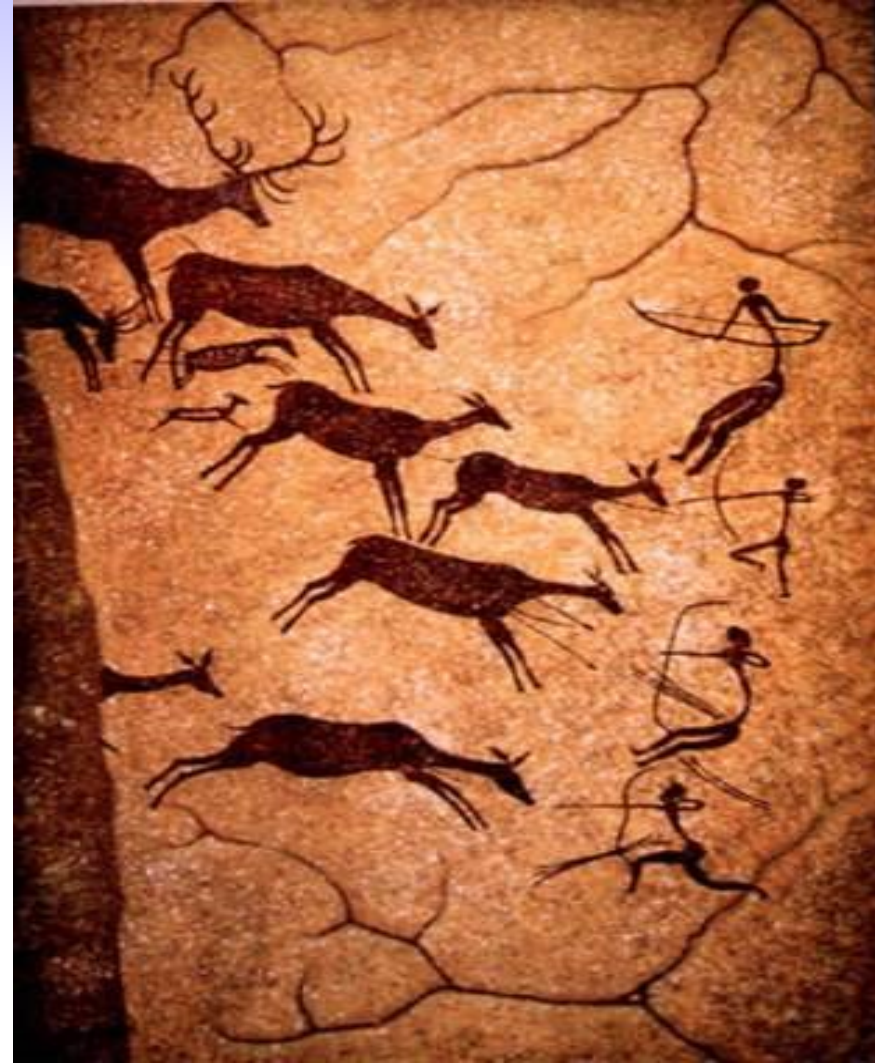


# *Lecture 4: Human Origins & Language Origins*

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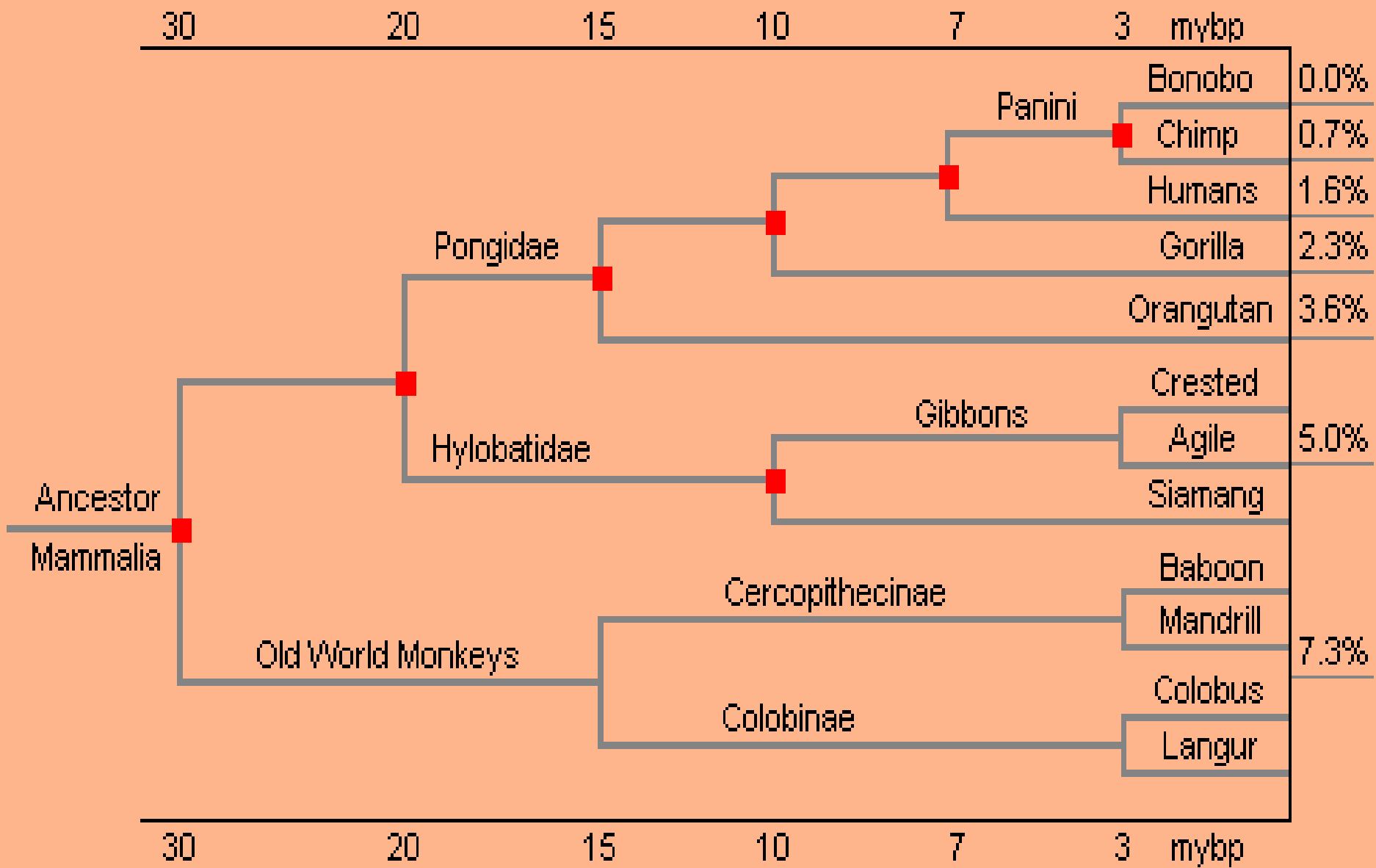
Evolution of Language'14



