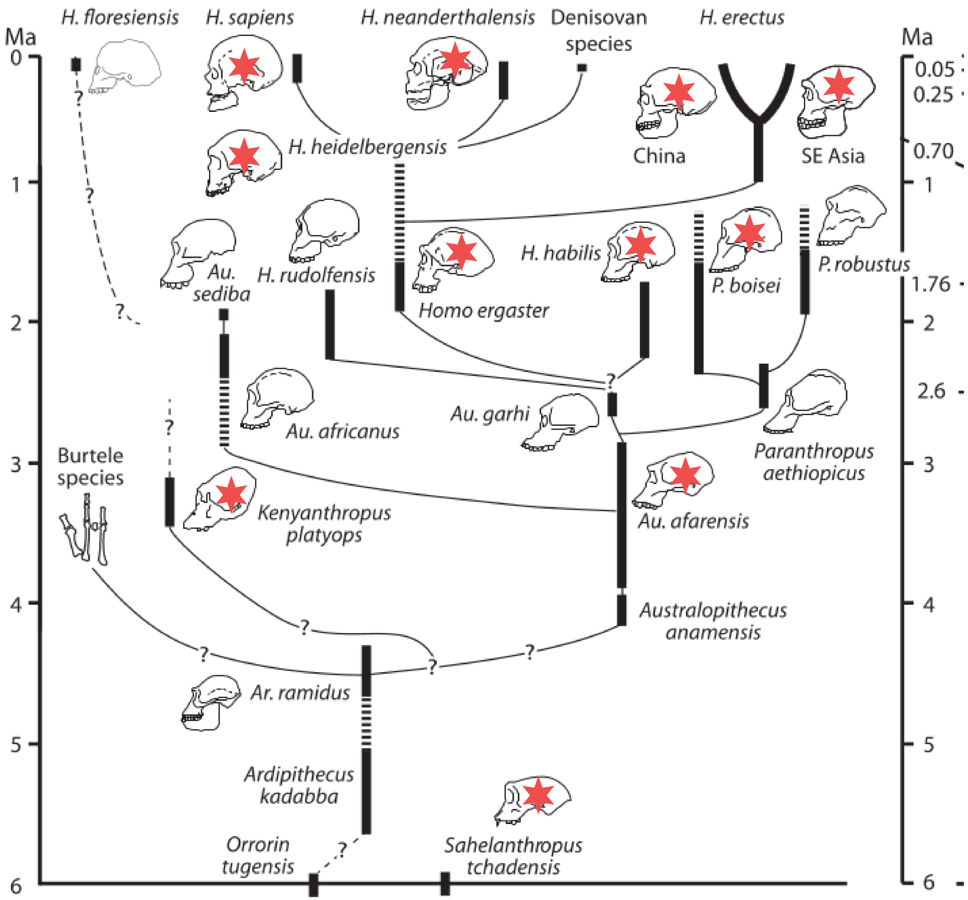
Hominin Genera and Species (before genus Homo)

- Sahelanthropus
  - Sahelanthropus tchadensis
- Kenyanthropus
  - Kenyanthropus platyops
- Genus Australopithecus
  - Australopithecus afarensis
- Genus Paranthropus
  - Paranthropus boisei

Genus *Homo* and its Species

- Genus Homo
  - Homo habilis
  - Homo ergaster
  - Homo erectus
  - Homo heidelbergensis
  - Homo neanderthalensis
  - Homo sapiens
- Newer Discoveries
  - Homo naledi
  - Denisovans
  - Homo floresiensis
  - Homo luzonensis
  - Homo longi

Summary: Hominin Fossils in Time



Section 2: Newer Discoveries

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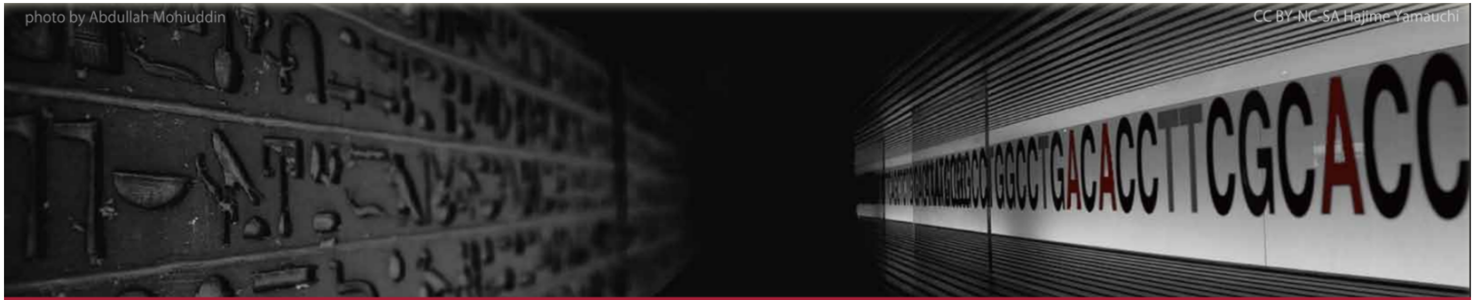
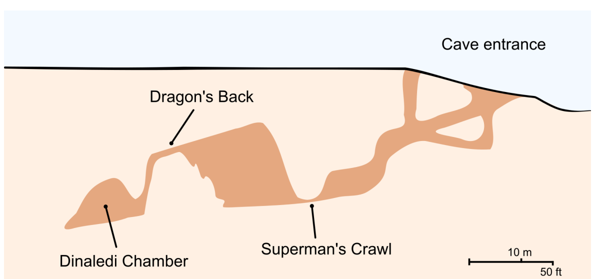


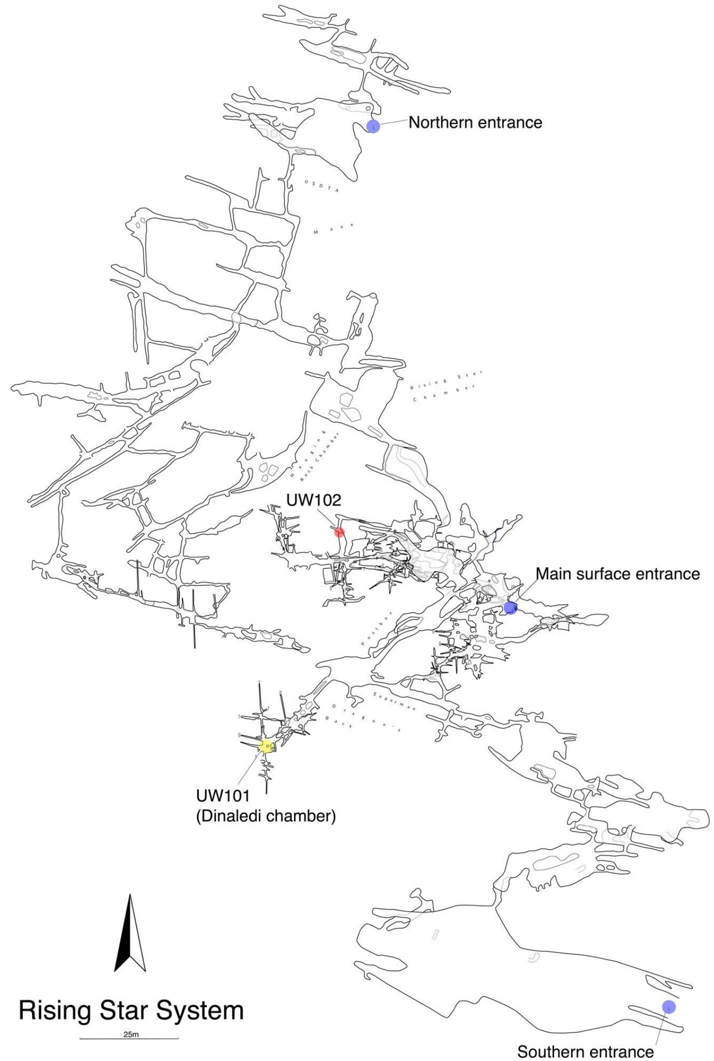
Homo Naledi

Rising Star Cave, South Africa (near Johannesburg)

Entrance to the rising star cave system with anthropologist Dr. Marina Elliott.

Rising Star Cave: Dinaledi Chamber





Super(wo)man's crawl

Dr. Marina Elliot (part of the excavation team of six women, called the "underground astronauts").

Naledi chamber finds: 1550 bone pieces, at least 15 individuals.

