



Language Evolution WiSe 2023/2024

Lecture 16: Revision & Allocation of Projects

19/12/2023, Christian Bentz



Overview

Section 1: Organization

Exam

Schedule

Course Summary

Lecture 2 & 3: Hominin Fossils

Lecture 4: Archaeology

Lecture 5 & 6: Genetics and Dispersals

Lecture 7: Language Evolution Theories

Lectures 8-10: Formal and Statistical Approaches

Lectures 11-14: Experimental & Evolutionary Semiotics

Lectures 15: Animal Communication

Projects



Section 1: Organization



ALMA

Remember to sign up on ALMA for the **Exam**, and for the **Project** (if you want the additional 6 ECTS).

Section 1:
Organization

Course Summary

Projects



Course Credits

- ▶ Exam on **Thursday 21st December 2023: 6 ECTS**
- ▶ Research Project: presentation in one of the slots in 2024. **6 ECTS**

Section 1:
Organization

Course Summary

Projects



Exam

- ▶ Exam on **21.12. at 14.15pm** in Room 181, Keplerstraße 2 (i.e. the lecture room).
- ▶ You can bring a one page A4 “cheat sheet”.
- ▶ You can bring a calculator, but the tasks should be doable without.

Section 1:
Organization

Course Summary

Projects



Schedule (2023)

24/10/2023	Lecture 1	Organization & Introduction
26/10/2023	Lecture 2	Human Evolution I: Hominin Fossils
31/10/2023	Lecture 3	Human Evolution II: Morphology
02/11/2023	Lecture 4	Human Evolution III: Archaeology
07/11/2023	Lecture 5	Human Evolution IV: Genetics
09/11/2023	Lecture 6	Human Evolution V: Dispersals
14/11/2023	Lecture 7	Language Evolution: Theories
16/11/2023	Lecture 8	Methods I: Formal Language Theory
21/11/2023	Lecture 9	Methods II: Quantitative Linguistics
23/11/2023	Lecture 10	Methods III: Information Theory
28/11/2023	Lecture 11	Methods IV: Experiments
30/11/2023	Lecture 12	Current Topics: Evolutionary Semiotics I
05/12/2023	Lecture 13	Current Topics: Evolutionary Semiotics II (online)
07/12/2023	Lecture 14	Current Topics: Evolutionary Semiotics III (online)
12/12/2023	Lecture 15	Current Topics: Animal Communication
19/12/2023	Lecture 16	Revision & Allocations of Projects
21/12/2023	Lecture 17	Exam

Section 1:
Organization

Course Summary

Projects



Course Summary

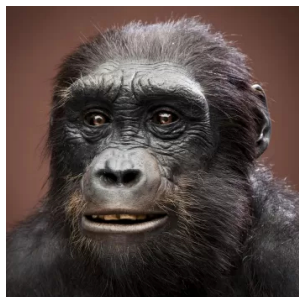


Lecture 2 & 3: Hominin Fossils

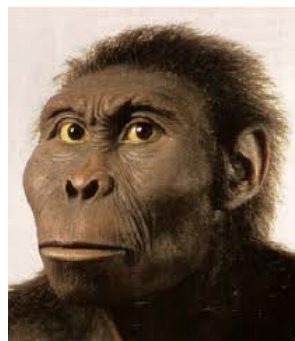


Summary: Hominin Fossils (before *Homo*)

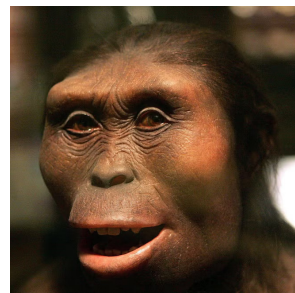
Sahelanthropus
tchadensis



Kenyanthropus
platyops



Australopithecus
afarensis



Paranthropus
boisei



Section 1:
Organization

Course Summary

Projects



Summary: Hominin Fossils (genus *Homo*)

Homo habilis



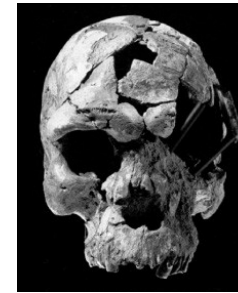
Homo erectus



Homo neand.



