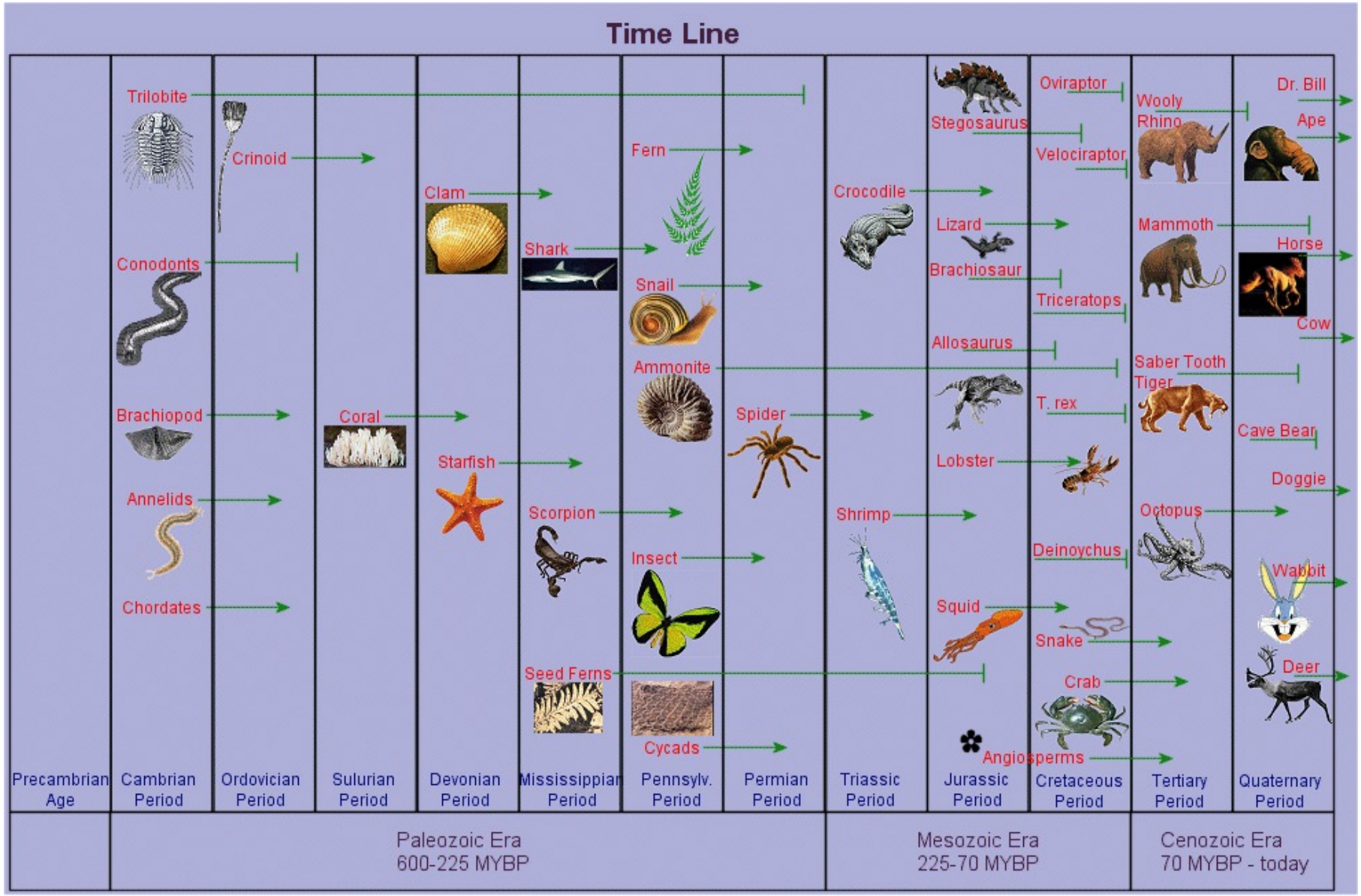
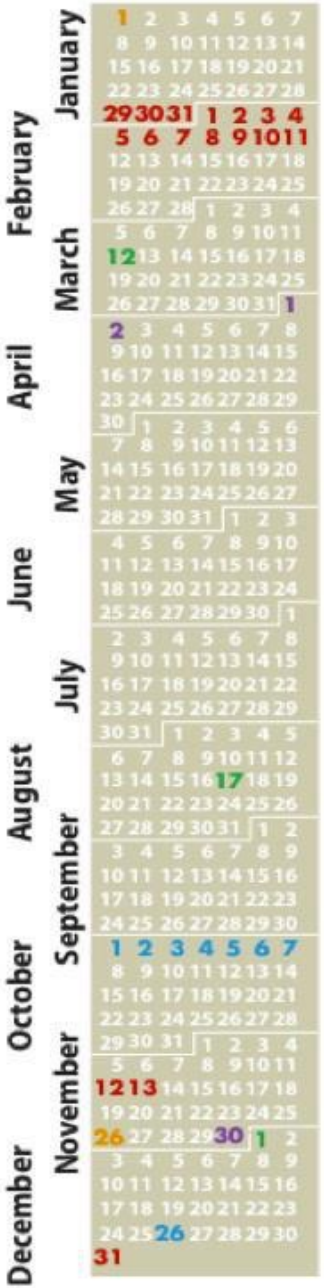

Time Line
Trilobite
Crinoid
Clam
Fern
Shark
Conodonts
Snail
Crocodile
Oviraptor
Stegosaurus
Velociraptor
Wooly Rhino
Dr. Bill
Ape
Lizard
Mammoth
Horse
Brachiosaur
Triceratops
Cow
Allosaurus
Ammonite
Saber Tooth Tiger
Brachiopod
Coral
Spider
T. rex
Cave Bear
Starfish
Lobster
Doggie
Annelids
Scorpion
Shrimp
Octopus
Deinoychus
Insect
Wabbit
Chordates
Squid
Snake
Seed Ferns
Deer
Crab
Cycads
Angiosperms
Precambrian Age
Cambrian Period
Ordovician Period
Sulurian Period
Devonian Period
Mississippian Period
Pennsylv. Period
Permian Period
Triassic Period
Jurassic Period
Cretaceous Period
Tertiary Period
Quaternary Period
Paleozoic Era
600-225 MYBP
Mesozoic Era
225-70 MYBP
Cenozoic Era
70 MYBP - today



1: Earth forms

29–11: Oldest known rocks

12: Oldest chemical evidence of life

1–2: Oldest fossil cells

17: First eukaryotes

1–7: First multicellular organisms (algae)

12–13: First animals with shells and limbs

26: First animals with vertebrae

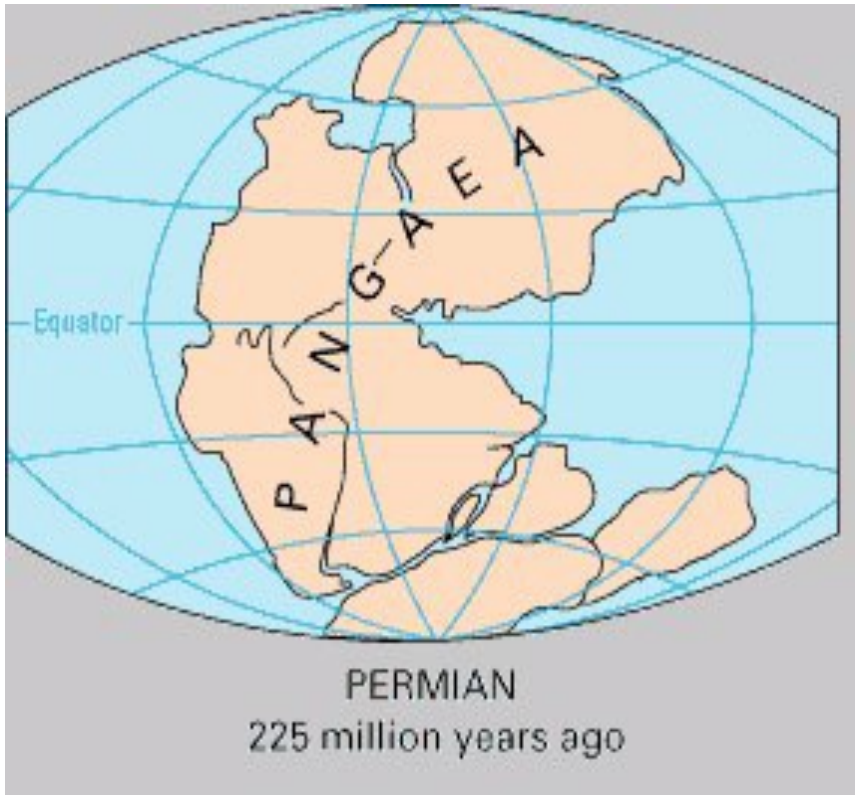
30: First land plants

1: First land animals

26: Extinction of dinosaurs

31: *Homo sapiens* appears one hour before midnight. Humans set foot on Moon $^{1}/_{4}$ second before midnight

1 day = 12.6 million years
1 second = 143 years



PERMIAN
225 million years ago

Gondwanaland

(approx. 75 mya)

