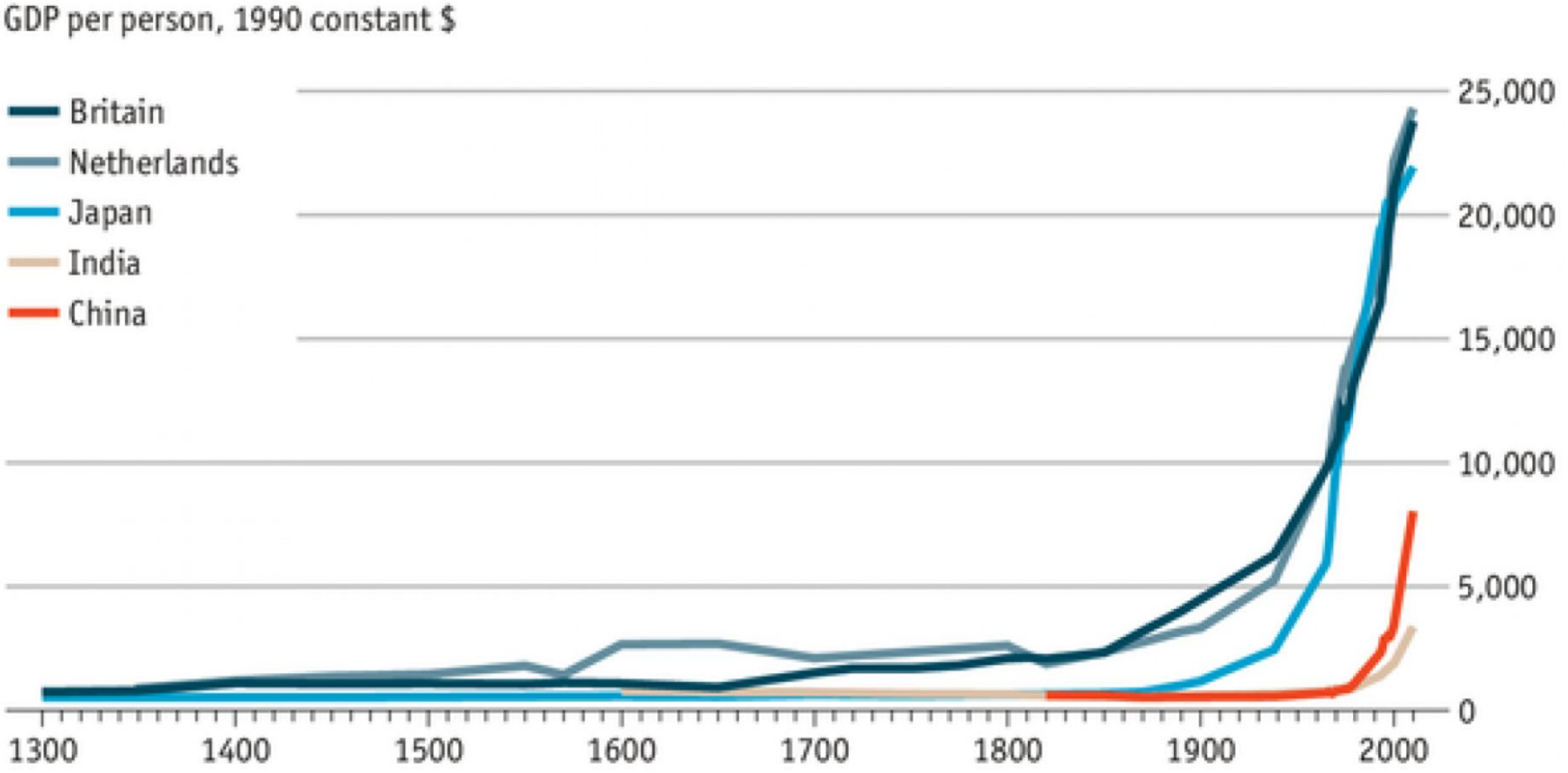
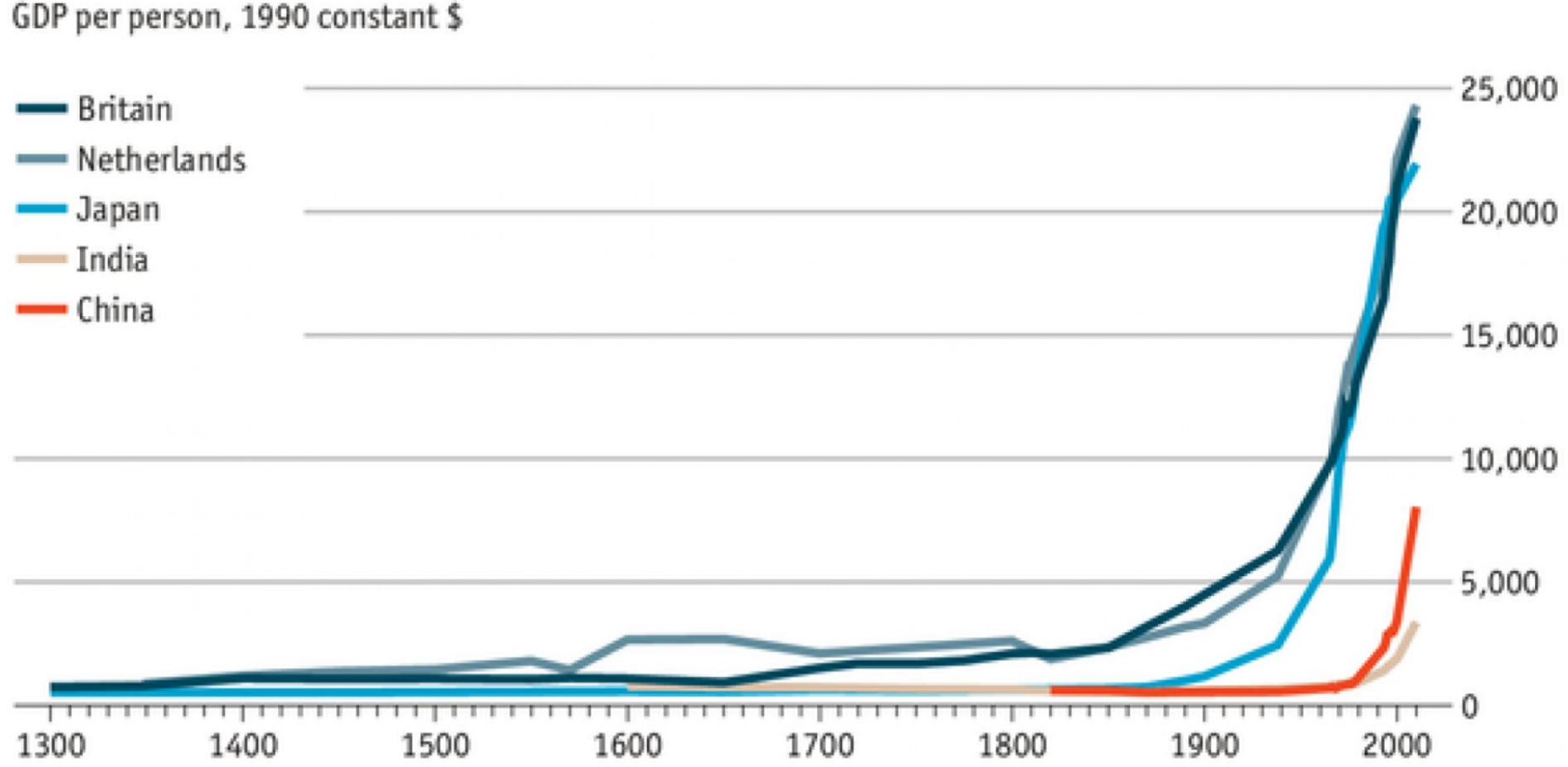
The Great Divergence

