

THEORIES OF HUMAN UNIQUENESS



HEB 1330: Primate Social Behavior
19 November 2020

TODAY

- Brief and incomplete review of human-primate differences
- Cultural niche hypothesis

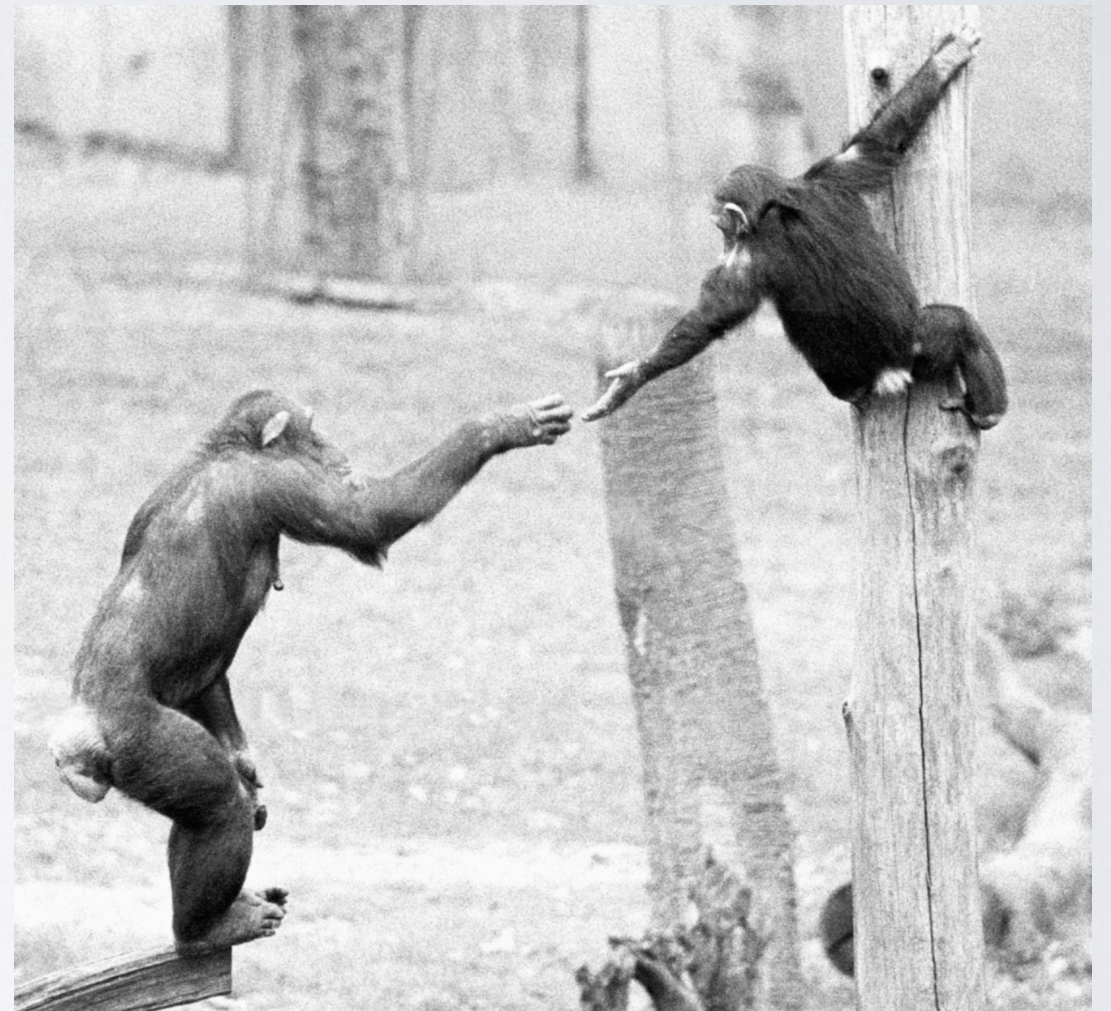
WHAT SETS HUMANS APART?

- Sociality
- Communication
- Brain size
- Social learning
- Theory of mind
- Life history



SOCIALITY

- Cooperation in context of kinship and strong social bonds
- Help provided when goal of recipient is clear
- Weak prosocial preferences compared with humans



COMMUNICATION

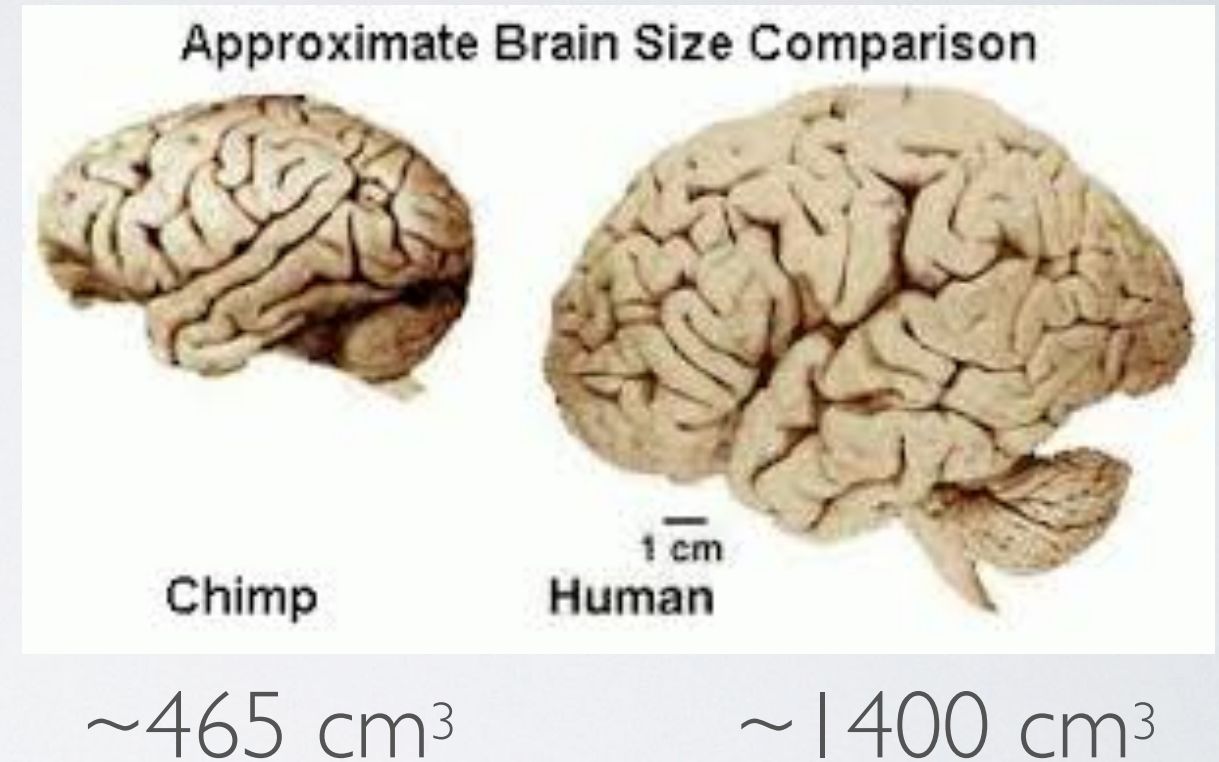
- Sophisticated comprehension
- Vocal flexibility limited
- Production is imperative
- Motivation to inform appears to be absent



Kitten give me!

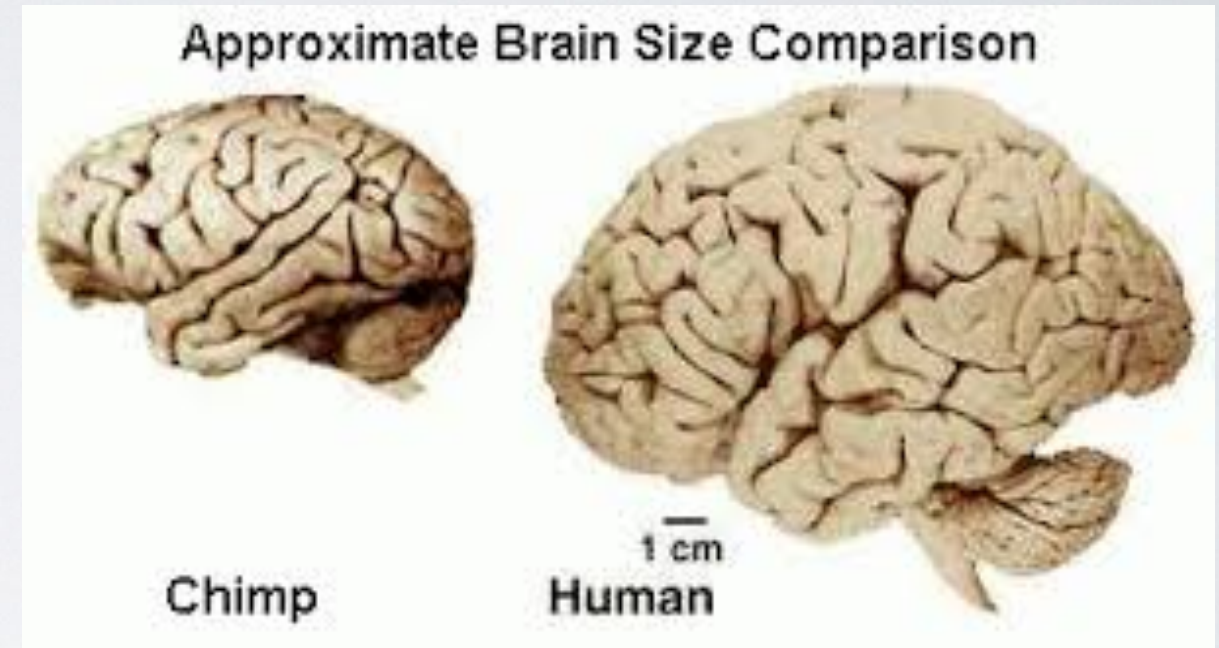
BRAIN SIZE

- Primates, on average, have larger brains than other mammals
- Huge variation within primate taxon
- Human brains ~3x than chimp/bonobo brains