Homo sapiens



Section 1:
Organization

Course Summary

Projects



Summary: New members of the Hominin family

Homo naledi



Denisovans



Homo flor.



Homo luz.



Homo longi(?)



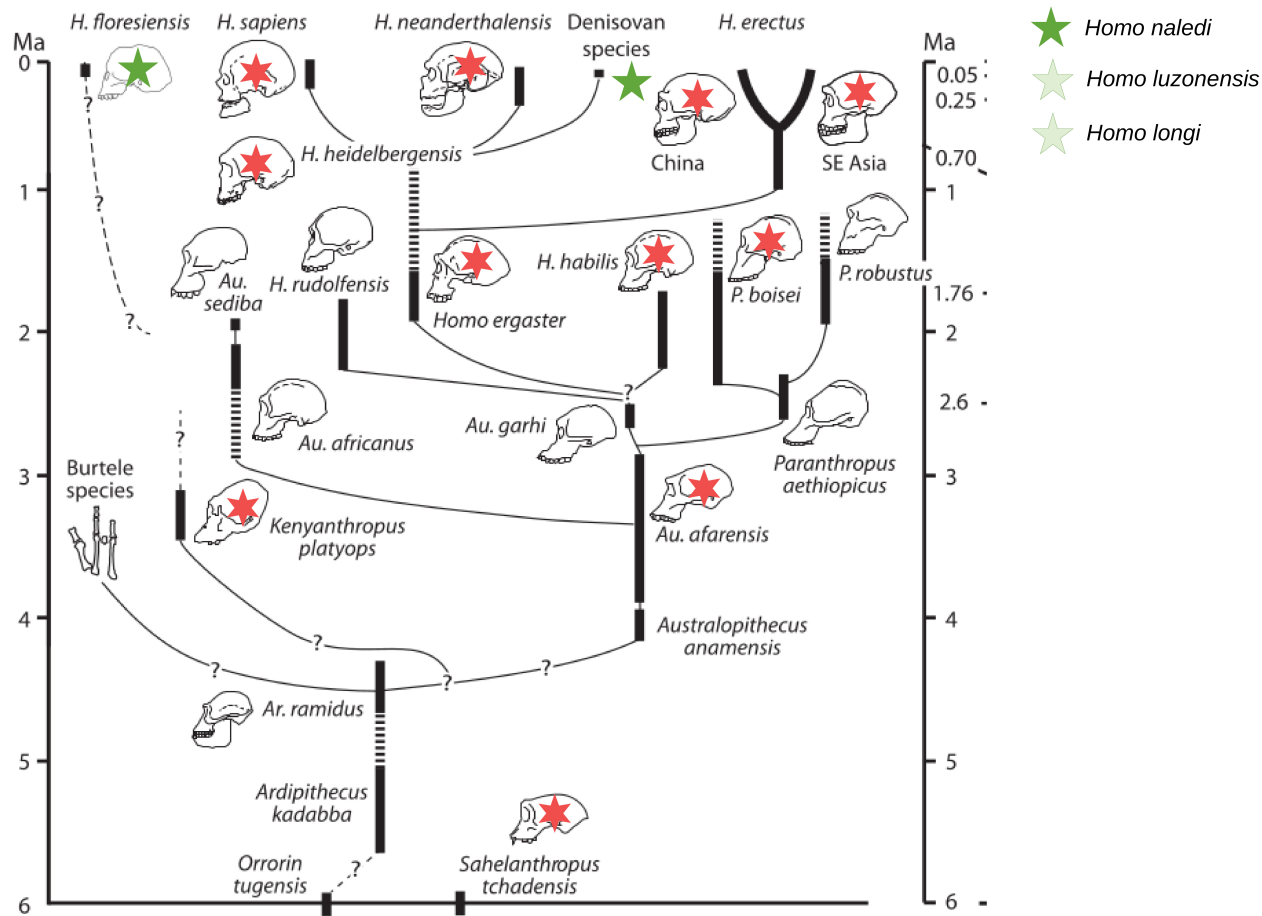
Section 1:
Organization

Course Summary

Projects



Summary: Hominin Fossils in Time



Section 1:
Organization

Course Summary

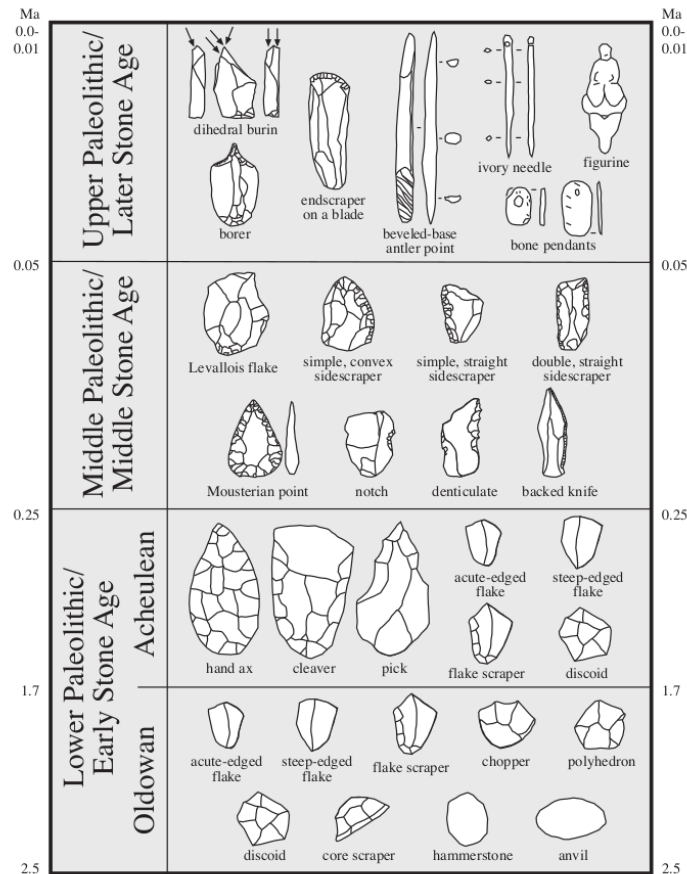
Projects



Lecture 4: Archaeology



Stone Tools: Overview



Notes:

– The terms *Lower, Middle and Upper Paleolithic* in Eurasia correspond (roughly) to *Early, Middle, and Late Stone Age* in Africa (often abbreviated ESA, MSA, LSA).

– The Lomekwian industry is not included here. This would extend the Lower Paleolithic further back to c. 3.3 Mya.

Section 1:
Organization

Course Summary

Projects

Klein (2009), p. 727



Solution: Hominin species and Stone Tools

Oldowan: *Homo habilis*, *Paranthropus*, etc.