Milestones in 10 Million Years of Human Evolution

10 million

Bipedalism

5 million

4 million

Australopithecus

3 million

First stone tools

2 million

Homo habilis

Homo erectus

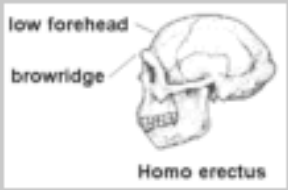
1 million

Signs of camps & meat eating

Use of fire

700,000

Homo erectus
brain size = 800 cm3



Environment of Evolutionary Adaption

200,000

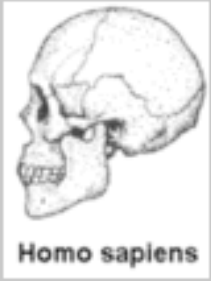
Homo sapiens

Advanced tools

100,000

Homo sapiens sapiens

- modern humans



Homo sapiens sapiens
brain size = 1700 cm3

40,000

Cave painting about 20,000 years old

10,000

150

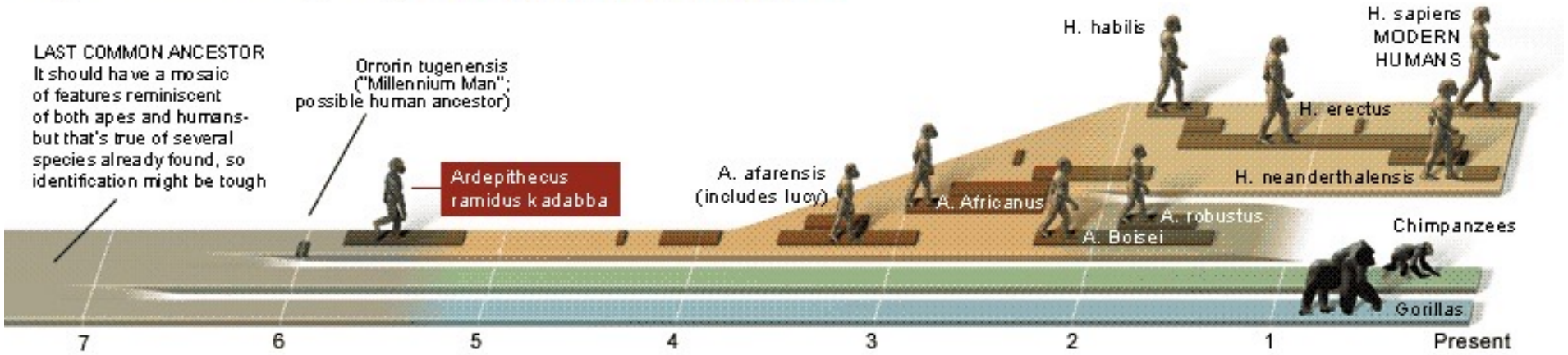
Industrial revolution

50

Technological revolution

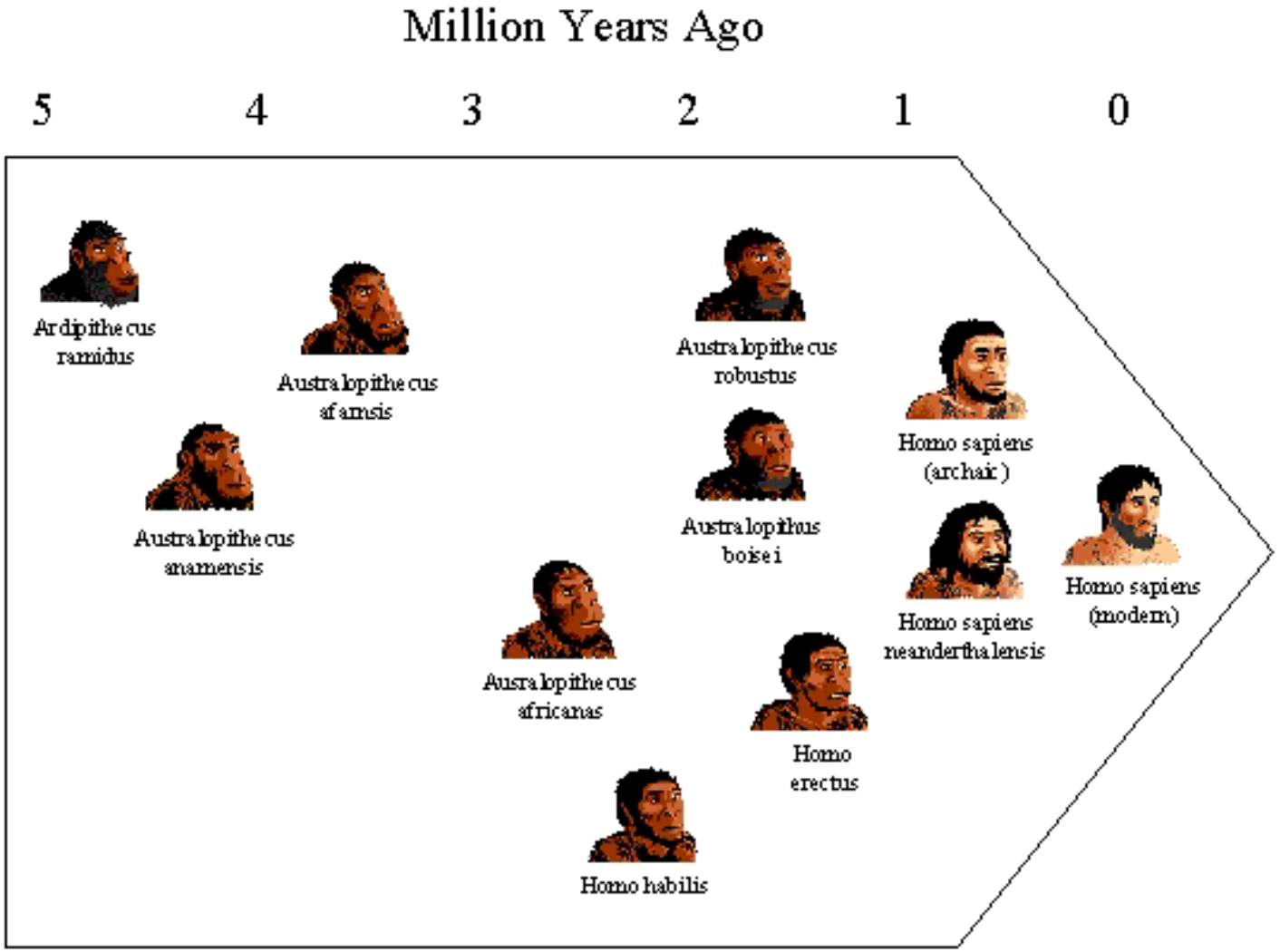
A WALK THROUGH HUMAN EVOLUTION

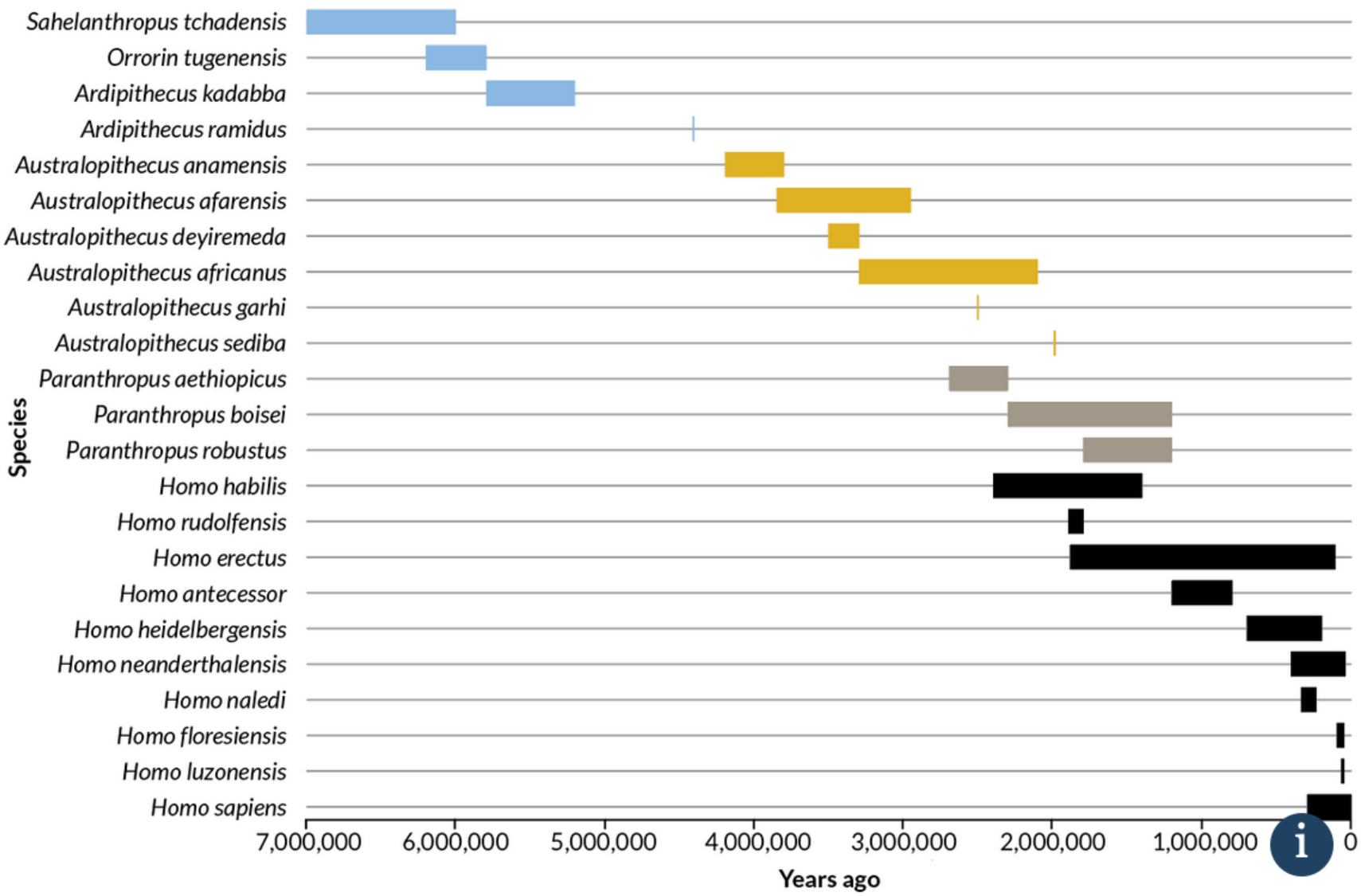
The newest fossils have brought scientists tantalizingly close to the time when humans first walked upright--splitting off from the chimpanzees. Their best guess now is that it happened at least 6 million years ago **Click here to read the cover story >>**

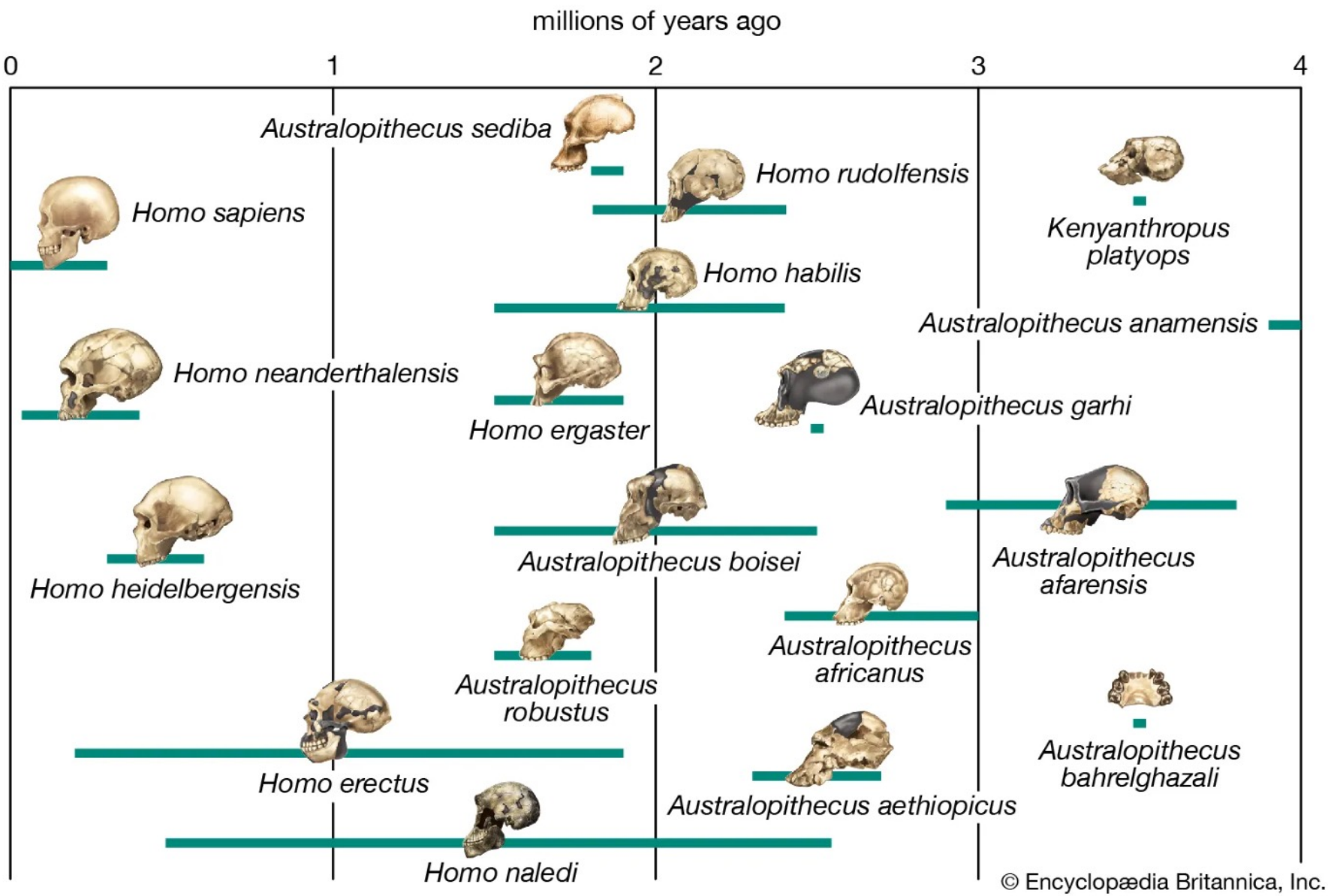


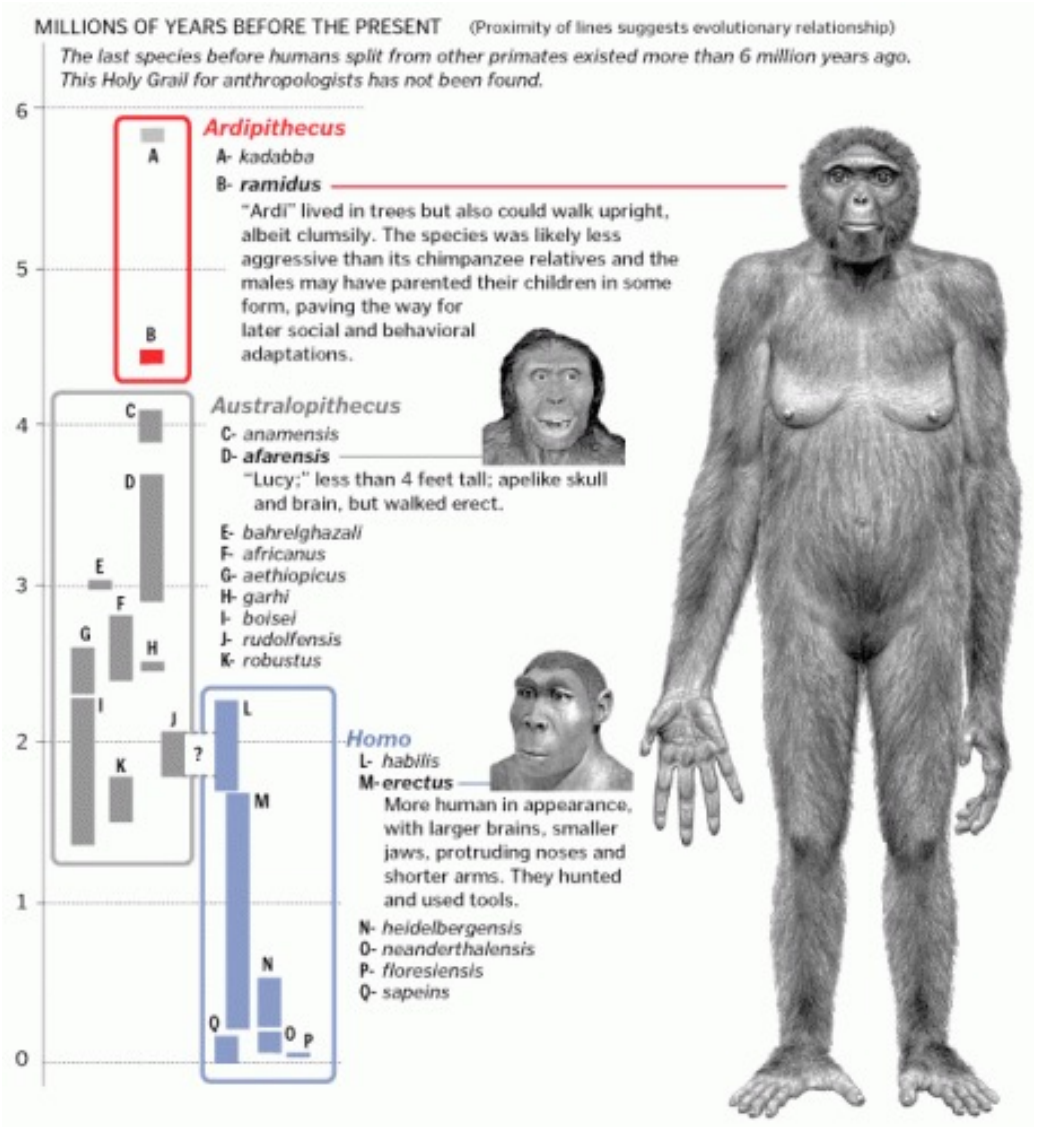
Timeline by Joe Lertola

In Millions of Years ***(All dates are approximate)***


Million Years Ago
5
4
3
2
1
0
Ardipithecus ramidus
Australopithecus anamensis
Australopithecus afarnsis
Australopithecus africanas
Homo habilis
Australopithecus robustus
Australopithus boisei
Homo erectus
Homo sapiens (archair)
Homo sapiens neanderthalensis
Homo sapiens (modern)


Sahelanthropus tchadensis
Orrorin tugenensis
Ardipithecus kadabba
Ardipithecus ramidus
Australopithecus anamensis
Australopithecus afarensis
Australopithecus deyiremeda
Australopithecus africanus
Australopithecus garhi
Australopithecus sediba
Paranthropus aethiopicus
Paranthropus boisei
Paranthropus robustus
Homo habilis
Homo rudolfensis
Homo erectus
Homo antecessor
Homo heidelbergensis
Homo neanderthalensis
Homo naledi
Homo floresiensis
Homo luzonensis
Homo sapiens
Species
7,000,000
6,000,000
5,000,000
4,000,000
3,000,000
2,000,000
1,000,000
0
Years ago


millions of years ago
0
1
2
3
4
Australopithecus sediba
Homo rudolfensis
Kenyanthropus platyops
Homo sapiens
Homo habilis
Australopithecus anamensis
Homo neanderthalensis
Homo ergaster
Australopithecus garhi
Homo heidelbergensis
Australopithecus boisei
Australopithecus afarensis
Australopithecus africanus
Australopithecus robustus
Australopithecus bahrelghazali
Homo erectus
Australopithecus aethiopicus
Homo naledi
© Encyclopædia Britannica, Inc.



Ardipithecus ramidus

Advantages of Bipedalism

*Increased Field of Vision
*Free Hands
*More Efficient Body Cooling
*More Energy Efficient for Long Distance Travel
*More Visible, Threatening Displays

Australopithecus Afarensis

(3 year Old Female)

Australopithecus africanus

Paranthropus bosei

Paranthropus robustus

Kenyanthropus Platyops

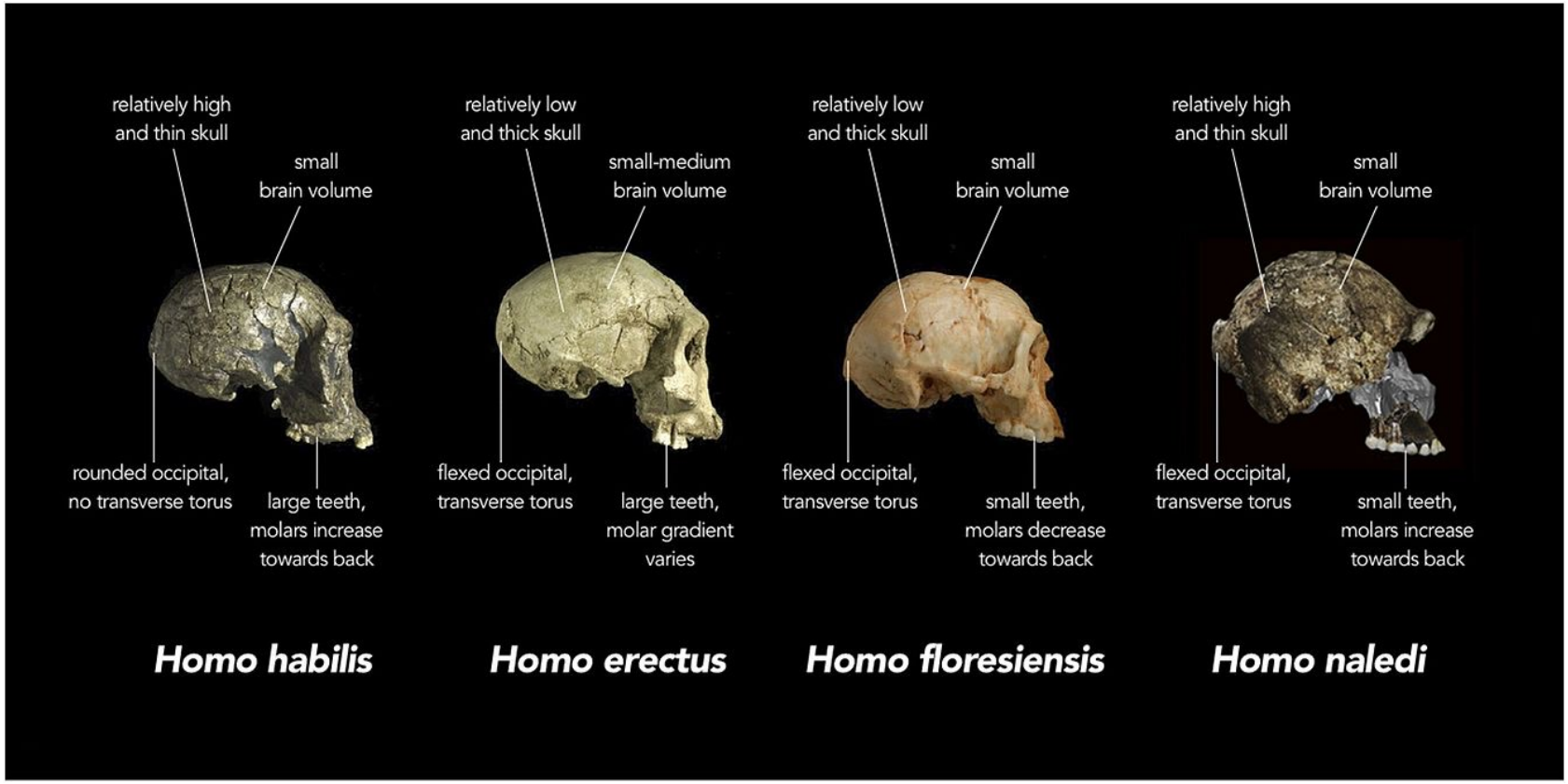
Homo naledi

[Video Clip of Discovery]