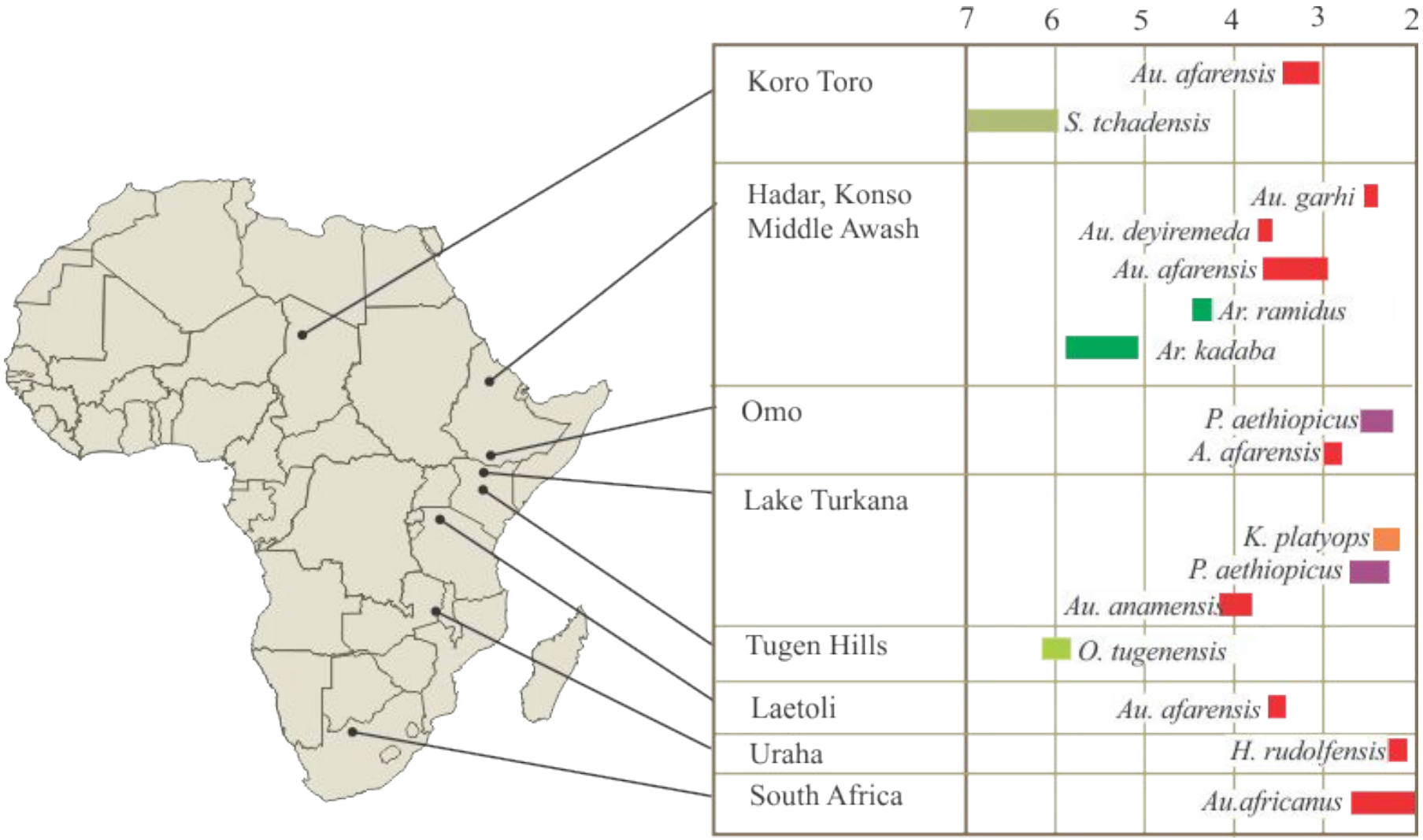


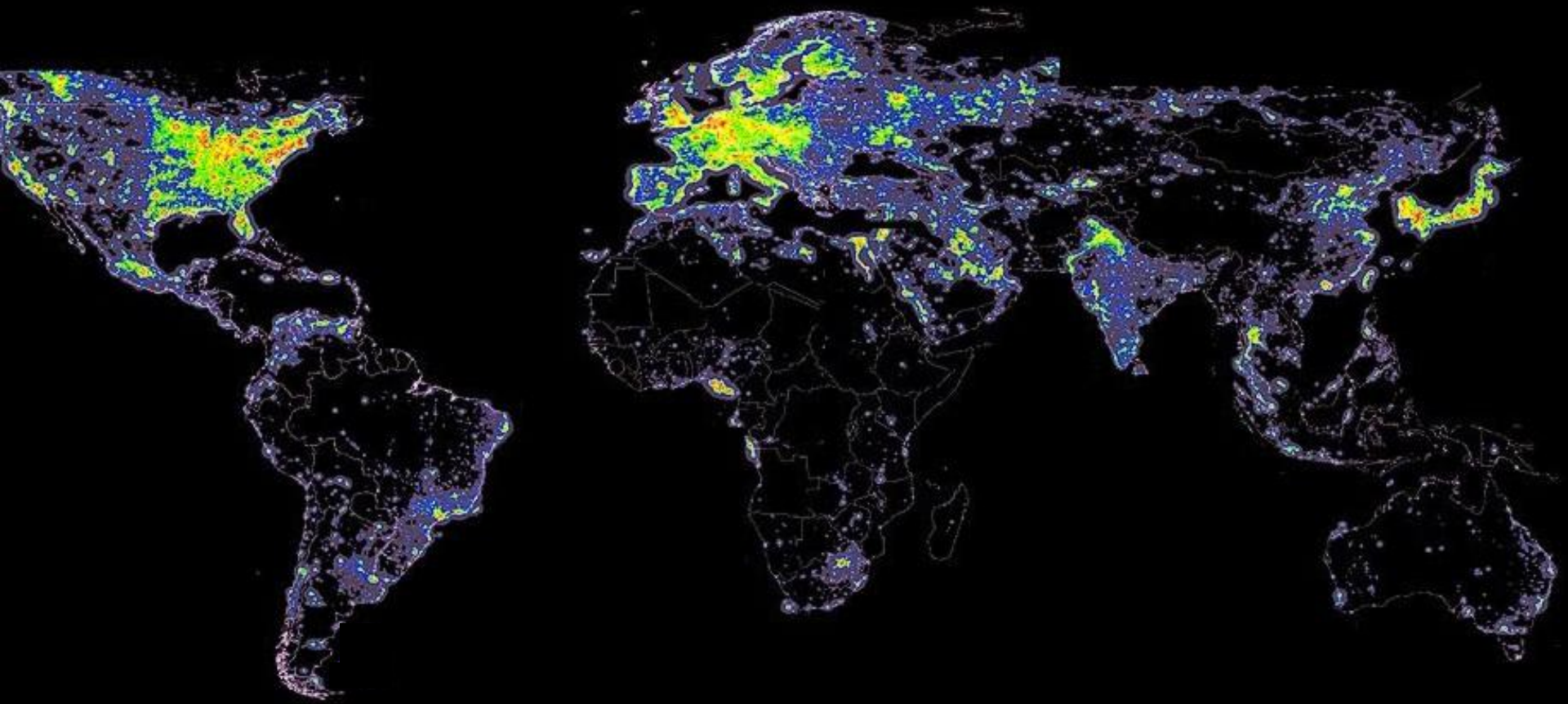
The Second Great Divergence



The FIRST great divergence


Chimpanzee
Gorilla
Orangutan
Gibbon


7
6
5
4
3
2
Koro Toro
Au. afarensis
S. tchadensis
Hadar, Konso
Middle Awash
Au. garhi
Au. deyiremeda
Au. afarensis
Ar. ramidus
Ar. kadaba
Omo
P. aethiopicus
A. afarensis
Lake Turkana
K. platyops
P. aethiopicus
Au. anamensis
Tugen Hills
O. tugenensis
Laetoli
Au. afarensis
Uraha
H. rudolfensis
South Africa
Au.africanus

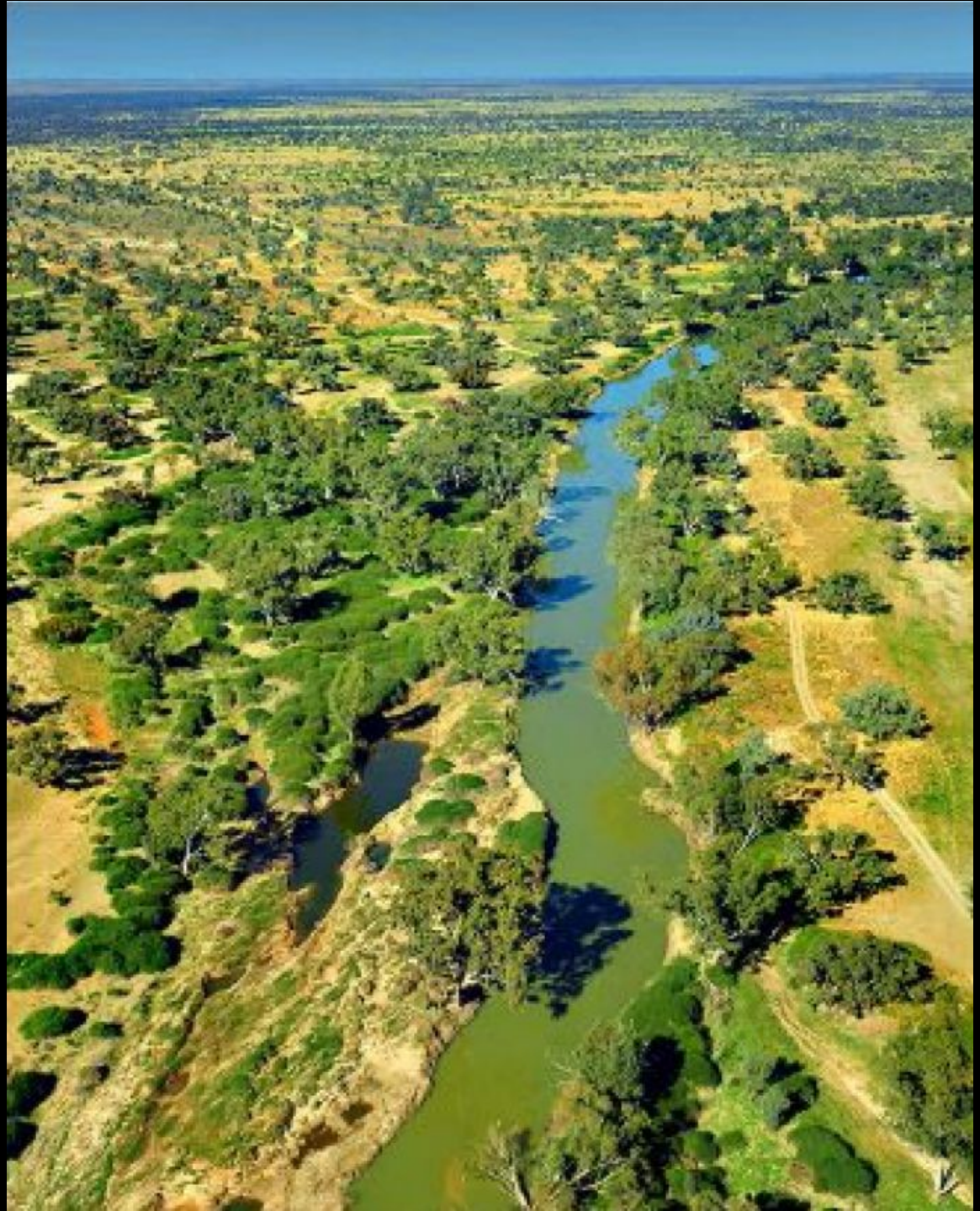


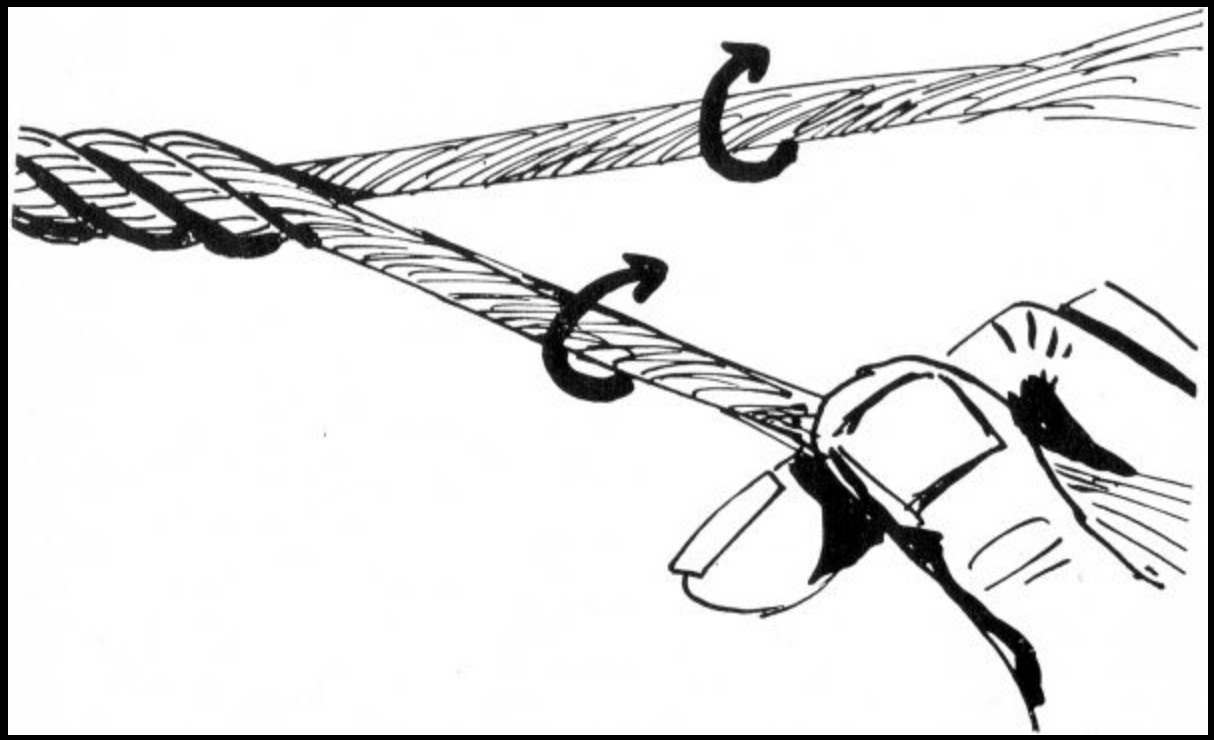
How were we able to do this?