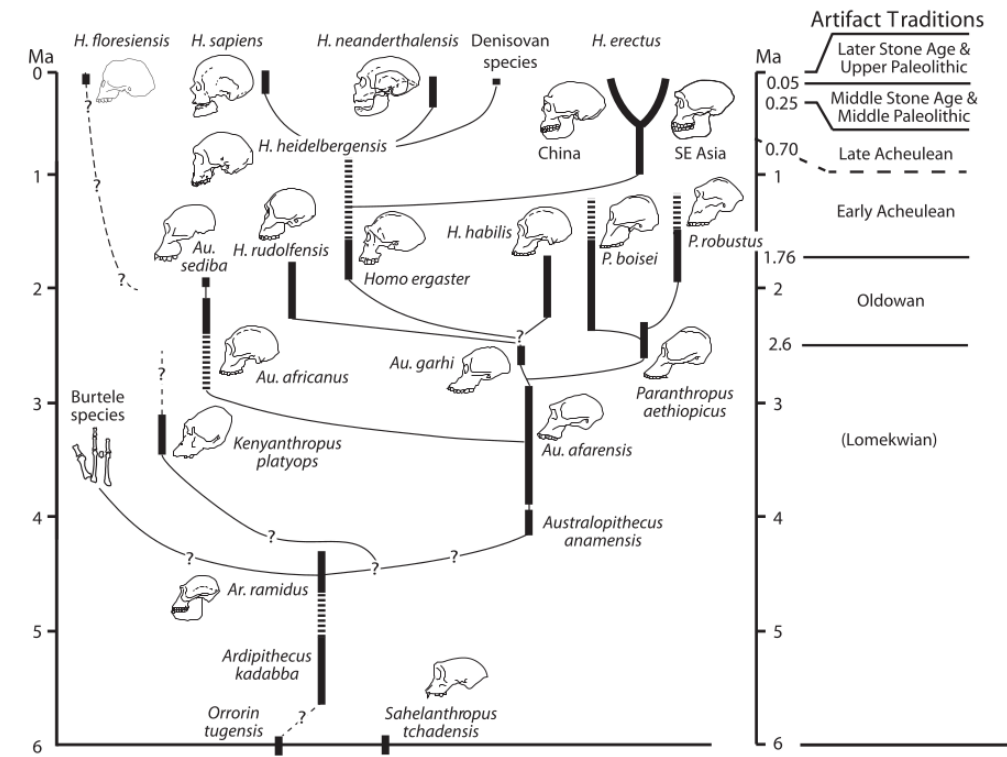
Acheulean: *Homo habilis*, *Homo ergaster* (*erectus*), etc.

Levallois: *Homo neanderthalensis*, Denisovans, etc.¹

Section 1:
Organization

Course Summary

Projects



¹I name here just the species which are typically associated with these industries.



Lecture 5 & 6: Genetics and Dispersals



Genetics: Summary

- ▶ Modern humans have **c. 20k genes**, i.e. regions on the DNA strands which code for *proteins* and hence shape the phenotype.
- ▶ These are packaged into **46 (23 pairs) of chromosomes**.
- ▶ Genetic diversity is ensured by **random segregation** (splitting of chromatid sisters), and **recombination** of homologous chromosomes in gametogenesis.
- ▶ Different **types of mutations** (pointwise, frameshift, chromosomal) will yield new phenotypes under selection (or neutral).

Section 1:
Organization

Course Summary

Projects



Out of Africa Dispersals

These recent finds and datings add nuance to the traditional idea that *Homo erectus* was the first hominin to leave Africa around 1.8 Mya. There were probably earlier dispersals.

Scardia et al. (2020). What kind of hominin first left Africa?