BRAIN SIZE

- Primates, on average, have larger brains than other mammals
- Huge variation within primate taxon
- Human brains ~3x than chimp/bonobo brains



~465 cm³

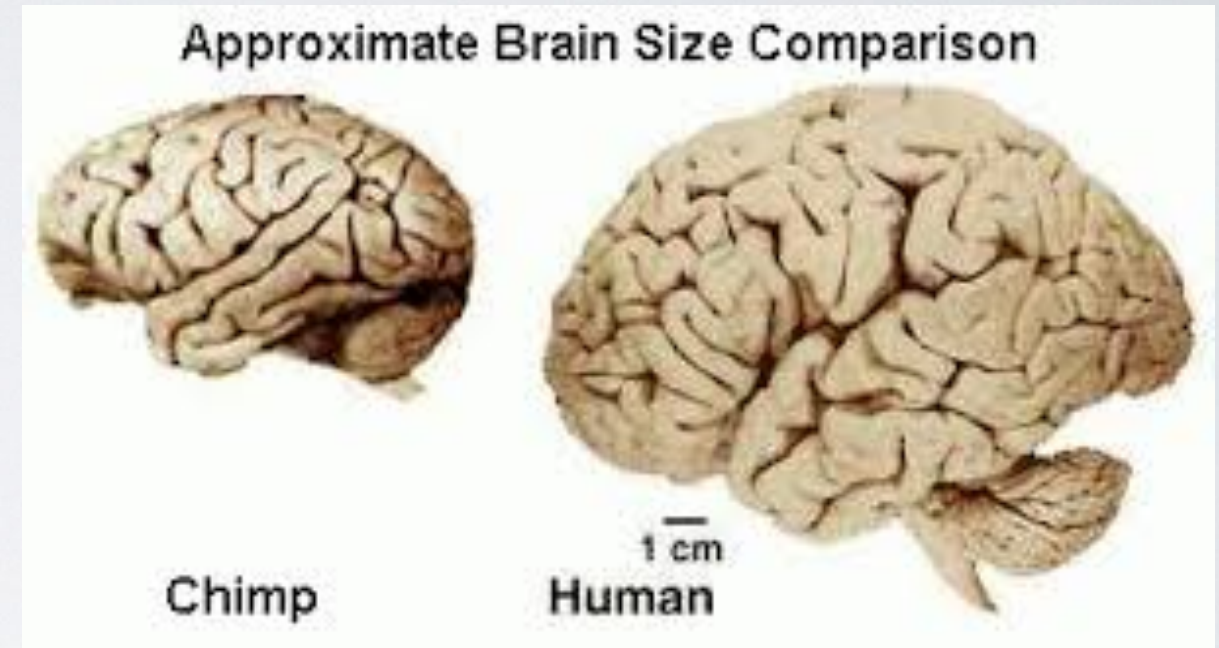
~1400 cm³



31 vs 95 tablespoons of brain

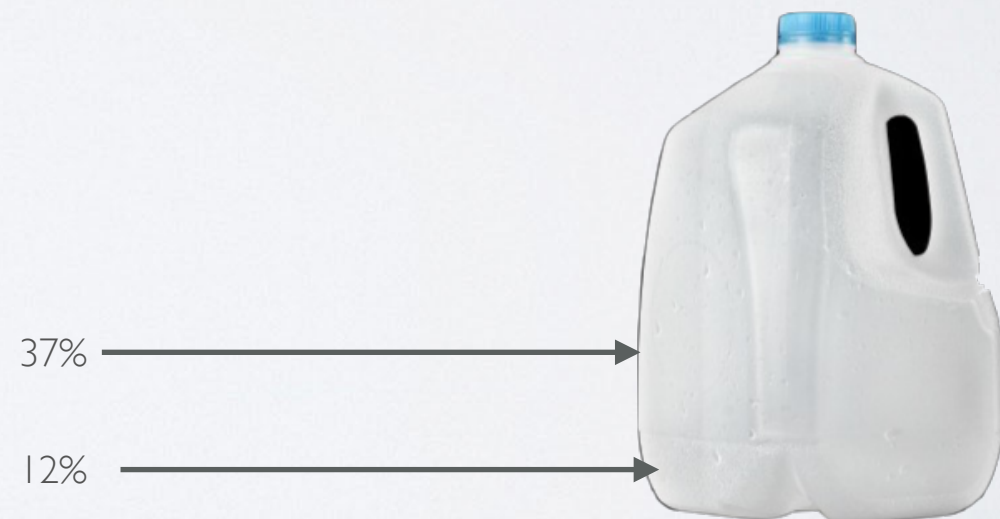
BRAIN SIZE

- Primates, on average, have larger brains than other mammals
- Huge variation within primate taxon
- Human brains ~3x than chimp/bonobo brains



~465 cm³

~1400 cm³

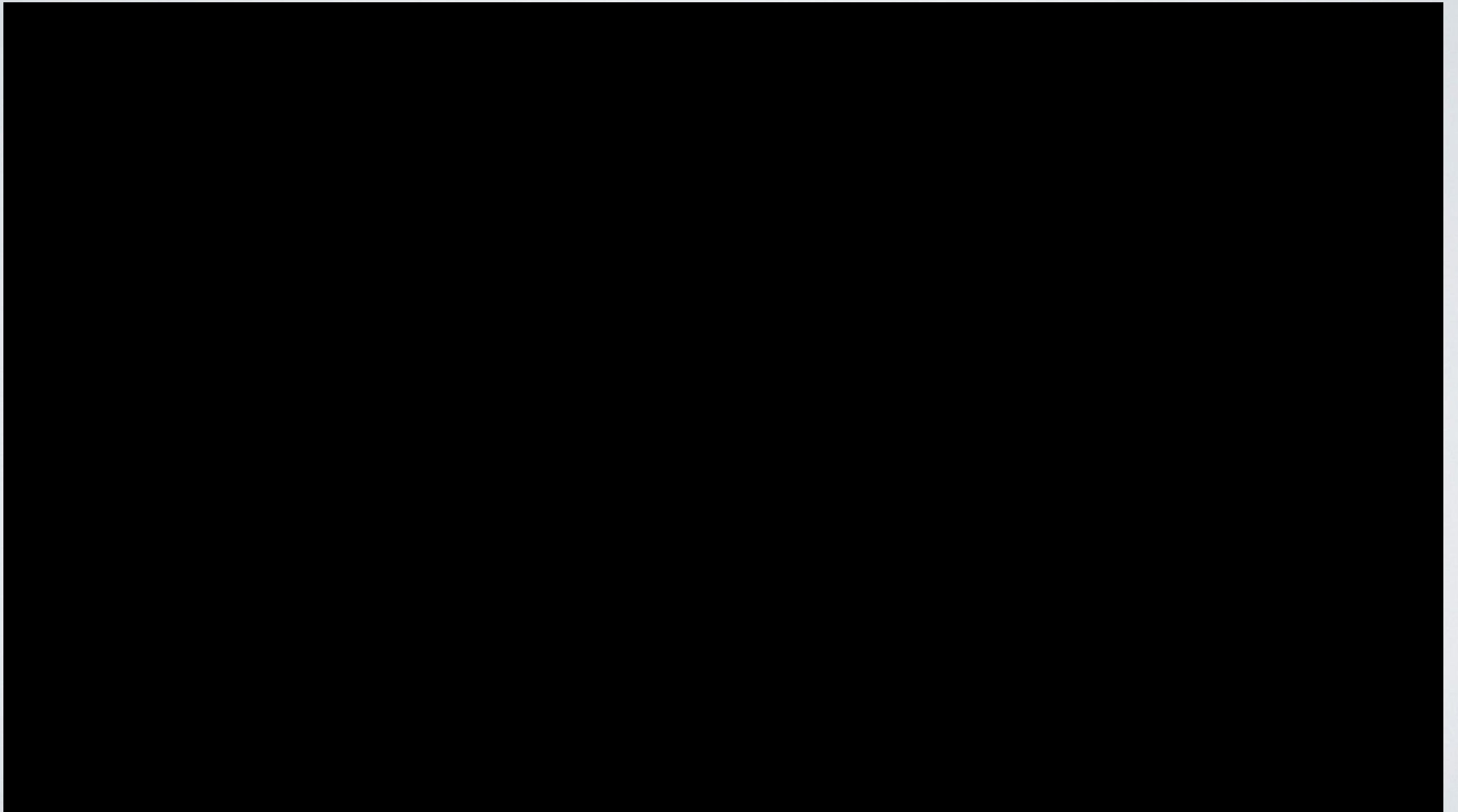


12% vs 37% of a gallon-jug's worth of brain

SOCIAL LEARNING

- Humans tend to over-imitate whereas apes emulate or selectively imitate
- Apes have low rates of fidelity when copying behavior
- Traditions common in primates; cumulative culture absent