# Outline

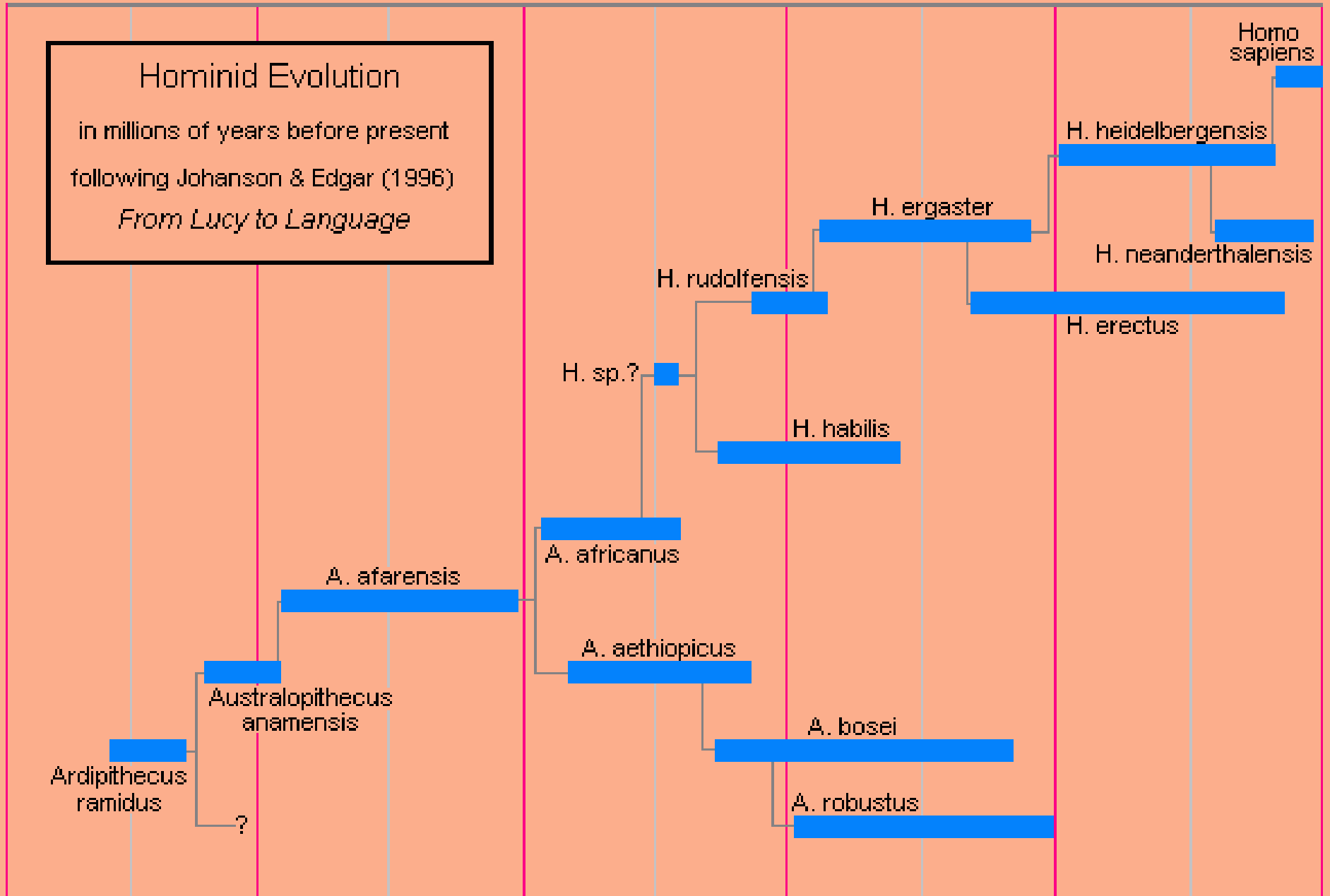
- Human origins: when did humanness evolve?
- Scenarios for the evolution of humanness
  - Language-first, Intelligence-first, Massive modularity
- Can we assess *evolutionary* plausibility?
  - Limited time & unusual traits
    - Hidden potential scenarios preferred
    - Common cause scenarios preferred
    - Self-reinforcement scenarios preferred

# Genetic Change Over Time (millions of years) Among the Primates



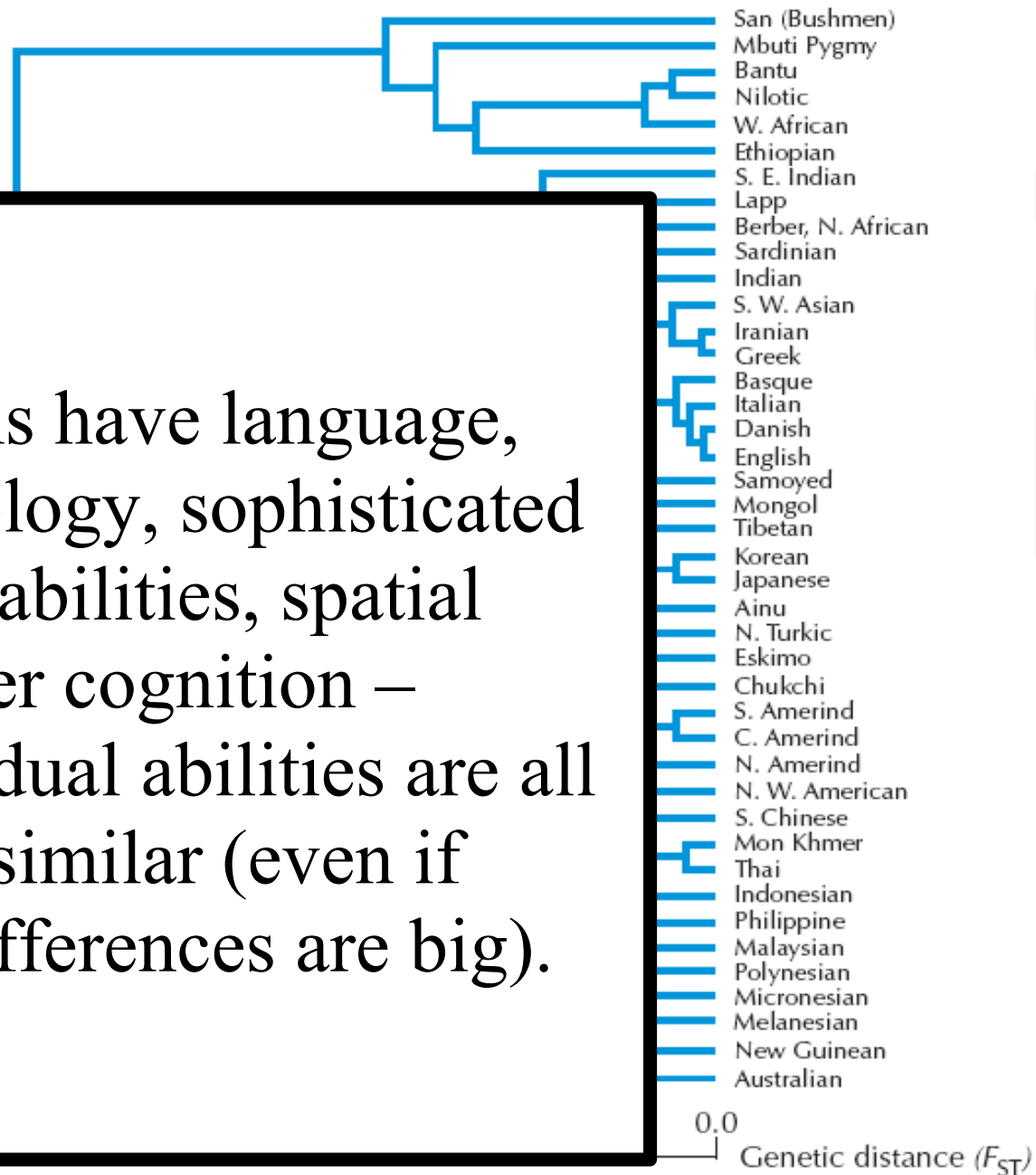
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Hominid Evolution  
in millions of years before present  
following Johanson & Edgar (1996)  
*From Lucy to Language*