Section 1:
Organization

Course Summary

Projects

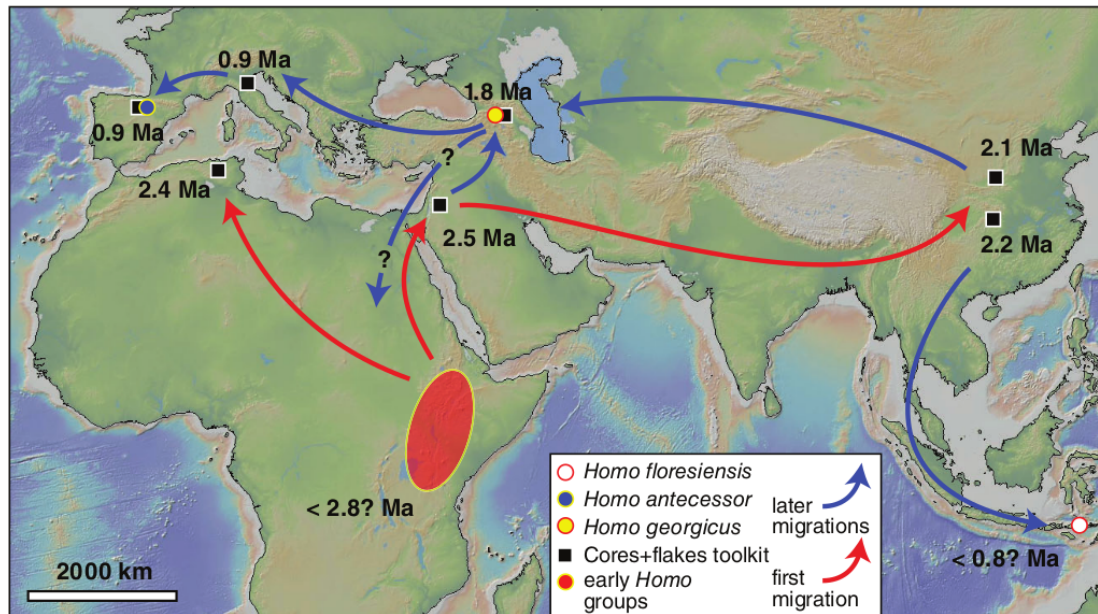


FIGURE 2 Tentative scenario for the first Out of Africa expansion at ca. 2.5 Ma according to the recent findings from Jordan and China, and later migrations stemming from the early *Homo* lineage. See text for discussion and references



Lecture 7: Language Evolution Theories



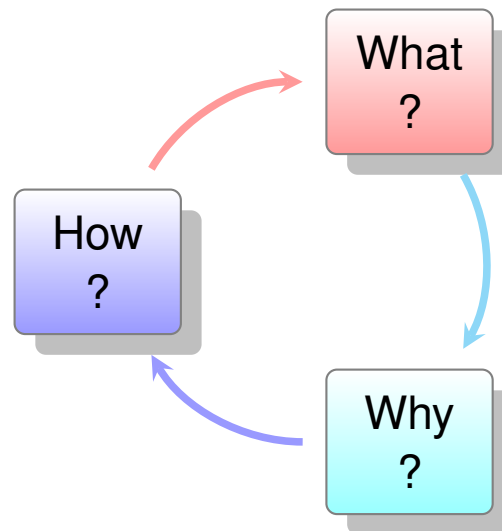
Three Questions

1. **What** evolved, i.e. what is “language” in the first place?
2. **Why** did it evolve, i.e. did it have particular functions?
3. **How** did it evolve?

Section 1:
Organization

Course Summary

Projects





Competing Definitions of *Language*

- ▶ **Formal Language Theory**
- ▶ **Faculty of Language**
 - ▶ Recursion
 - ▶ Rich Language Faculty (Narrow Sense)
- ▶ **Minimalism**
 - ▶ Strong Minimalist Thesis
 - ▶ Minimalist Layers Hypothesis
- ▶ **Usage-Based Grammar**
- ▶ **Combinatoriality and Compositionality**

Section 1:
Organization

Course Summary

Projects



Evolutionary Functions: *Why* did Language evolve?

- ▶ **Vocal Communication**
- ▶ **Gestural Communication**
- ▶ **Social Bonding** (Grooming/Gossiping)
- ▶ **Thinking**
- ▶ **No Function**