Usual explanation:

We're smarter than the average bear

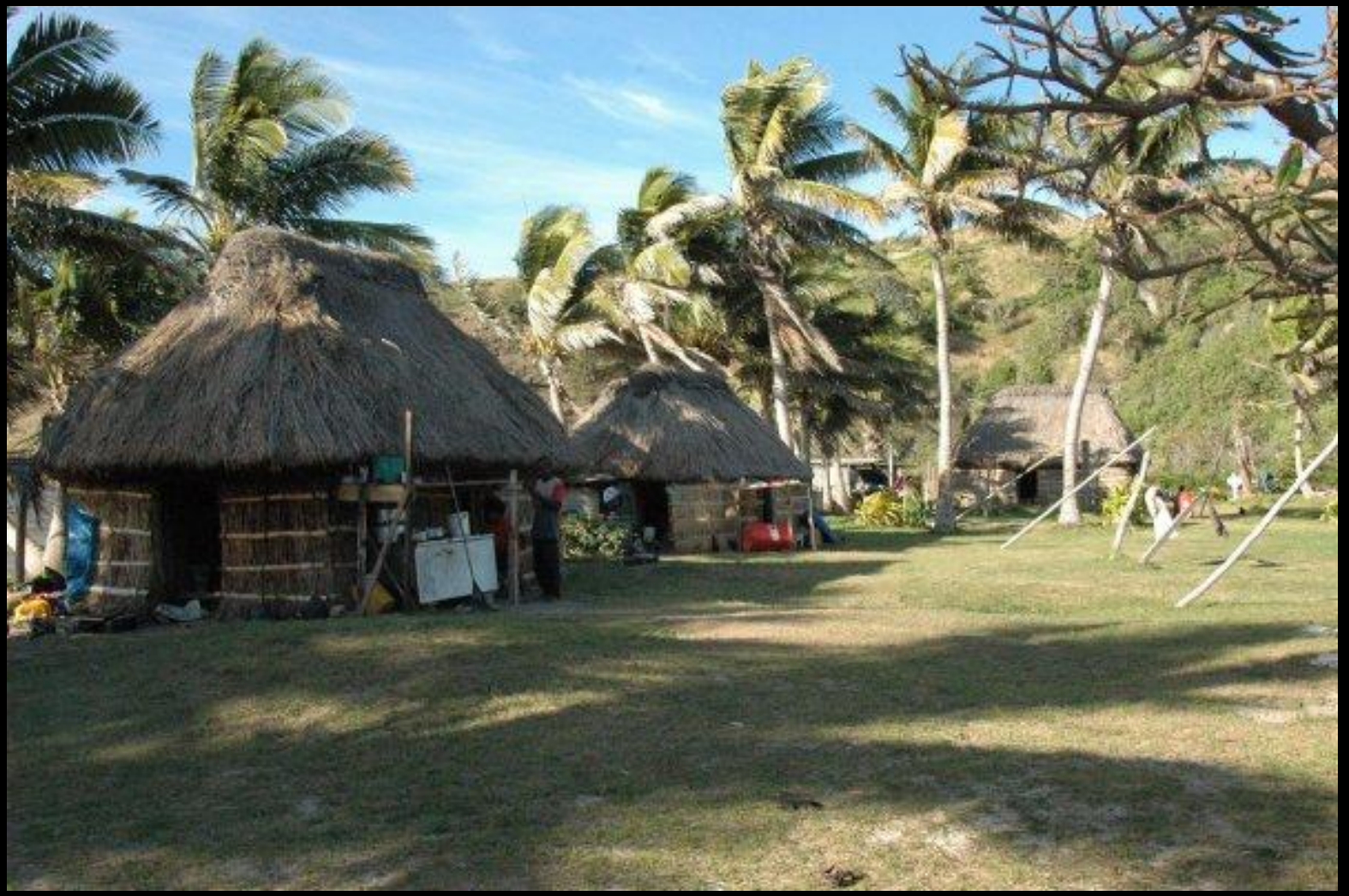

GULF
OF
CARPENTARIA
Cumberland Islands
BASS STRAIT



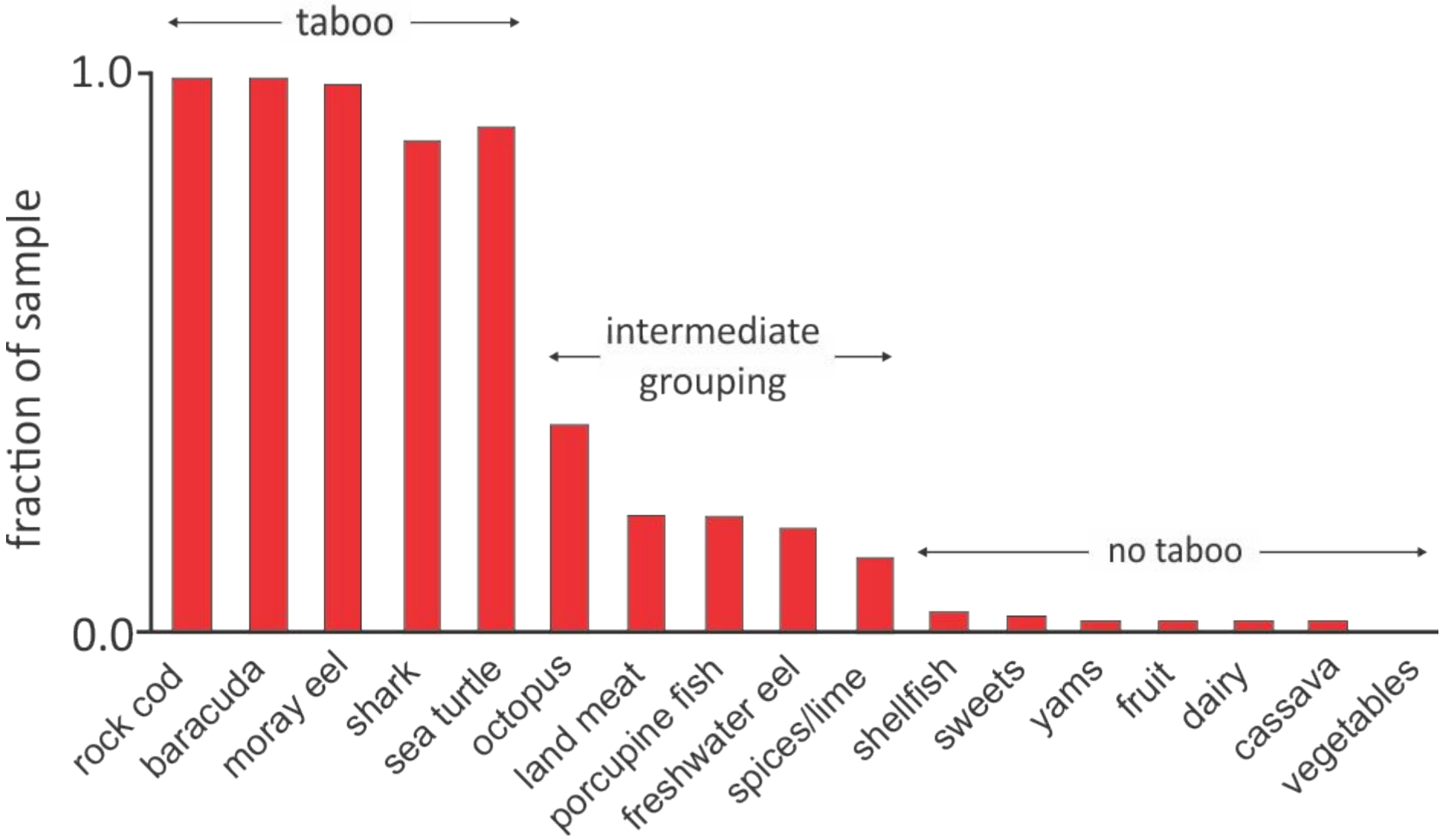


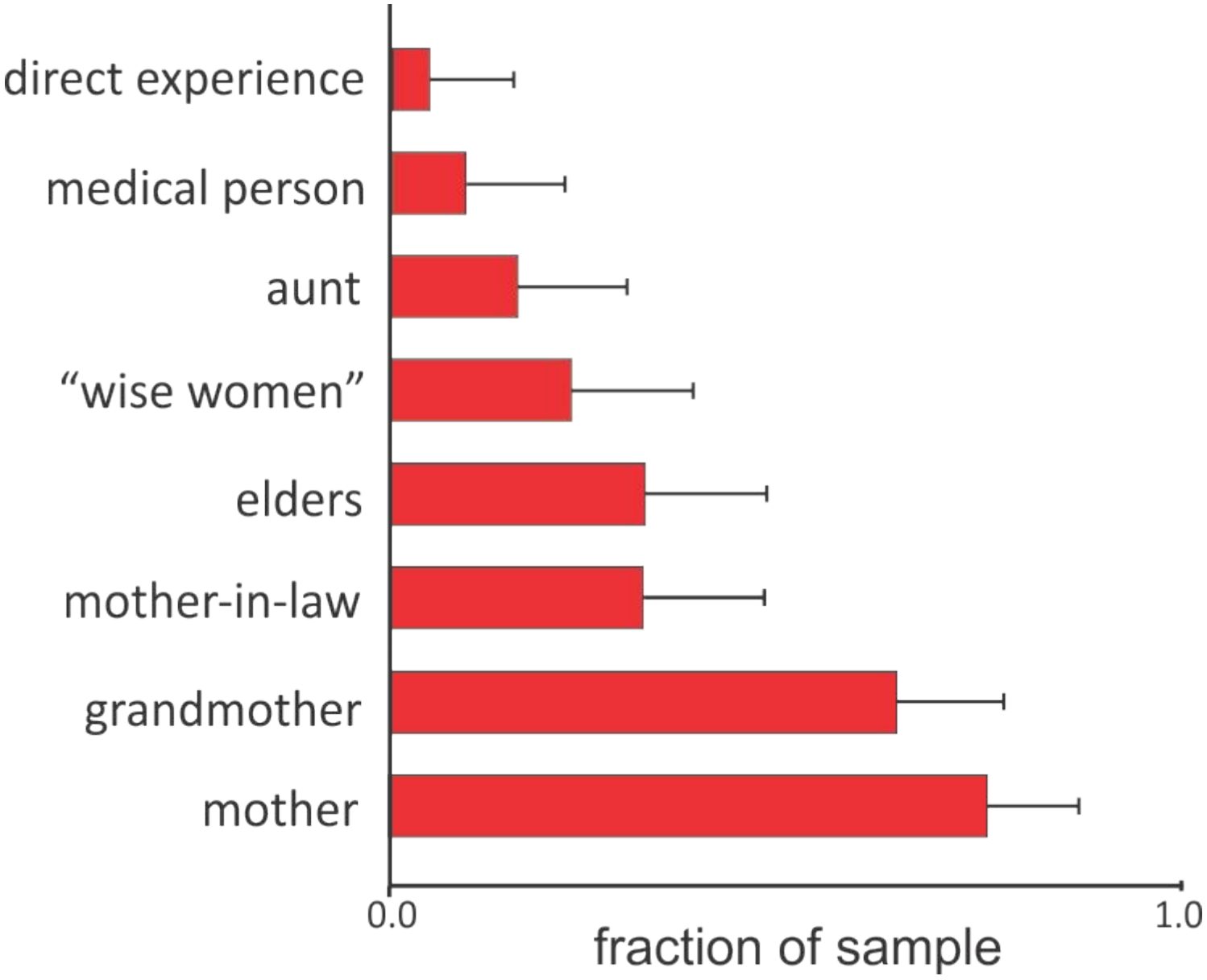
Why is cultural information any good?