Homo naledi

(approximately 300,000 years ago)

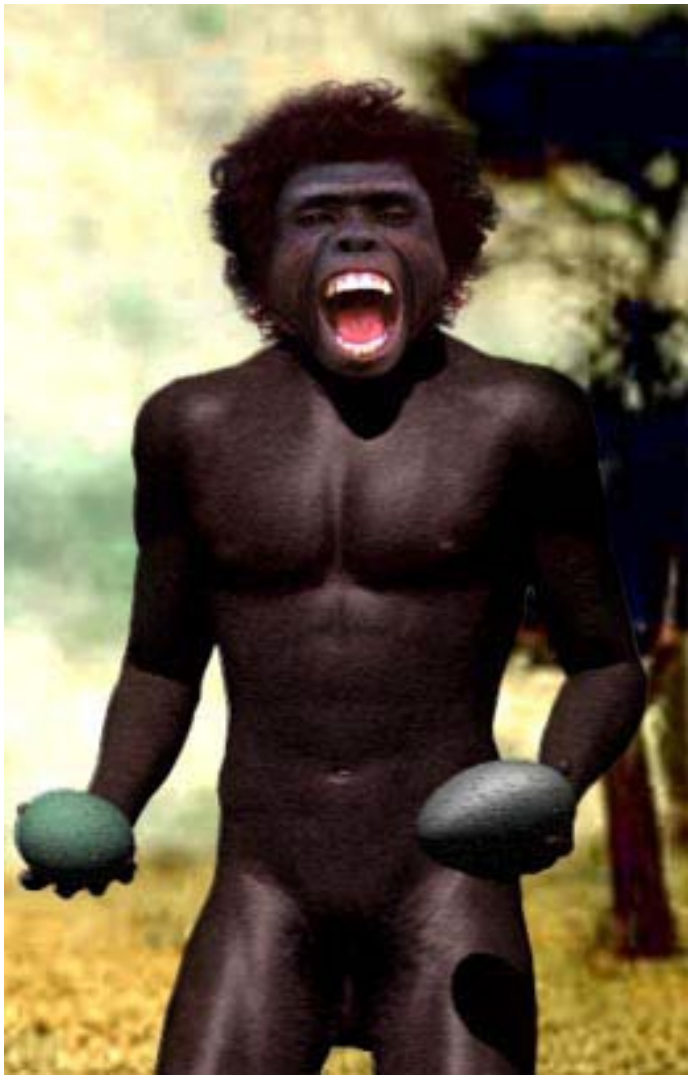
(A curious mix of very early evolutionary characteristics in a fairly recent creature)



Early Homo(Homo habilis?)

Homo ergaster

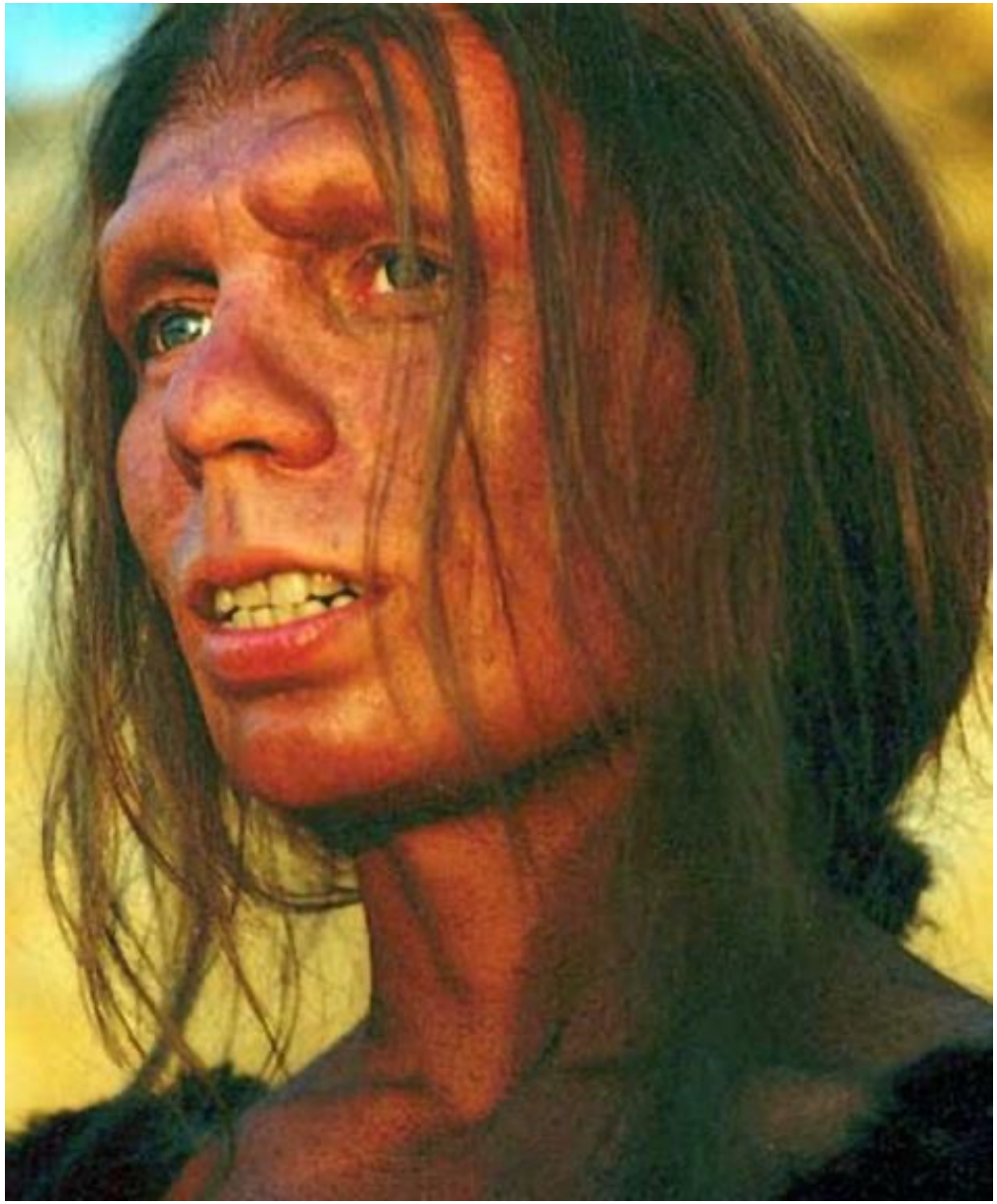
Homo ergaster (adolescent)



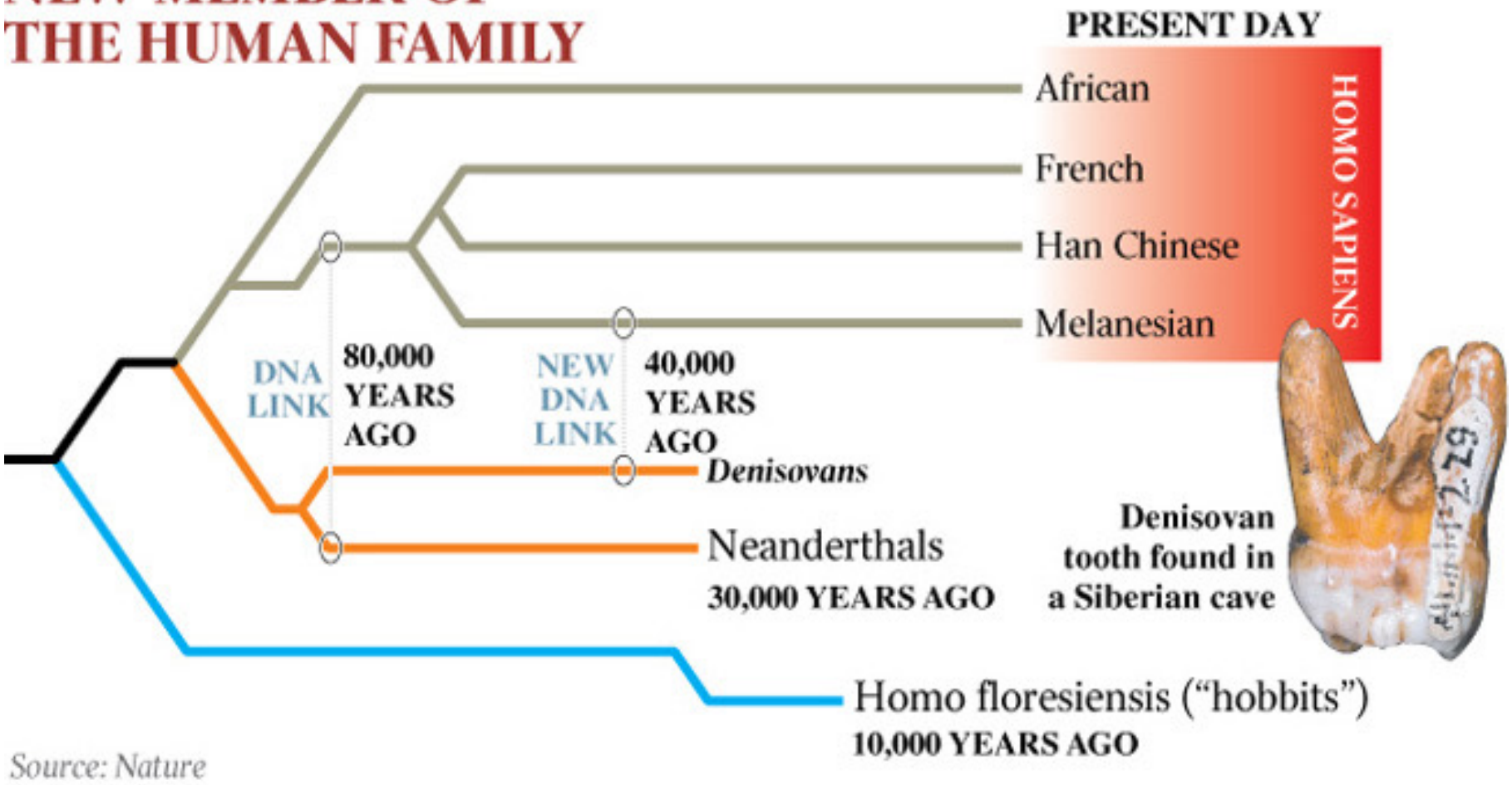
Homo erectus

Homo heidelbergensis

Denisova Hominin



NEW MEMBER OF THE HUMAN FAMILY



Source: Nature

Homo neanderthalis

(action figure)

Homo neanderthalensis

Neanderthals may not have had a firm division of labor between males and females, as females also appear to have been designed for hunting.

Neanderthal & Homo sapiens skeletons

Homo floresiensis

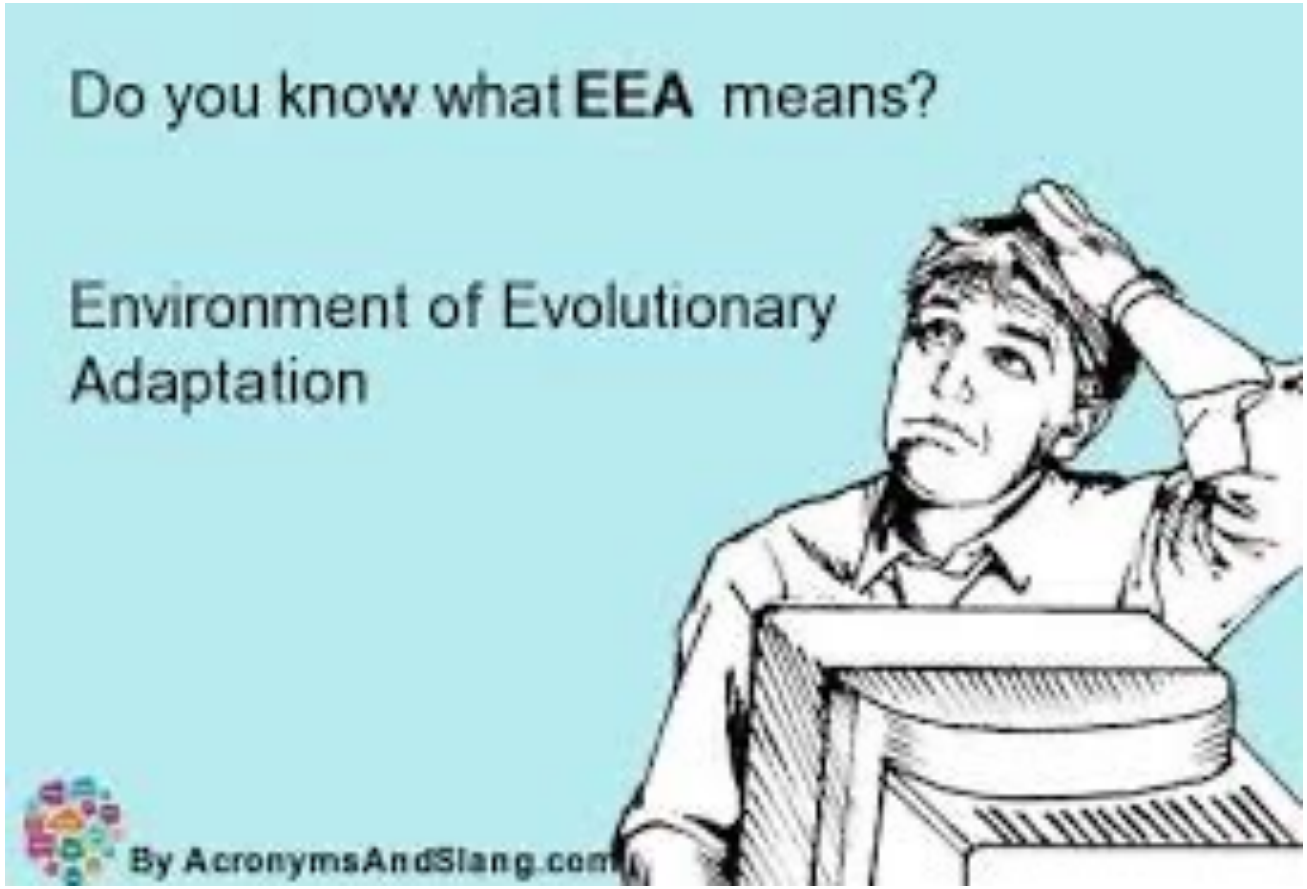
Homo sapiens (archaic)

Homo sapiens sapiens

How was Homo Sapiens different from other homo species?