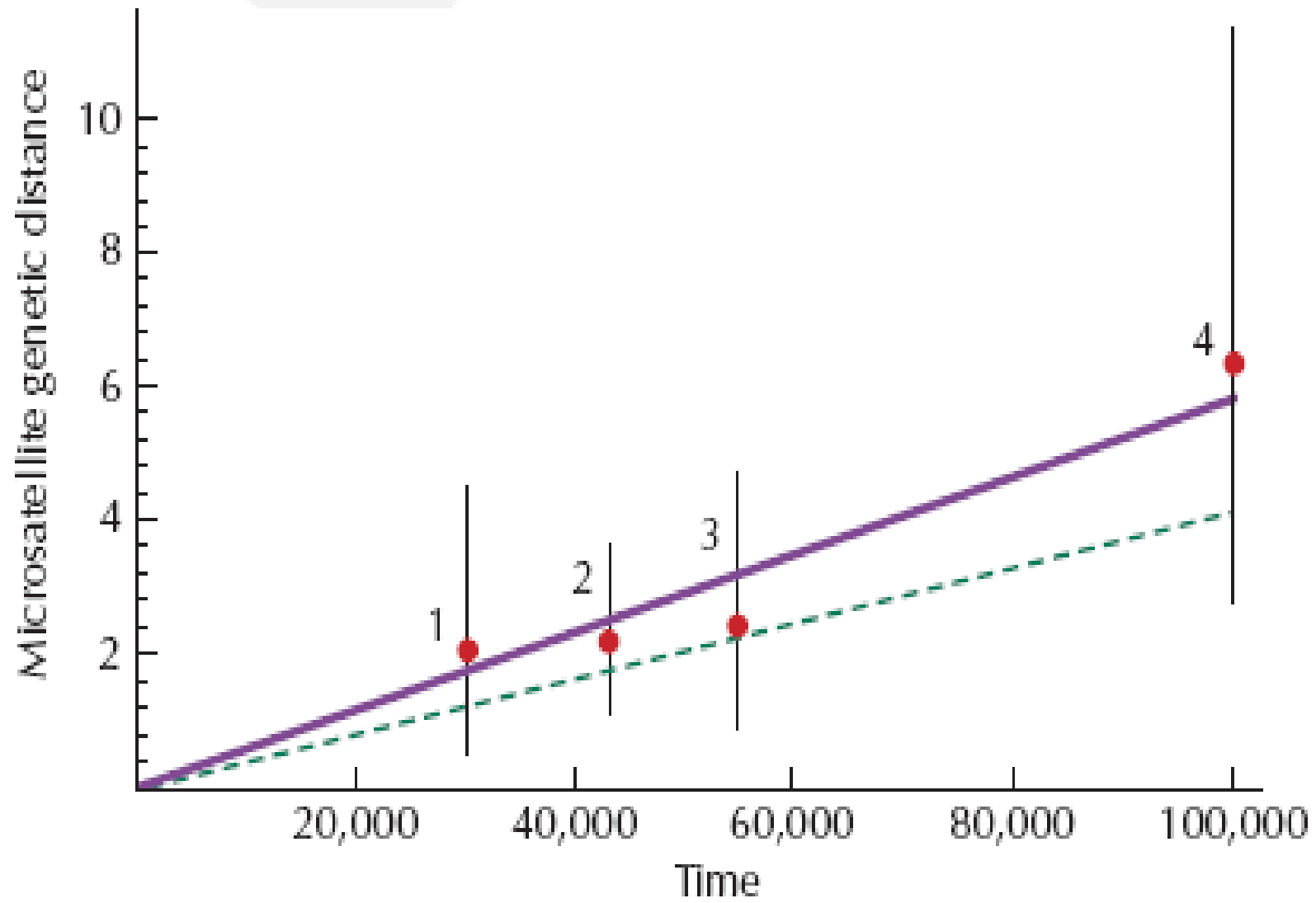


5 4.5 4 3.5 3 2.5 2 1.5 1 .5 0

All humans have language, art, technology, sophisticated reasoning abilities, spatial and number cognition – and individual abilities are all relatively similar (even if cultural differences are big).



**FIGURE 25.19.** Average linkage tree for 42 populations. The genetic distance (*bottom*) was calculated on the basis of 120 allele frequencies.