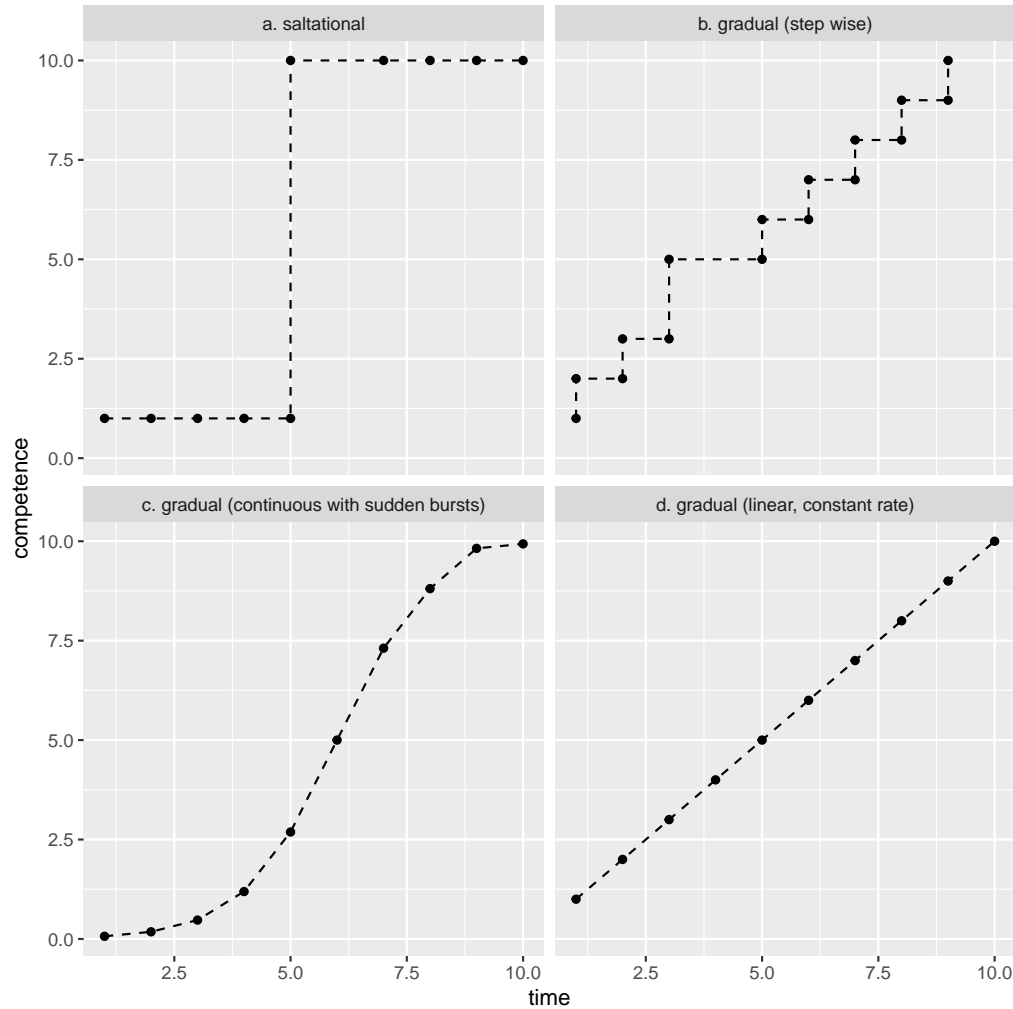
Section 1:
Organization

Course Summary

Projects



How did Language evolve?



Section 1:
Organization

Course Summary

Projects



Lectures 8, 9 & 10: Formal and Statistical Approaches



Chomsky Hierarchy

- ▶ Regular (Type 3):
 $X \rightarrow x, X \rightarrow xY$ (or Yx)
- ▶ Context-free (Type 2):
 $X \rightarrow \beta$
- ▶ Context-sensitive (Type 1):
 $l(\alpha) \leq l(\beta)$
- ▶ Recursively enumerable (Type 0):
 $\alpha \rightarrow \beta$

Section 1:
Organization

Course Summary

Projects



Quantitative Linguistics & Information Theory

Section 1:
Organization

Course Summary

Projects

- ▶ Type-Token Ratio (TTR):

$$TTR = \frac{V}{\sum_{i=1}^V f_i}$$

- ▶ Repetition Rate (R):

$$R = \frac{r}{\sum_{i=1}^V f_i - 1}$$

- ▶ Maximum likelihood (ML) estimation of probabilities:

$$\hat{p}(x_i) = \frac{f_i}{\sum_i^V f_i}$$

- ▶ Information Content (Surprisal):

$$I(x) = -\log_2 p(x) = \log_2 \frac{1}{p(x)}$$

- ▶ Entropy (H): $H(X) = -\sum_{i=1}^V p(x_i) \log_2 p(x_i),$



Lectures 11-14: Experimental & Evolutionary Semiotics



Semiotics (Peirce)

“I extend logic to embrace all the necessary principles of semeiotic, and I recognize a logic of **icons**, and a logic of **indices** as well as a logic of **symbols**; [...]”