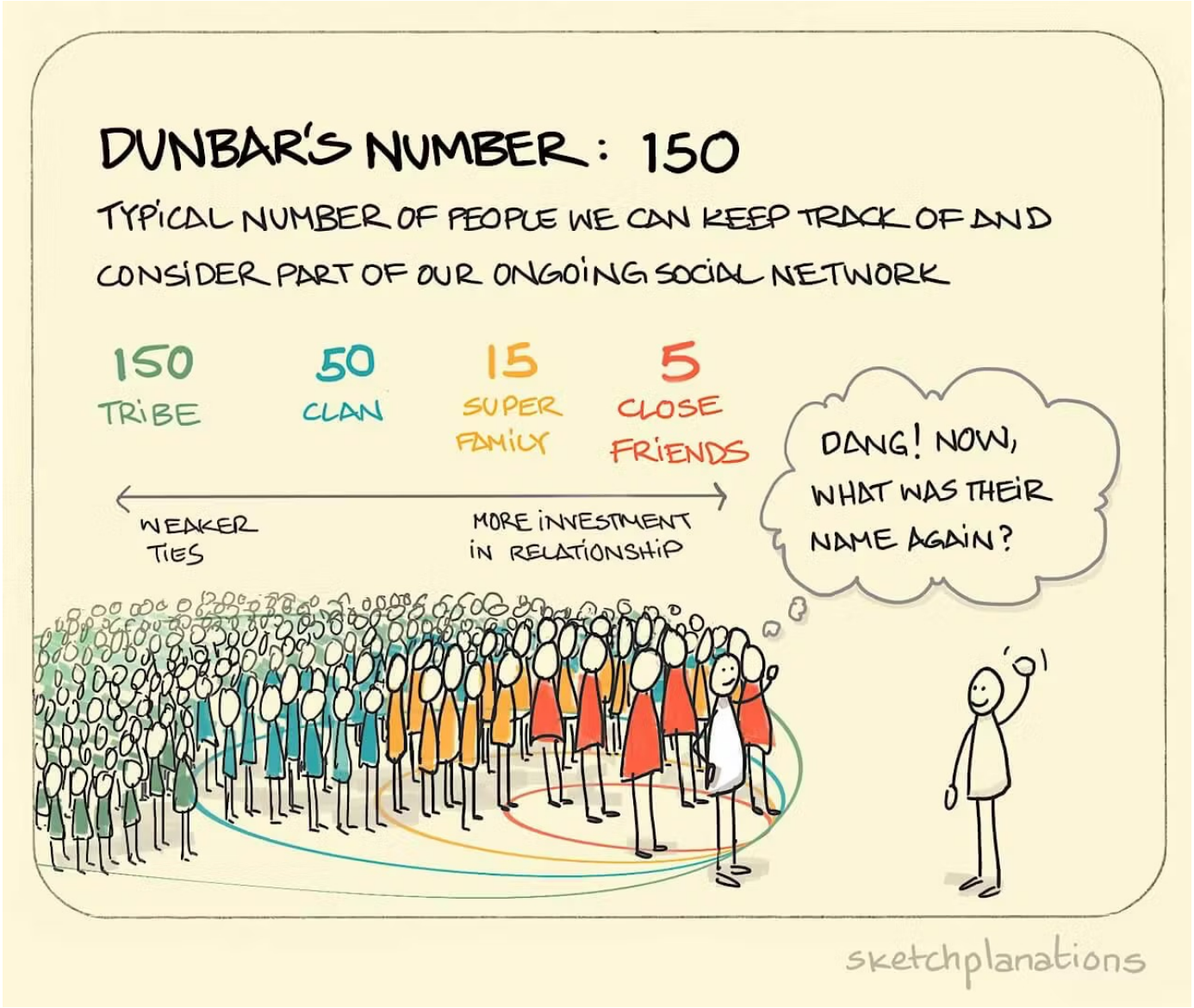
- Culture & Social-Learning Ability
- Tools from materials other than stone
- Wider variety of prey species (even fishing)
- Built shelters
- Higher population densities
- Longer lives
- Less disease & injury
- Art
- Sexual Division of Labor
- Prolonged juvenile period

The EEA


Do you know what EEA means?
Environment of Evolutionary Adaptation
By AcronymsAndSlang.com

How Large Were Early Human Groups?

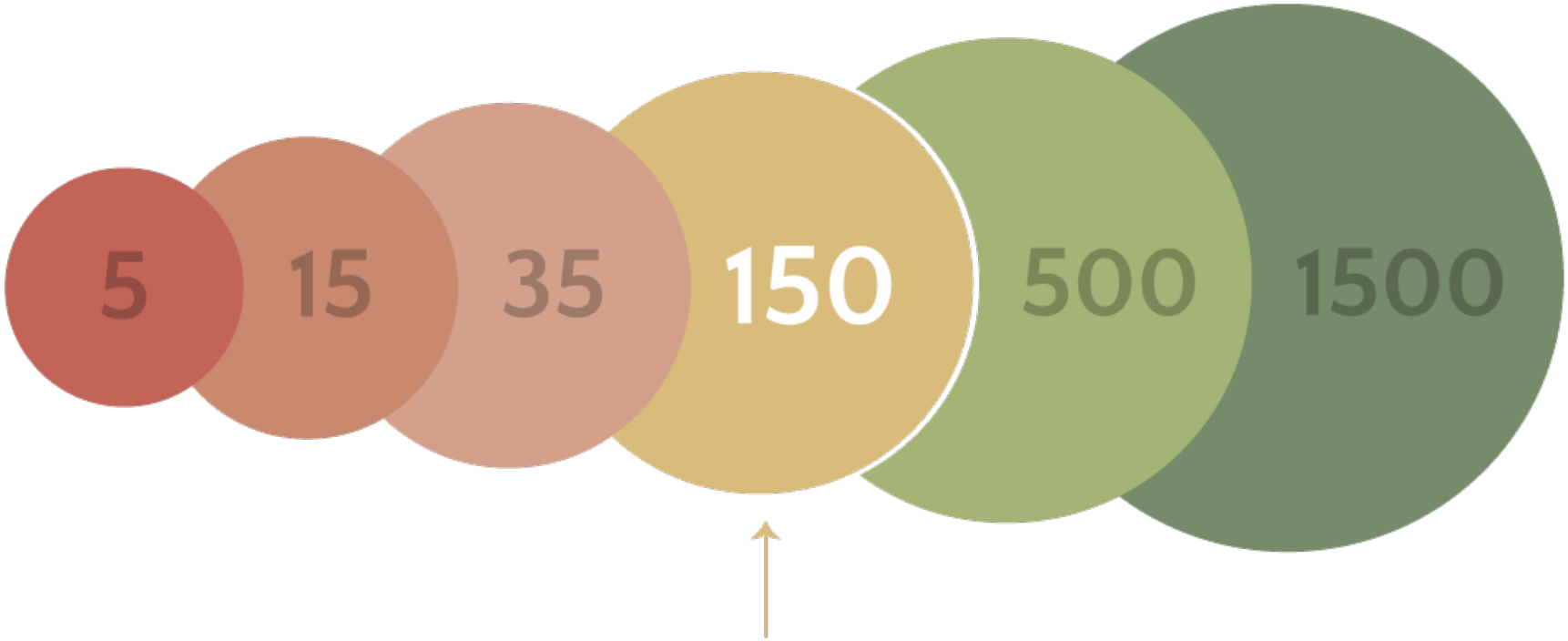
150 (Dunbar's Number)



The Ratio of the Neocortex to the rest of the Brain Predicts the Naturally Occurring Size of Primate Social Groups

150 is a consistent size for:

- Hunter-Gatherer “Clans”
- Farming Villages in the Middle East 7,000 years ago
- Small farming communities around the world today
- Religious Cults
- Church Congregations
- Military Companies
- Optimal Size for high school graduating classes



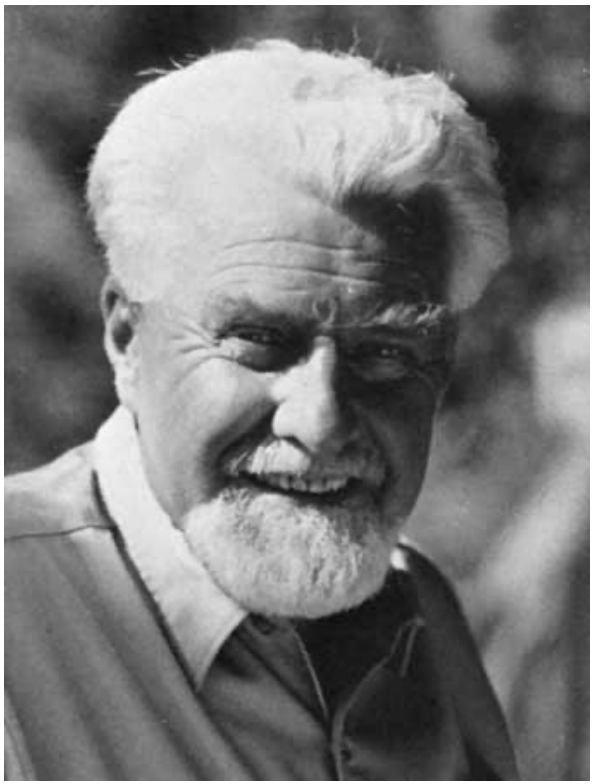
Dunbar's Number

the max number of relationships a person can maintain

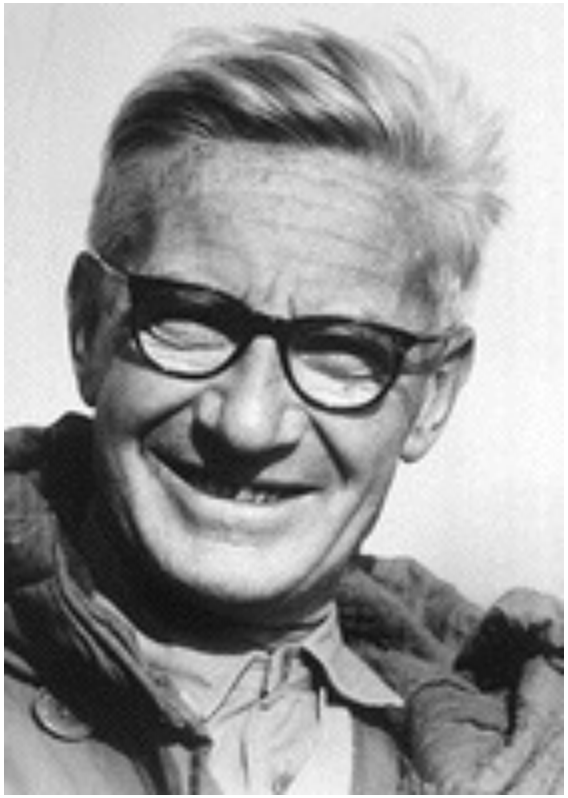
Biophilia & the Green Experience

- Are human landscape preferences evolutionarily determined?

Ethology

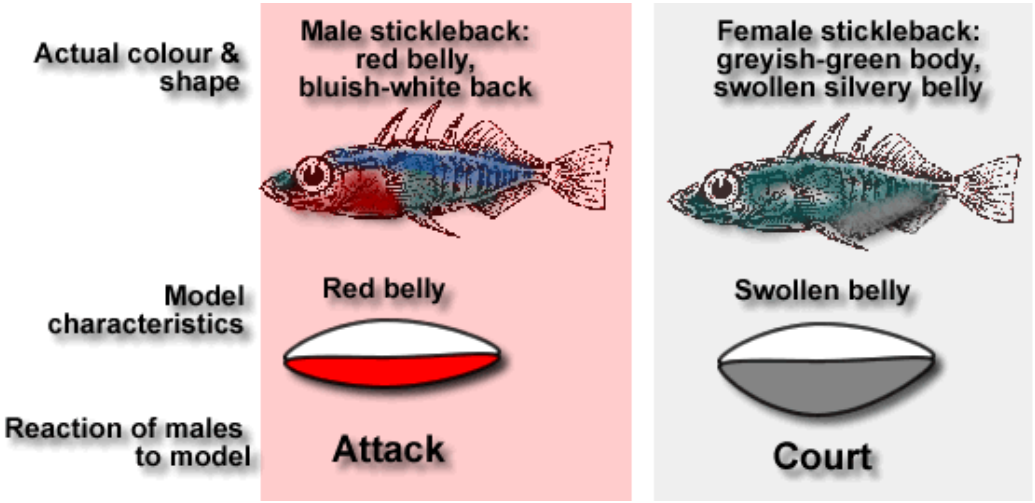


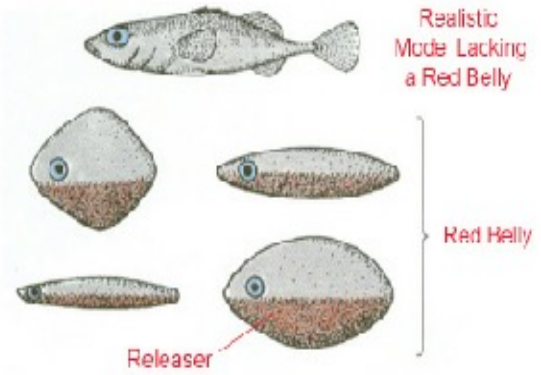
Konrad Lorenz (1903-1989)

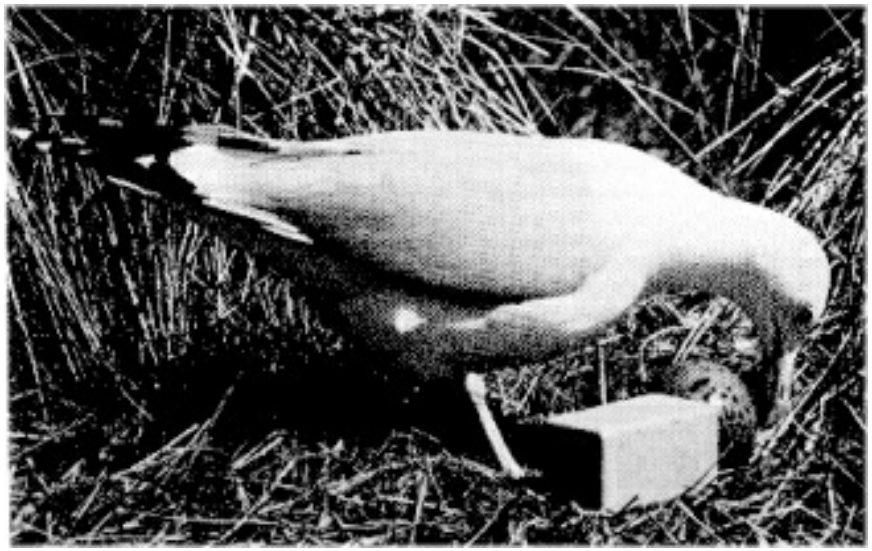


Niko Tinbergen (1907-1988)

RELEASER STIMULUS







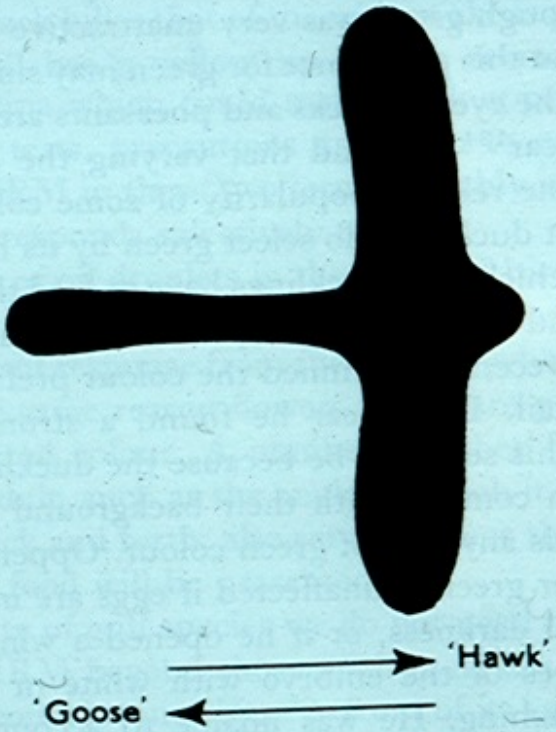


Fig. 3.8 The 'hawk-goose' silhouette used in experiments on the alarm response of geese and game-birds. (From Tinbergen,[258] 1951, *The Study of Instinct*. Oxford University Press, London.)