SOCIAL LEARNING

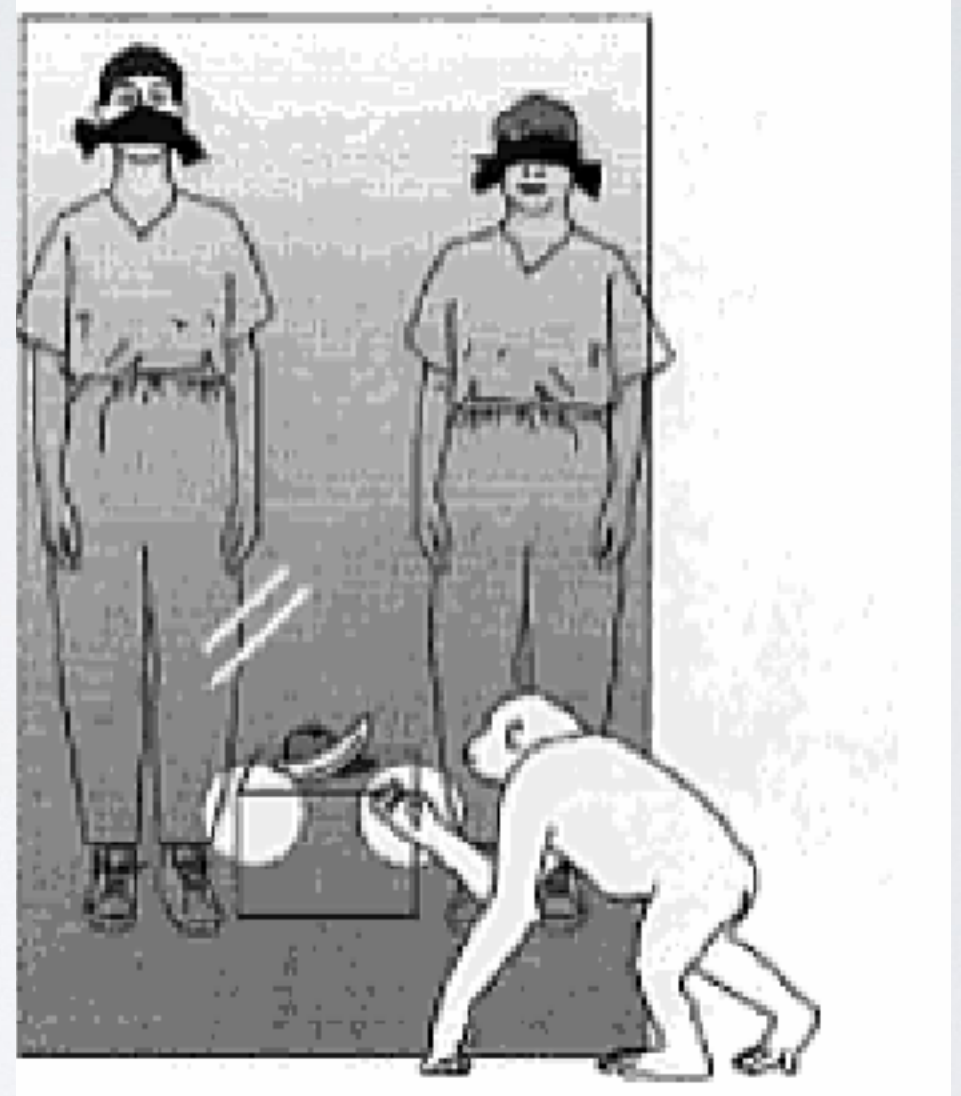


SOCIAL LEARNING



THEORY OF MIND

- Able to attribute mental states to others
- Good at inferring goals/intentions of others
- Can attribute knowledge and false belief in certain competitive contexts
- ToM less robust than humans, esp. in cooperative context



LIFE HISTORY

Great Ape Species	Maximum Lifespan (Years)	Age at First Birth (Years)	Age at Weaning (Years)	Interbirth Interval (Years)	Age at Last Birth (Years)
Orangutan (<i>Pongo pygmaeus</i> and <i>P. abelii</i>)	58.7 ^a	15.6 ^d	7.0 ^e	8.05 ^d	>41 ^d
Gorilla (<i>Gorilla gorilla</i>)	54.0 ^a	10.0 ^e	2.8 ^e	4.40 ^e	–
Bonobo (<i>Pan paniscus</i>)	50.0+ ^b	14.2 ^f	–	6.25 ^r	–
Chimpanzee (<i>Pan troglodytes</i>)	53.4 ^a	13.3 ^g	4.5 ^e	5.46 ^s	42 ^u
Human (<i>Homo sapiens</i>)	85.0 ^c	19.5 ^h	2.8 ^e	3.69 ^t	45 ^v

LIFE HISTORY:

AKA AN ANTHROPOLOGICAL EXPLANATION FOR WHY I DON'T PAY MY OWN CELL PHONE BILL

Great Ape Species	Maximum Lifespan (Years)	Age at First Birth (Years)	Age at Weaning (Years)	Interbirth Interval (Years)	Age at Last Birth (Years)
Orangutan (<i>Pongo pygmaeus</i> and <i>P. abelii</i>)	58.7 ^a	15.6 ^d	7.0 ^e	8.05 ^d	>41 ^d
Gorilla (<i>Gorilla gorilla</i>)	54.0 ^a	10.0 ^e	2.8 ^e	4.40 ^e	–
Bonobo (<i>Pan paniscus</i>)	50.0+ ^b	14.2 ^f	–	6.25 ^r	–
Chimpanzee (<i>Pan troglodytes</i>)	53.4 ^a	13.3 ^g	4.5 ^e	5.46 ^s	42 ^u
Human (<i>Homo sapiens</i>)	85.0 ^c	19.5 ^h	2.8 ^e	3.69 ^t	45 ^v

LIFE HISTORY

- Long life, esp. post-reproduction
- Slow maturation
- Early weaning
- Short inter-birth interval
- Three-generation provisioning

Great Ape Species	Maximum Lifespan (Years)	Age at First Birth (Years)	Age at Weaning (Years)	Interbirth Interval (Years)	Age at Last Birth (Years)
Orangutan (<i>Pongo pygmaeus</i> and <i>P. abelii</i>)	58.7 ^a	15.6 ^d	7.0 ^e	8.05 ^d	>41 ^d
Gorilla (<i>Gorilla gorilla</i>)	54.0 ^a	10.0 ^e	2.8 ^e	4.40 ^e	–
Bonobo (<i>Pan paniscus</i>)	50.0+ ^b	14.2 ^f	–	6.25 ^r	–
Chimpanzee (<i>Pan troglodytes</i>)	53.4 ^a	13.3 ^g	4.5 ^e	5.46 ^s	42 ^u
Human (<i>Homo sapiens</i>)	85.0 ^c	19.5 ^h	2.8 ^e	3.69 ^t	45 ^v

NATURE OF HUMAN-PRIMATE DIFFERENCES

- Sociality: social vs ultra-social
- Communication: imperative vs informative
- Cognition: empirical vs hypothetical
- Culture: traditions vs cumulative culture

NATURE OF HUMAN-PRIMATE DIFFERENCES

- Sociality: social vs ultra-social
- Communication: imperative vs informative
- Cognition: empirical vs hypothetical
- Social learning: traditions vs cumulative culture

What were the selection pressures underlying human-unique traits?

SUMMARY

- Account of human uniqueness needs to account for following human-primate differences:
 - Sociality: social vs ultra-social
 - Communication: imperative vs informative
 - Cognition: empirical vs hypothetical
 - Social learning: traditions vs cumulative culture
- Theories can be tested by looking for examples of convergent evolution in other primate species
- Cooperative breeding, self-domestication, and cultural niche theories not mutually exclusive

3 THEORIES OF HUMAN UNIQUENESS

- Cultural niche hypothesis
- Self-domestication hypothesis
- Cooperative breeding/teaching hypothesis

3 THEORIES OF HUMAN UNIQUENESS

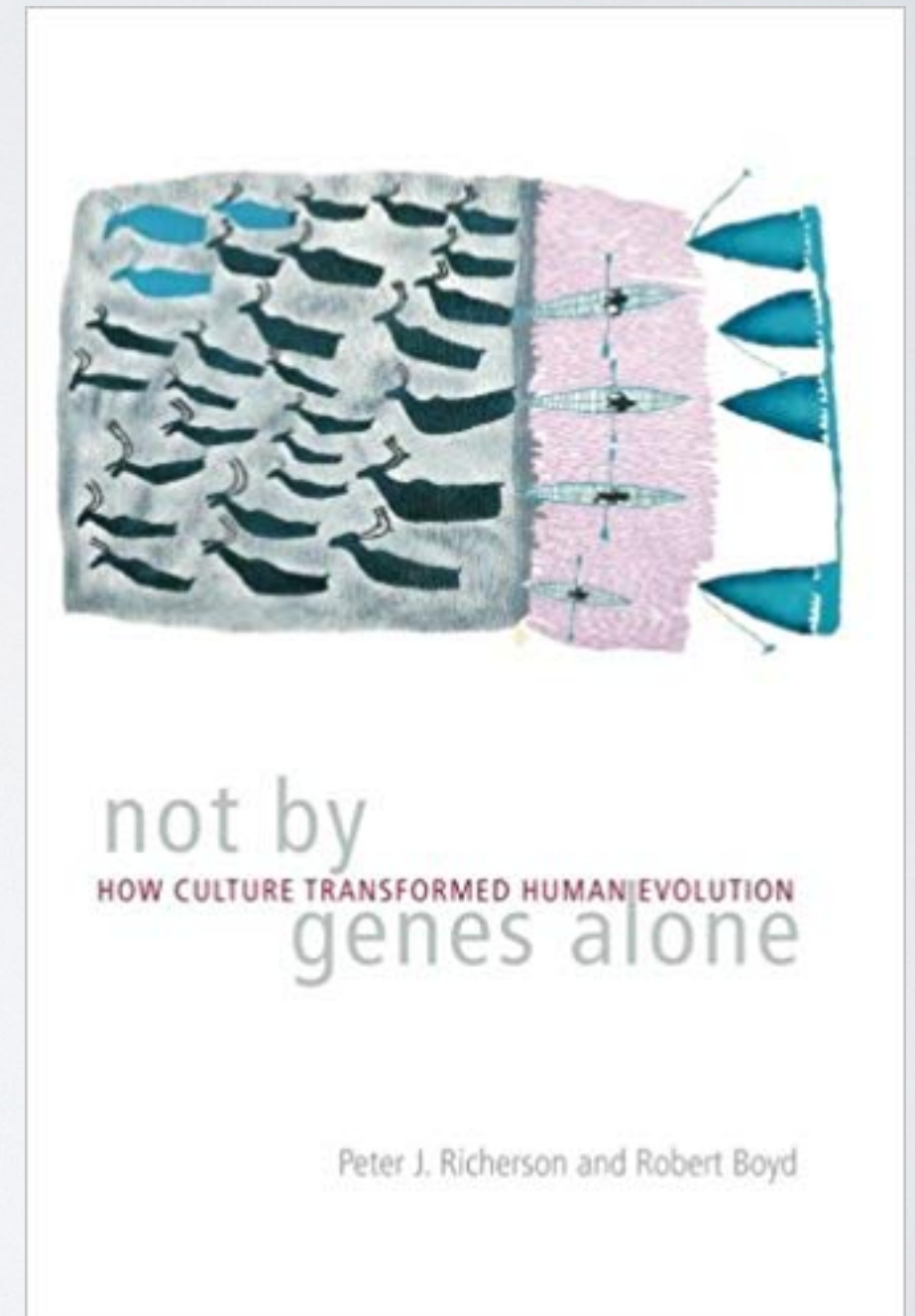
- Cultural niche hypothesis
- Self-domestication hypothesis
- Cooperative breeding/teaching hypothesis

Evidence of convergent evolution in other primate species?