Did the Yandruwandha understand why the processed nardoo?



Yasawa Island, Fiji


taboo
1.0
fraction of sample
0.0
intermediate
grouping
no taboo
rock cod
baracuda
moray eel
shark
sea turtle
octopus
land meat
porcupine fish
freshwater eel
spices/lime
shellfish
sweets
yams
fruit
dairy
cassava
vegetables


direct experience
medical person
aunt
“wise women”
elders
mother-in-law
grandmother
mother
0.0
1.0
fraction of sample

Why believe the wise women?

Can selection favor blind imitation?

The evolution of imitation

Large population of organisms

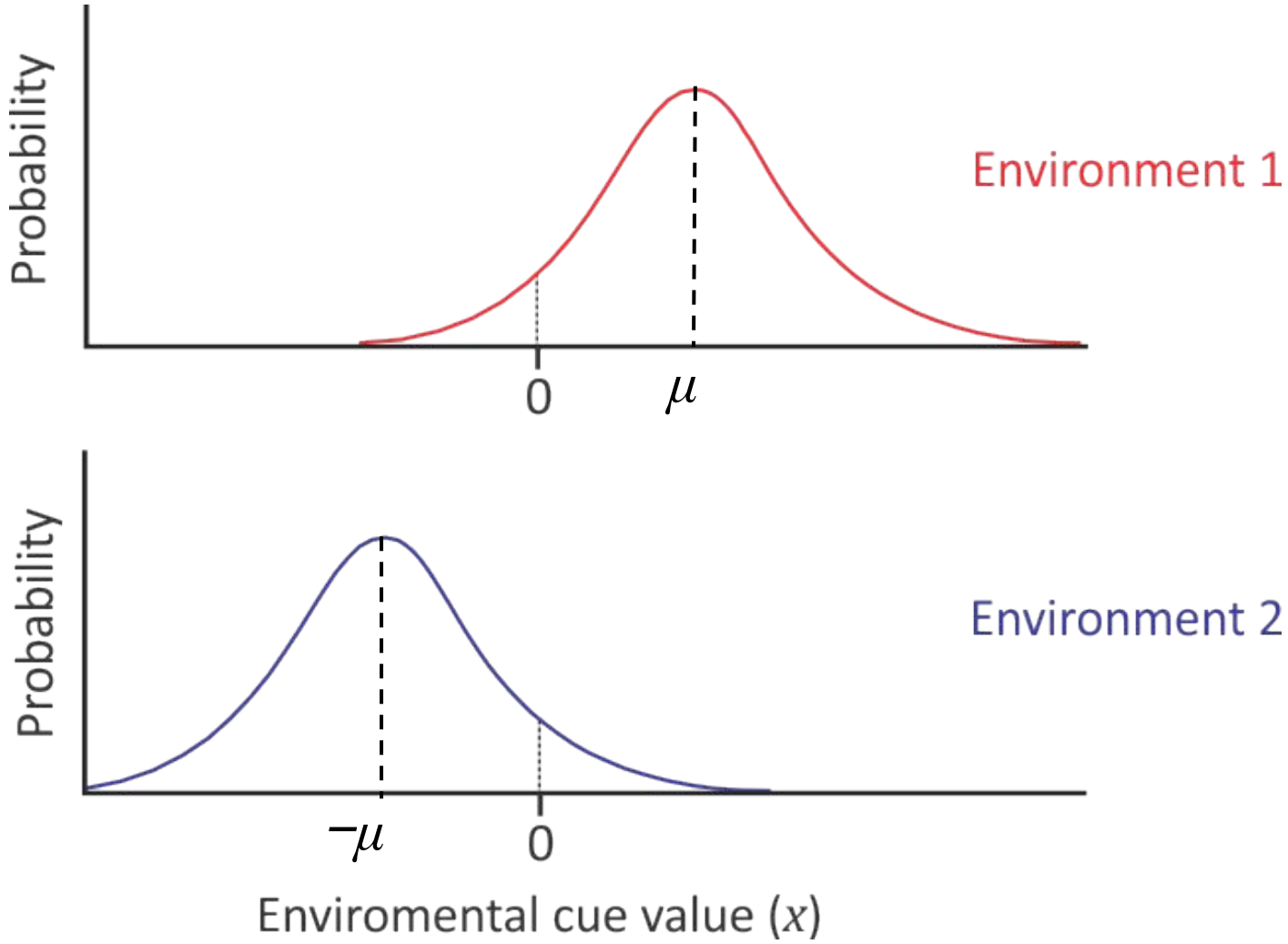
Environment has two states 1 & 2

Switches states with constant probability γ each time period

Two behaviors, each favored in one environment

Two sources of information about state of environment

1. An environmental cue value (x)



Two sources of information about state of environment

1. An environmental cue value (x)
2. The behavior of n individuals from the previous generation

   j individuals use behavior 1

   $n - j$ individuals use behavior 2

To maximize expected fitness, choose behavior 1 if

$$j - \frac{n}{2} > -gx$$

Assume g is a heritable component of individual psychology. Let

$$\varphi_t(g) = \text{distribution of } g \text{ at time } t$$

Then

$$p_{t+t} = f\left(p_t, \varphi_t(g)\right)$$

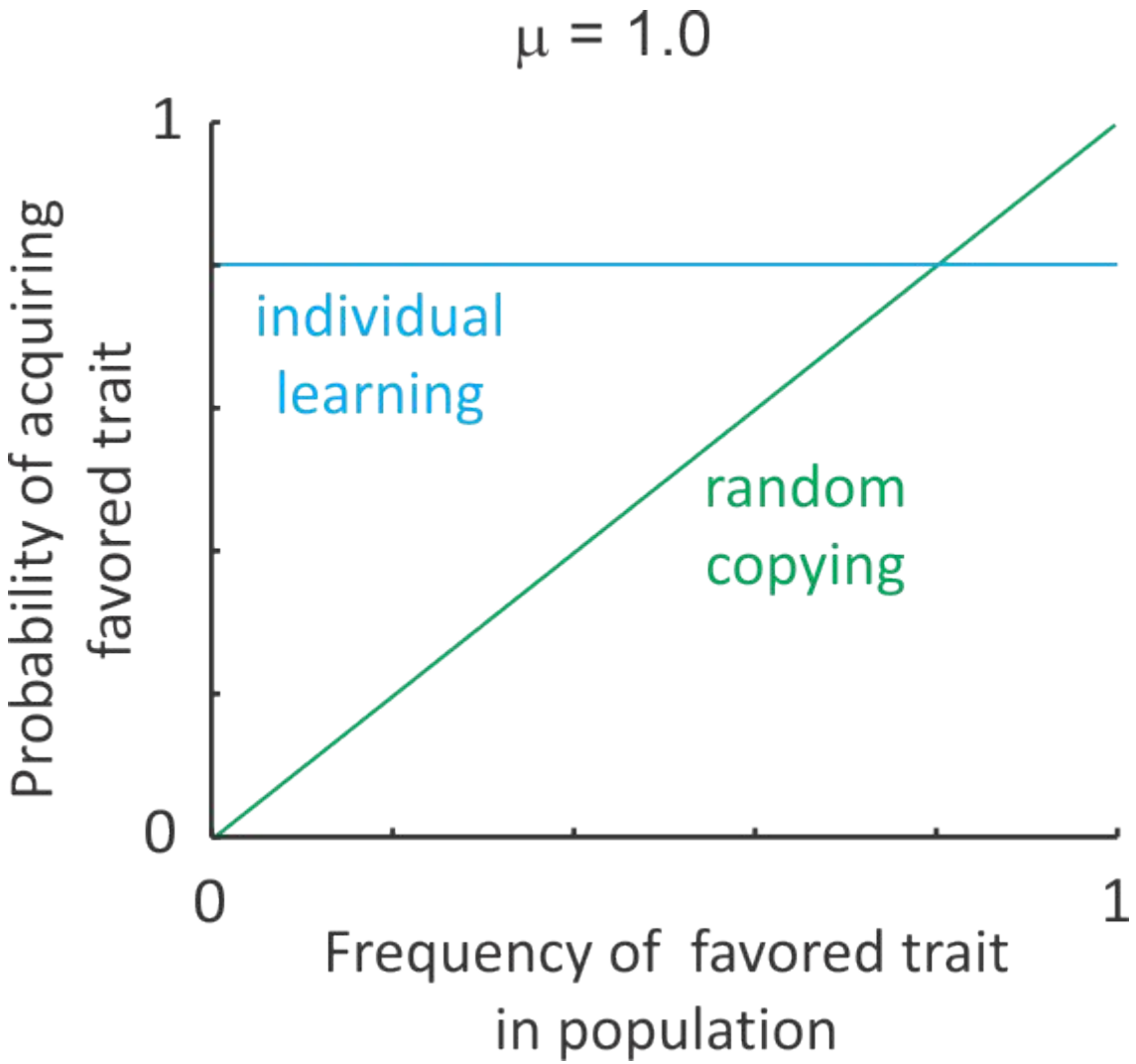
$$\varphi_{t+1}(g) = h(p_t, \varphi_t(g))$$