Newly Hatched Cuckoos Push Eggs of Host Out of Nest

Laughing Gull Chicks Feeding

Snake Phobias

Snake Phobias

- A variety of animals ranging from ground squirrels to monkeys have an innate fear of snakes and have evolved numerous behavioral strategies for dealing with them

Imprint Training

Cuckoo

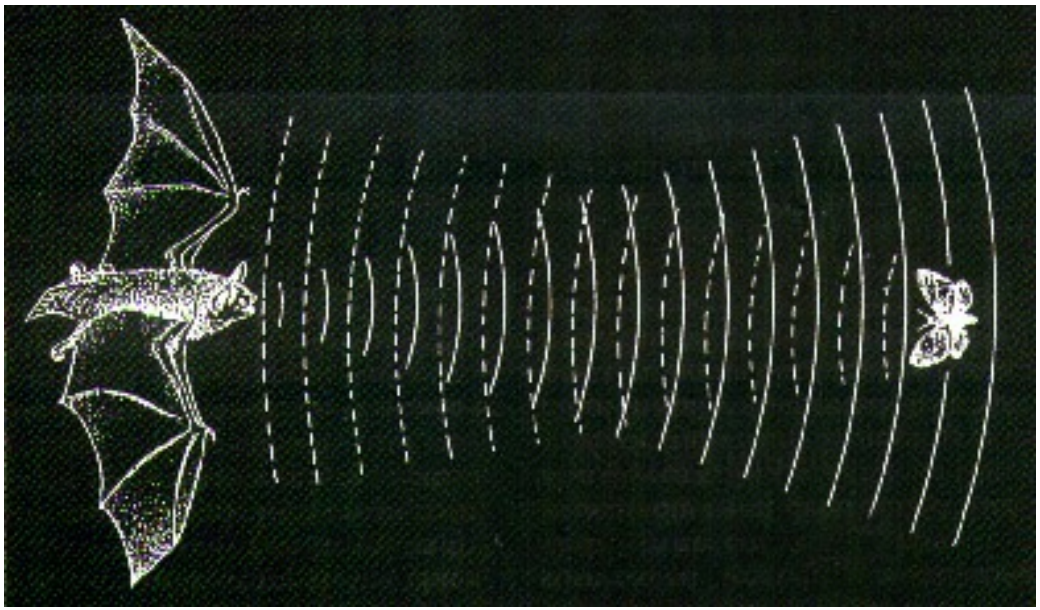
Cowbird

Mockingbird

Song Sparrow

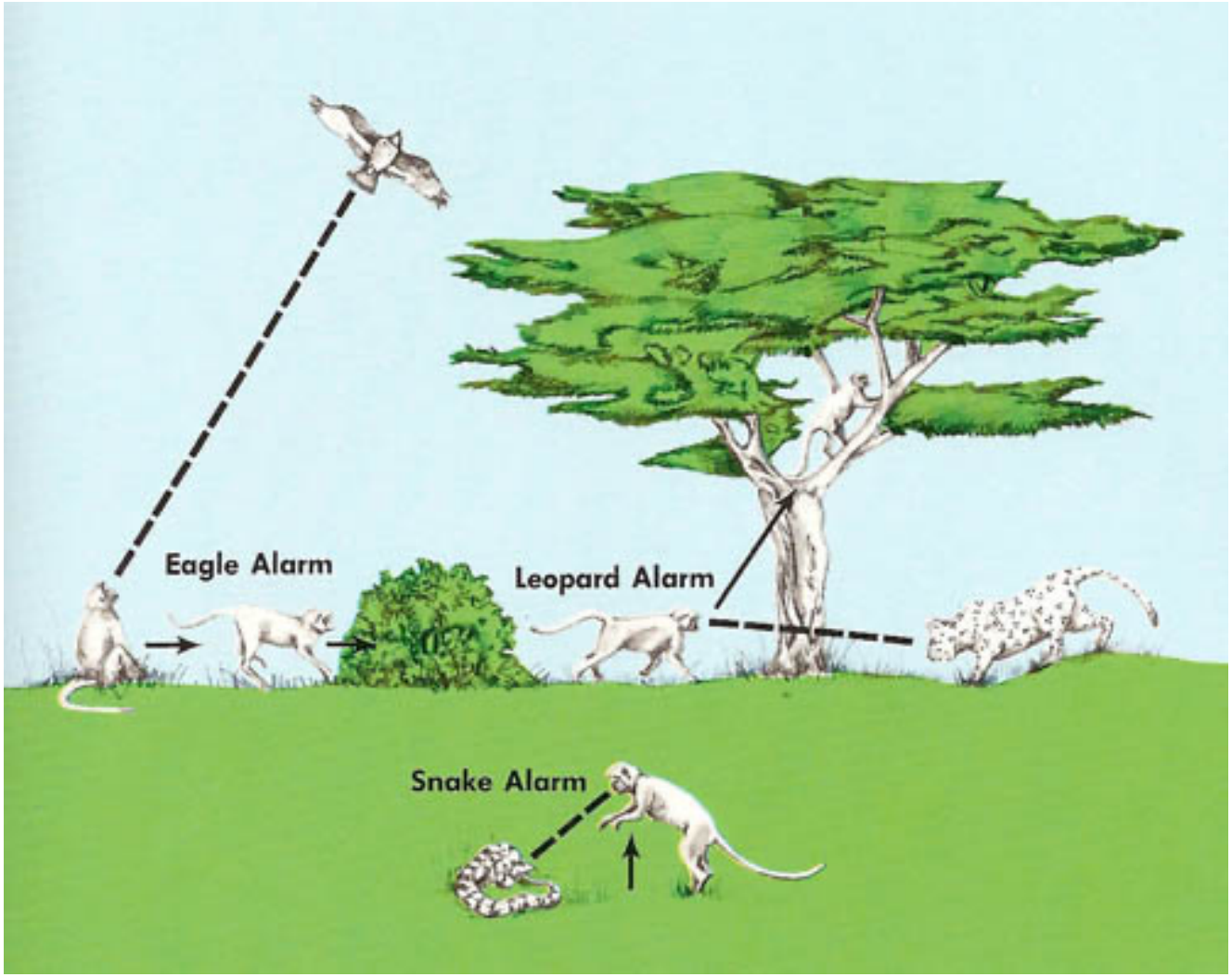
White Crowned Sparrow

Chaffinch



Predator-Specific Alarm Calls in Vervet Monkeys

Predator-Specific Alarm Calls in Vervet Monkeys



Ritualization

Human Ritualization

Eyelike Stimuli Have Arousing Properties & Humans are prewired to respond to eyes

Natural Selection for Eyelike Stimuli

- Eye Spots
- Eye Patches
- Eye Rings

Eye Spots

Eye Spots

Eye Spots

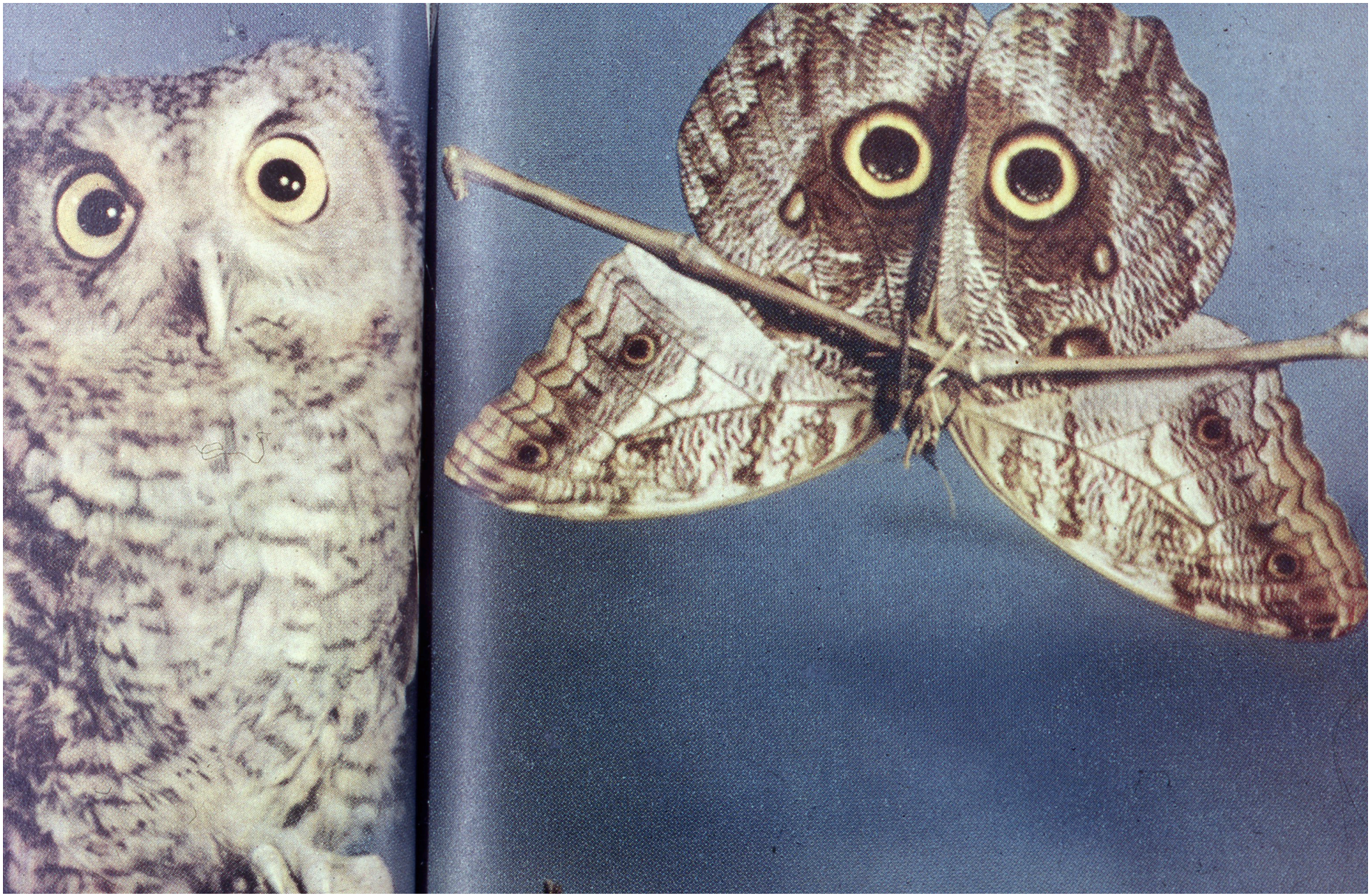
Eye Spots

Eye Spots

Eye Spots

Eye Spots

Eye Spots



Eye Spots

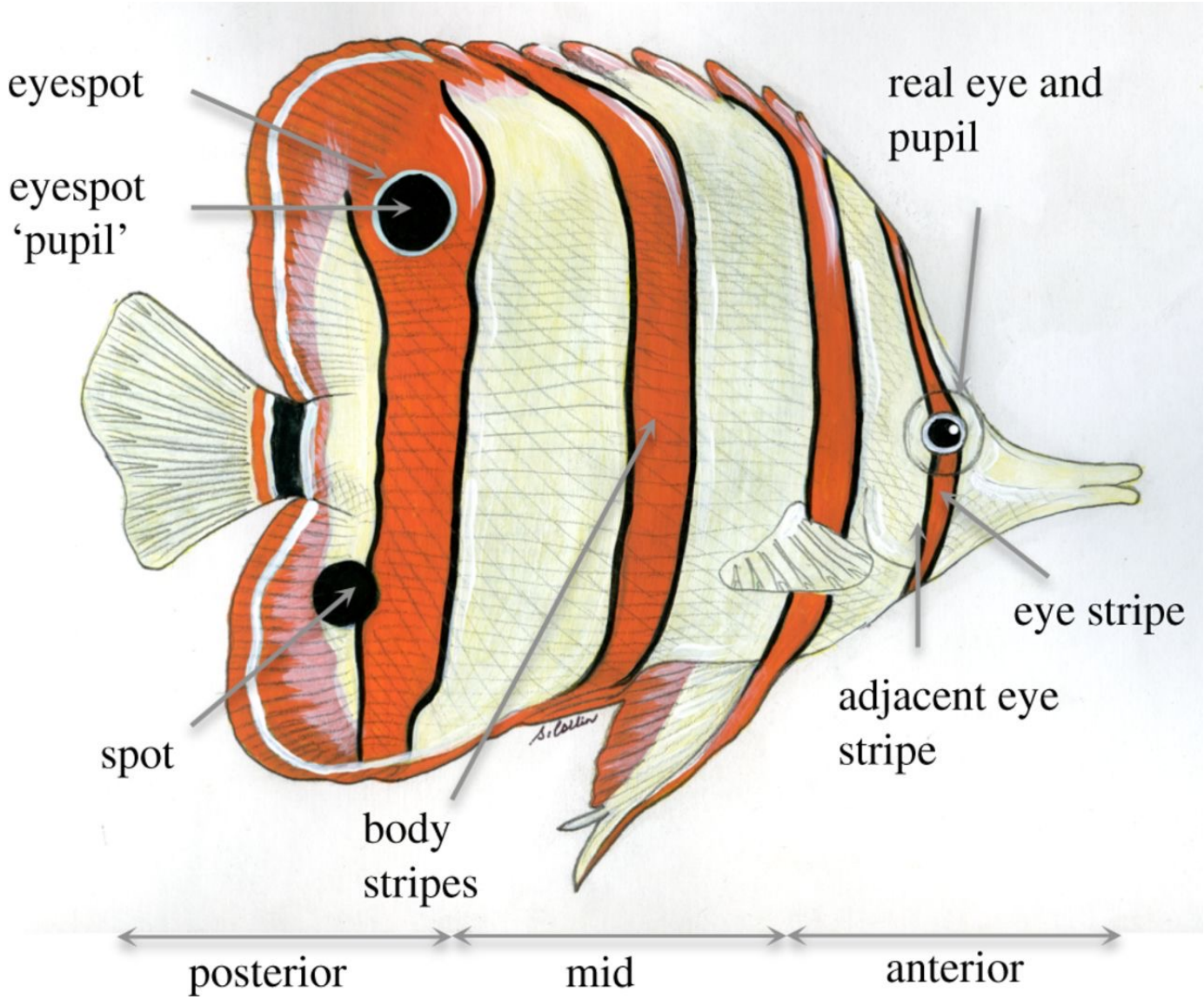
Eye Spots

Eye Spots

Eye Spots

Eye Spots

Eye Spots


eyespot
eyespot
'pupil'
real eye and
pupil
eye stripe
adjacent eye
stripe
spot
body
stripes
posterior
mid
anterior