CULTURAL NICHE HYPOTHESIS

GENE-CULTURE CO-EVOLUTION (AKA, DUAL INHERITANCE THEORY)

- Propensity to accept, learn, transmit cultural information is humanity's most important adaptation
- Humans now have two inheritance systems: genes and culture
- Culture acts as selective pressure on genetic evolution and vice versa



GENE-CULTURE CO-EVOLUTION (AKA, DUAL INHERITANCE THEORY)

- Culture creates its own ecological niche and selection pressures on individuals inhabiting the niche
- e.g., Selection against aggression occurs because cooperative individuals have higher fitness in cultural niche.
- Features that make human unique are adaptations to facilitate learning cultural knowledge
- e.g., Over-imitation facilitates high-fidelity copying
- e.g., Big brains/general intelligence facilitate capacity to learn huge variety of cultural information; human life history reflects long maturation period needed to learn all cultural knowledge

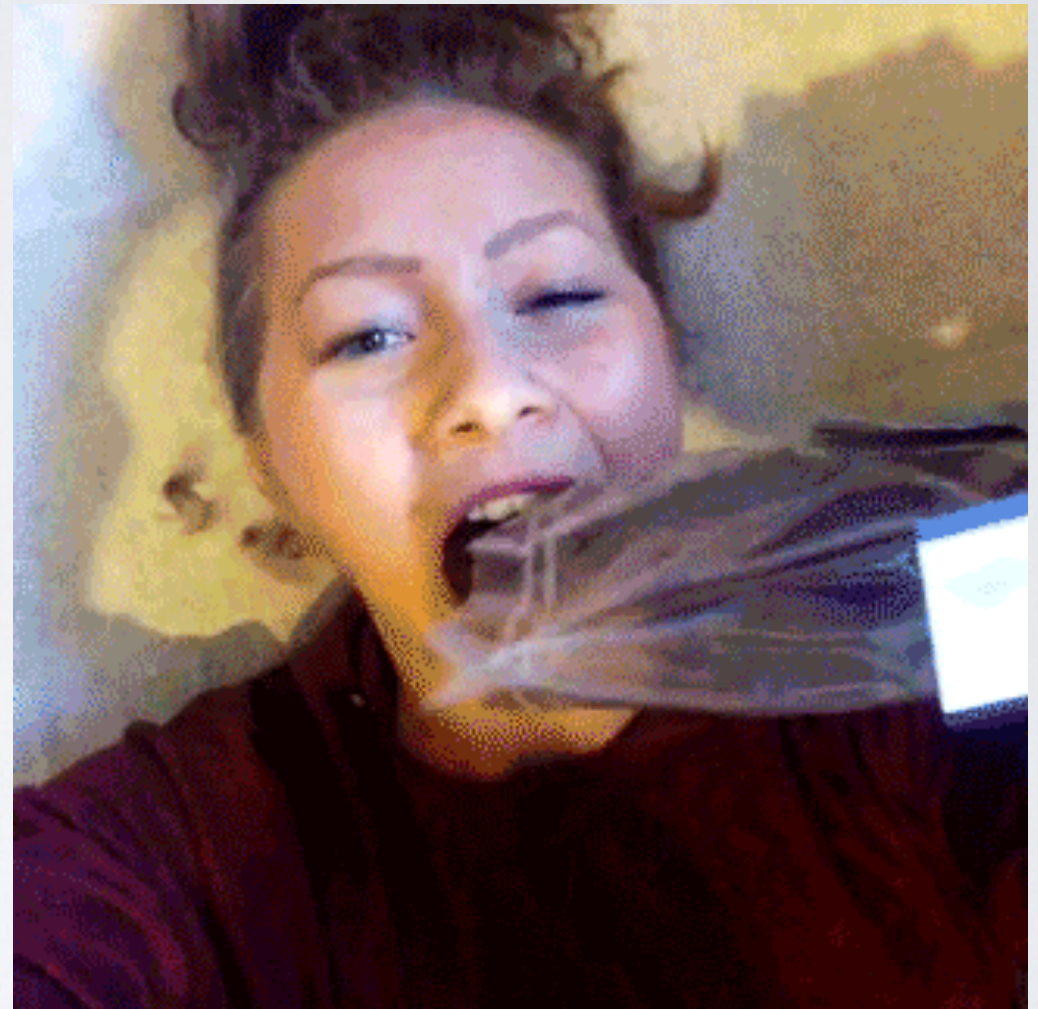
LACTOSE TOLERANCE

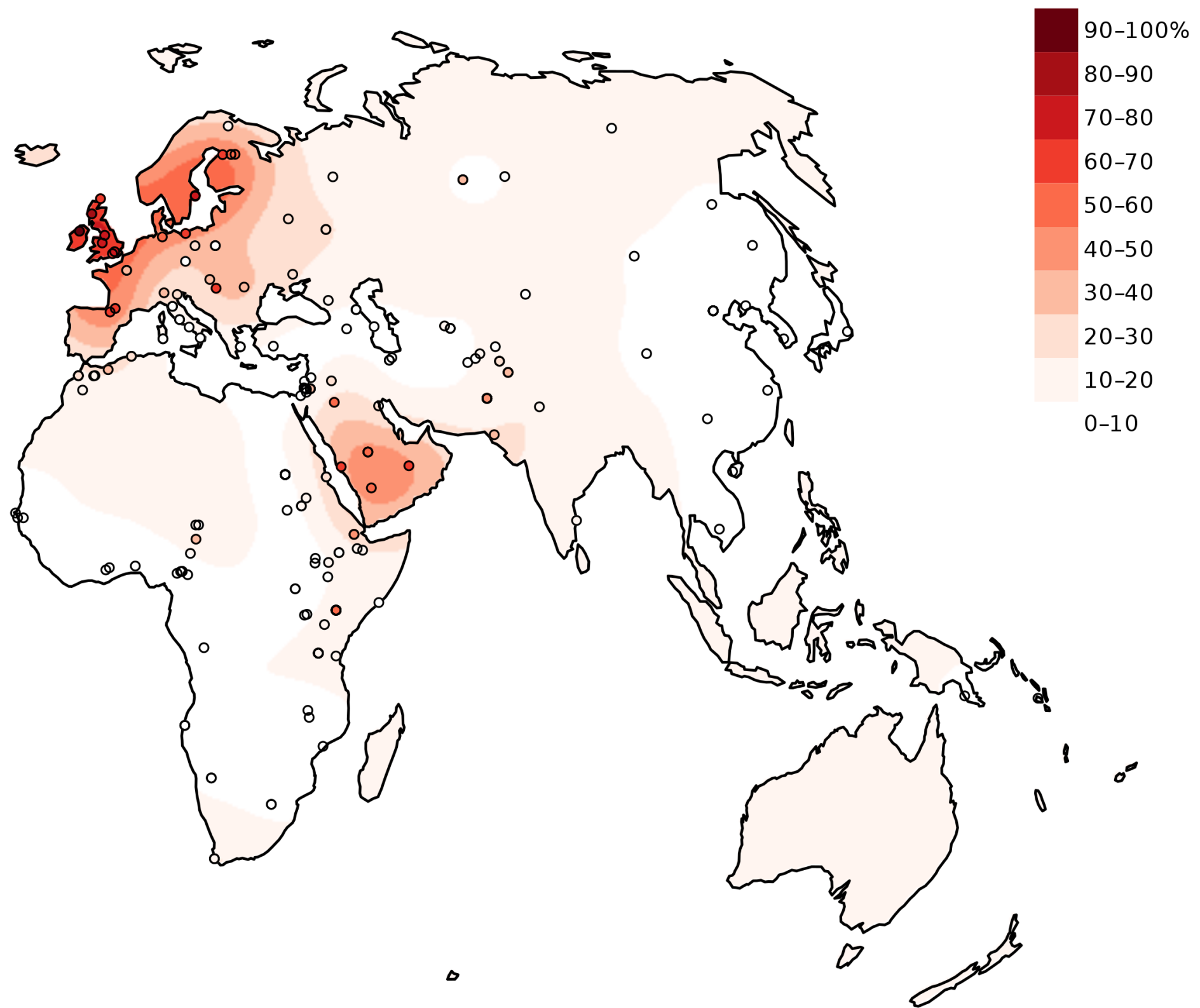
- Mammals usually lose the ability to absorb lactose as adults
- *Some* humans can drink milk as adults without getting sick