# Story of human evolution

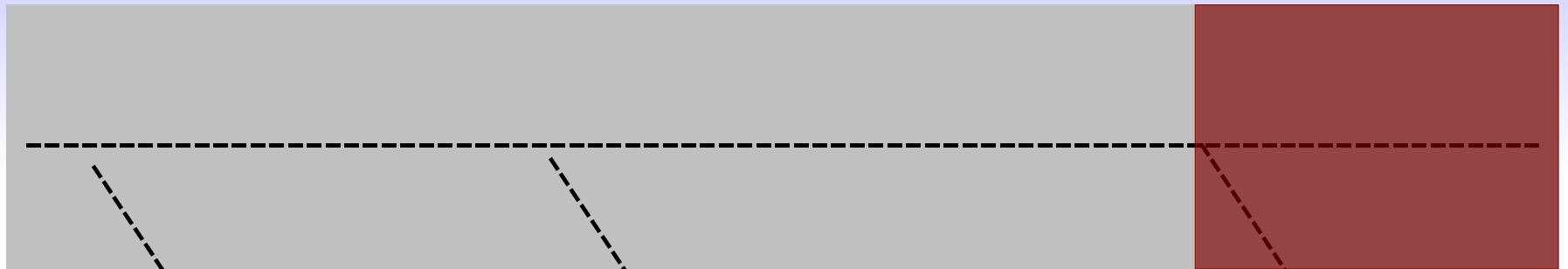
30 million yrs

20

15

7

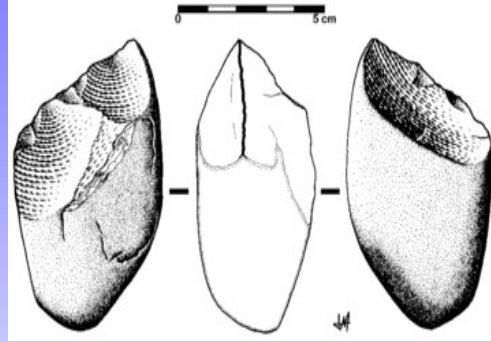
1



Monkeys

Gibbons

Chimpansees



Oldowan

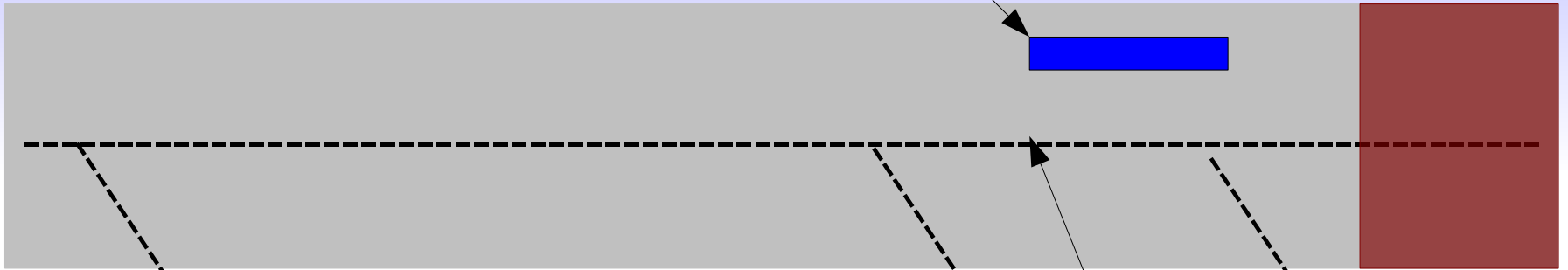
7 million yrs

3

2.5

1.5

1



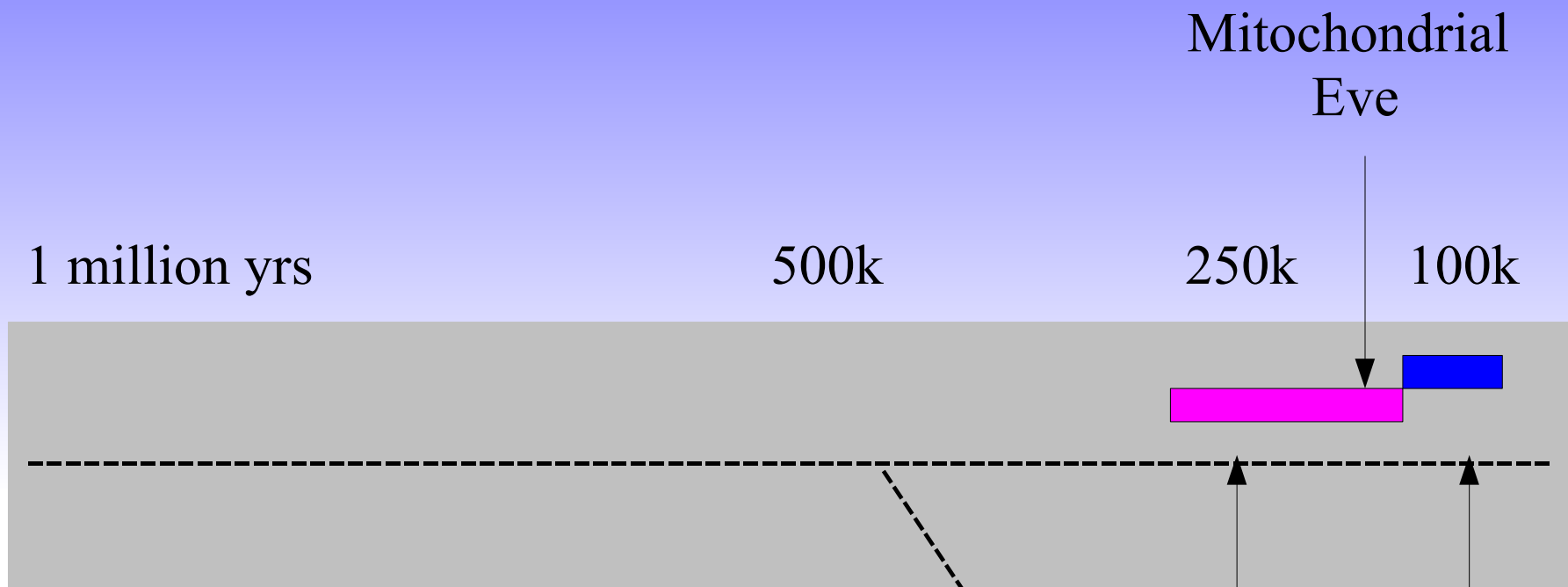
Chimpansees

Australopithecus

Homo  
genus

Ergaster

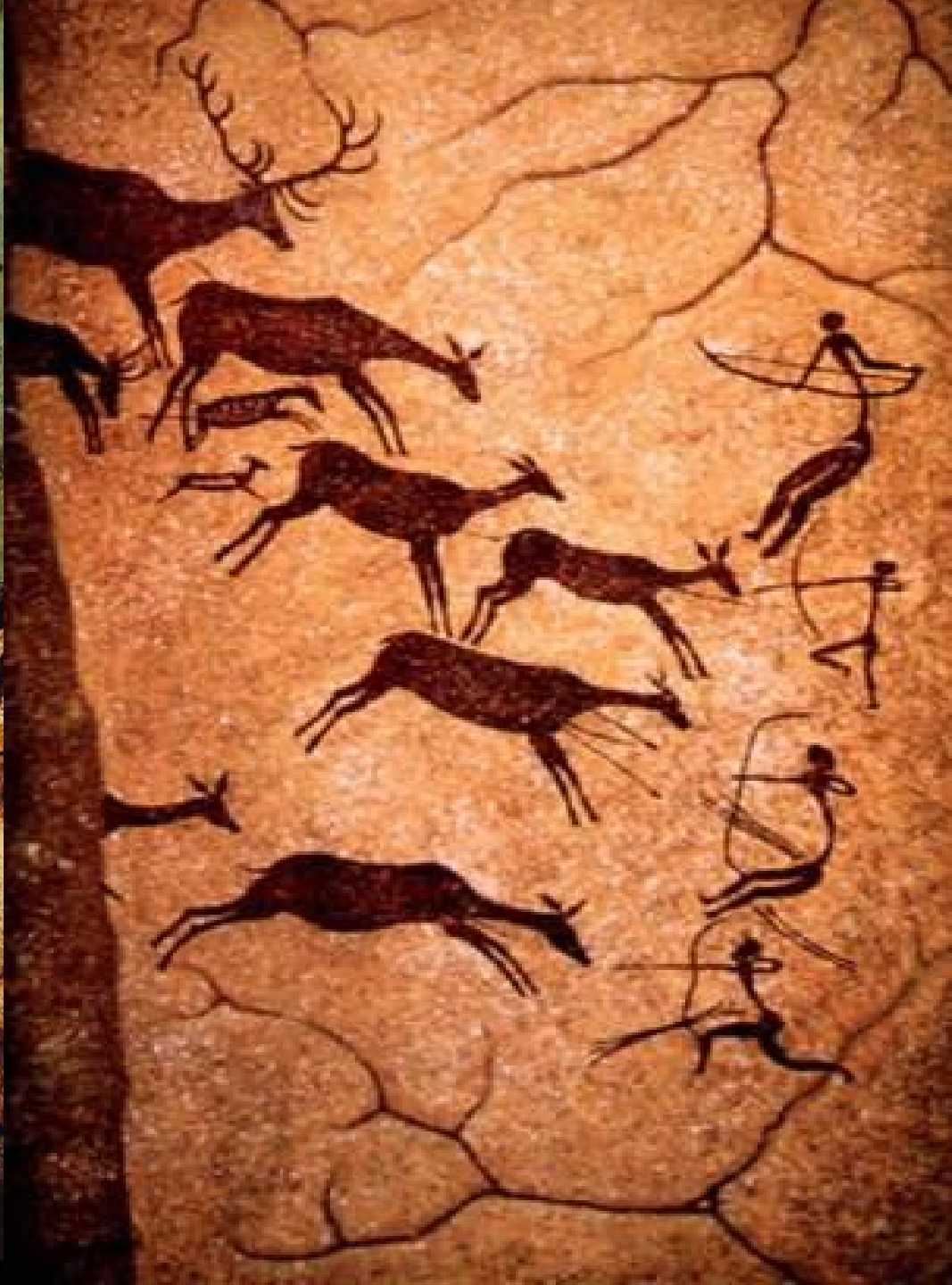




Neanderthals

Homo Sapiens Art





# The 'humanness' package

- Language
- Complex reasoning
- Mathematics
- Music
- Consciousness
- Music
- Cooperativity
- Life history, upright posture, opposable thumb, running

# What has happened?

- Earliest evidence for some (very limited) aspects of 'humanness' 2.5My BP
- Last common ancestor all humans:
  - 140Ky-290Ky BP (mtDNA)
  - 70Ky BP (Ychromosome)
- Between 2.5My and 100,000 years BP something very significant has happened in hominin evolution!