Homo naledi (Holotype: Dinaledi Hominin 1, DH1)

Profile

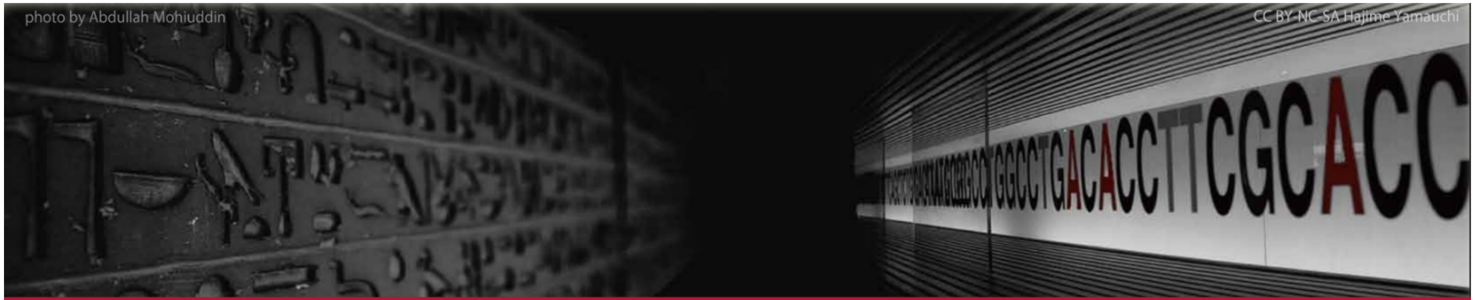
Genus: Homo

Species: Homo naledi

Age: c. 335 – 236 Kya

Location: Rising Star Cave, South Africa

Berger et al. (2013). Homo naledi, a new species of the genus Homo from the Dinaledi Chamber, South Africa.
Hawks et al. (2017). New fossil remains of Homo naledi from the Lesedi Chamber, South Africa



Denisovans

Background: Denisova Cave

Krause et al. (2010). The complete mitochondrial DNA genome of an unknown hominin from southern Siberia.

Reich et al. (2010). Genetic history of an archaic hominin group from Denisova Cave in Siberia.

Denisovans (A species discovered purely by genetics)

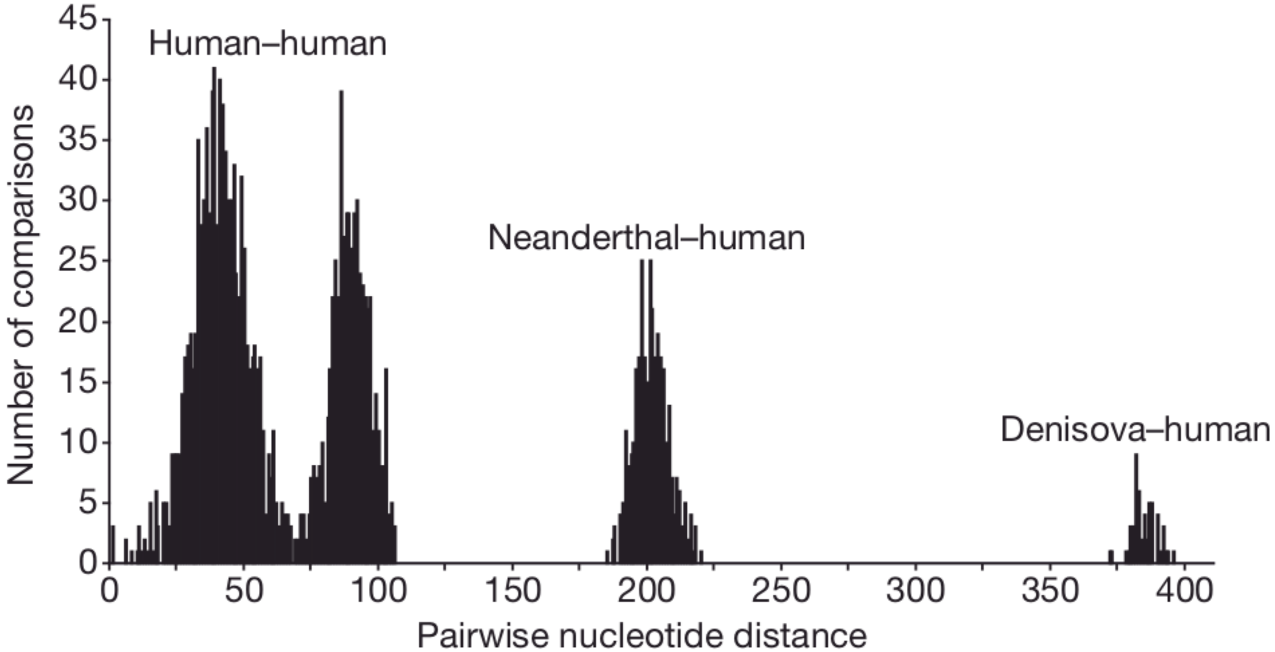
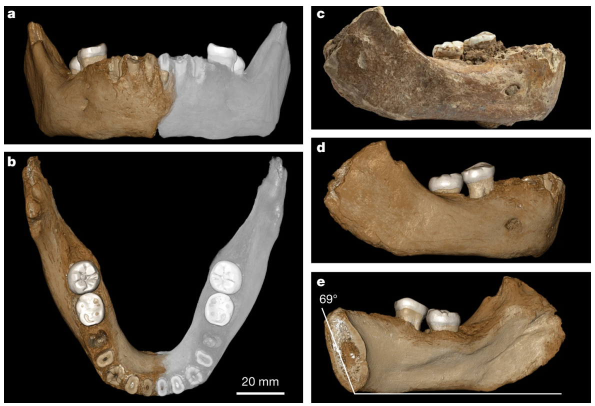
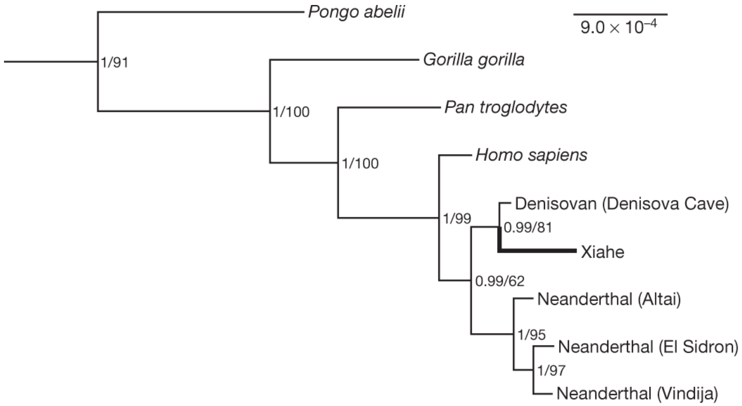


Figure 2 | Distribution of pairwise nucleotide differences. Pairwise nucleotide differences from all pairs of complete mtDNAs from 54 present-day and one Pleistocene modern human, six Neanderthals and the Denisova hominin are shown.

Krause et al. (2010), p. 895

Denisovan Mandible





Chen et al. (2019). A late Middle Pleistocene Denisovan mandible from the Tibetan Plateau.

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Homo floresiensis

Ling Bua Cave, Island of Flores, Indonesia

Discovered in 1950, picture taken in 2007.

Homo floresiensis (Holotype: Ling Bua 1, LB1)