LACTOSE TOLERANCE

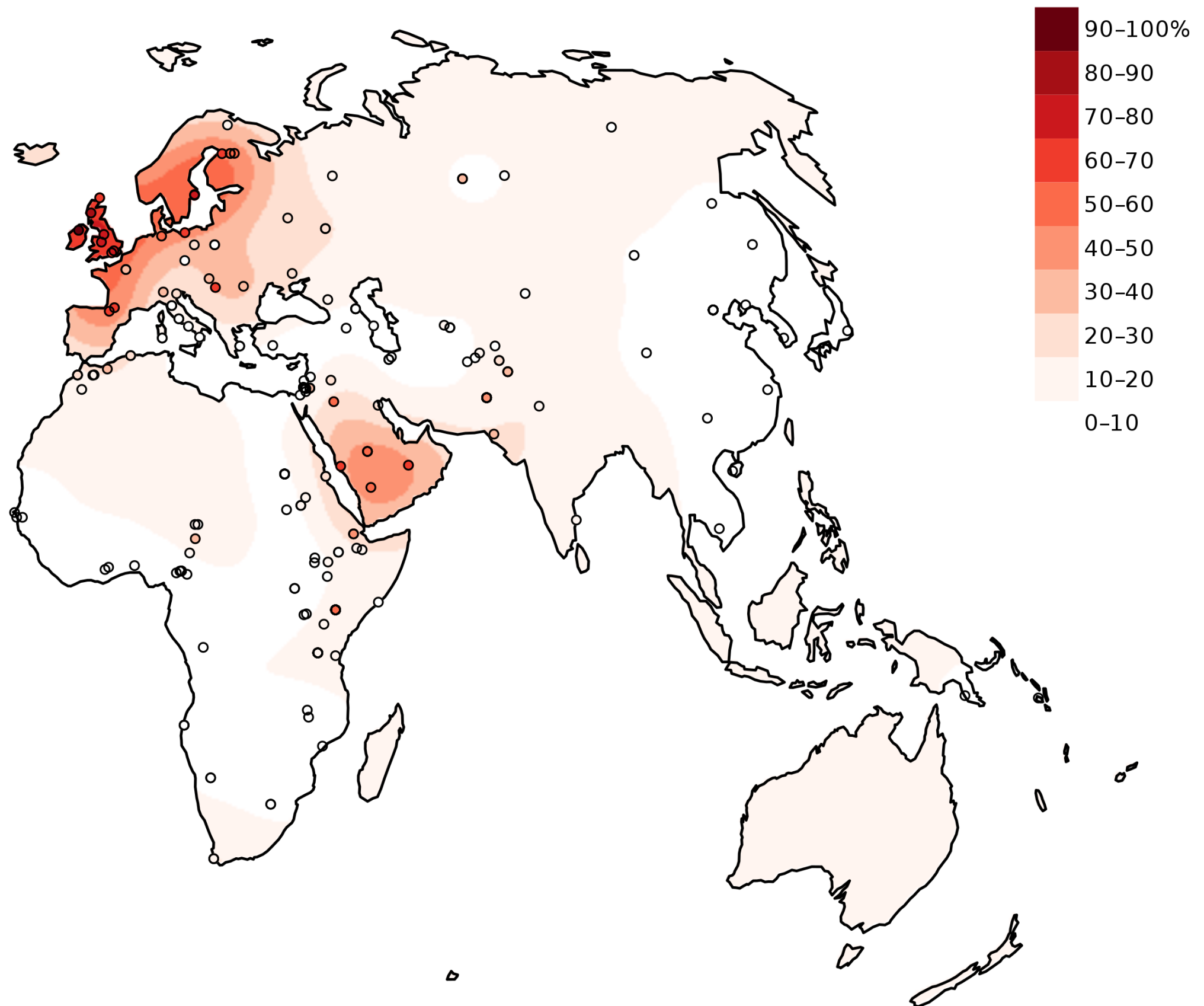
- Mammals usually lose ability to absorb lactose as adults
- *Some* humans can drink milk as adults without getting sick





Why White Supremacists Are Chugging Milk (and Why Geneticists Are Alarmed)

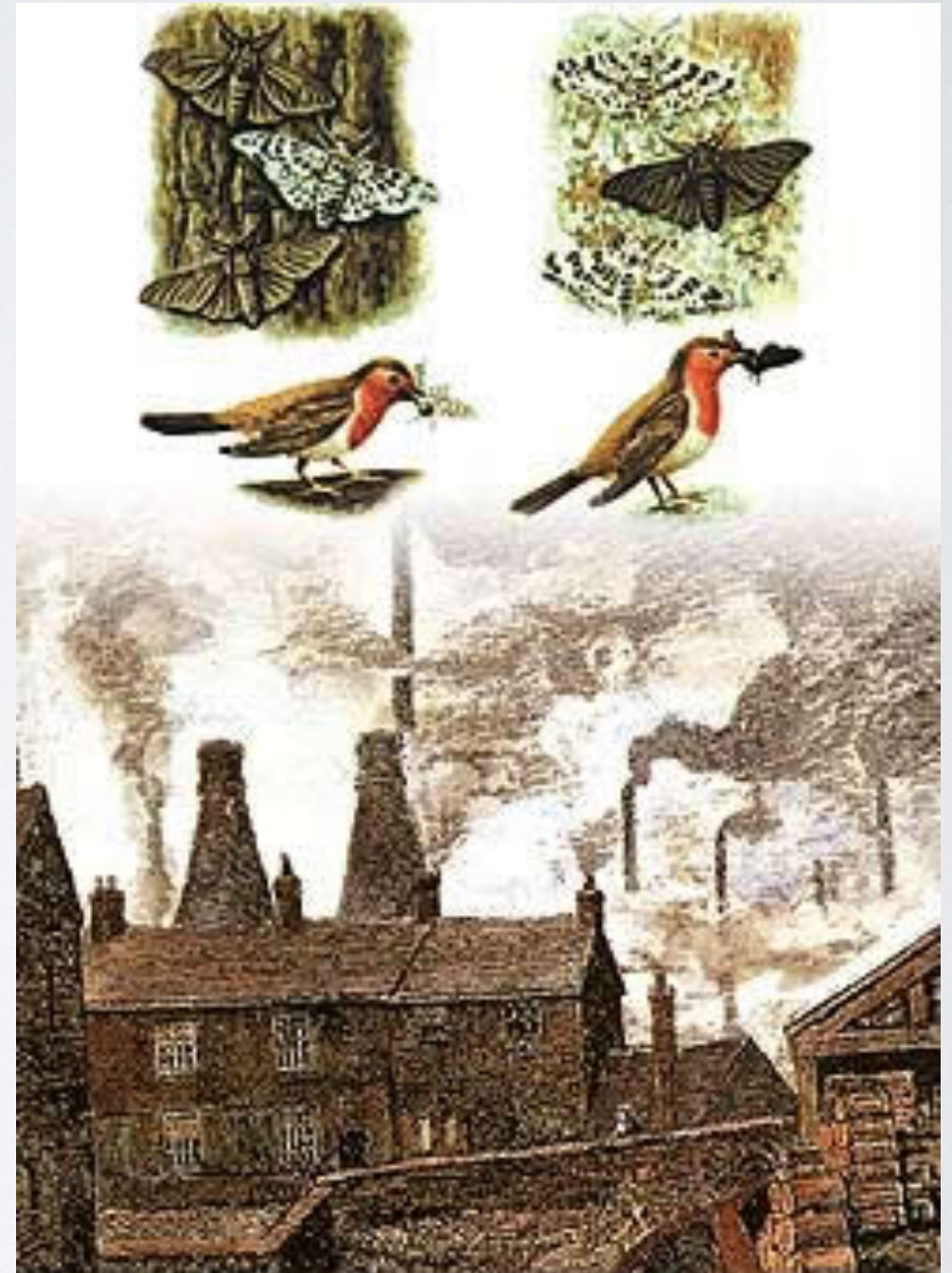




Genetic evolution (increase
in lactase-absorbing allele)

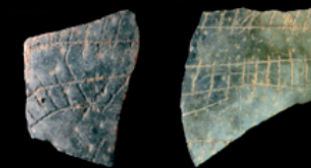
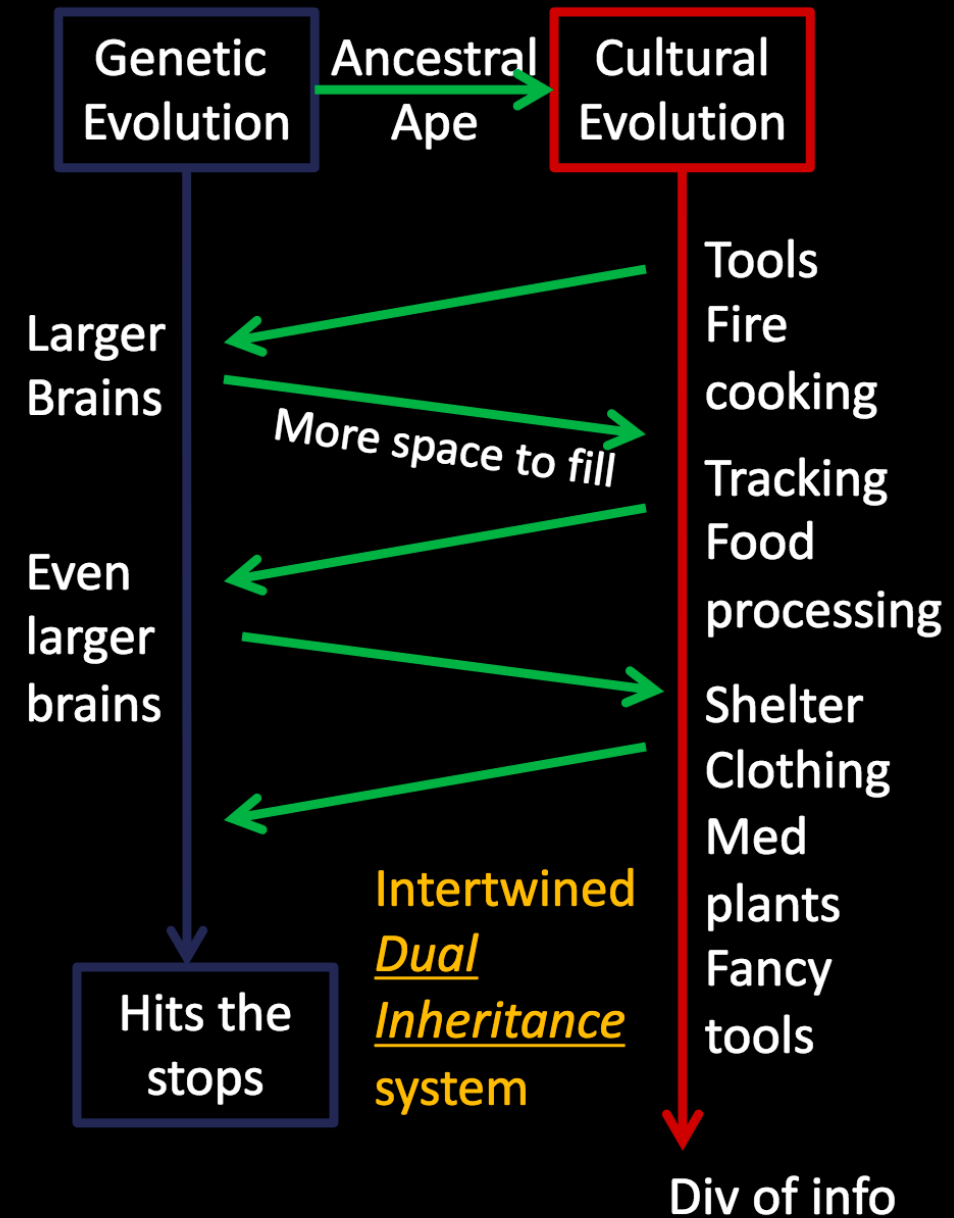