# Three scenarios

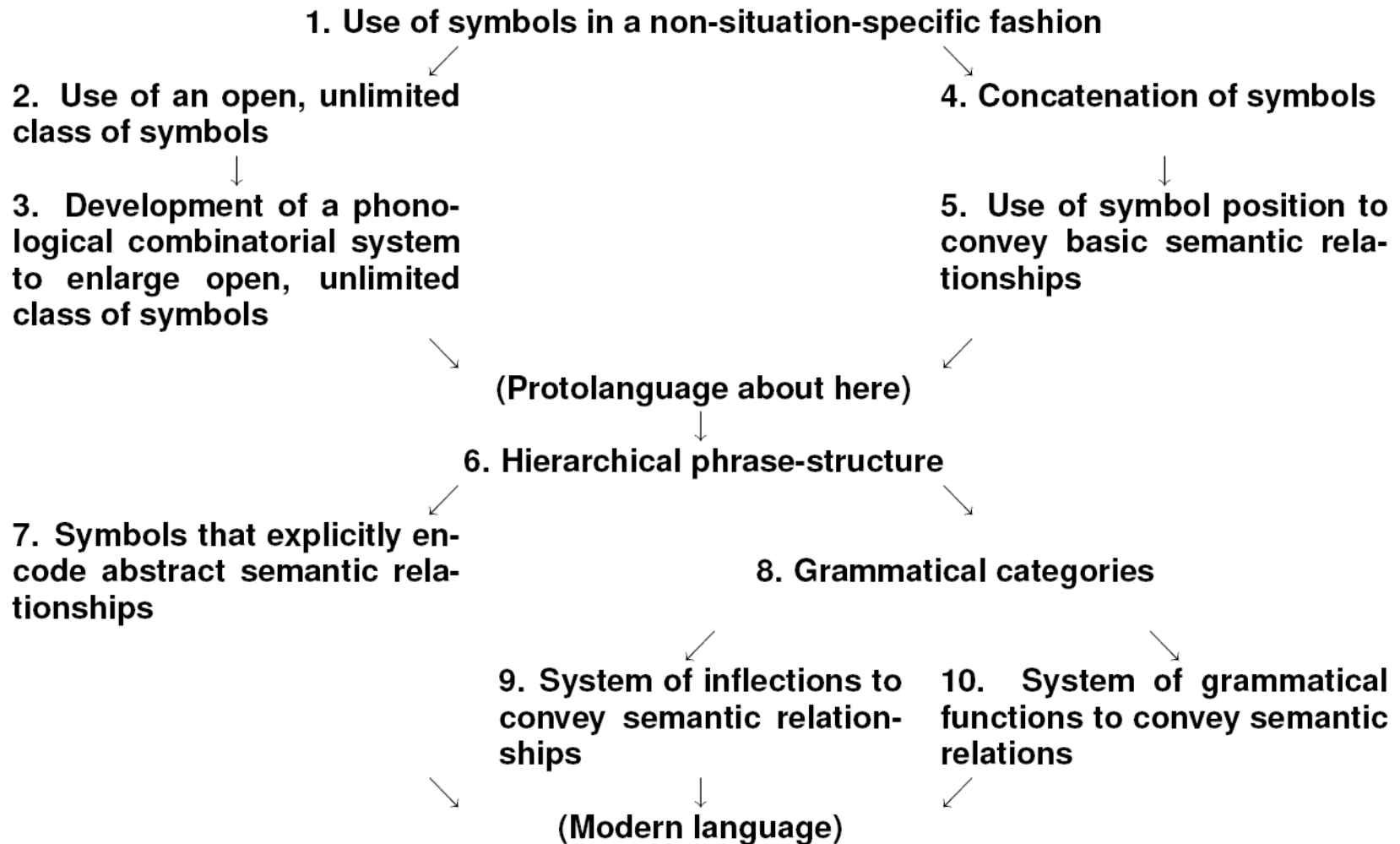
- “Language-first scenario”: humans discovered language, and language made us smart
- “Intelligence-first scenario”: human intelligence increased and affected many other human cognitive traits (once it reached a threshold)
- “Massive modularity scenario”: human specific traits are modules, evolved one by one under selection pressure of savannah life

# Scenarios of language evolution

- Language-specific mechanisms, gradualist evolution: Pinker & Bloom'90, Jackendoff'02
- Language-specific mechanisms, saltationist evolution: Bickerton'90, Chomsky
- General cognitive mechanisms, ~saltationist evolution: Tomasello
- (Modified) general cognitive mechanisms, gradualist evolution: Deacon'97

# Language-specific, gradualist scenario

(e.g., Jackendoff 2002)