Cultural transmission

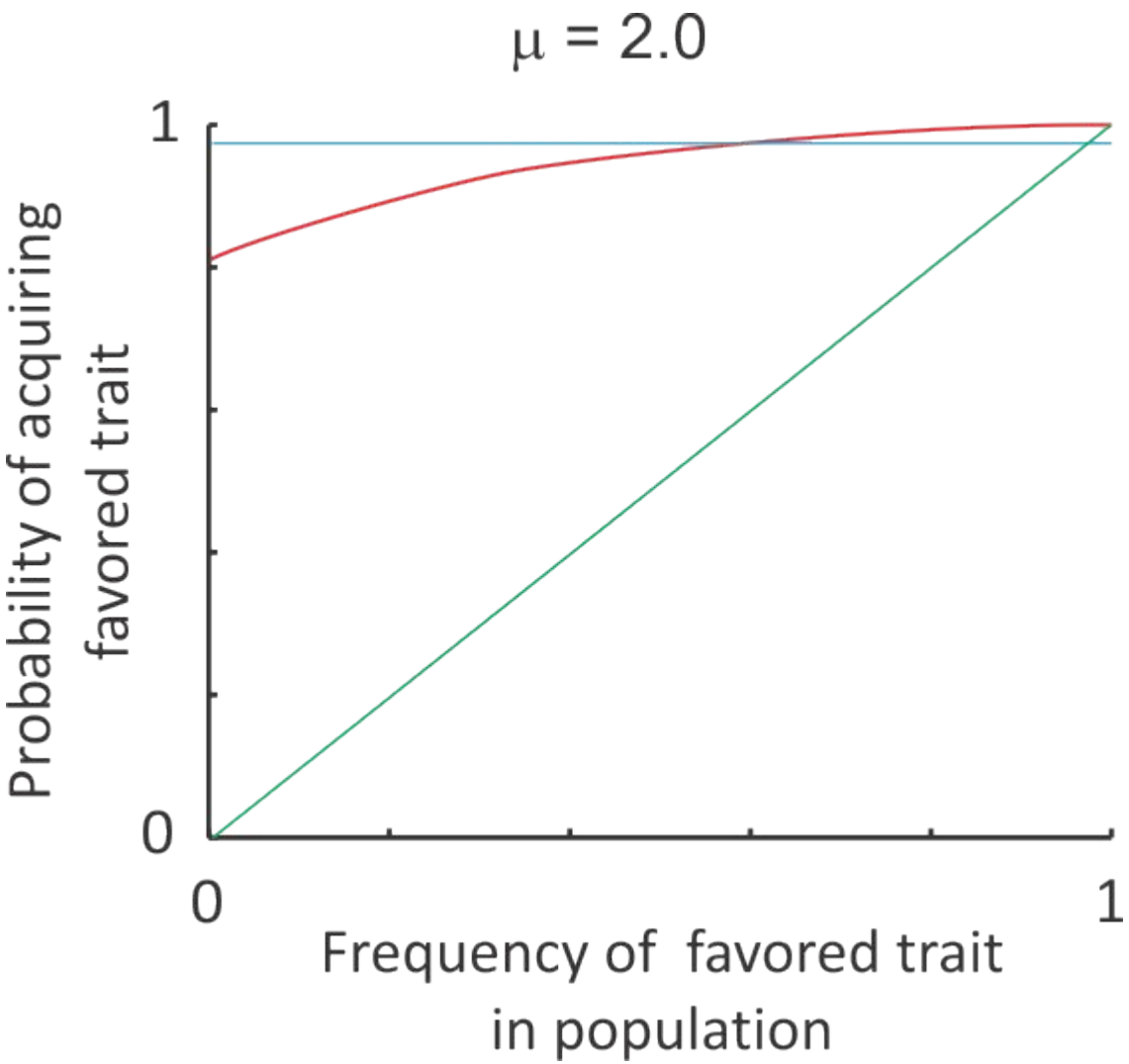
Natural selection

Iterate recursions to find evolutionary equilibrium distribution of g

Plot stationary results in this space

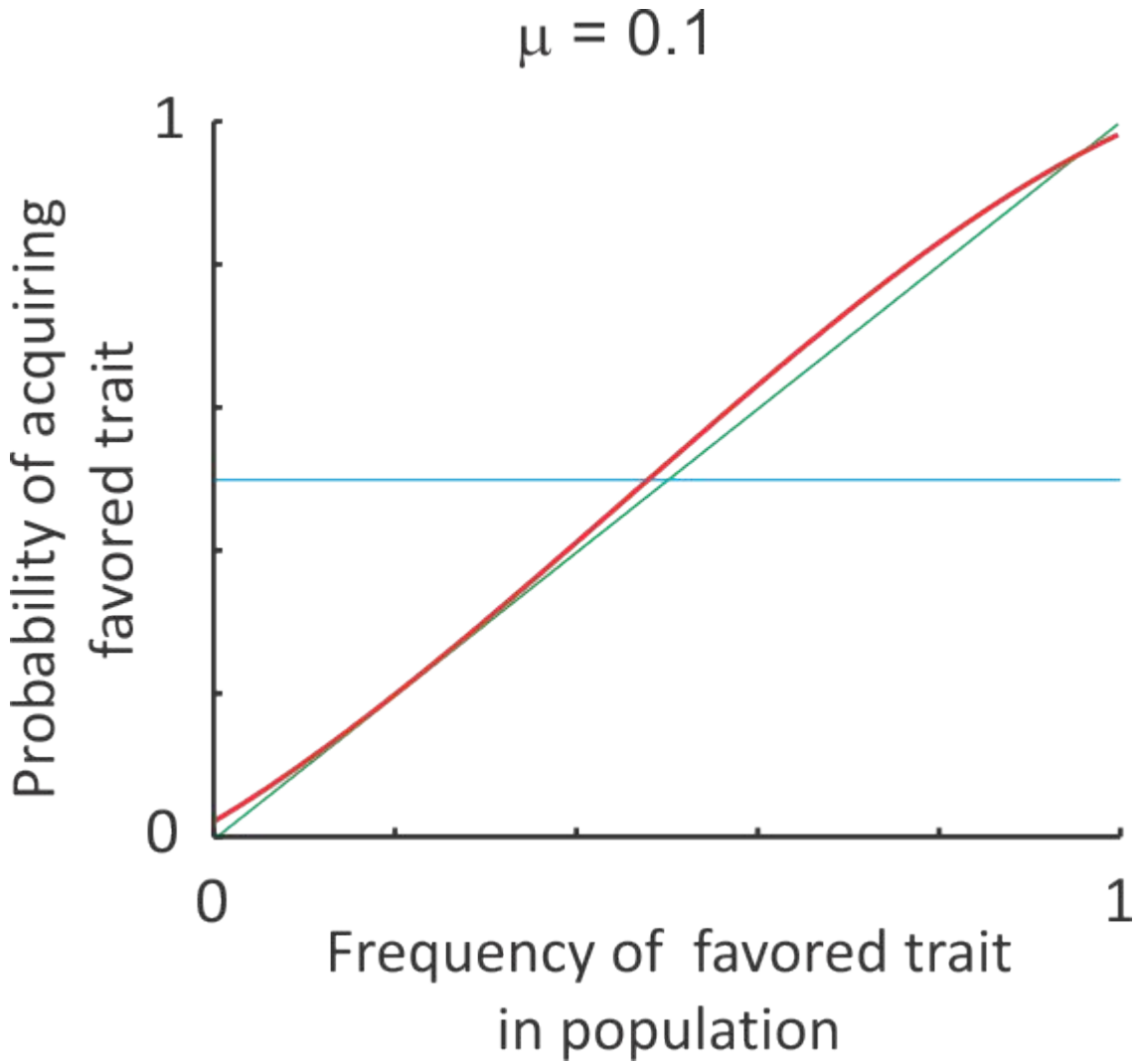


Accurate cues ⇒ little social learning



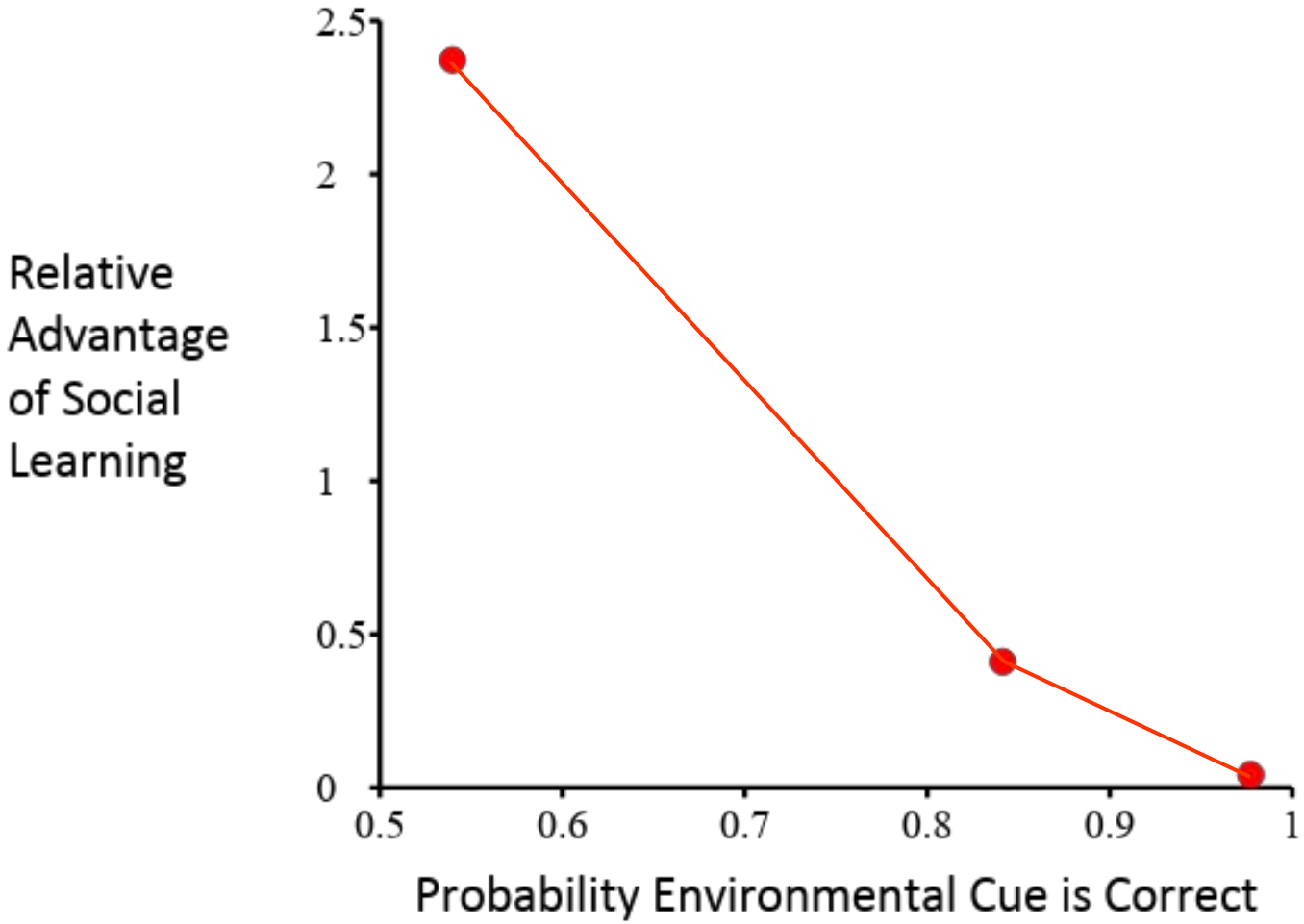
n = 3, γ = 0.01

Low quality cue ⇒ emphasis on social learning



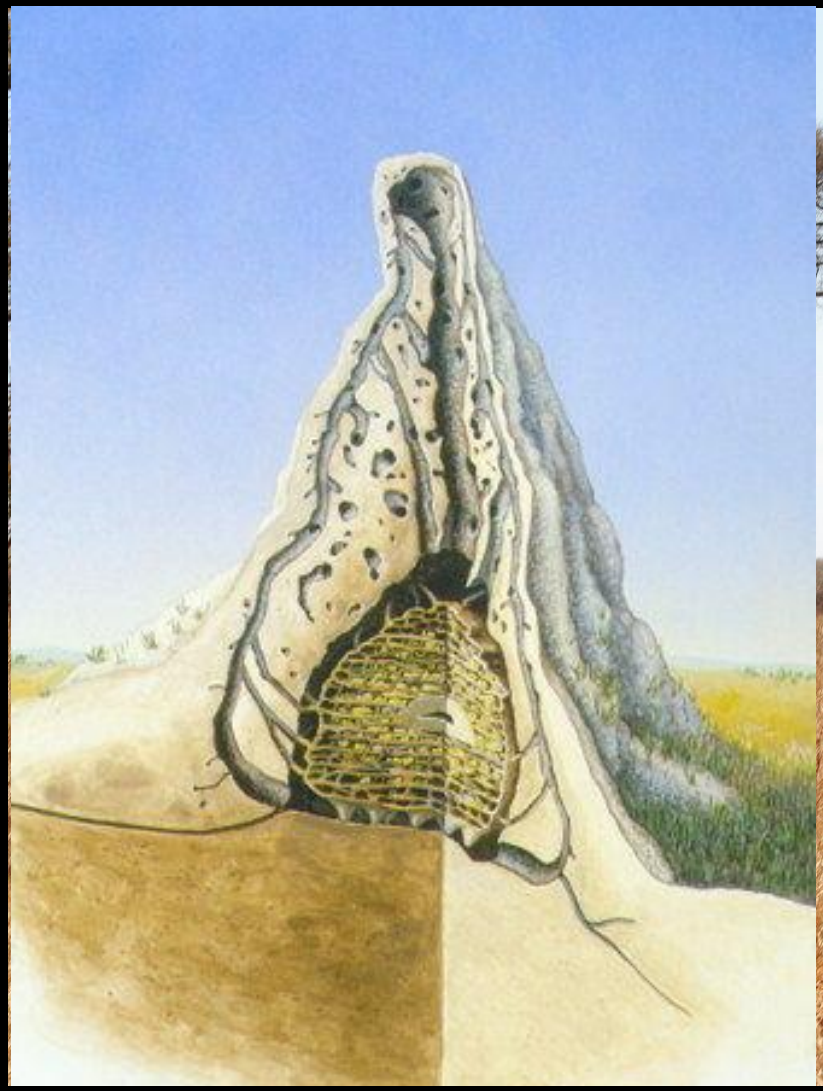
n = 3, γ = 0.01

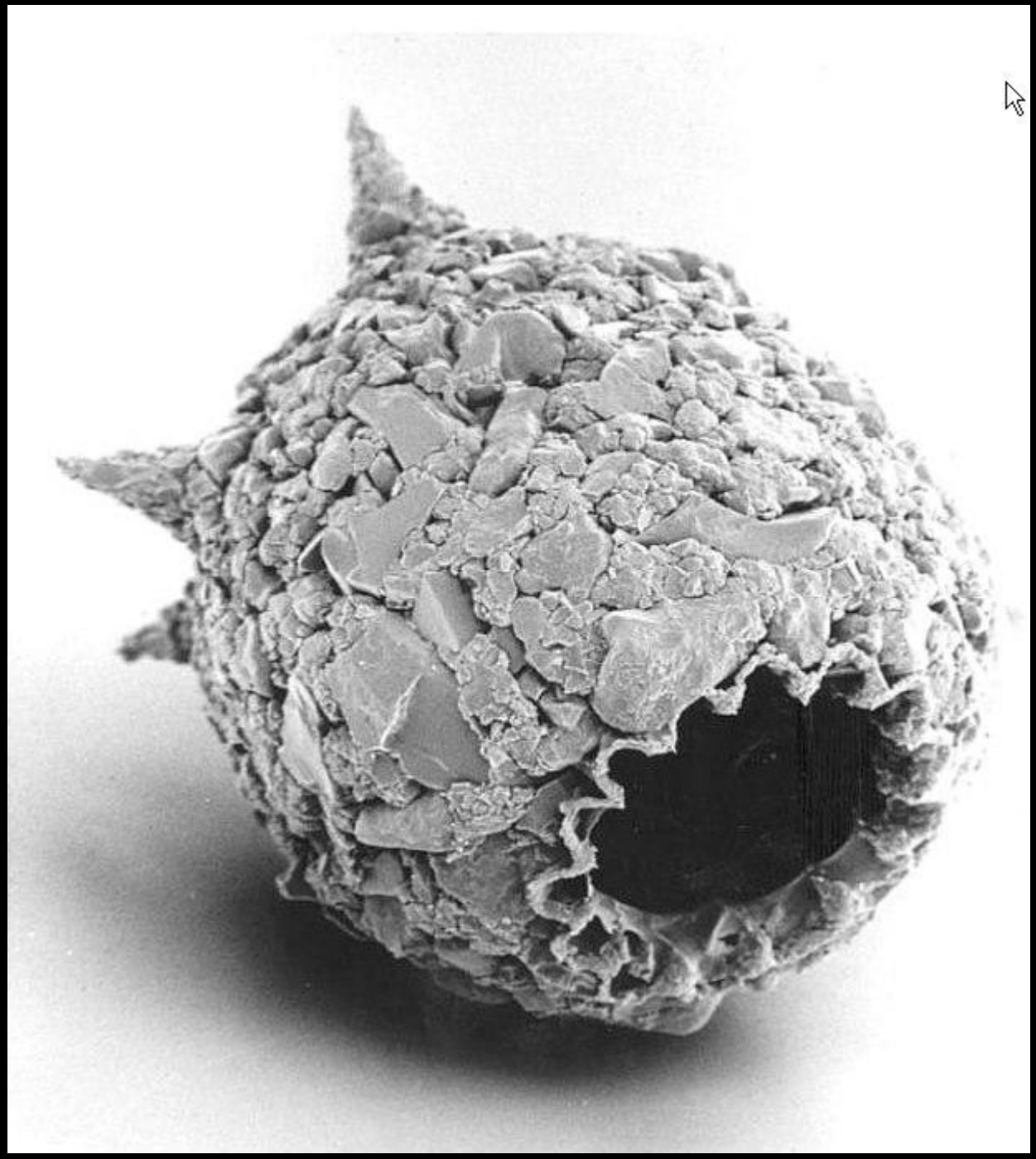
Social learning leads to higher payoffs

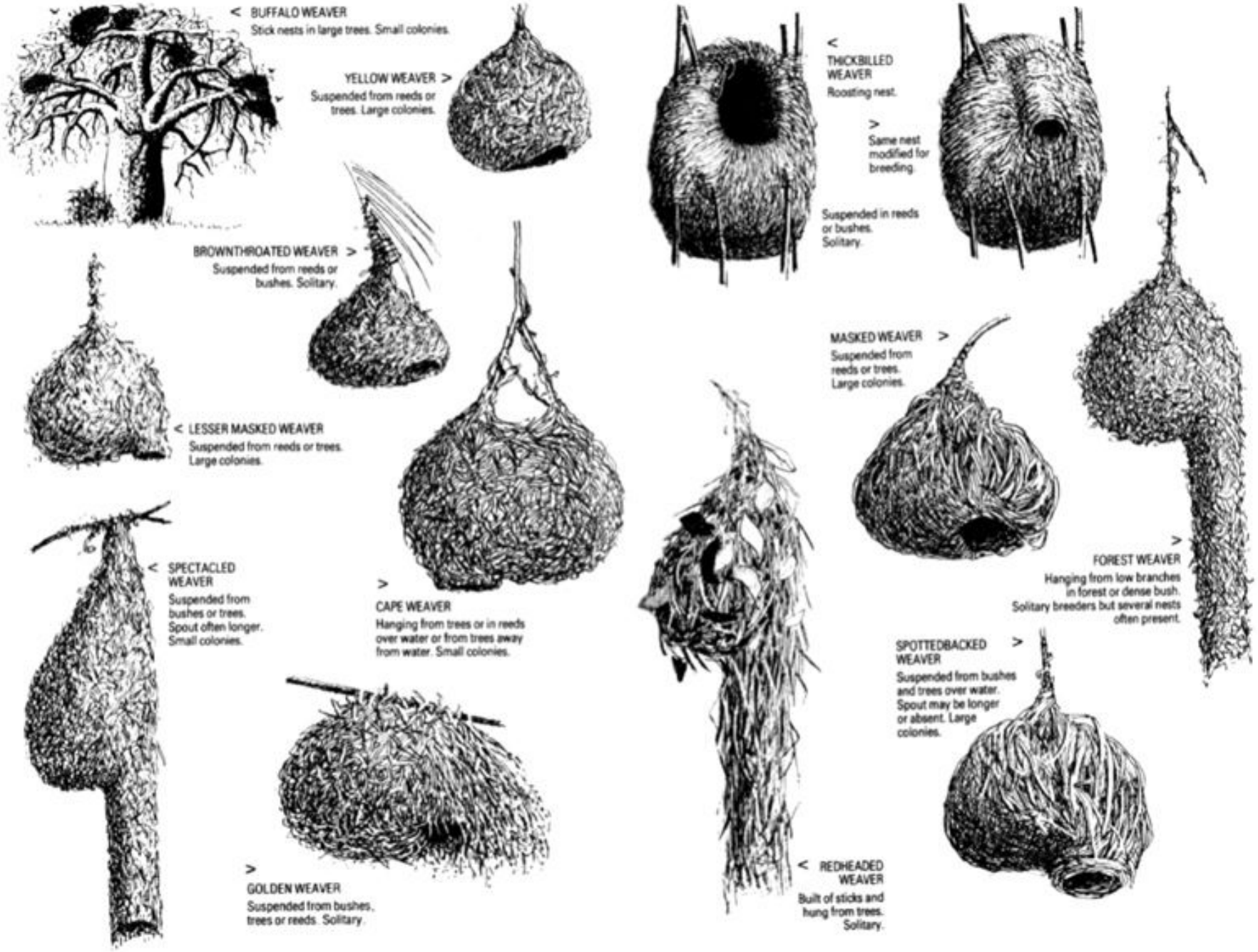


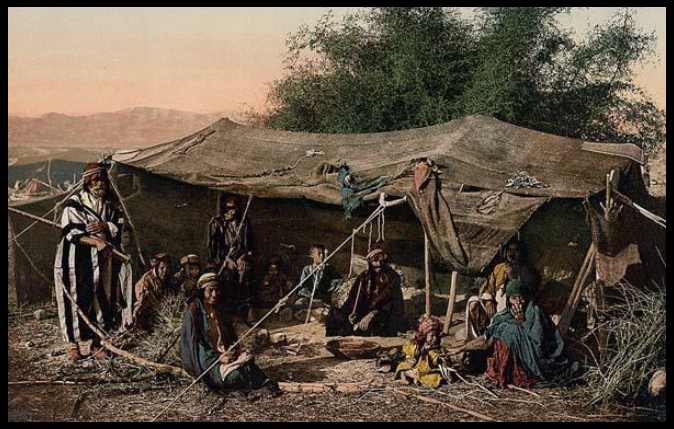