Culture (history of dairy
production)

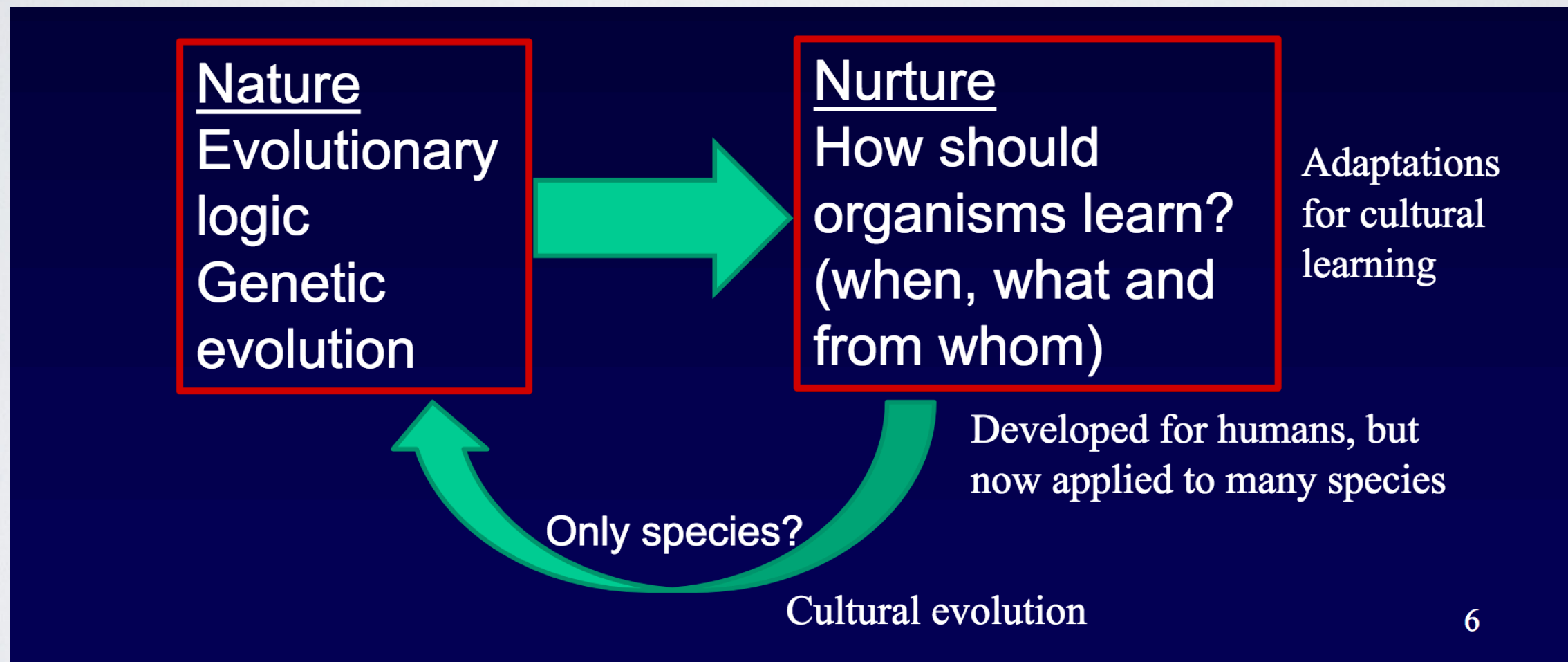


The effect is autocatalytic

- Constant pressure for larger brains that are better able to acquire, store, organize and retransmit cultural info.
- As soon as brains improve, increasing in size, cultural evolution rapidly expands the pool of information.
- Selection pressures
 - Culturally available info
 - Cultural products



CULTURAL NICHE HYPOTHESIS



CULTURAL NICHE HYPOTHESIS

The availability of large amounts of valuable socially learned information favors the evolution of:

- a)** big brains to maximize the acquisition, organization, storage, and retrieval of socially learned information,
- b)** increased social and asocial cognitive abilities,
- c)** life history traits that facilitate high levels of social learning

CULTURAL NICHE HYPOTHESIS

The availability of large amounts of valuable socially learned information favors the evolution of:

- a)** big brains to maximize the acquisition, organization, storage, and retrieval of socially learn information,
- b)** increased social and asocial cognitive abilities,
- c)** life history traits that facilitate high levels of social learning

Convergent evidence from primates?

CULTURAL NICHE HYPOTHESIS

The availability of large amounts of valuable socially learned information favors the evolution of:

- a)** big brains to maximize the acquisition, organization, storage, and retrieval of socially learned information,
- b)** increased social and asocial cognitive abilities,
- c)** life history traits that facilitate high levels of social learning

Convergent evidence from primates?

What types of evidence would provide support for this theory?

CULTURAL NICHE HYPOTHESIS: ORANGUTAN CASE STUDY

Forss et al. (2016)

- Sumatran orangutans more social than Bornean orangutans
- Sumatran diet depends on socially learned techniques for extractive foraging



Bornean orangutan

Sumatran orangutan

CULTURAL NICHE HYPOTHESIS: ORANGUTAN CASE STUDY

- Sumatran orangutans more social than Bornean orangutans
- Sumatran diet depends on socially learned techniques for extractive foraging

Forss et al. (2016)



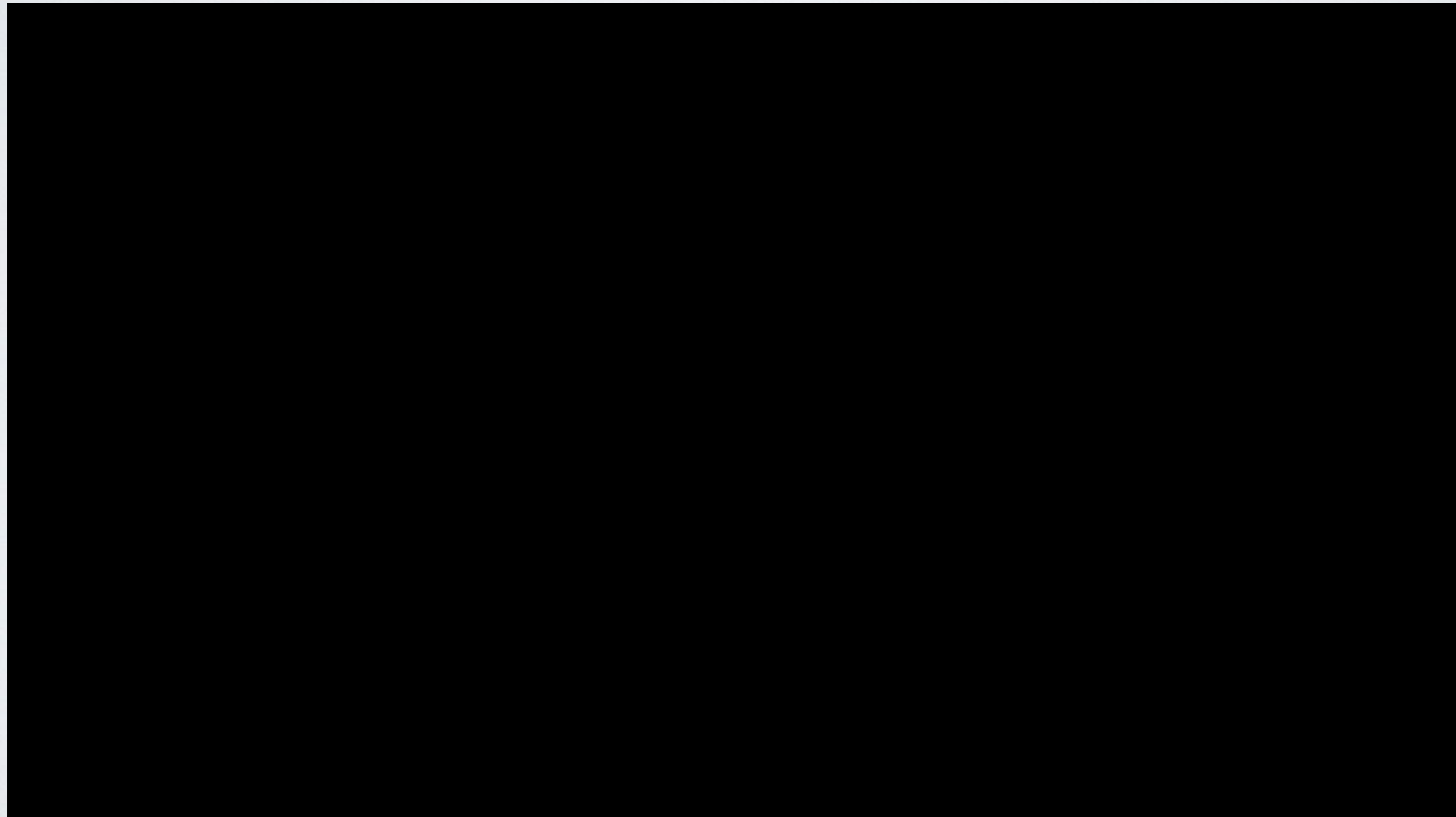
Bornean orangutan

Sumatran orangutan

Has Sumatran orangutans' cultural niche favored cognitive abilities not exhibited in Borean orangutans?