Peirce (2016). Prolegomena to a science of reasoning, p. 86.

Note: In Peirce’s terminology these are all *signs*.



huǒ
火
Fire

Icon: A sign which represents the object by means of **resemblance/similarity**.

Index: A sign which is typically in a **co-occurrence relation** with the object it represents.

Symbol: A sign with an **arbitrary relation** to an object, **conventionally** used by interpretes to be also understood by other interpretes.

Section 1:
Organization

Course Summary

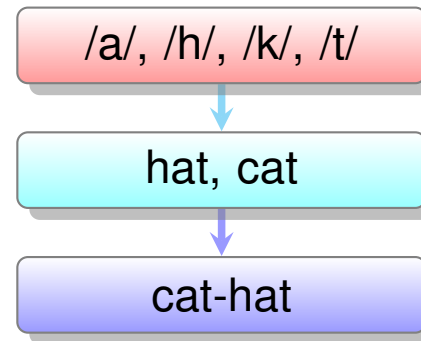
Projects



Duality of Patterning

“Language is structured on at least two levels (Hockett, 1960). On one level, a small number of **meaningless building blocks** (phonemes, or parts of syllables for instance) are combined into an **unlimited set of utterances** (words and morphemes). This is known as **combinatorial structure**. On the other level, meaningful building blocks (words and morphemes) are combined into **larger meaningful utterances** (phrases and sentences). This is known as **compositional structure**.”

Little et al. (2017), p. 1.



Section 1:
Organization

Course Summary

Projects



Lectures 15: Animal Communication



Summary: Great Ape Research

- ▶ Early experiments (mid 20th century) on **vocal learning** of chimpanzees failed largely to illustrate capacities anywhere close to human infants.
- ▶ At roughly the same time, it was illustrated that chimpanzees (and other apes) can **use gestures and signs in combinations** (compositionality) in an **enculturated** context.
- ▶ Systematic observations and experiments **in the wild** have been conducted since the early 21st century.
- ▶ Very recently, some evidence has been brought forward suggesting that chimpanzees use gesture types and vocalizations in **meaningful combinations**.

Section 1:
Organization

Course Summary

Projects



Projects



Schedule (2024)

Section 1:
Organization

Course Summary

Projects

- 09/01/2024 **Lecture 18** Hao-han Yu (Project 7: Time Depth)
- 11/01/2024 **Lecture 19** Ruiyu Wang (Project 1: Sign Entropy)*
Ruitong Liu (Project 1: Sign Entropy)*
- 16/01/2024 **Lecture 20** Anne Honold (Project 6: Compositionality)
Alexandra Din (Project 7: Time Depth)*
- 18/01/2024 **Lecture 21** Valentin Pickard (Project 8: Bird Song)
- 23/01/2024 **Lecture 22** Matthias Drews (Project 9: Primate Com.)
- 25/01/2024 **Lecture 23** Nikita Beklemishev (Project 10: Whale Song)
- 30/01/2024 **Lecture 24** Yanxing Yang (Project 5: Cave Signs)
- 01/02/2024 **Lecture 25** Zhexuan Li (Project 5: Cave Signs)
- 06/02/2024 **Lecture 26** Kimberly Sharp (Project 4: Calendars)
- 08/02/2024 **Lecture 27** Yueyun Xiao (Project 4: Calendars)

*online via videos

*online via zoom



Projects

- ▶ Choose a topic (latest by **friday 22nd December**).
- ▶ Prepare data analyses – or reviews of articles.
- ▶ Prepare presentation (c. 60 mins).
- ▶ Send presentation to me **one week before** your time slot.
- ▶ Prepare final version.
- ▶ Present results + discussion (30 mins) in plenum.

Section 1:
Organization

Course Summary

Projects



Project 1: Analyzing the Mammoth and Red Deer Teeth Data

Take the codings of students provided in this course (will be shared on github repo) for the **mammoth figurine** and **red deer teeth**, and calculate the entropies, repetition rates for these. How robust are the differences? That is, are there significant divergences between the sequences of the mammoth vs. deer teeth despite variability in codings?