$n = 3$, $\gamma = 0.01$

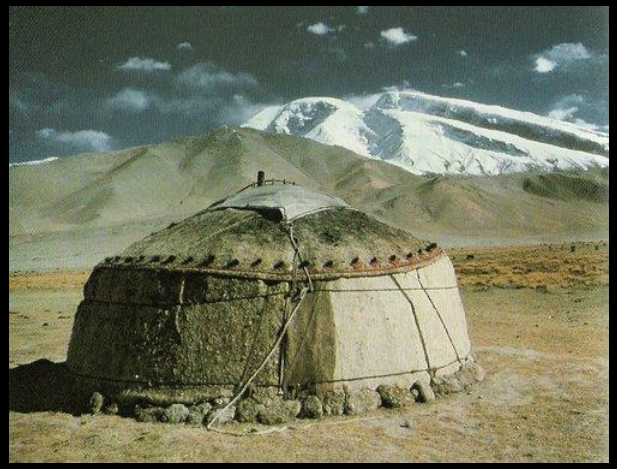
Can complex adaptations result from such a dumb process?

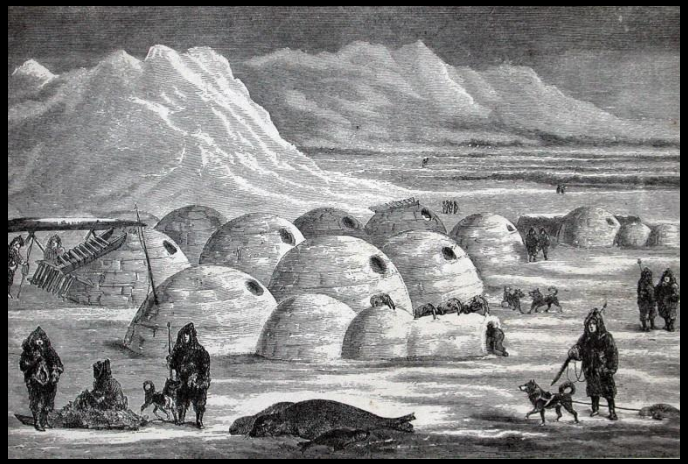


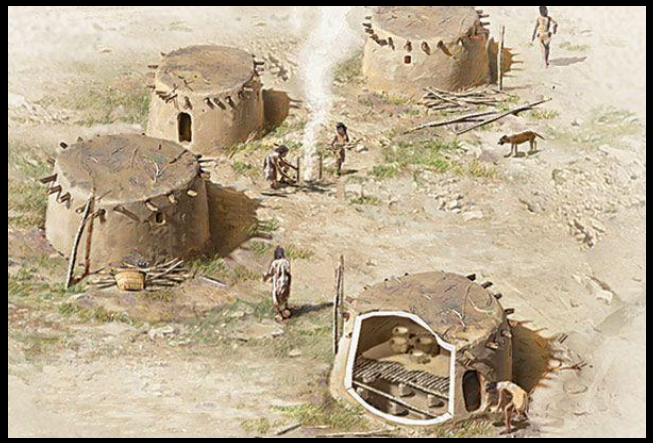


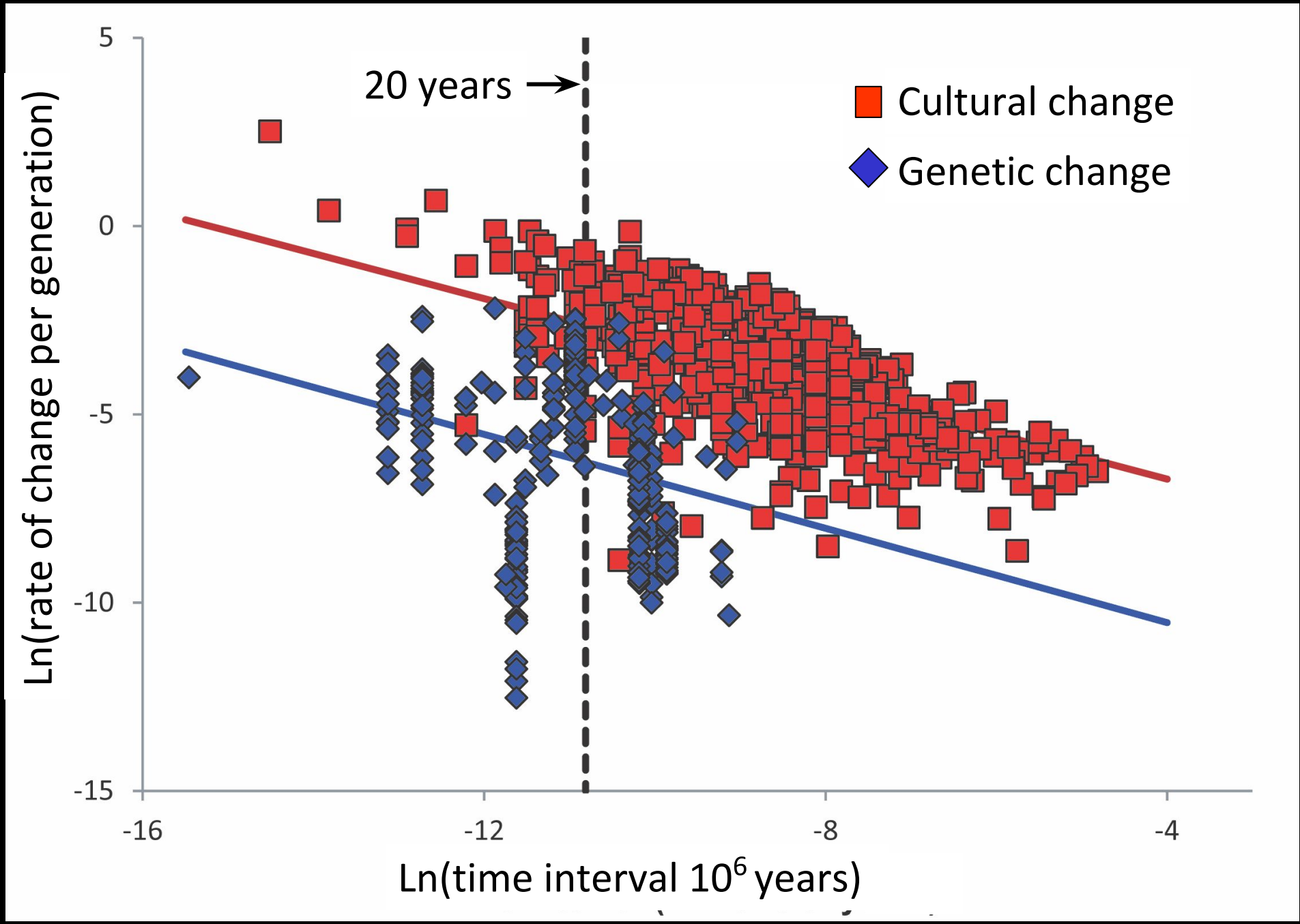

< BUFFALO WEAVER
Stick nests in large trees. Small colonies.
YELLOW WEAVER >
Suspended from reeds or trees. Large colonies.
< THICKBILLED WEAVER
Roosting nest.
> Same nest modified for breeding.
Suspended in reeds or bushes. Solitary.
BROWNTHROATED WEAVER >
Suspended from reeds or bushes. Solitary.
MASKED WEAVER >
Suspended from reeds or trees. Large colonies.
< LESSER MASKED WEAVER
Suspended from reeds or trees. Large colonies.
> FOREST WEAVER
Hanging from low branches in forest or dense bush. Solitary breeders but several nests often present.
< SPECTACLED WEAVER
Suspended from bushes or trees. Spout often longer. Small colonies.
> CAPE WEAVER
Hanging from trees or in reeds over water or from trees away from water. Small colonies.
SPOTTEDBACKED WEAVER >
Suspended from bushes and trees over water. Spout may be longer or absent. Large colonies.
> GOLDEN WEAVER
Suspended from bushes, trees or reeds. Solitary.
< REDHEADED WEAVER
Built of sticks and hung from trees. Solitary.