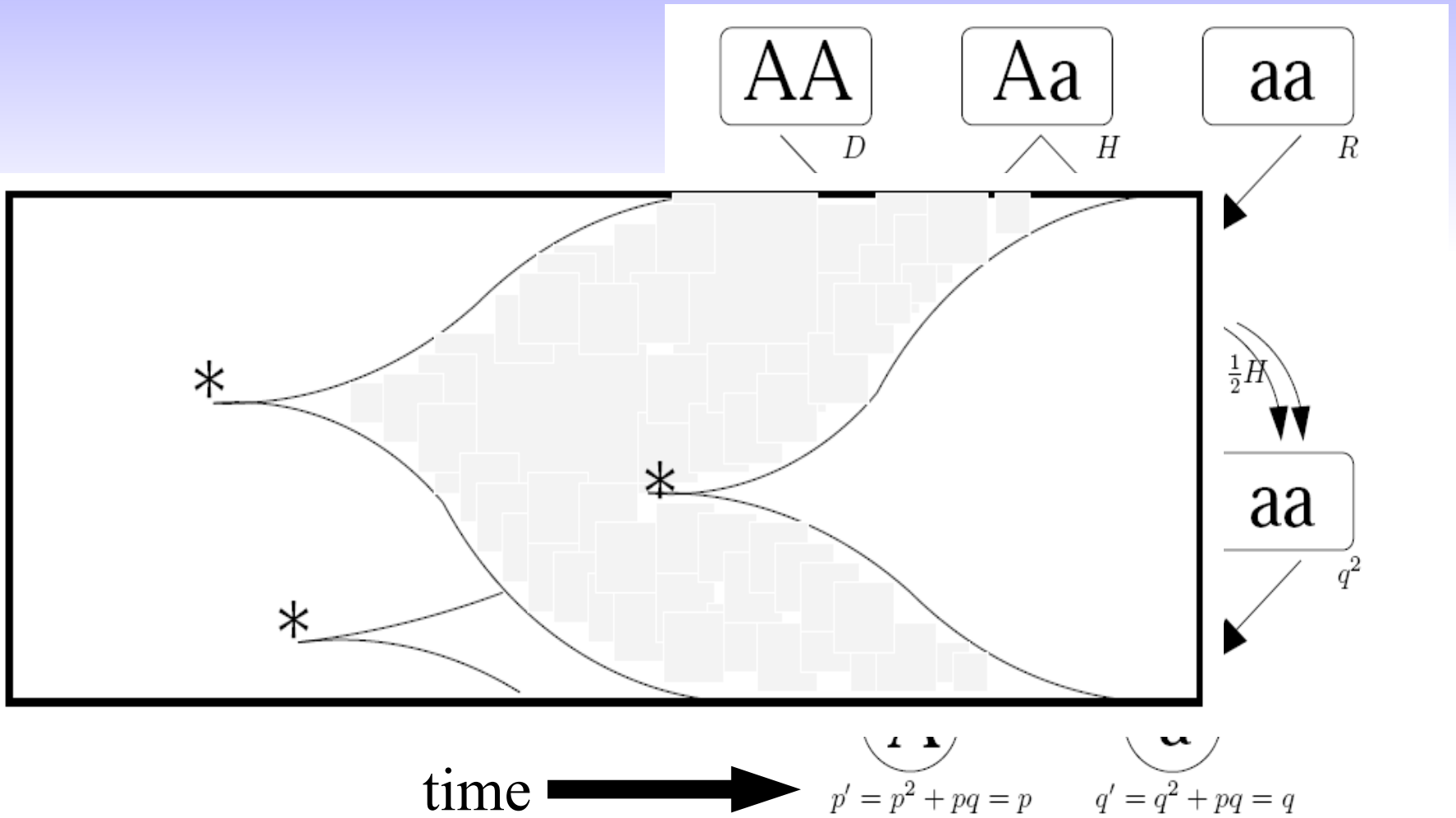


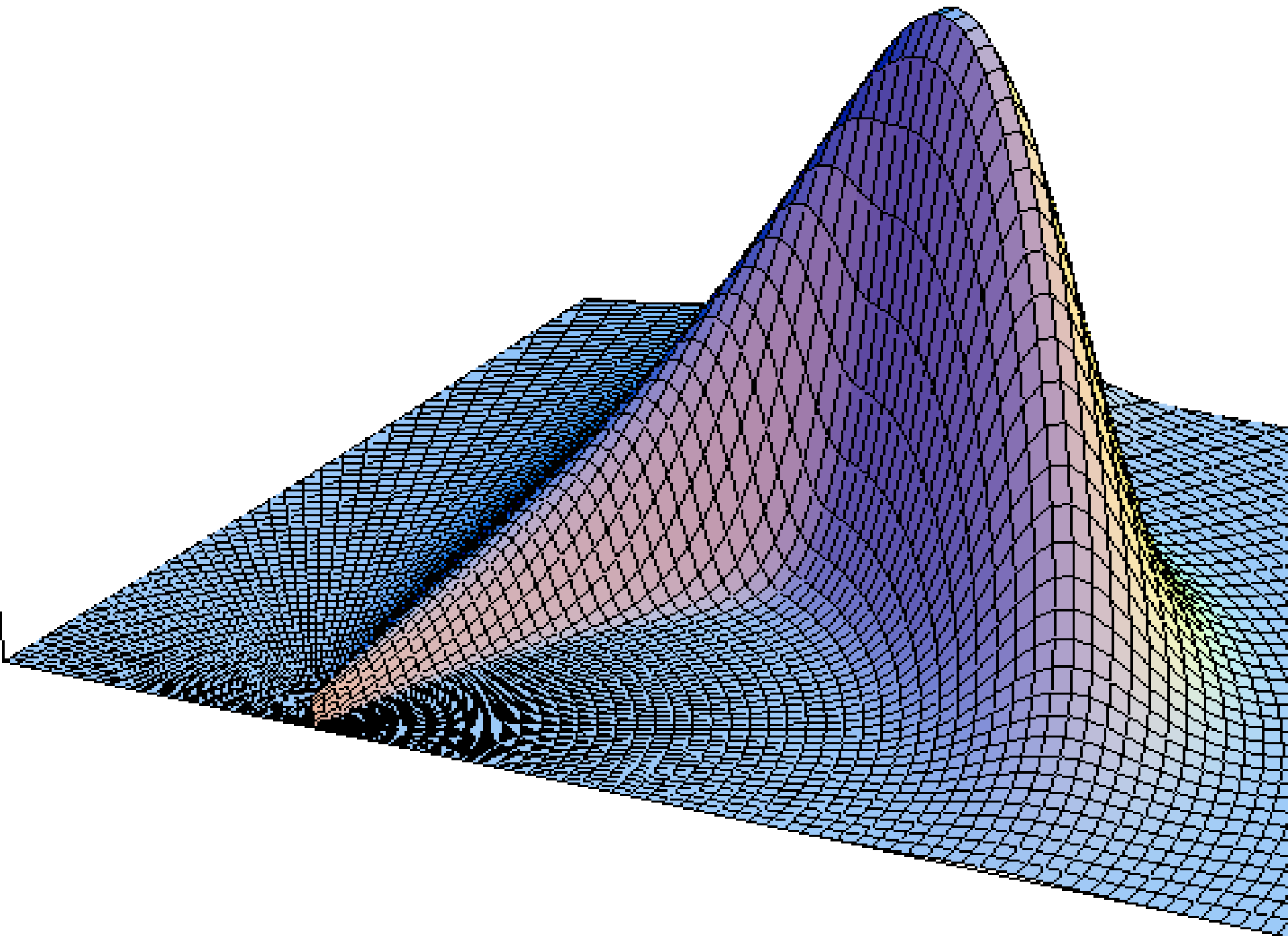
Can we assess the evolutionary plausibility of  
alternative scenarios?