Section 1:
Organization

Course Summary

Projects



Project 2: Experiment with Sign Intensionality

Use a sample of drawings of the patterns found in the Lower, Middle and Upper Paleolithic as discussed in the lecture (see also <https://www.signbase.org/>), and replicate the **intensionality experiment** in Tylén et al. (2020) with these. That is, are the later patterns (e.g. Upper Paleolithic) identified as *more intensional* by participants in an experiment?

Section 1:
Organization

Course Summary

Projects



Project 3: Experiment with Sign Codings

Use a sample of drawings of the patterns found in the Lower, Middle and Upper Paleolithic as discussed in the lecture (see also <https://www.signbase.org/>). Have participants (ideally 20) in an experiment encode what they see on these objects. Calculate the agreement in codings for the different objects and periods.

Section 1:
Organization

Course Summary

Projects



Project 4: Phenological Calendars

Get the data from Bacon et al. (2023) on phenological calendars in cave art, and compare this to the data from SignBase (<https://www.signbase.org/>). Are there similar strings found in the SignBase data on mobile objects, especially for the zoomorph figurines?

Section 1:
Organization

Course Summary

Projects



Project 5: Distribution of Geometric Signs in Caves

Find 3D models of caves (e.g. Lascaux) online and prepare **maps of geometric marks**. Review the hypothesis of Leroi-Gourhan, namely, that certain types of geometric marks are found in the entrance, alongside panels with animals, and in the deepest parts of caves. Beware: the respective literature by Leroi-Gourhan is mostly available only in French.

Section 1:
Organization

Course Summary

Projects



Project 6: Combinatoriality and Compositionality in Primate Communication

Provide an overview of the literature (last c. 20 years) of **combinatoriality and compositionality in primate communication**. Illustrate the findings on a primate family tree. Discuss the evidence for whether combinatoriality/compositionality evolved several times independently in the primate lineage, or whether they go back to the last common ancestor.

Section 1:
Organization

Course Summary

Projects



Project 7: Time Depth of Human Language

Provide an overview of the literature about **when human language evolved** (i.e. actual time before present or hominin species). Discuss how these time depths are connected to the evolutionary frameworks (*what?*, *how?*, *why?*) which the respective researchers adhere to.

Section 1:
Organization

Course Summary

Projects



Project 8: Birdsong

Use the **birdsong database** at <http://taylor0.biology.ucla.edu/birdDBQuery> and compare these transliterations to written languages in terms of entropy, repetition rate, and TTR. **Alternatively:** Give simplest re-write rules according to the Chomsky hierarchy. A cross-linguistic corpus (TeDDi) for comparison available at <https://drive.switch.ch/index.php/s/MJv7xFkzqlzFn0y>.

Section 1:
Organization

Course Summary

Projects



Project 9: Primate Communication

Find transliterations of **primate communication** (chimpanzees, bonobos, gorillas, etc.). Compare these transliterations in terms of entropy, TTR, repetition rates to human languages. A cross-linguistic corpus (TeDDi) for comparison available at <https://drive.switch.ch/index.php/s/MJv7xFkzqlzFn0y>.

Section 1:
Organization

Course Summary

Projects



Project 10: Cetacean Communication

Find transliterations of **cetacean communication** (sperm whales, killer whales, dolphins, etc.) and compare these transliterations to written languages in terms of entropy, repetition rate, and TTR. A cross-linguistic corpus (TeDDi) for comparison available at <https://drive.switch.ch/index.php/s/MJv7xFkzqlzFn0y>.

Section 1:
Organization

Course Summary

Projects



Thank You.

Contact:

Faculty of Philosophy

General Linguistics

Dr. Christian Bentz

SFS Keplerstraße 2, Room 168

chris@christianbentz.de

Office hours:

During term: Wednesdays 10-11am

Out of term: arrange via e-mail