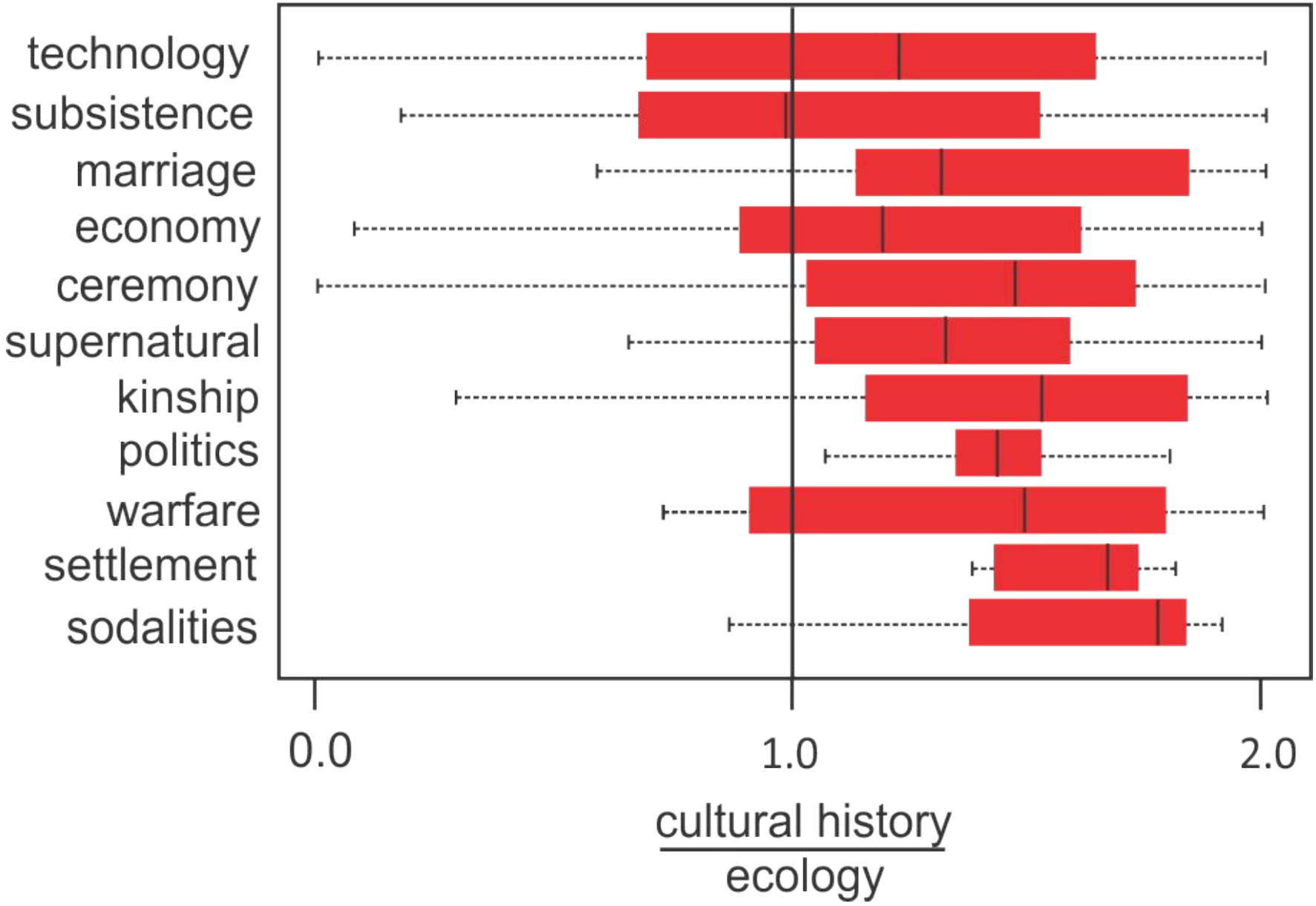




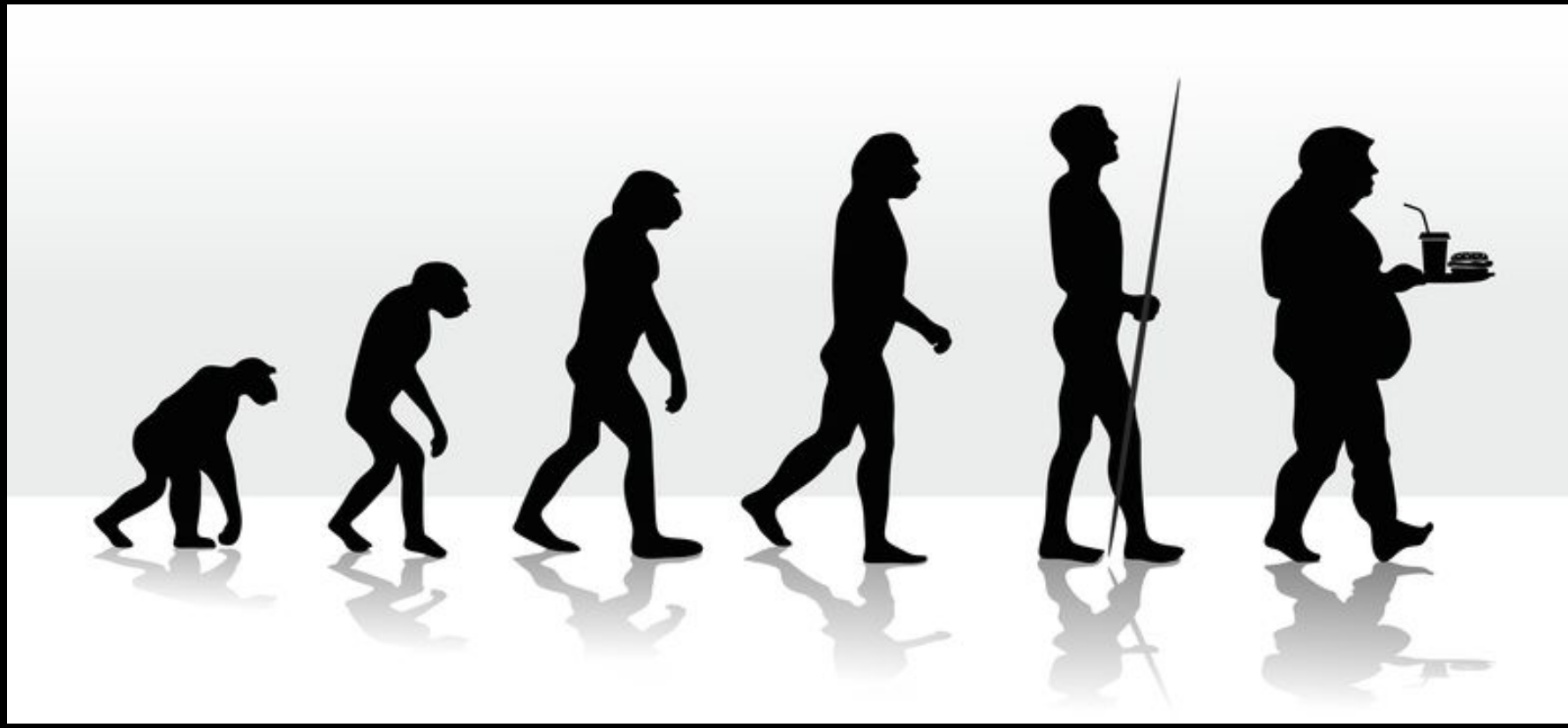





20 years
Cultural change
Genetic change
Ln(rate of change per generation)
5
0
-5
-10
-15
-16
-12
-8
-4
Ln(time interval 10^6 years)


technology
subsistence
marriage
economy
ceremony
supernatural
kinship
politics
warfare
settlement
sodalities
0.0
1.0
2.0
cultural history
ecology

This changes everything

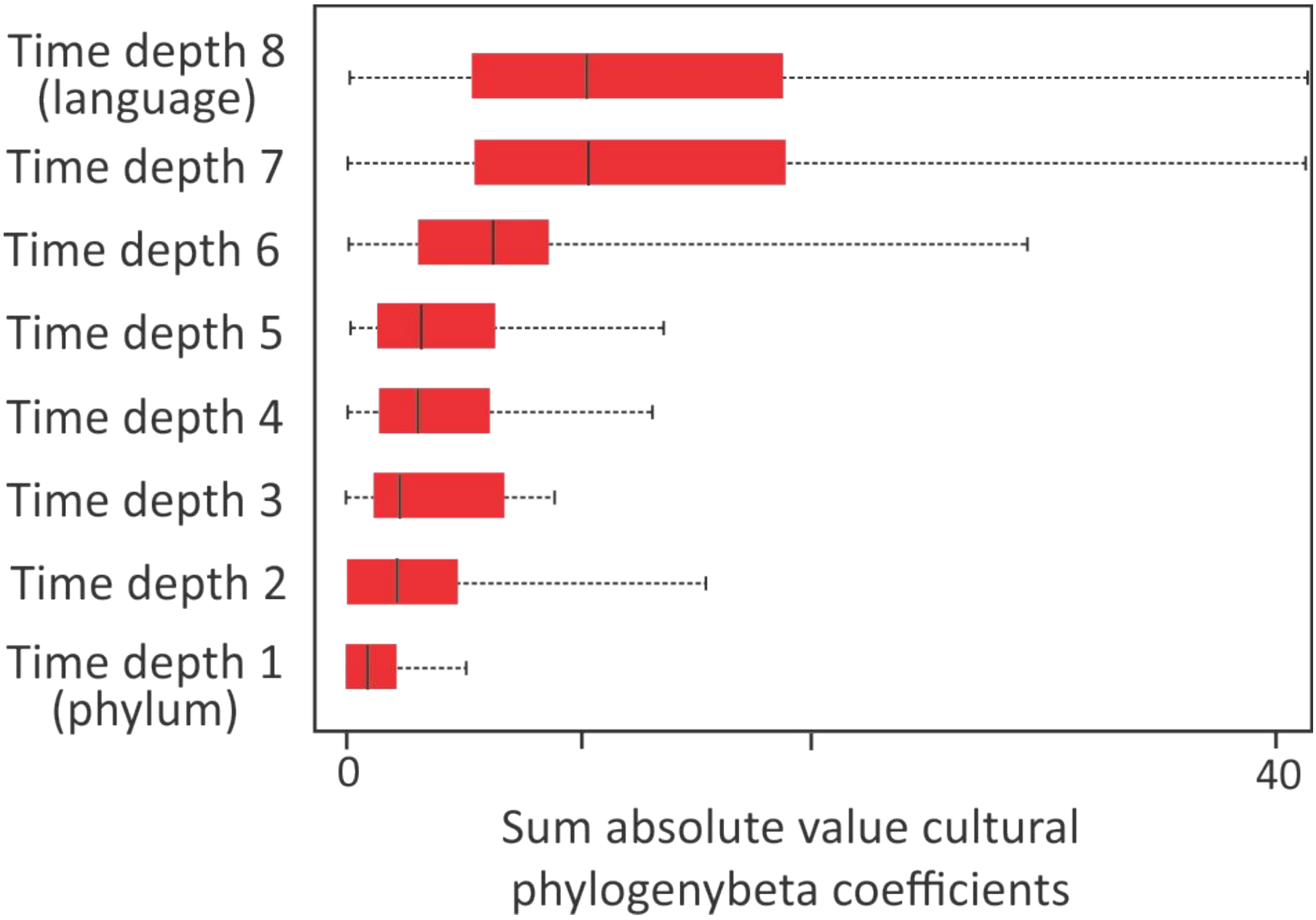


Cultural adaptation involves a tradeoff

Benefit: low cost information.

Cost: have to be credulous

Result: “Maladaptive” ideas can spread


Time depth 8 (language)
Time depth 7
Time depth 6
Time depth 5
Time depth 4
Time depth 3
Time depth 2
Time depth 1 (phylum)
0
40
Sum absolute value cultural phylogenybeta coefficients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