Profile

Genus:
Homo

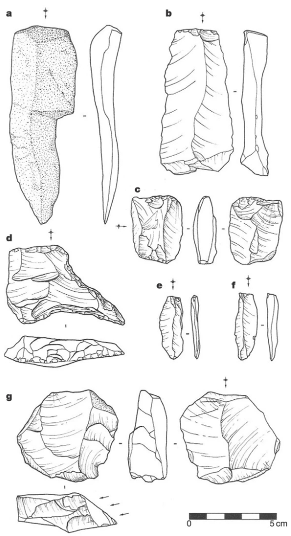
Species:
Homo floresiensis

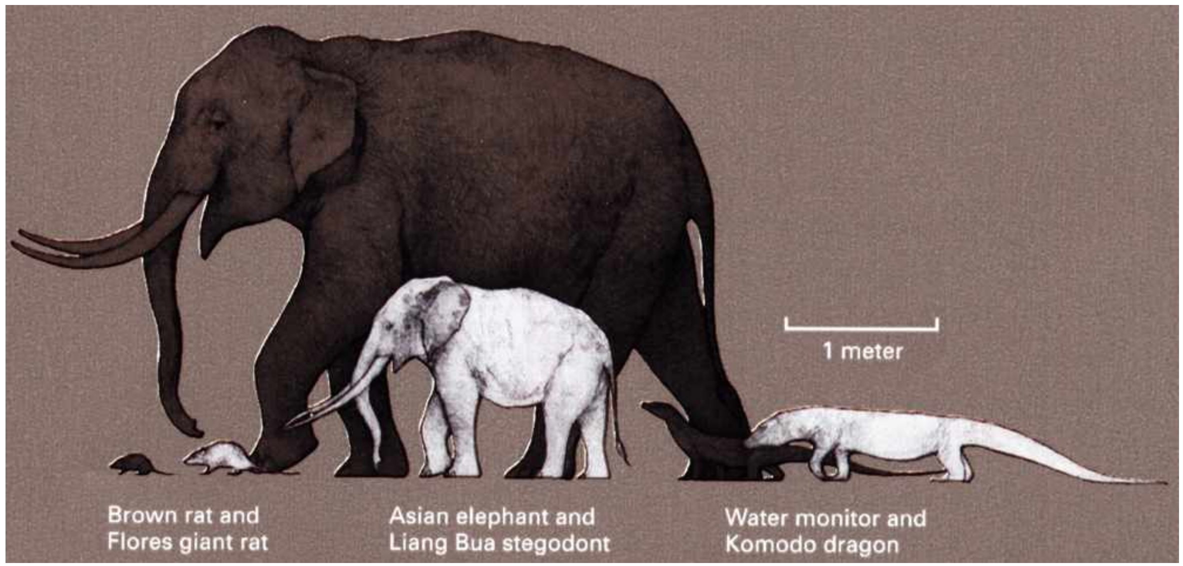
Age:
c. 100 – 60 Kya

Location: Ling Bua Cave, Flores

Brown et al. (2004). A new small-bodied hominin from the Late Pleistocene of Flores, Indonesia.

Further Finds





“Associated deposits contain stone artefacts and animal remains, including Komodo dragon and an endemic, dwarfed species of *Stegodon*.”

Morwood et al. (2004). Archaeology and age of a new hominin from Flores in eastern Indonesia.

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Homo luzonensis

Callao Cave, Northern Luzon, Phillipines

Background: Early Seafarers?

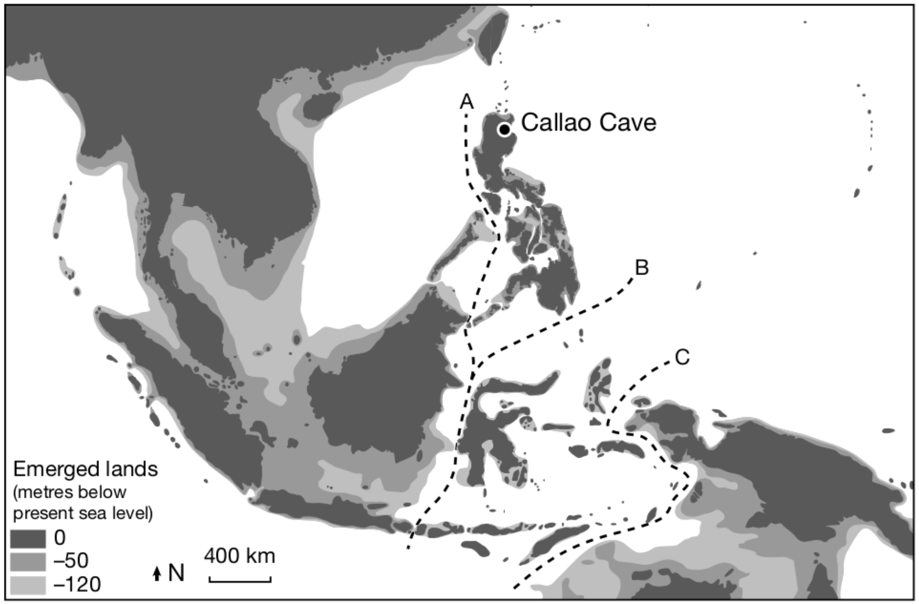


Fig. 1 | Geographical location of Callao Cave. Map showing the location of Callao Cave on Luzon Island (the Philippines), emerged lands at 50 and 120 m below present sea level (adapted from ref. [46], H. K. Voris, Field Museum of Natural History) and the major biogeographical boundaries recognized in the area. A, Wallace's Line modified by Huxley; B, Wallace's Line; C, Lydekker's Line. Luzon Island lies in between the original Wallace's Line and the Wallace's Line modified by Huxley and was never connected to mainland Asia during the Quaternary.

Detroit et al. (2019). A new species of Homo from the Late Pleistocene of the Philippines.

Homo luzonensis (Holotype: Callao Cave Human 1, CCH6)

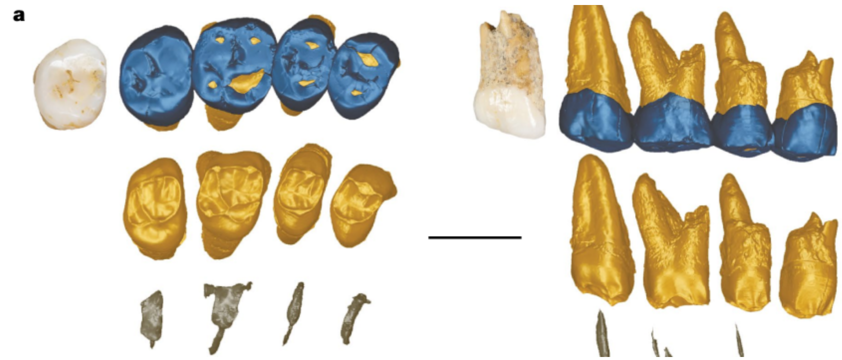
Profile

Genus:
Homo

Species:
Homo luzonensis

Age:
c. 67 Ka

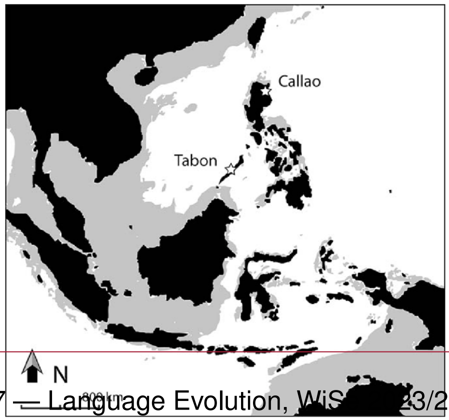
Location: Callao Cave, Northern Luzon, Phillipines



Fossil remains of H. luzonensis from Late Pleistocene sediments at Callao Cave. a, Holotype CCH6: postcanine maxillary teeth in occlusal (left) and buccal (right) aspects, with three-dimensional rendering of enamel (dark blue), dentine and cement (light brown), and pulp cavity (dark grey) for CCH6-b–CCH6-e.

Detroit et al. (2019). A new species of Homo from the Late Pleistocene of the Philippines.

Mijares et al. (2010). New evidence for a 67,000-year-old human presence at Callao Cave, Luzon, Philippines.



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Homo longi

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Homo longi/daliensis/denisova? (Holotype: HBSM2018-000018(A))

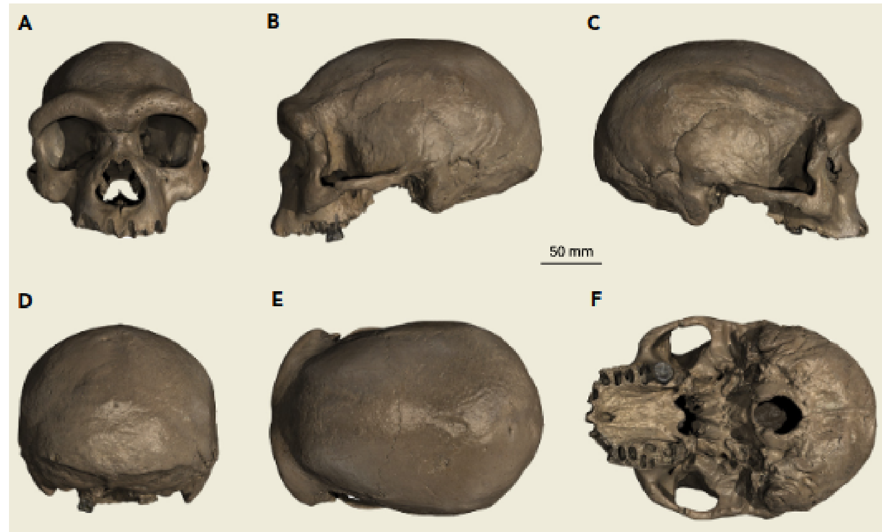
Profile

Genus:
Homo

Species:
Homo longi (?)