Eye Spots

Eye Spots

Eye Spots

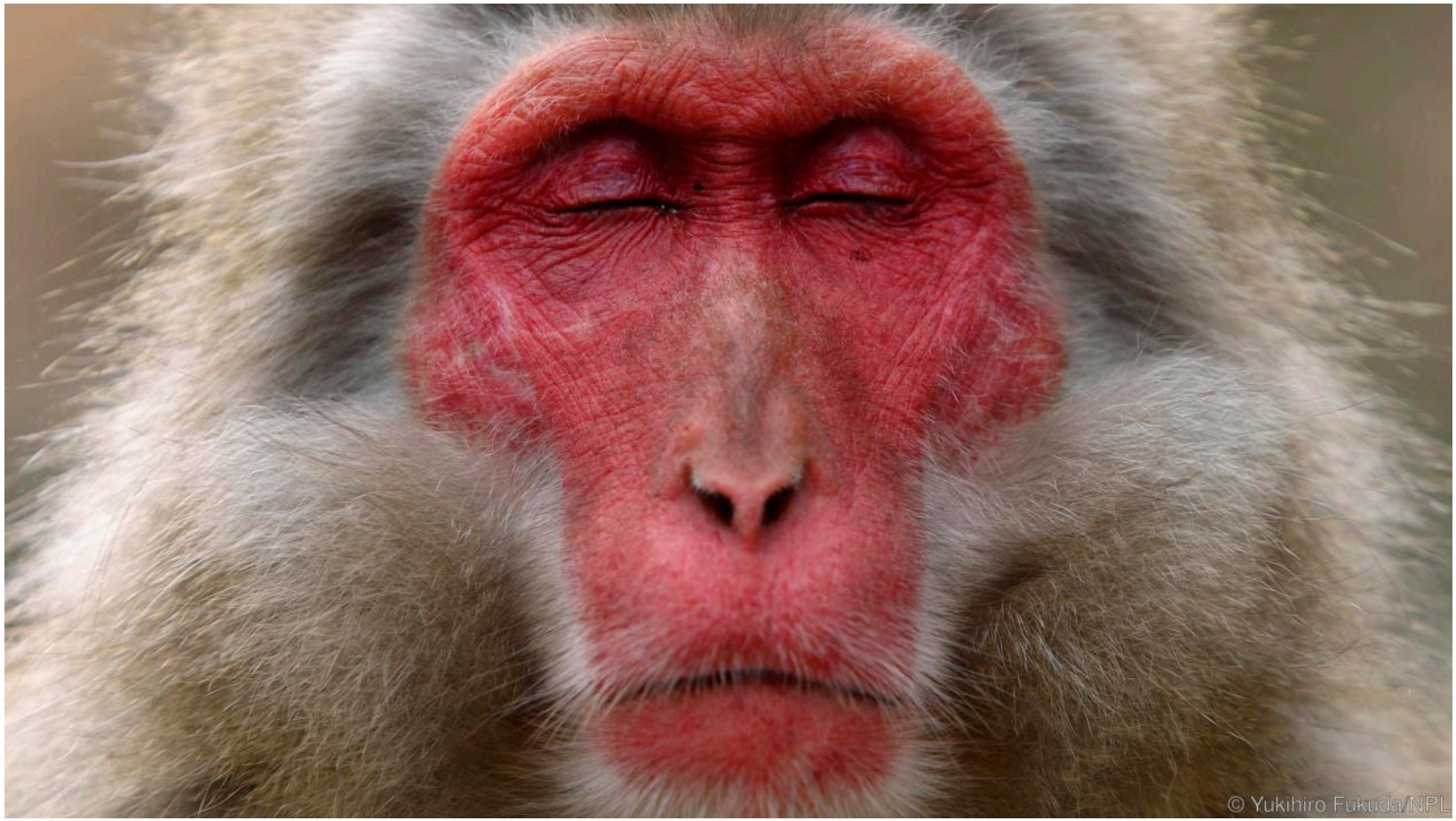
Eye Spots

Eye Spots

Eye Spots

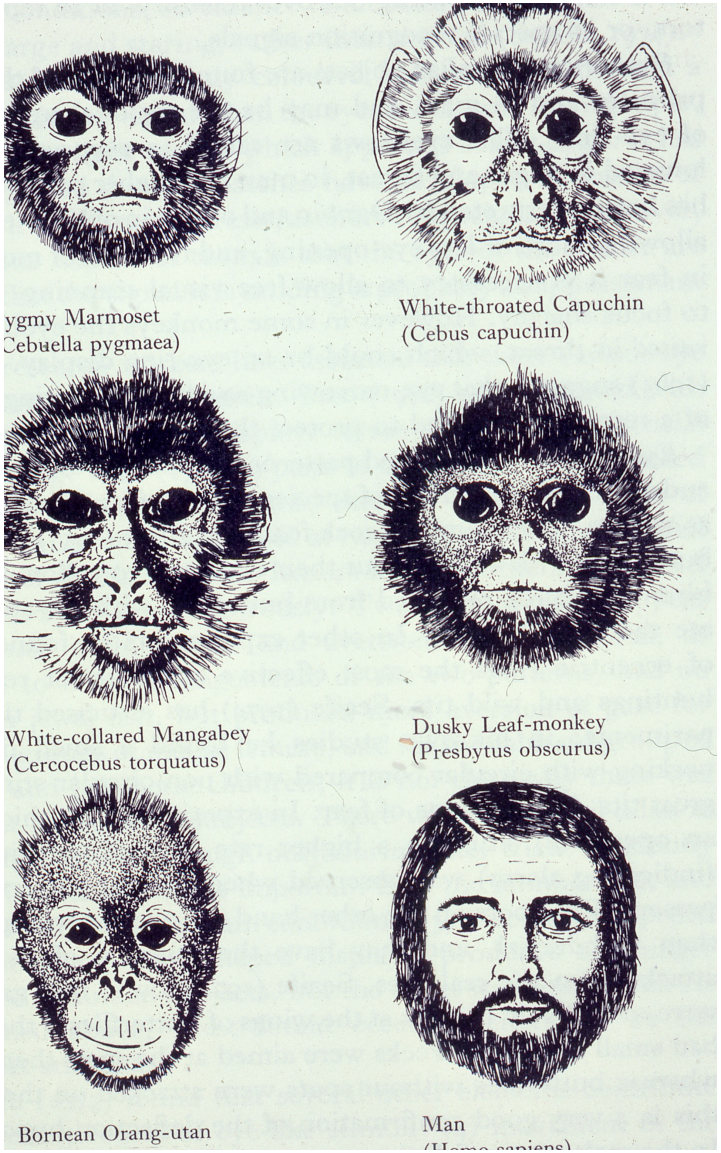
Eye Spots

Eye Patches



Eye Patches

Eye Rings


ygmy Marmoset
Cebuella pygmaea)
White-throated Capuchin
(Cebus capuchin)
White-collared Mangabey
(Cercocebus torquatus)
Dusky Leaf-monkey
(Presbytus obscurus)
Bornean Orang-utan
Man

Eye Rings

Eye Rings

Eye Rings

Eye Rings

Eye Rings

Eye Rings

Eye Rings

Eye Rings

Eye Rings

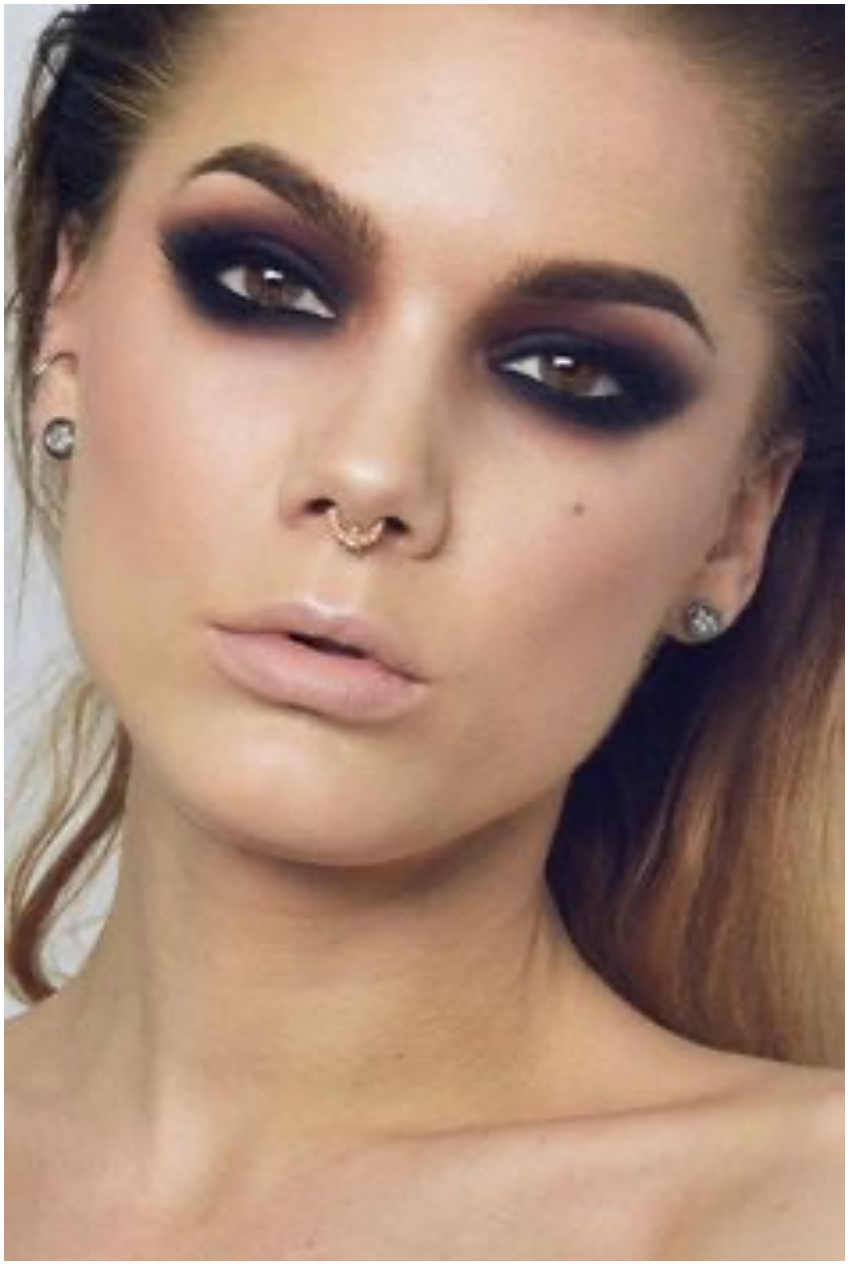
Eye Rings

Eye Rings

Eye Rings

Eye Rings

Eye Rings



Eye Rings

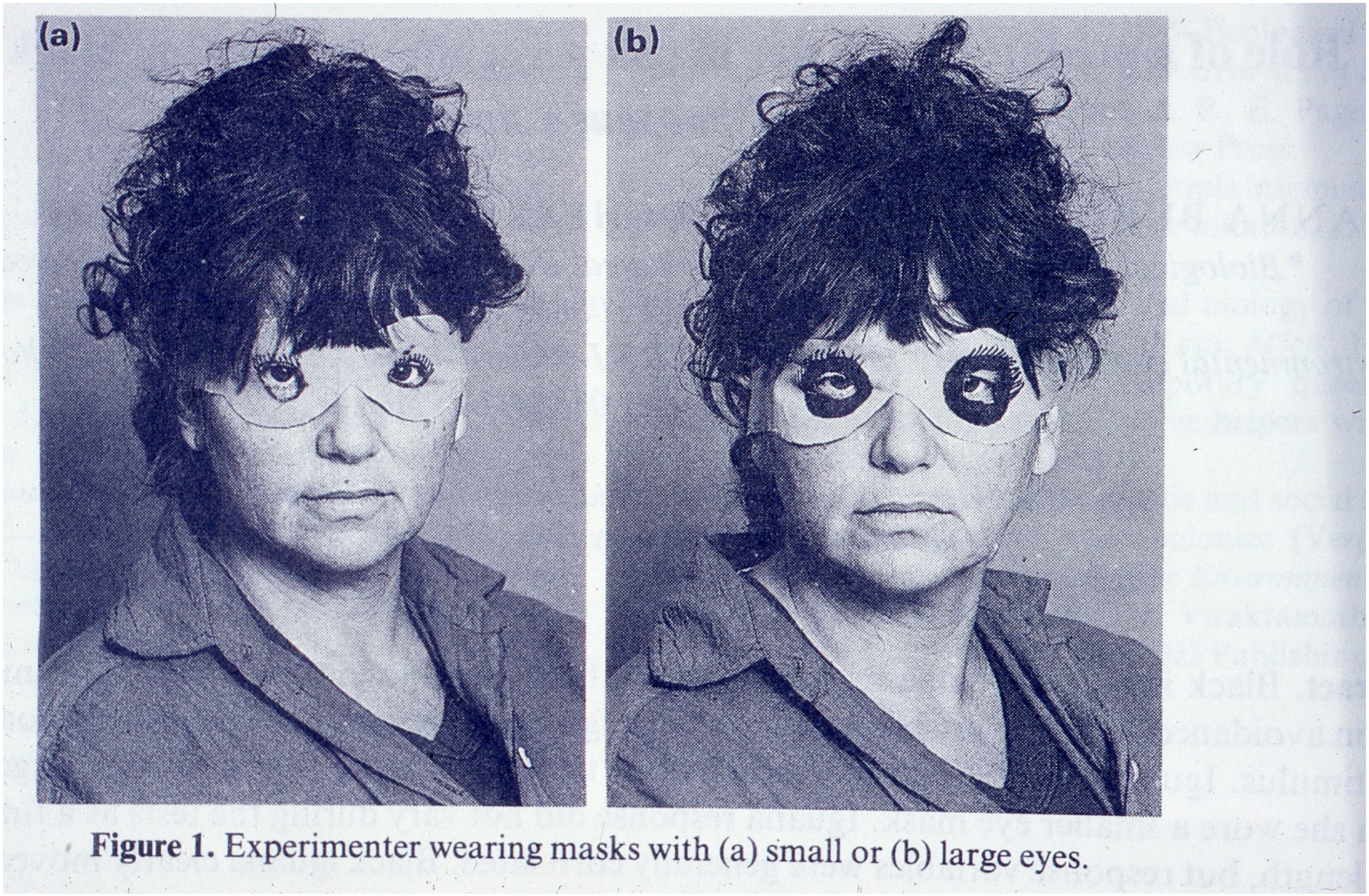


Figure 1. Experimenter wearing masks with (a) small or (b) large eyes.