CULTURAL NICHE HYPOTHESIS: ORANGUTAN CASE STUDY

- Subjects tested on 7 different non-social cognitive tasks



Detour reaching task

CULTURAL NICHE HYPOTHESIS: ORANGUTAN CASE STUDY

- Subjects tested on 7 different non-social cognitive tasks



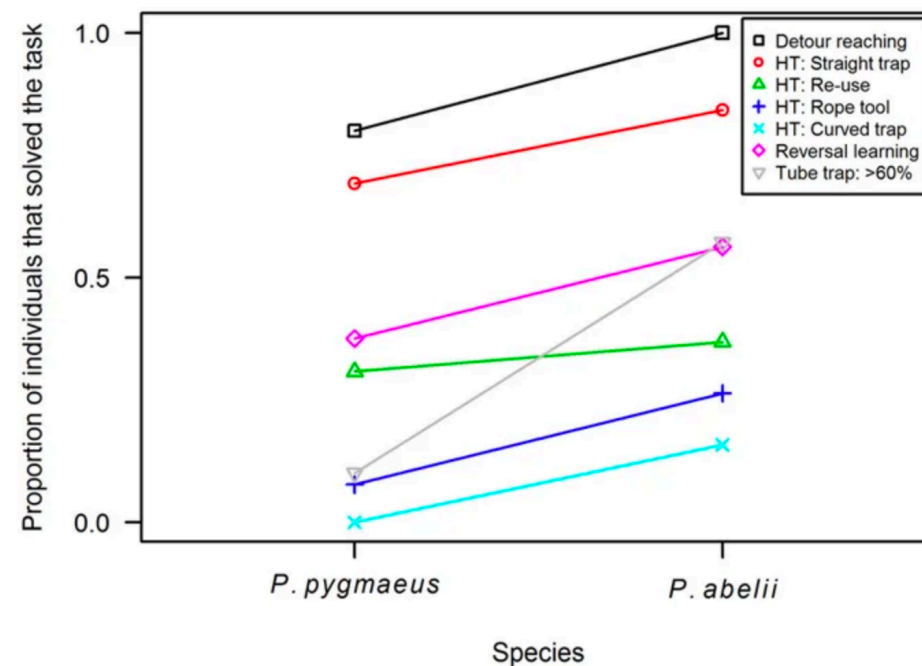
Trap tube task

CULTURAL NICHE HYPOTHESIS: ORANGUTAN CASE STUDY

- Sumatran orangutans performed better than Bornean orangutans across a variety of cognitive tasks unrelated to social learning
- Cultural Niche Interpretation: increased opportunities for social learning not only increased capacity for social learning but also for general cognitive abilities

Figure 1

From: [Cognitive differences between orang-utan species: a test of the cultural intelligence hypothesis](#)



Overall task performance over the different tasks and subtasks by *Pongo pygmaeus* and *Pongo abelii*.

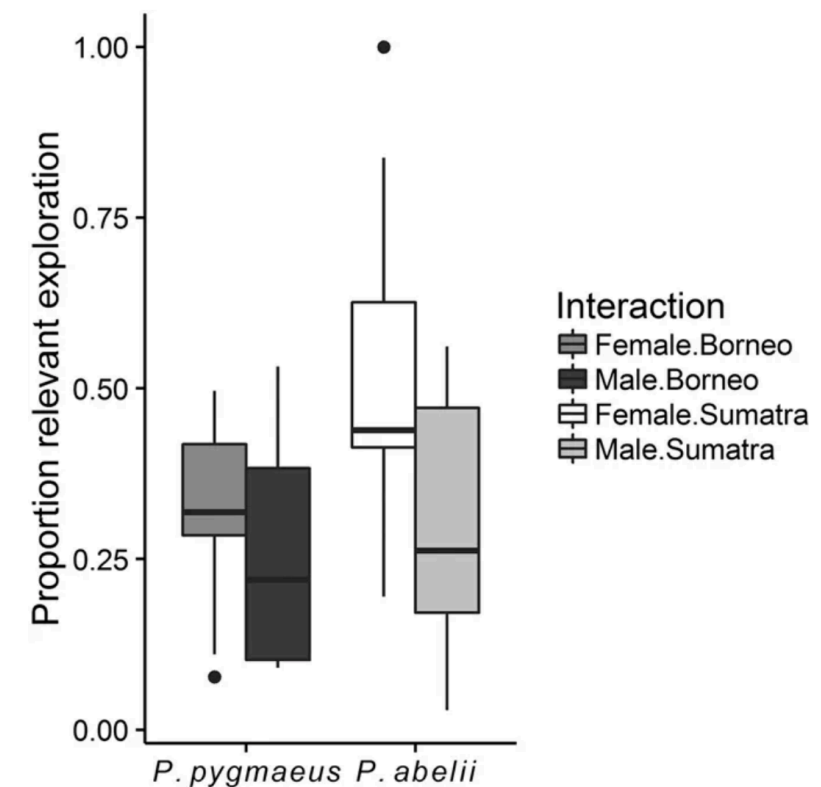
Subjects of *P. abelii* were significantly more likely to solve a task than *P. pygmaeus* subjects (Binomial GLMM: $B = 1.934$, $SE = 0.74$, $z = 2.63$, $P < 0.01$).

CULTURAL NICHE HYPOTHESIS: ORANGUTAN CASE STUDY

- Exploration styles also differ between Borean and Sumatran species

Figure 6

From: [Cognitive differences between orang-utan species: a test of the cultural intelligence hypothesis](#)

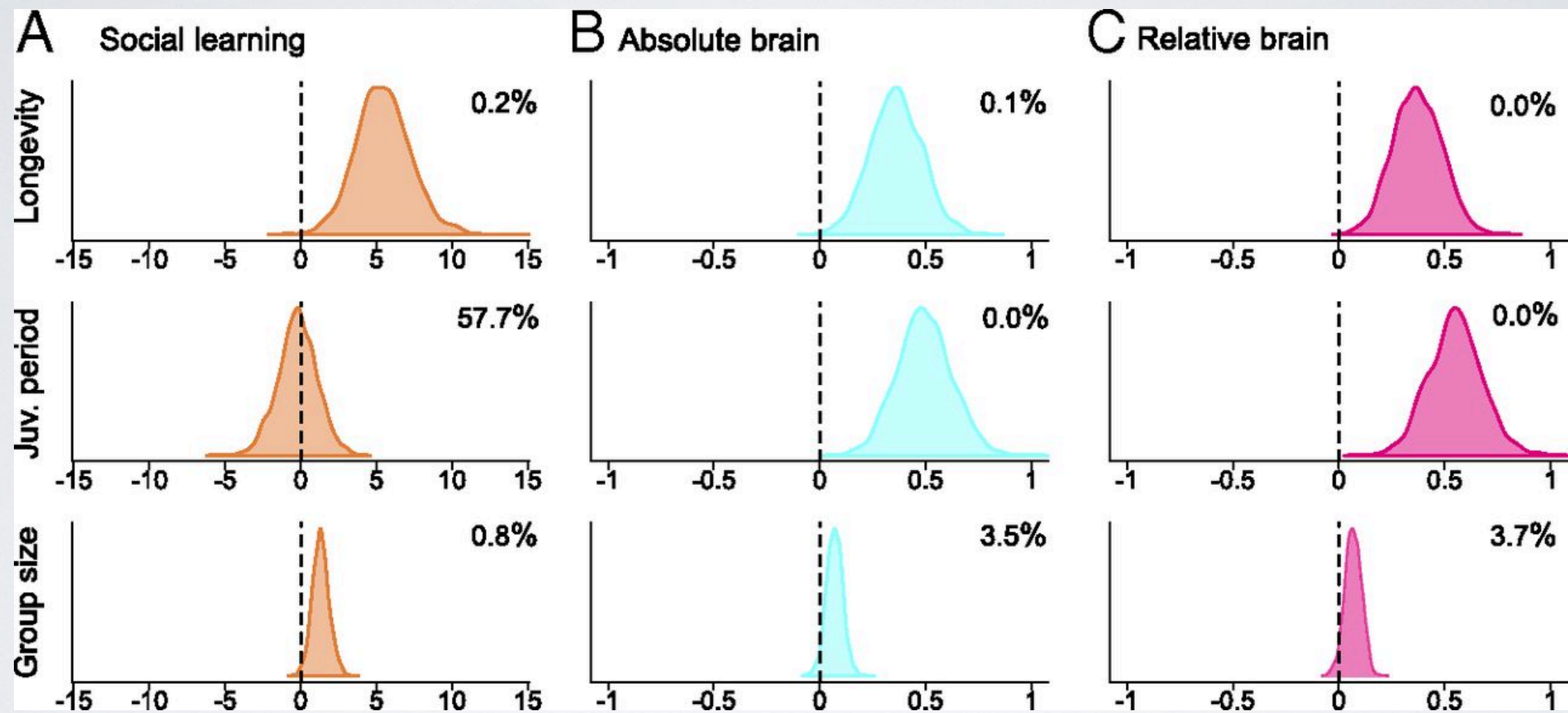


Relevant exploration.