Age:
c. 146 Kya

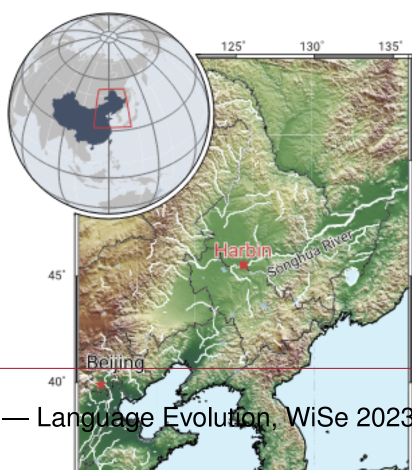
Location: Harbin, Northereastern China



Harbin Cranium, found along the Songhua river while Dongjiang bridge was under construction in 1933, commonly referred to as “dragon man”.

Ji et al. (2021). Late Middle Pleistocene Harbin cranium represents a new Homo species.

Ni et al. (2021). Massive cranium from Harbin in northeastern China establishes a new Middle Pleistocene human lineage.



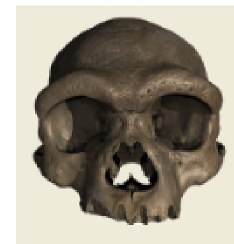
Section 1: Recap
Section 2: New Members of the Hominin Family
Section 3: Human Morphology
Section 4: Geometric Morphometrics
Summary
References

Summary: New members of the Hominin family

Homo naledi | Denisovans | Homo flor. | Homo luz. | Homo longi(?)

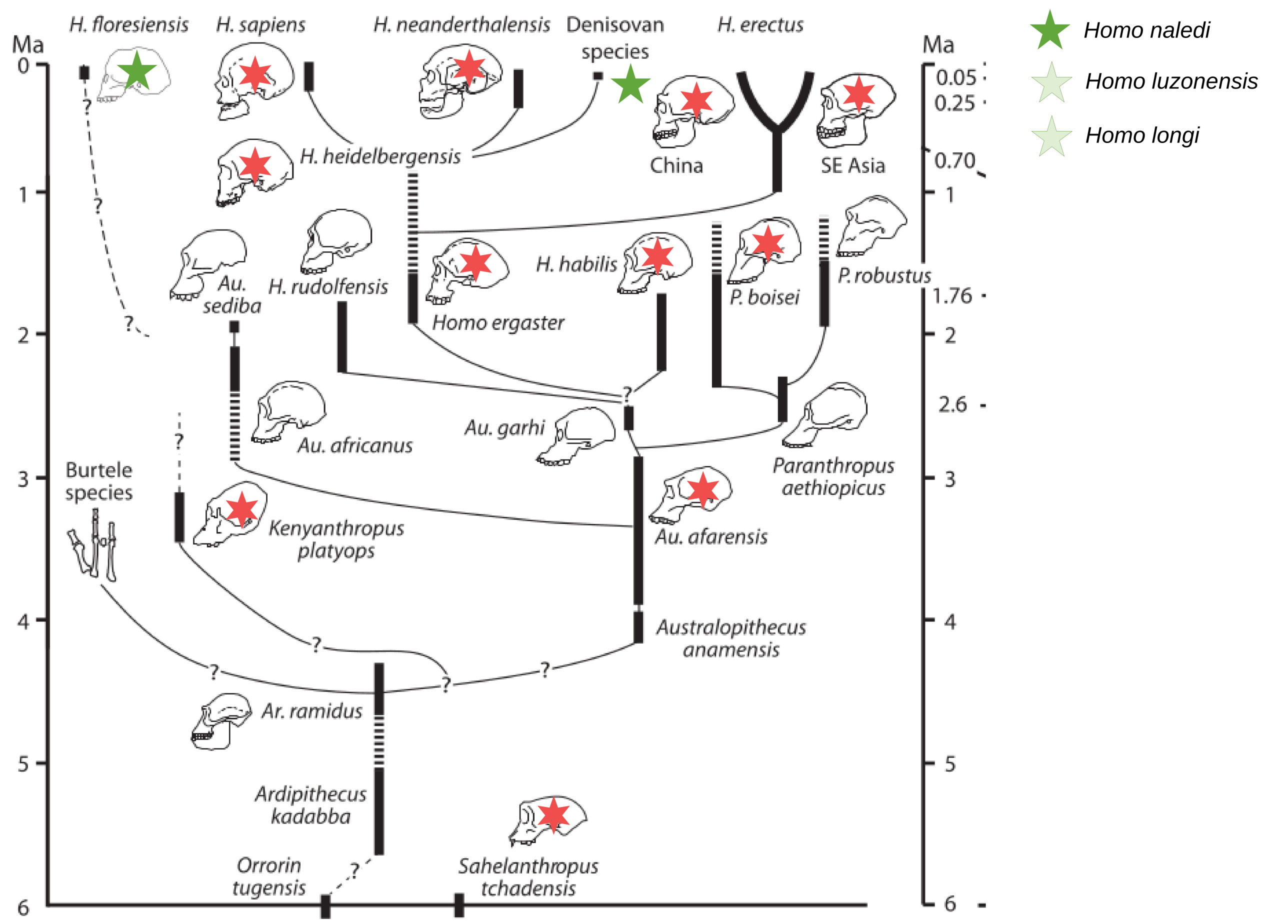









Summary: Hominin Fossils in Time



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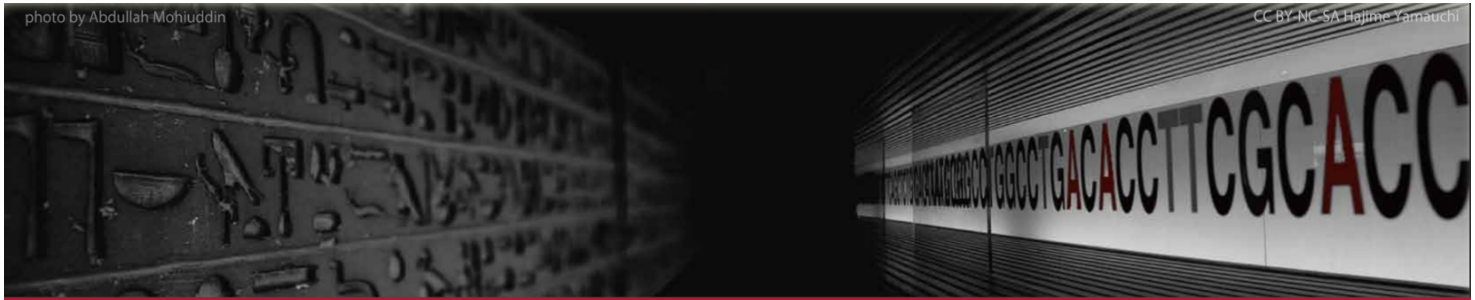

Section 3: Human Morphology

Taxonomic Considerations

How are species classified?

- **Morphometrics**: Analysing and comparing the morphological shape of fossils.
- Behavior: Analysing archaeological assemblages (mostly stone tools).
- Genetics: Analyses of different parts of the (available) DNA, applying phylogenetic methods from evolutionary biology.