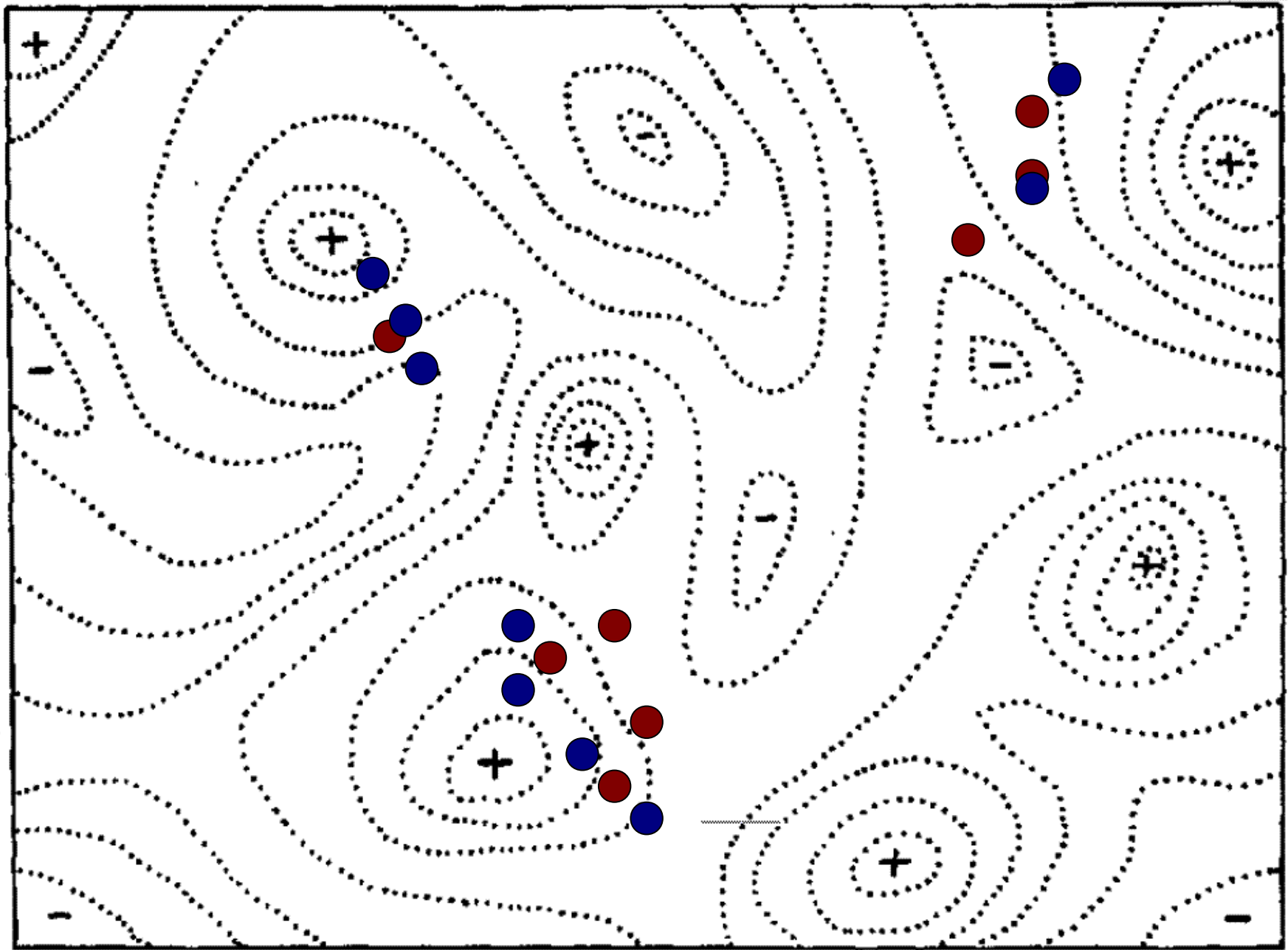


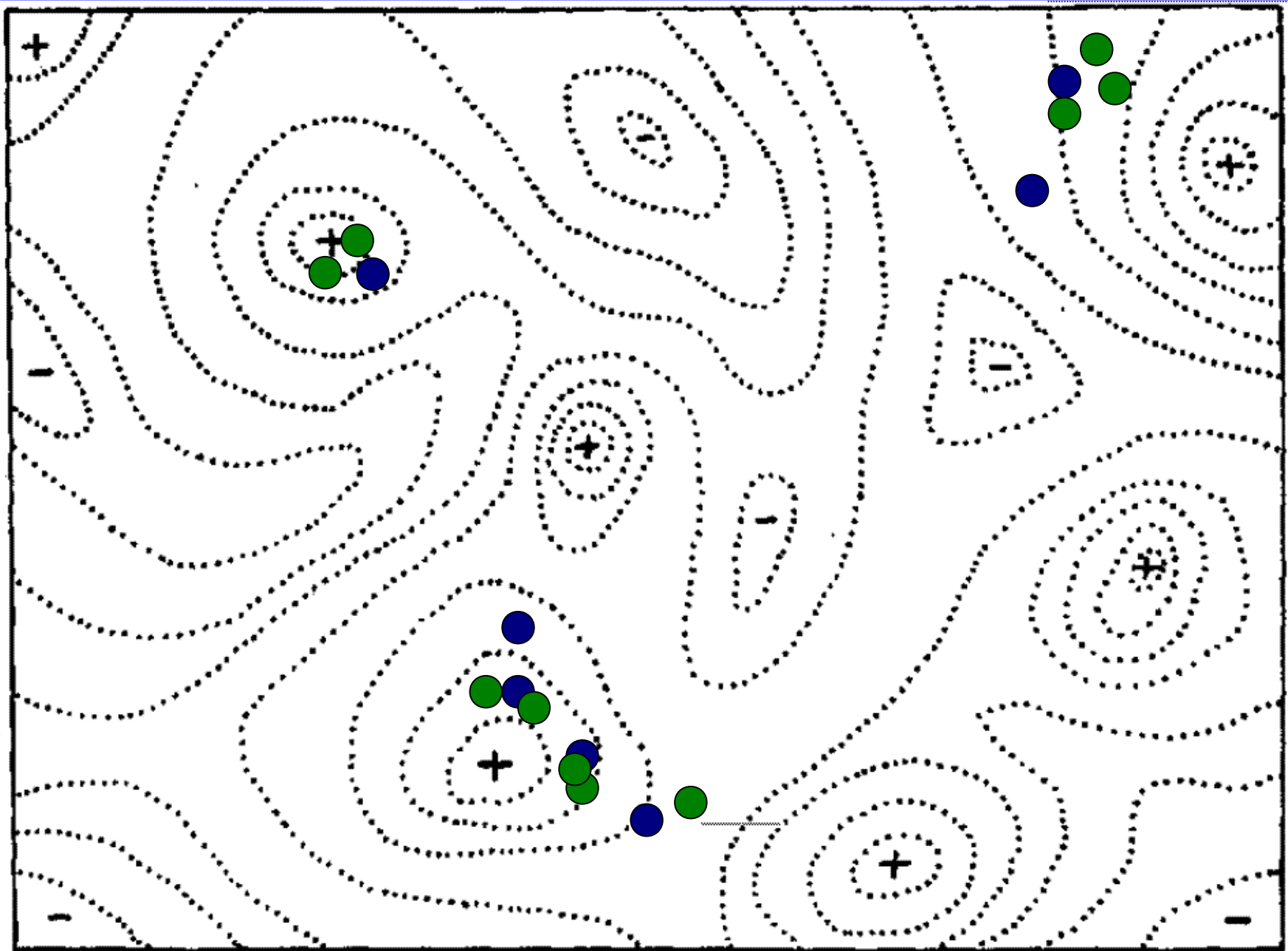
Yes - Evolutionary considerations provide important constraints on plausible scenarios