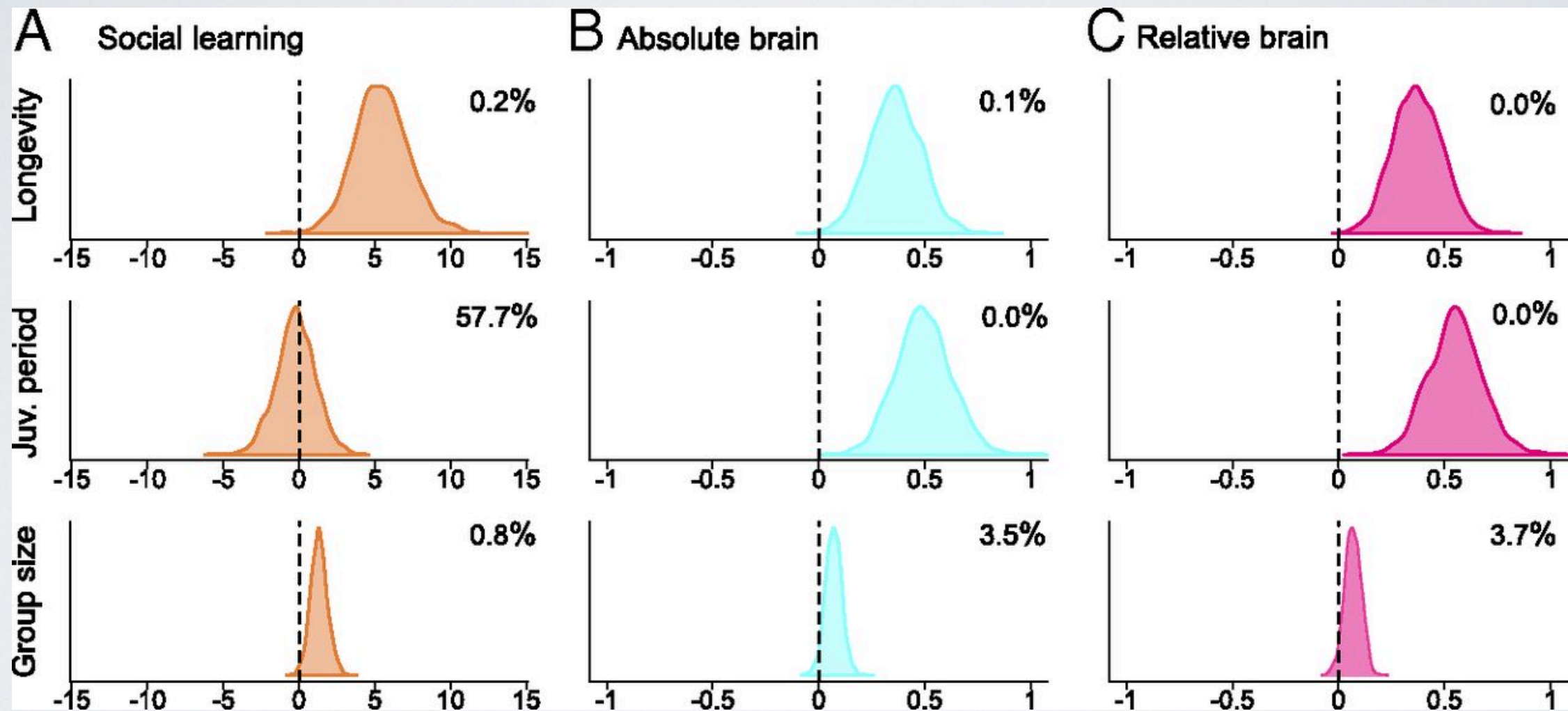
Proportion of relevant exploration time devoted to the honey extraction, corrected for total exploration duration of apparatus. Sumatran females spent more time exploring the relevant parts of the problem solving apparatus than Bornean and males showed less relevant exploration time than females (LM: $N_{\text{Sumatra}} = 19$, $N_{\text{Borneo}} = 13$, $P_{\text{species}} = 0.064$, $\beta_{\text{species}} = 0.139 \pm 0.072$, $P_{\text{age}} = 0.210$, $P_{\text{sex}} = 0.029$, $\beta_{\text{sex}} = -0.183 \pm 0.080$).

Forss et al. (2016)

CULTURAL NICHE HYPOTHESIS



CULTURAL NICHE HYPOTHESIS



What does this graph tell us?

How is it relevant to the Cultural Niche Hypothesis?

CO-EVOLUTION OF SOCIAL LEARNING, BRAIN SIZE, GROUP SIZE, AND LONGEVITY

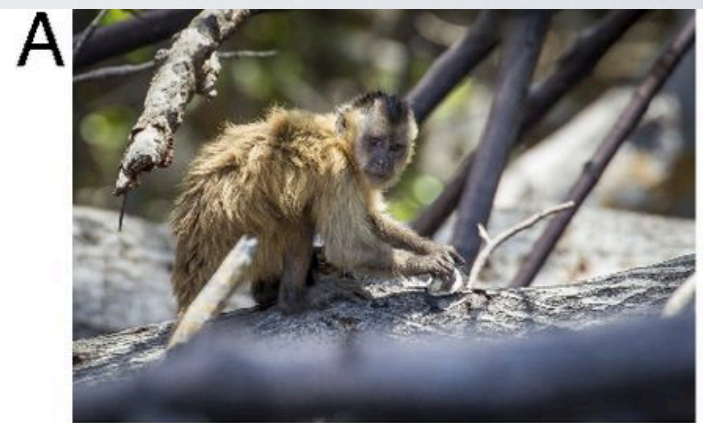
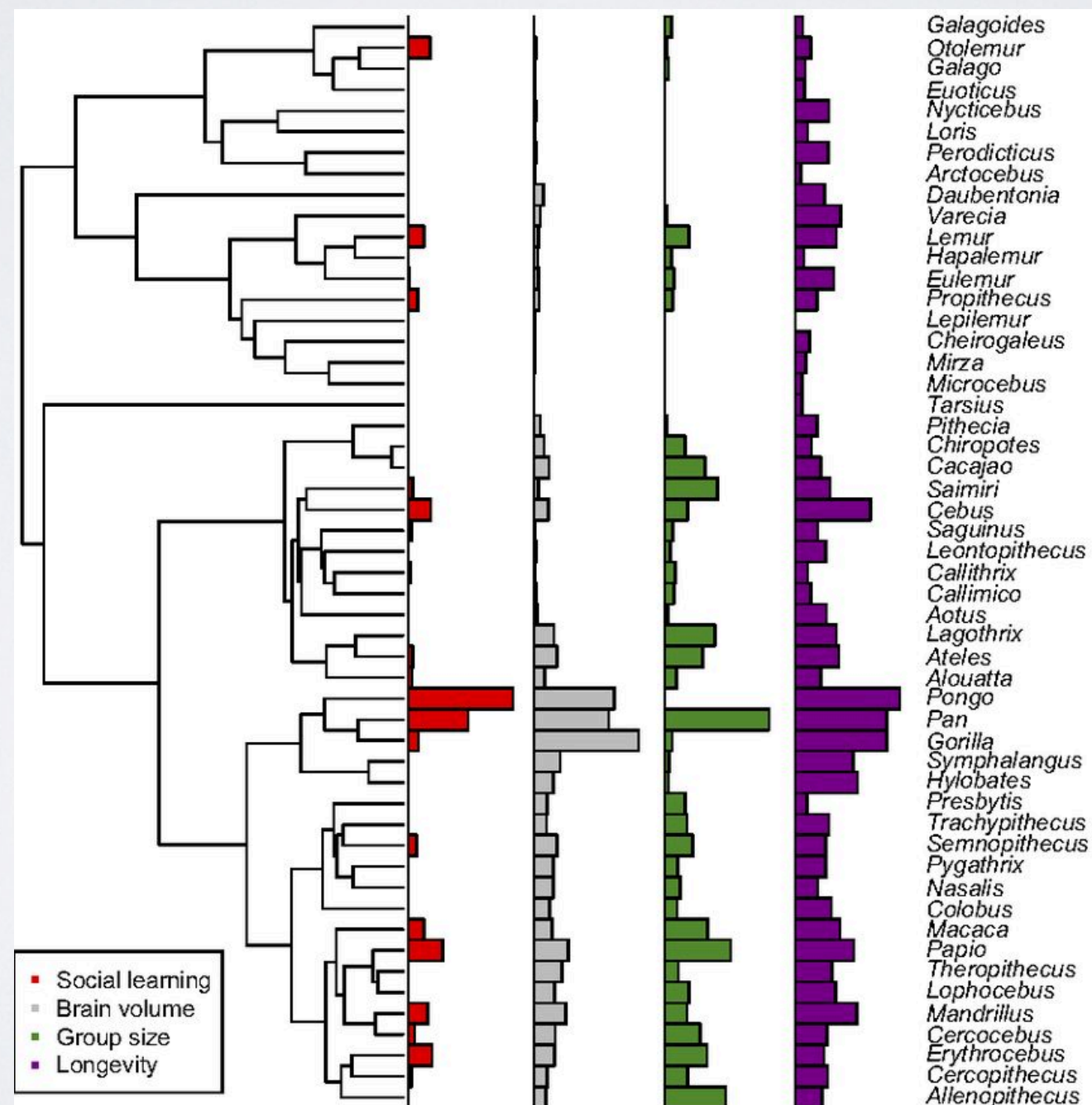
- Species that exhibit high level of social learning should also exhibit other features of 'cultural niche'

CO-EVOLUTION OF SOCIAL LEARNING, BRAIN SIZE, GROUP SIZE, AND LONGEVITY

- Species that exhibit high level of social learning should also exhibit other features of 'cultural niche'
- Do they?

CO-EVOLUTION OF SOCIAL LEARNING, BRAIN SIZE, GROUP SIZE, AND LONGEVITY

- Species that exhibit high level of social learning should also exhibit other features of 'cultural niche'
- Do they? Yes.



CULTURAL NICHE HYPOTHESIS

- Prosociality and cooperation
- Language
- Brain size
- Social learning (over-imitation and high-fidelity copying)
- Theory of mind
- Life history

CULTURAL NICHE HYPOTHESIS

- Prosociality and cooperation
- Language
- Brain size
- Social learning (over-imitation and high-fidelity copying)
- Theory of mind
- Life history

But not much convergent evidence from primates yet

QUESTIONS?