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Cranial Morphology

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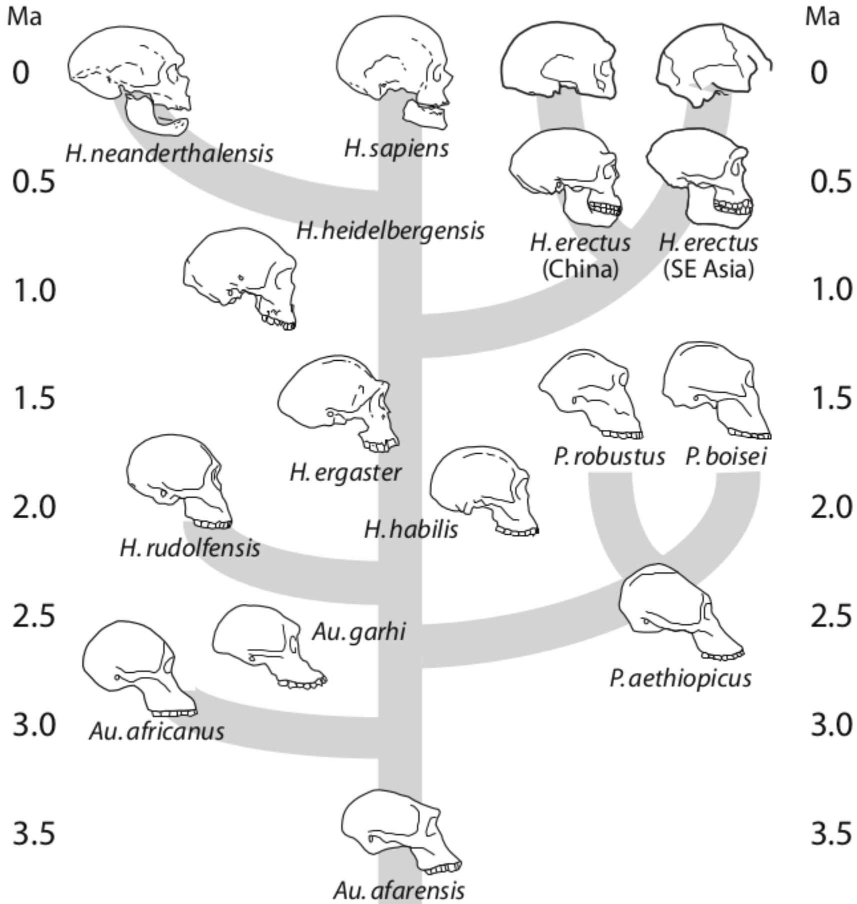
Cranial Morphology



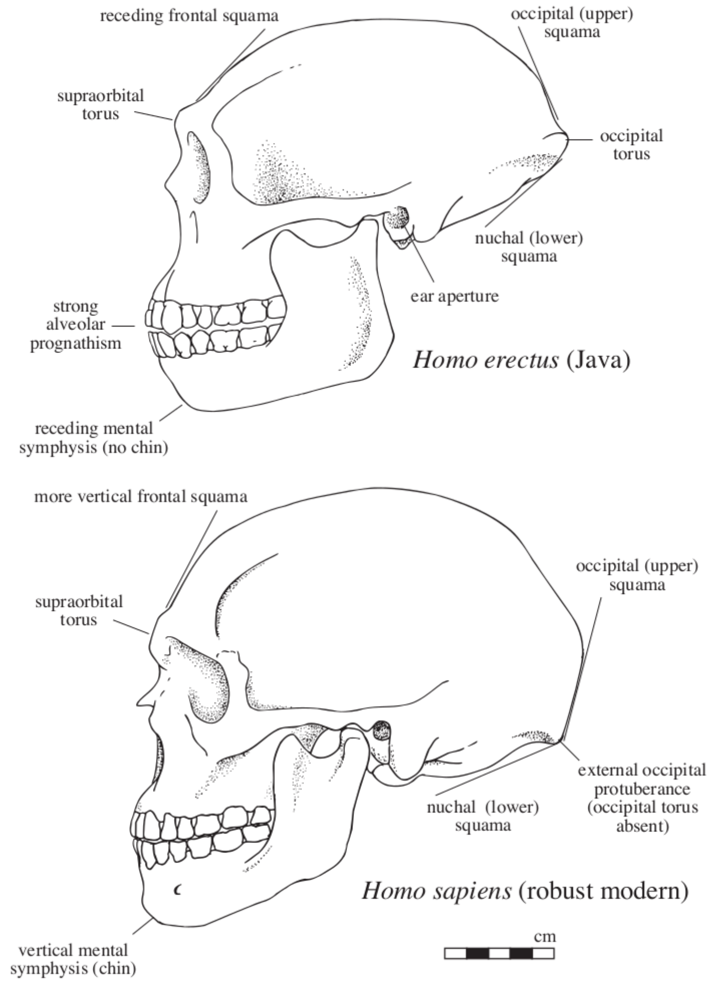
Klein (2009), p. 726.

Cranial Morphology

Typical features for distinction:

- **Globularity** (globular vs. flat)
- **Occipital torus** (rounded vs. angled)
- **Supraorbital torus** (robust vs. less pronounced)
- **Mandibular chin** (vertical vs. receding)
- **Facial angle** (orthognathic vs. prognathic)

Note: Some anatomical variation due to sexual dimorphism.

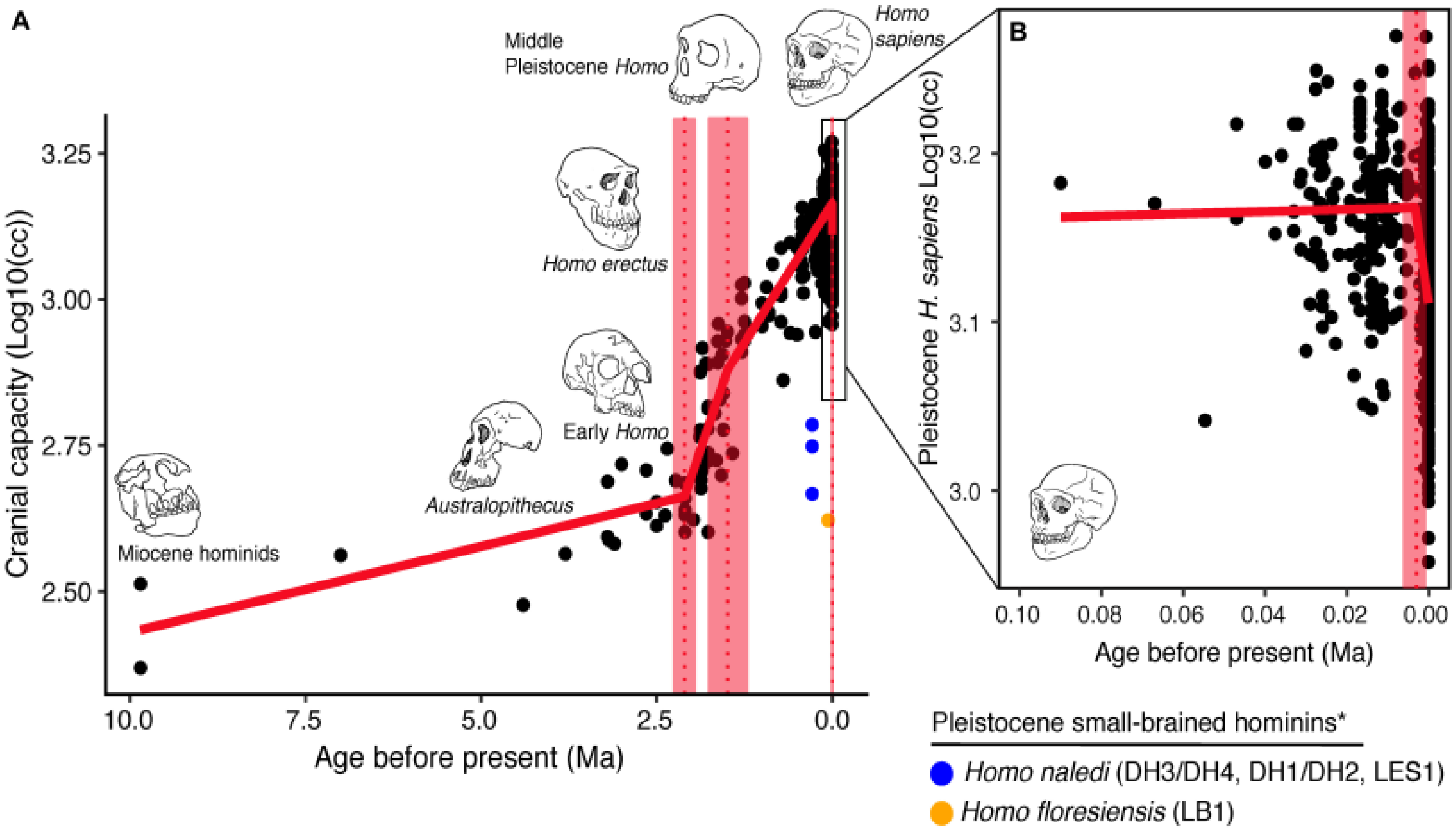


Klein (2009).

Cranial Capacity (Homo naledi vs. Homo sapiens)

https://www.nationalgeographic.com/history/article/150910-human-evolution-change

Cranial Capacity



DeSilva et al. (2021). When and why did human brains decrease in size?
DeSilva et al. (2023). Human brains have shrunk: the questions are *when* and *why*.

Conclusions by DeSilva et al. (2021).