Eye Contact is an Essential Social Signal

Eye Contact is an Essential Social Signal

Eye Contact is an Essential Social Signal

Eye Contact is an Essential Social Signal

Eye Contact is an Essential Social Signal

Eye Contact is an Essential Social Signal

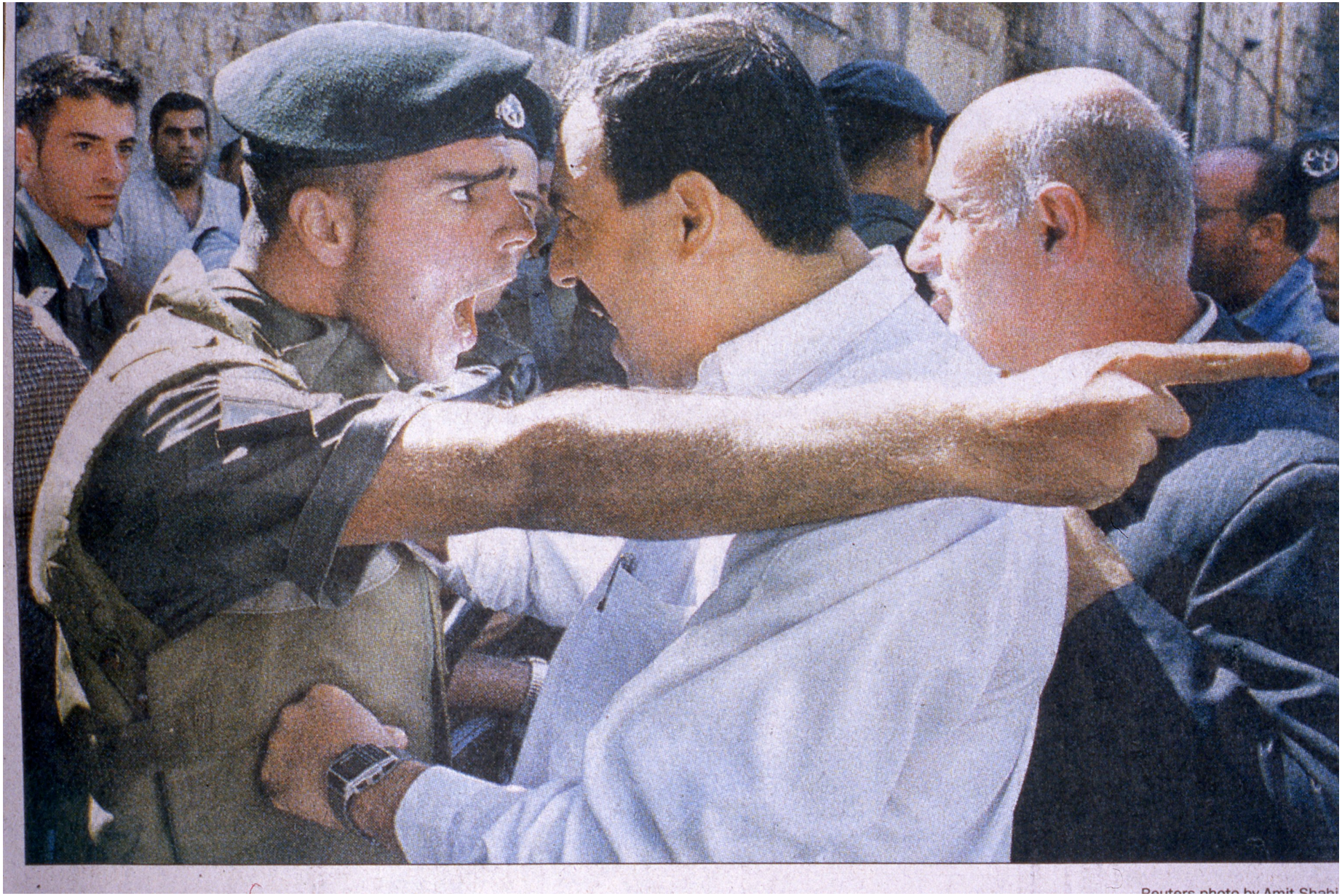
Eye Contact is an Essential Social Signal

Eye Contact is an Essential Social Signal

Eye Contact is an Essential Social Signal

Eye Contact is an Essential Social Signal

Eye Contact is an Essential Social Signal



Eye Contact is an Essential Social Signal

Eye Contact is an Essential Social Signal

Eye Contact is an Essential Social Signal

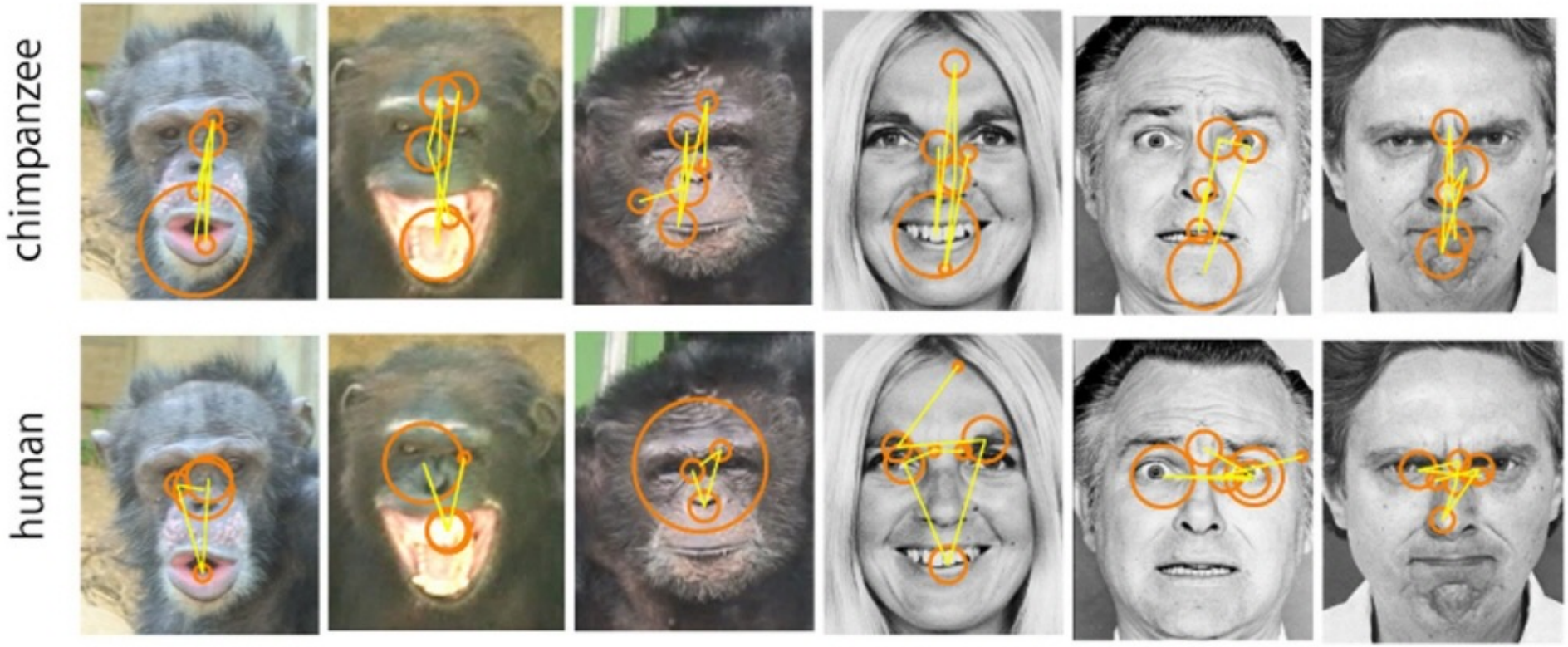
Eye Contact is an Essential Social Signal

Eye Contact is an Essential Social Signal

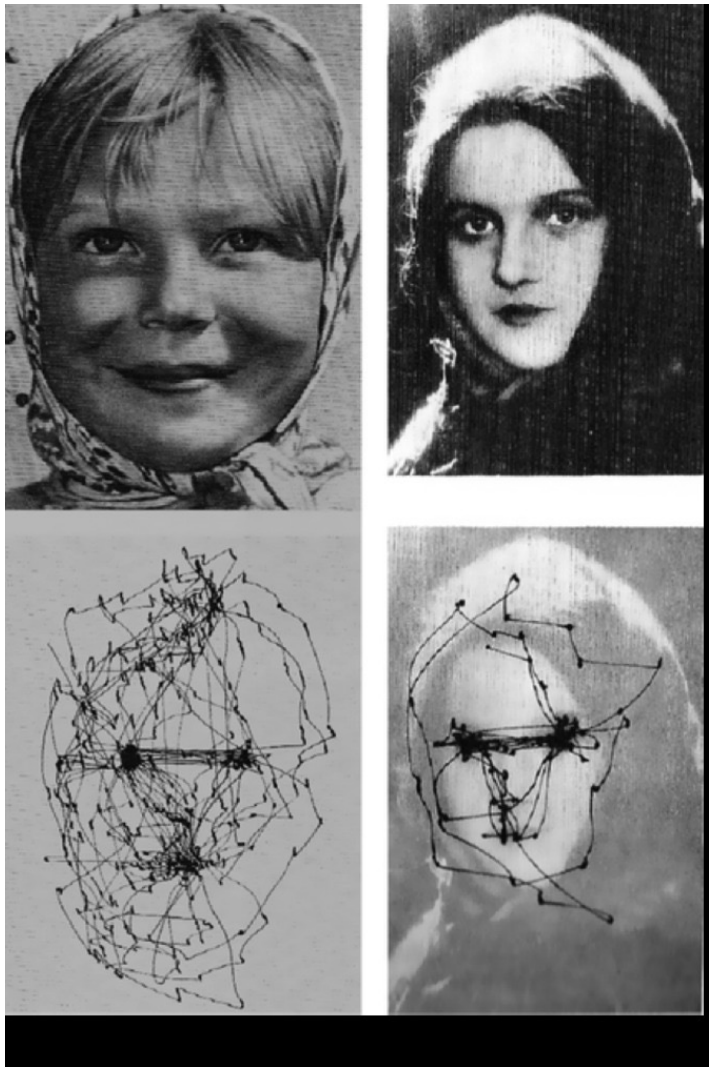
Eye Contact is an Essential Social Signal

Do we pay attention to faces because that is where the eyes are?

Do we pay attention to faces because that is where the eyes are?



Do we pay attention to faces because that is where the eyes are?

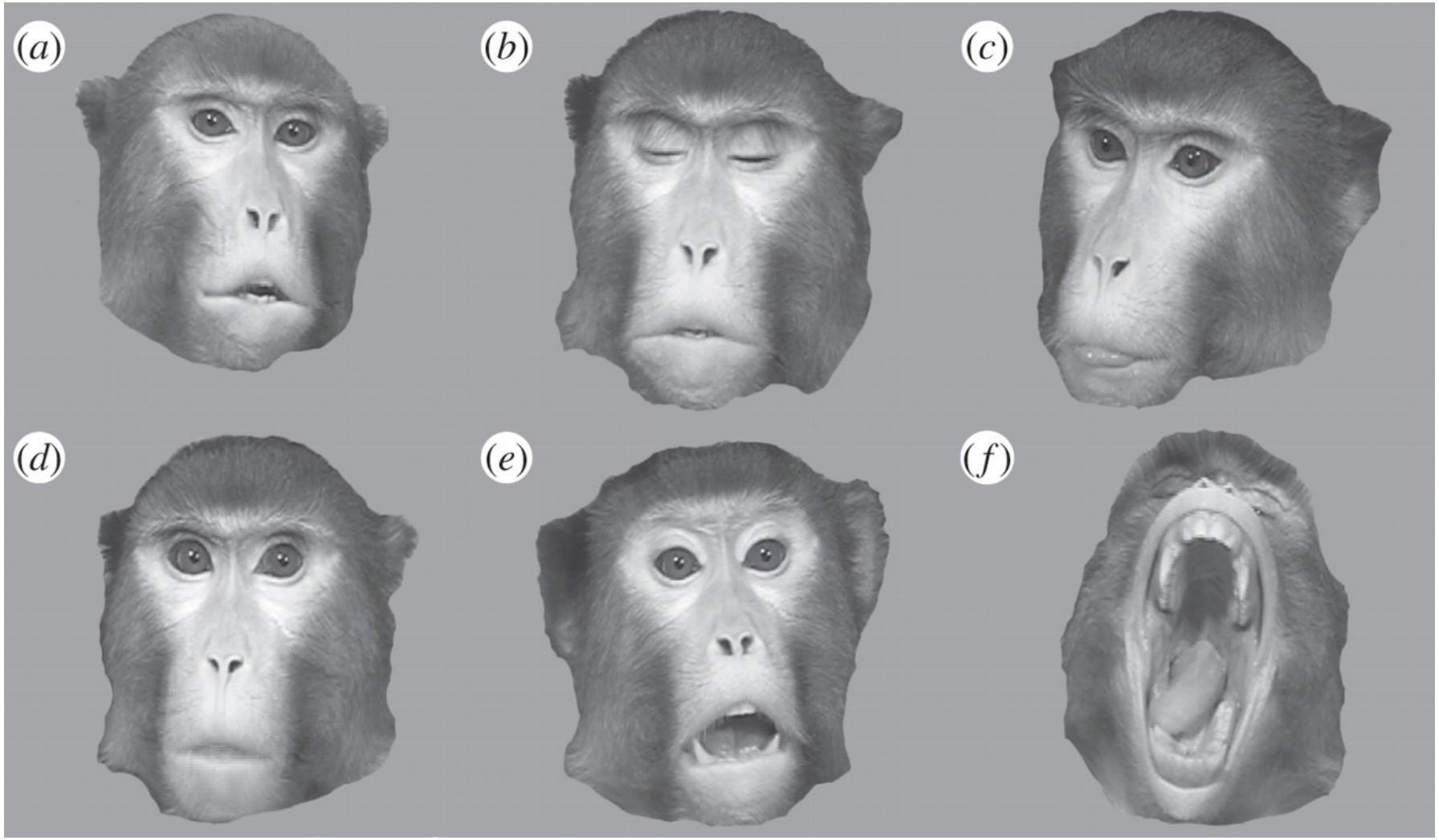


Human Facial Expressions of Emotion: An Evolved Ritualized Display?

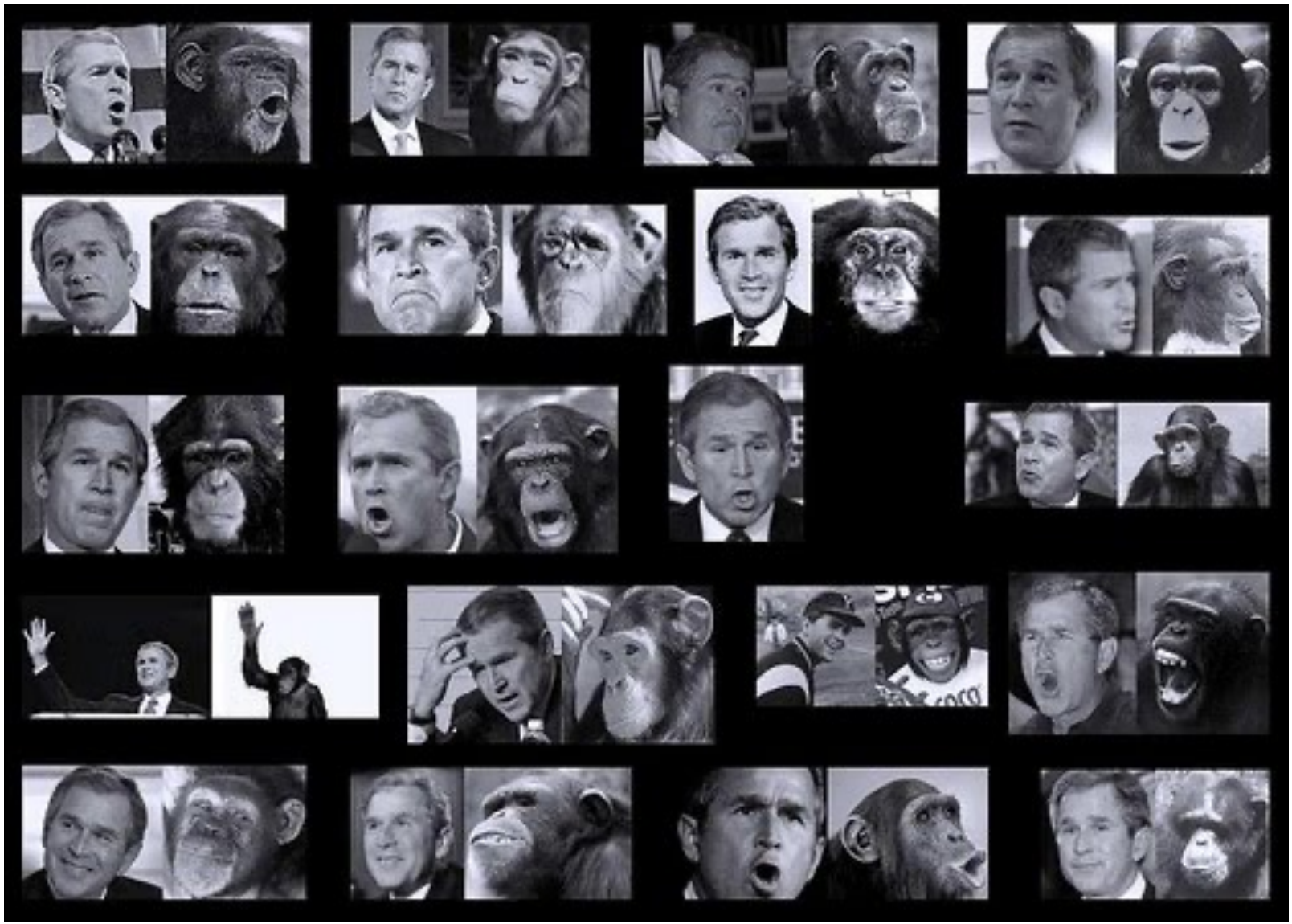
Evidence for the Universality of Facial Expressions of Emotion