# Evolution

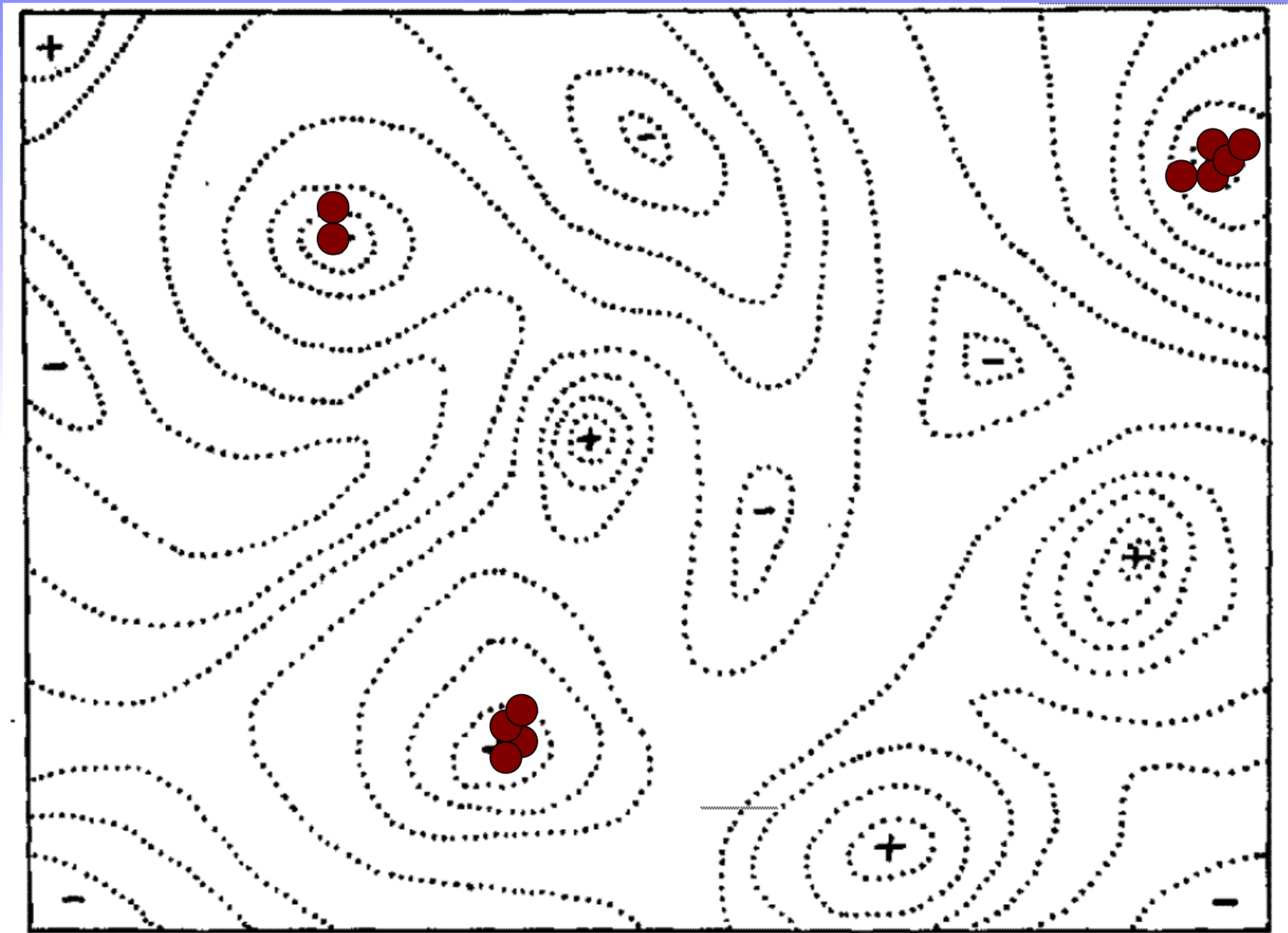








Sewall Wright, 1932



Sewall Wright, 1932

# Components of evolutionary explanations

- Heritability & variation
- Strategy set
- Fitness
- Path of ever increasing fitness
  - Frequency-dependent fitness: solutions to the problems of coordination and cooperation (reciprocity, kin selection)

# Genome data

- Chimp-human genome comparison: 98% in common, but still 35 million single nucleotide substitutions (half in human lineage);
- 600 genes strong positive selection in those lineages (immune system, transcription factors)
- 6 chromosomal regions show evidence of strong selection, including region of FOXP2 and CFTR (sweat, cholera)



# Limited time argument

- Implausible to assume very many *selected* genes for each uniquely human trait
  - 100,000 yrs  $\sim$  4,000 generations, 2My  $\sim$  80,000 gens
  - Population size  $N$ : 10,000 (estimate for 12,000 y BP)
  - Fixation time  $\sim 2N$  generations  $\sim 4$  selective sweeps (if consecutive as in asexual reproduction)
  - but: evidence for recent selection on  $\approx 1,800$  human genes (last 50Ky; Hawks et al, 2007, *PNAS*)
  - but: “strong evidence of positive selection unique to the human lineage is thus limited to a handful of genes” - (Chimp sequencing consortium 2005)

# Social traits argument

- Most uniquely human traits are 'unusual', social traits in evolution because their benefits are *for* or *dependent on* the social group.
- E.g., evolution of language, communication, music, cooperativity, social cognition etc. all pose coordination and altruism problems:
  - Kin selection / Social evolution theory
  - Frequency dependent selection
- Require unusual circumstances; implausible to simply assume a prolonged selection regime favoring social traits

Can we assess the linguistic adequacy of  
different scenarios?

# Arguments

- Argument from Personal Incredulity (?)
- Argument from Authority (?)
- “No miracles” argument
- “No intermediate language” argument
  - Across human individuals
    - But: SLI...
  - Across primate species

# Language Universals: consensus & controversies

- Phonetics
- Phonology
- Lexicon
- Morphosyntax
- Semantics
- Pragmatics

# Requirements for plausible scenarios

- Explain how such a radical new phenotype can be based on relatively few genetic changes
  - (1) Common causes
  - (2) Hidden potential
- Explain how the unusual circumstances needed for the evolution of social traits can be sustained
  - (3) Self-enforcing dynamic

# Language & cognition

- Reasoning: logic  $\leftrightarrow$  language (not, and, or, if, then, all, every, some, X is Y, ...)
- Planning: hierarchical plans  $\leftrightarrow$  hierarchical phrase-structure
- Theory of mind: intentional embedding  $\leftrightarrow$  sentential embedding
- Mathematics: number words, context-free syntax of algebra
- Music: pitch, rhythm, phrasal structure, cultural transmission
- Consciousness: inner voice