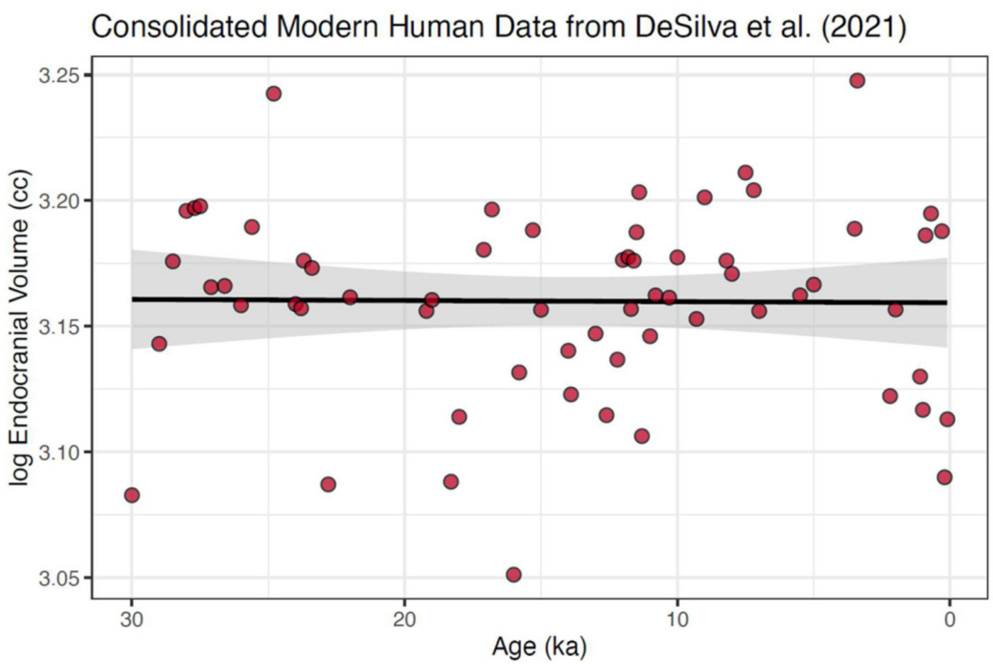
- “We find that hominin brains experienced positive rate changes at 2.1 and 1.5 million years ago, coincident with the early evolution of *Homo* and *technological innovations* evident in the archeological record.”
- “[...] human brain size reduction was surprisingly recent, *occurring in the last 3,000 years*. Our dating does not support hypotheses concerning brain size reduction as a by-product of body size reduction, a result of a shift to an agricultural diet, or a consequence of self-domestication.”
- “[...] decrease in brain size may instead result from the *externalization of knowledge* and advantages of group-level decision-making due in part to the advent of social systems of distributed cognition and the storage and sharing of information.”

DeSilva et al. (2021) When and why did human brains decrease in size?

However ...

"Our analysis of these data fails to **find a decrease in human brain size** over the last few thousands of years. When the large sample sizes of the most recent human samples are adjusted for, the pattern disappears [...]"

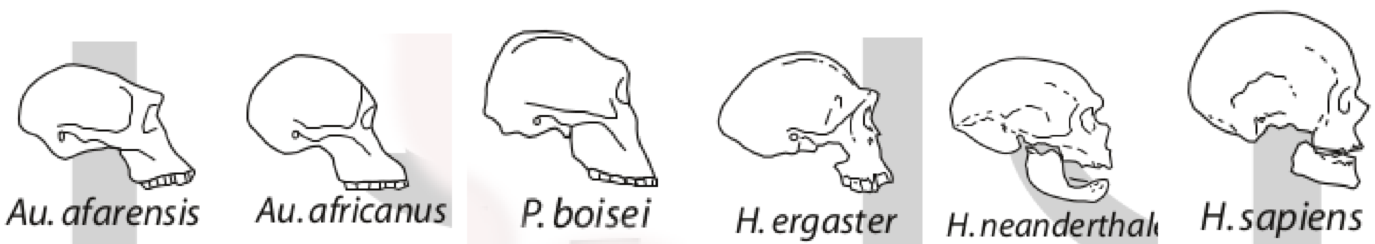
Villamoare & Grabowski (2022). Did the transition to complex societies in the Holocene drive a reduction in brain size?



Exercise

For the following specimen crania, prepare a table with the *binary feature values* for the following features: *globularity, occipital torus, supraorbital torus, mandibular chin, facial angle*.

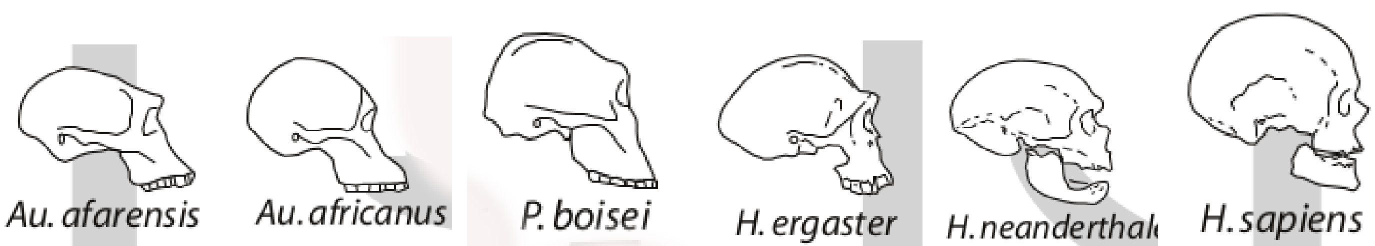
Does the *H. sapiens* cranium have more in common in terms of these feature values with the species in its *direct lineage* than with other hominin species?



Solution

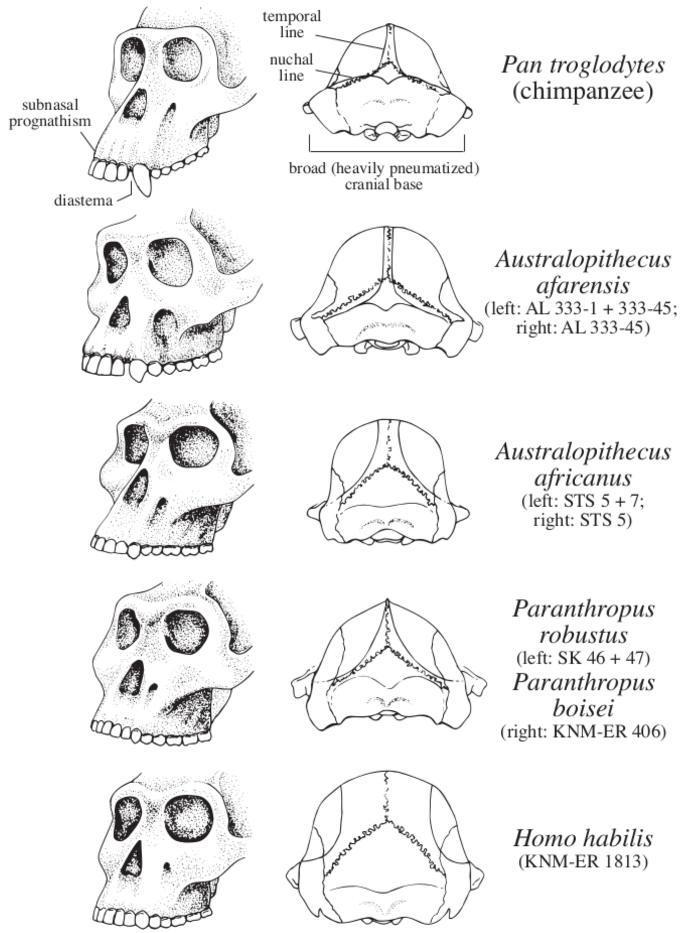
Species	globularity	occ. tor.	supraorb. tor.	chin	face
Au. afar.	flat	angled	robust	NA	progn.
Au. afric.	globular	round	non-robust	NA	progn.
P. boisei	flat	angled	robust	NA	progn.
H. ergaster	flat	angled	robust	NA	progn.
H. neand.	flat	angled	robust	receding	progn.
H. sapiens	globular	round	non-robust	vertical	orthogn.

The H. sapiens cranium seems to have most features in common with the Au. africanus, which is not in its direct lineage (as far as the tree by Klein 2009 is concerned).



Dental Morphology

FIGURE 4.28. Facial and occipital views of *Pan troglodytes* (chimpanzee), *Australopithecus afarensis*, *A. africanus*, *Paranthropus robustus*, *P. boisei*, and *Homo habilis* (redrawn after White et al. [1981], figs. 9, 10). Note that *A. afarensis* and the chimpanzee share pronounced subnasal prognathism, relatively large anterior teeth, a diastema between the lateral incisor and the canine, confluence of the temporal and nuchal lines, great breadth of the cranial base, and other features. Note also that *A. afarensis* differs from other hominins in all these respects. *AL* = Hadar; *STS* = Sterkfontein; *SK* = Swartkrans; *KNM-ER* = Kenya National Museum East Rudolf.



Klein (2009).

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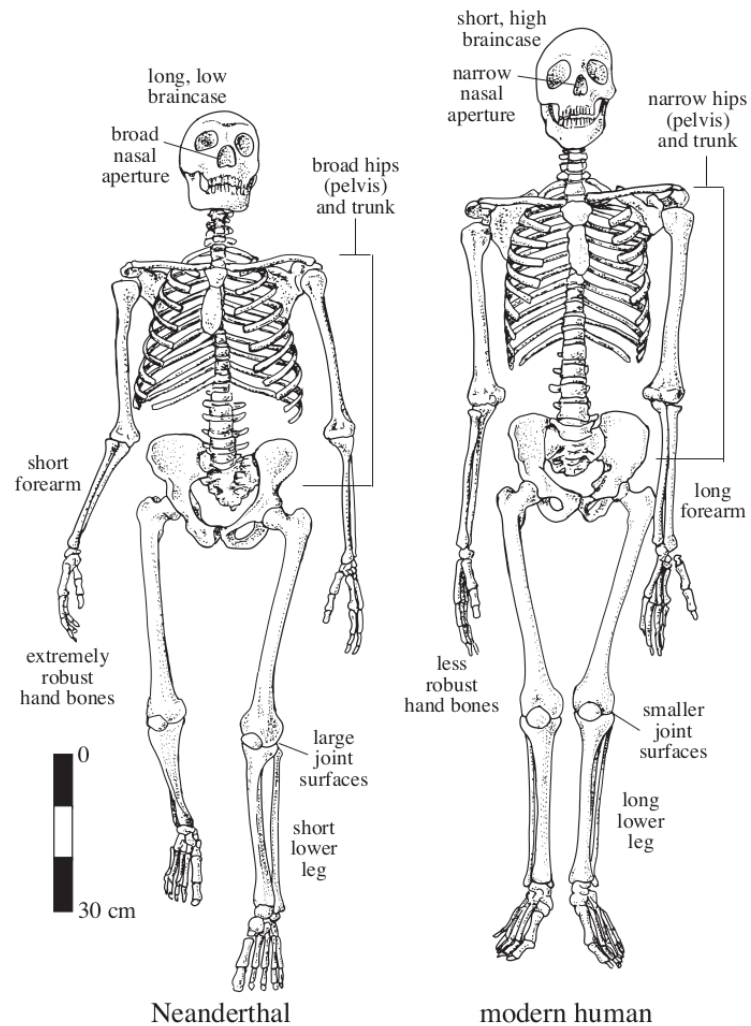
Postcranial Morphology

Postcranial Morphology

In *H. sapiens* compared to earlier species of genus *Homo*, we typically find:

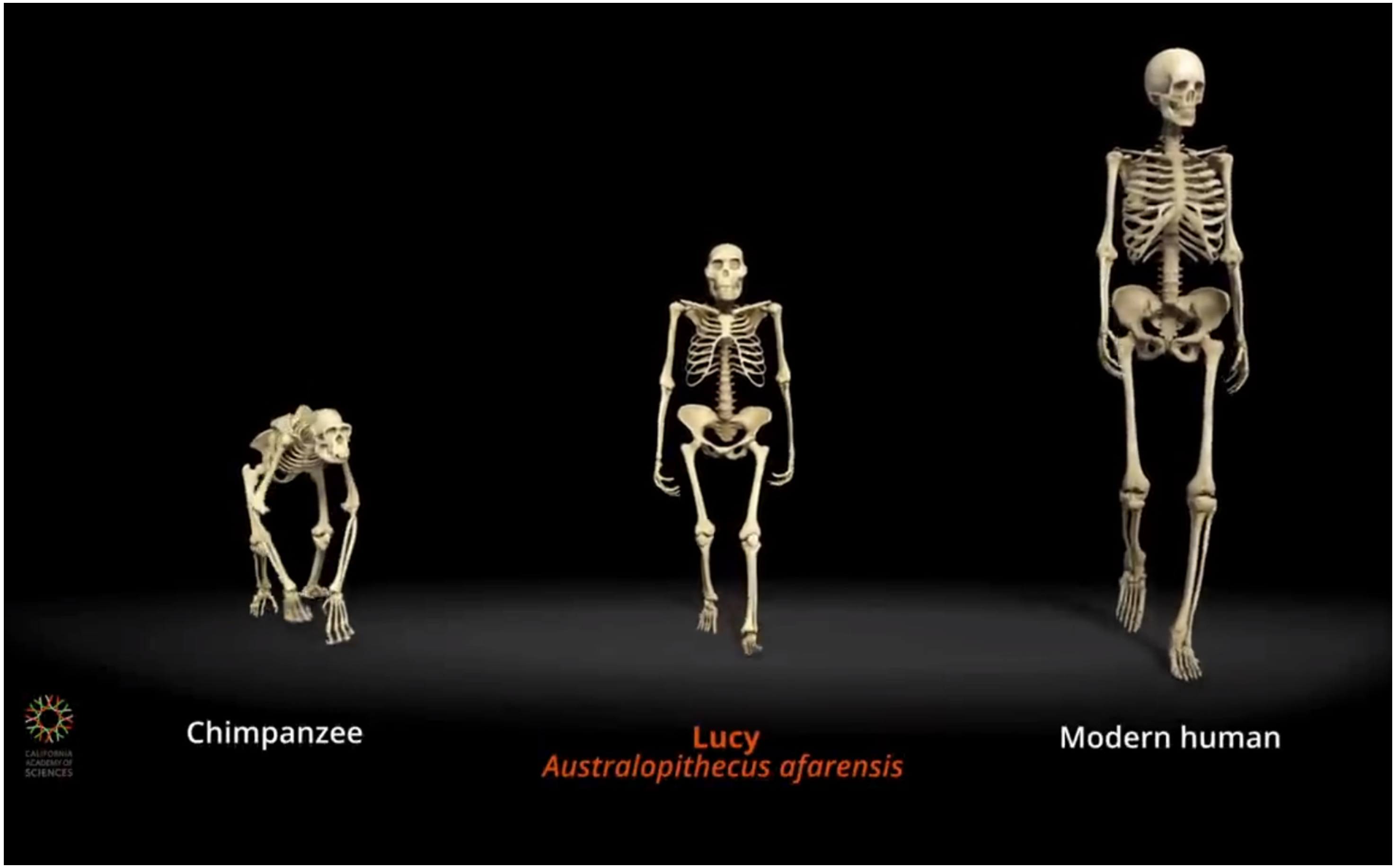
- **Long limbs**
- **Narrow thorax**
- **Narrow hips**
- More **gracile bones**

Note: We still find some variation across world populations due to *drift* and *adaptations*. Cranial and pelvic structure evolves mostly neutrally, while limbs (and likely the thorax) are more plastic and subject to adaptation.



Klein (2009).

Locomotion Comparison



https://www.youtube.com/watch?v=xT8Np0gI1dI

Section 4: Geometric Morphometrics

Linear measurements vs. landmarks

Traditional morphometric analyses would use **linear measurements** (between predefined points) for univariate or multivariate analyses. More recently, these points themselves – i.e. the so-called **landmarks** – are considered as the 2D or 3D representation of the fossil (with scaling and normalizations).

Baab et al. (2012). The shape of human evolution: A geometric morphometrics perspective.

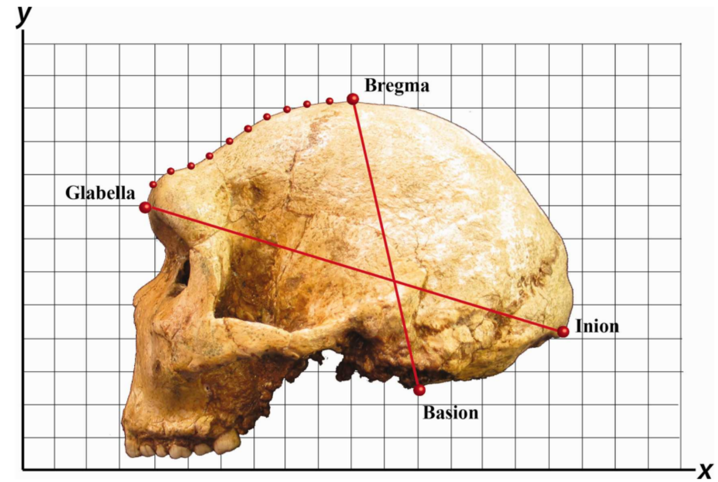


Figure 2. Example of two simple interpoint measurements, basion to bregma and inion to glabella. (Color figure can be viewed in the online issue, which is available at wileyonlinelibrary.com.)

TABLE 1. Comparison of Measurement Data Derived from Linear and Coordinate Data

Type of data	Measurement	Data
Linear	basion - bregma	9.7
	inion - glabella	13.1
Coordinate (*x*, *y*)	basion	12, 2.4
	bregma	10, 11.3
	inion	16.5, 4.1
	glabella	3.8, 8.0

Landmark Example (LB1)

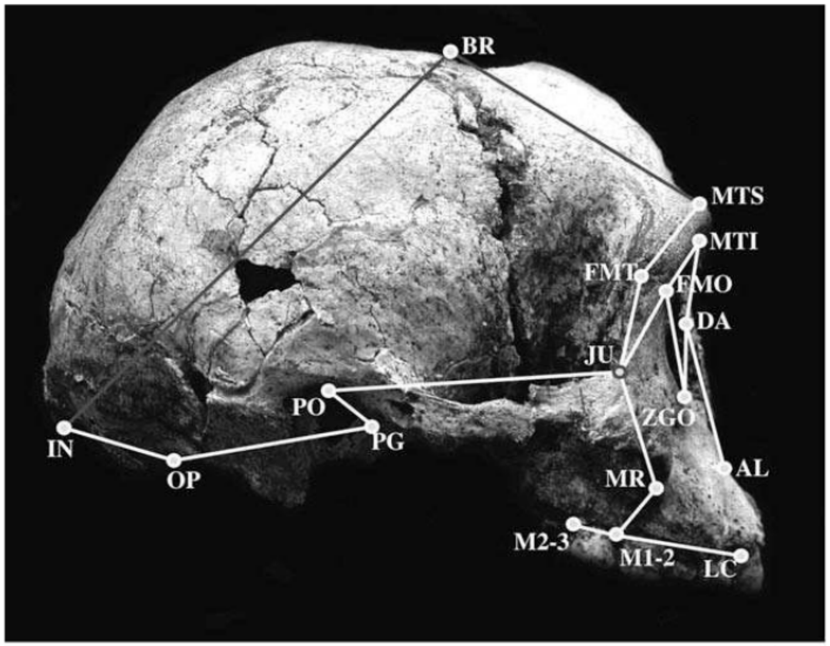


Photo courtesy P. Brown

Fig. 1. The neurocranium + face landmark set illustrated on the LB1 cranium. The wireframe connecting landmarks is for visualization purposes and does not represent actual data. Landmark abbreviations and definitions can be found in Table 2. The OP and LCAN landmarks are not actually visible in this view but their approximate positions are indicated.

BR: Bregma
IN: Inion
MTS: Mid-Torus Superior
MTI: Mid-Torus Inferior
LC: Lingual Canine margin
PG: Postglenoid
etc.

Baab & McNulty (2008). Size, shape, and asymmetry in fossil hominins: The status of the LB1 cranium based on 3D morphometric analyses.

Principal Component Analysis (PCA) Example

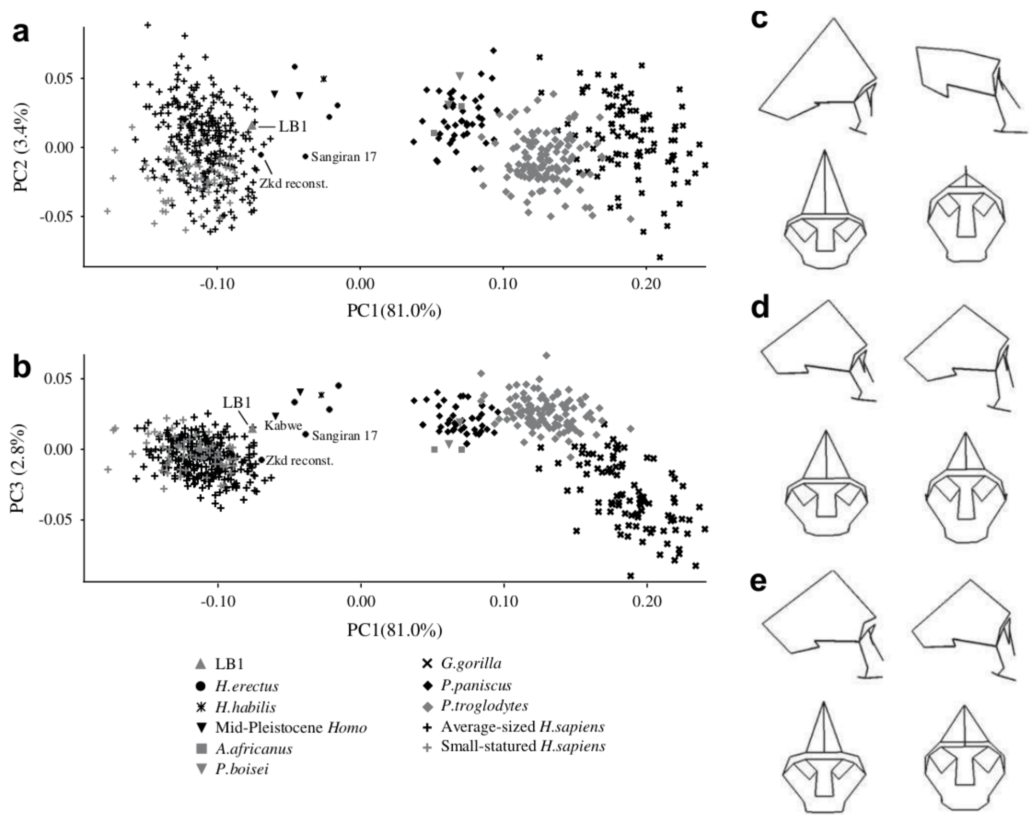


Fig. 3. (a) Plot of PC 1 vs. PC 2 and (b) PC 1 vs. PC 3 of neurocranium + face PCA. The cranial shape associated with the negative (left column) and positive (right column) ends of (c) PC 1, (d) PC 2, and (e) PC3, in right lateral and anterior views. Wireframe refers to that illustrated in Fig. 1.

Baab & McNulty (2008). Size, shape, and asymmetry in fossil hominins: The status of the LB1 cranium based on 3D morphometric analyses.

Conclusions by Baab & McNulty(2008).

- "The cranial morphology of LB1 clearly aligns it with the **genus Homo**, even though LB1 is smaller in both body and brain size than any other members of our genus."
- "[...] the cranial shape of LB1 largely fits a model for a small specimen of **archaic Homo**."
- "[...] it is unnecessary to postulate additional factors, such as microcephaly, in the absence of strong evidence to support this claim."

Baab & McNulty (2008). Size, shape, and asymmetry in fossil hominins: The status of the LB1 cranium based on 3D morphometric analyses.

Summary

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- Some recently discovered hominin fossils include: *Homo naledi*, *Homo floresiensis*, *Homo luzonensis*. These illustrate that there were **sister lineages with unexpected features** (small brains, small stature, robust features) living alongside *Homo sapiens* in Africa and across the world until fairly recently ($<$100 Kya).
- The distinctive **morphological features** of hominin species include: **globularity**, shape of **occipital torus**, **brow ridges** (supraorbital torus), **chin**, and **facial angle**, the breadth of **thorax**, **body size**, and **cranial capacity**.
- Appart from qualitative assessments of these features, **geometric morphometrics** offers finer-grained statistical analyses.

References

References

Berger et al. (2013). Homo naledi, a new species of the genus Homo from the Dinaledi Chamber, South Africa. *eLIFE*.

Chen et al. (2019). A late Middle Pleistocene Denisovan mandible from the Tibetan Plateau. *Nature*.

Hawks et al. (2017). New fossil remains of Homo naledi from the Lesedi Chamber, South Africa. *eLIFE*.

Hublin, J. et al. (2017). New fossils from Jebel Irhoud, Morocco and the pan-African origin of Homo sapiens. *Nature*.

Klein, Richard G. (2009). *The human career. Human biological and cultural origins. Chicago/London: The University of Chicago Press.*

Klein, Richard G. (2017). Language and human evolution. *Journal of Neurolinguistics*.

Wood, B. and Richmond, B. G. (2000). Human evolution : taxonomy and paleobiology. *The Journal of Anatomy*.

Thank You.

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