- Similarities to other Primate Expressions
- Cross-Cultural Research
  - Display Rules get in the way!
- Studies on the Blind-Born
- Appropriate early facial displays in newborns

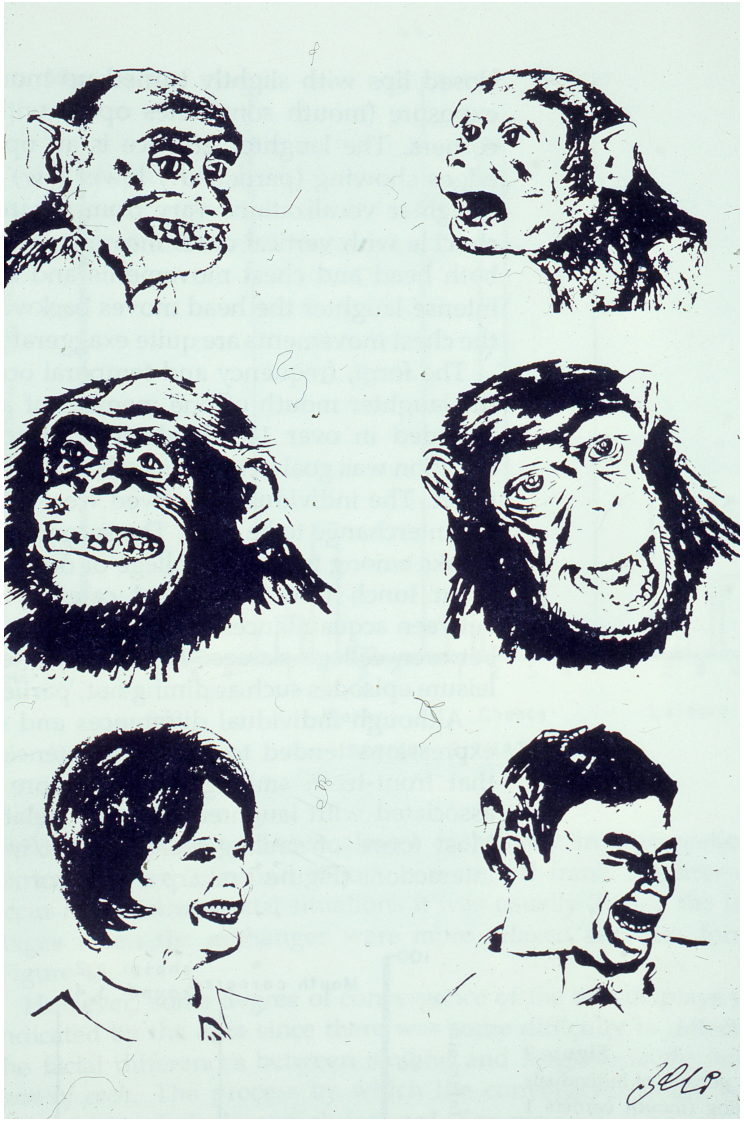
Most primates display similar expressions in similar situations



Most primates display similar expressions in similar situations



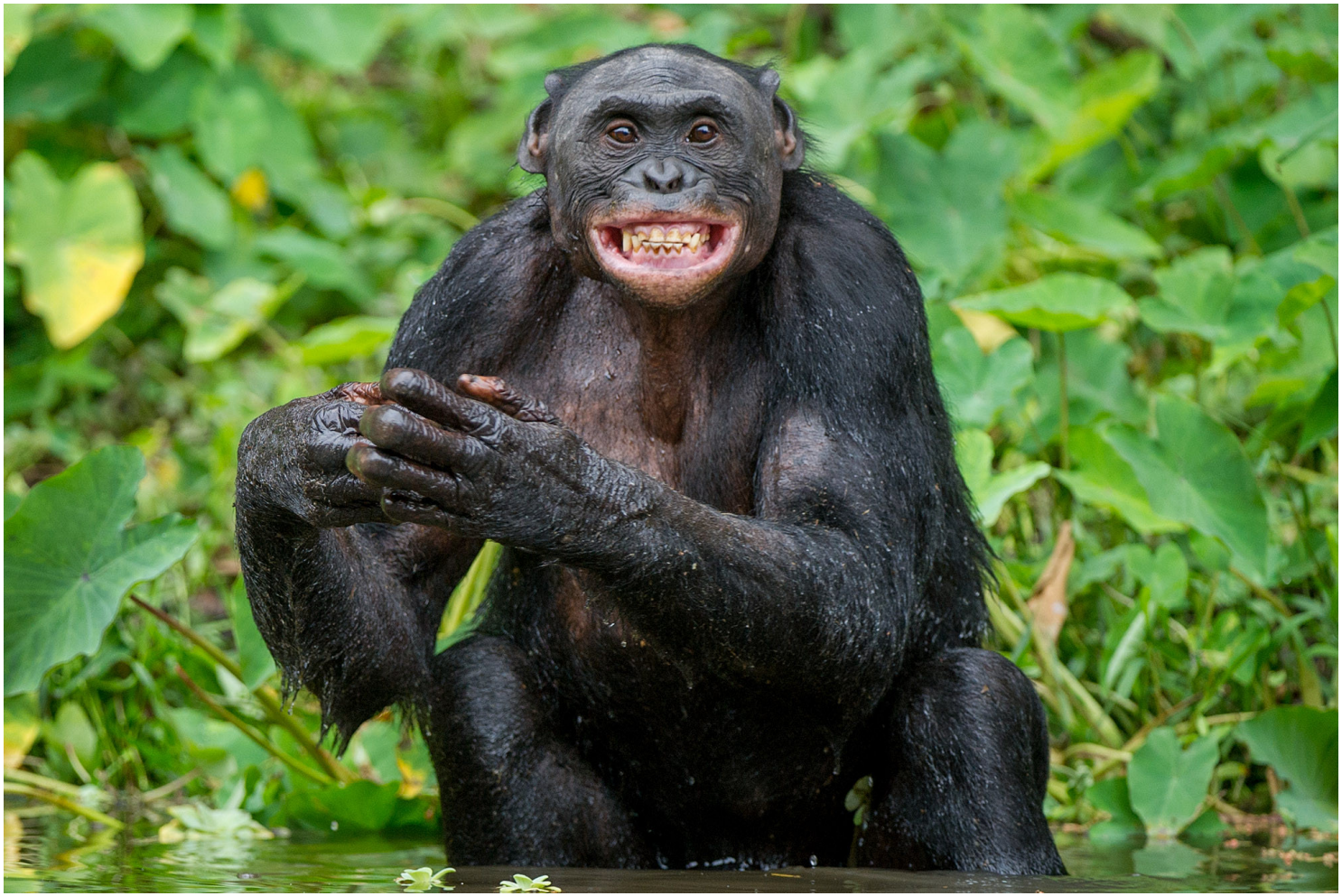
Smiling versus Laughing



Smiling versus Laughing

Smiling versus Laughing

Smiling versus Laughing

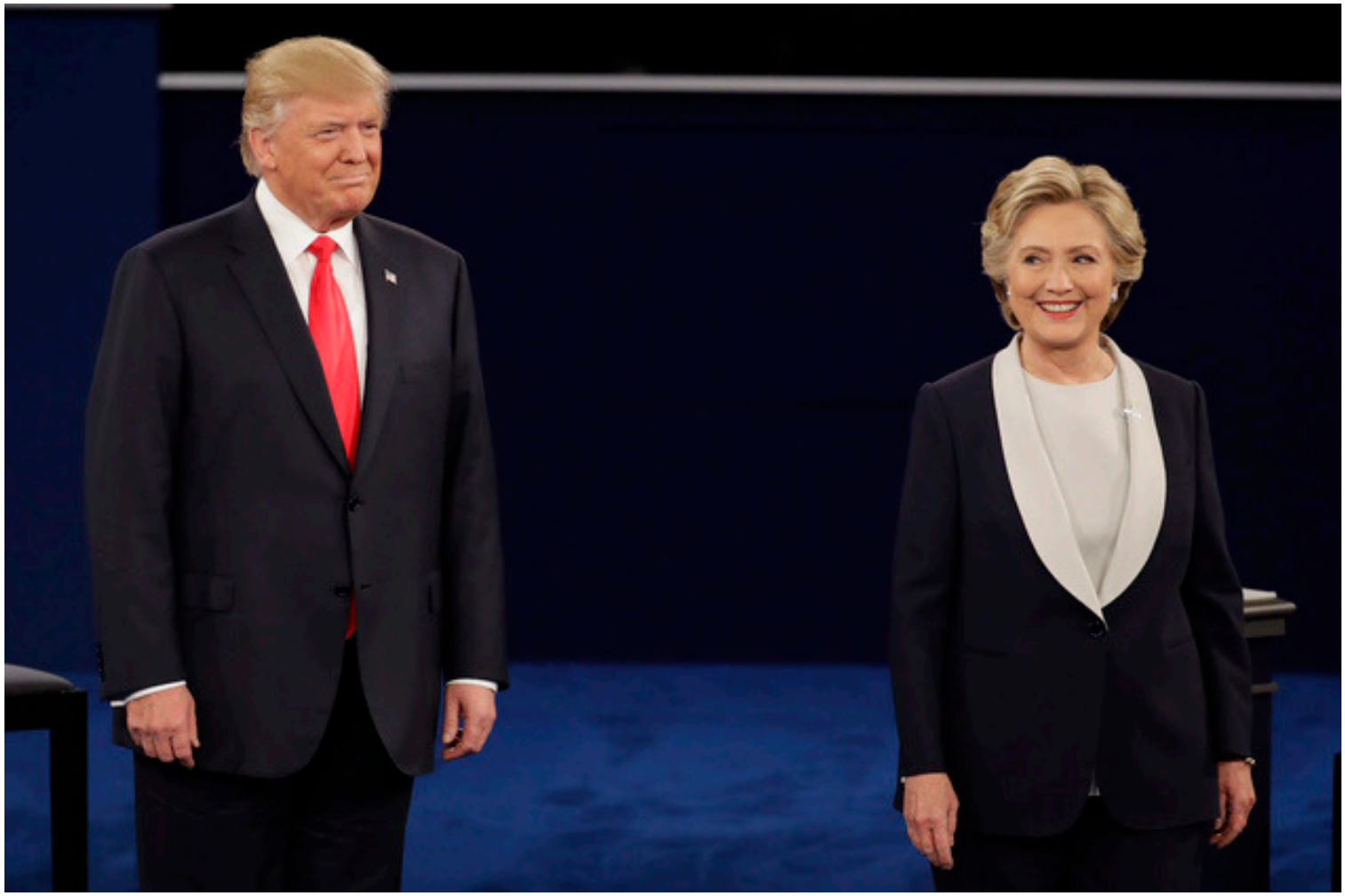


Smiling versus Laughing

Smiling versus Laughing

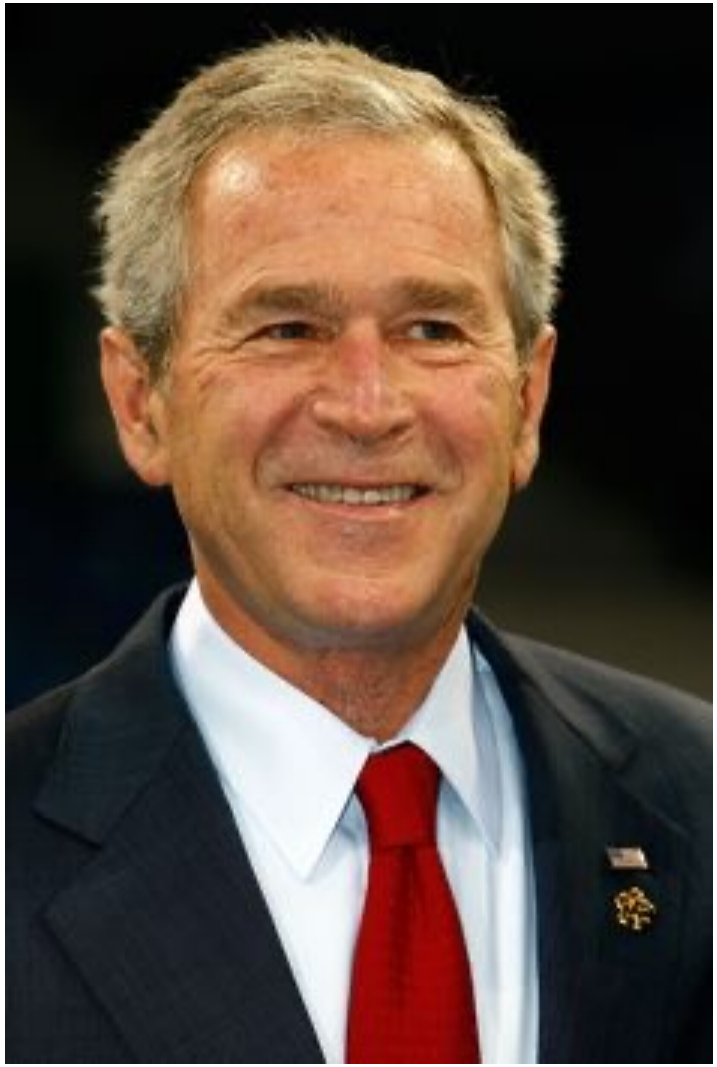
Smiling versus Laughing

Smiling versus Laughing



Smiling versus Laughing

Smiling versus Laughing

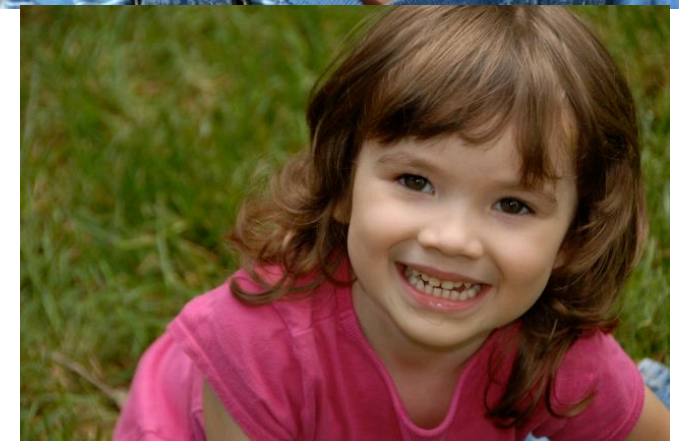


Smiling versus Laughing

Smiling versus Laughing

Smiling versus Laughing

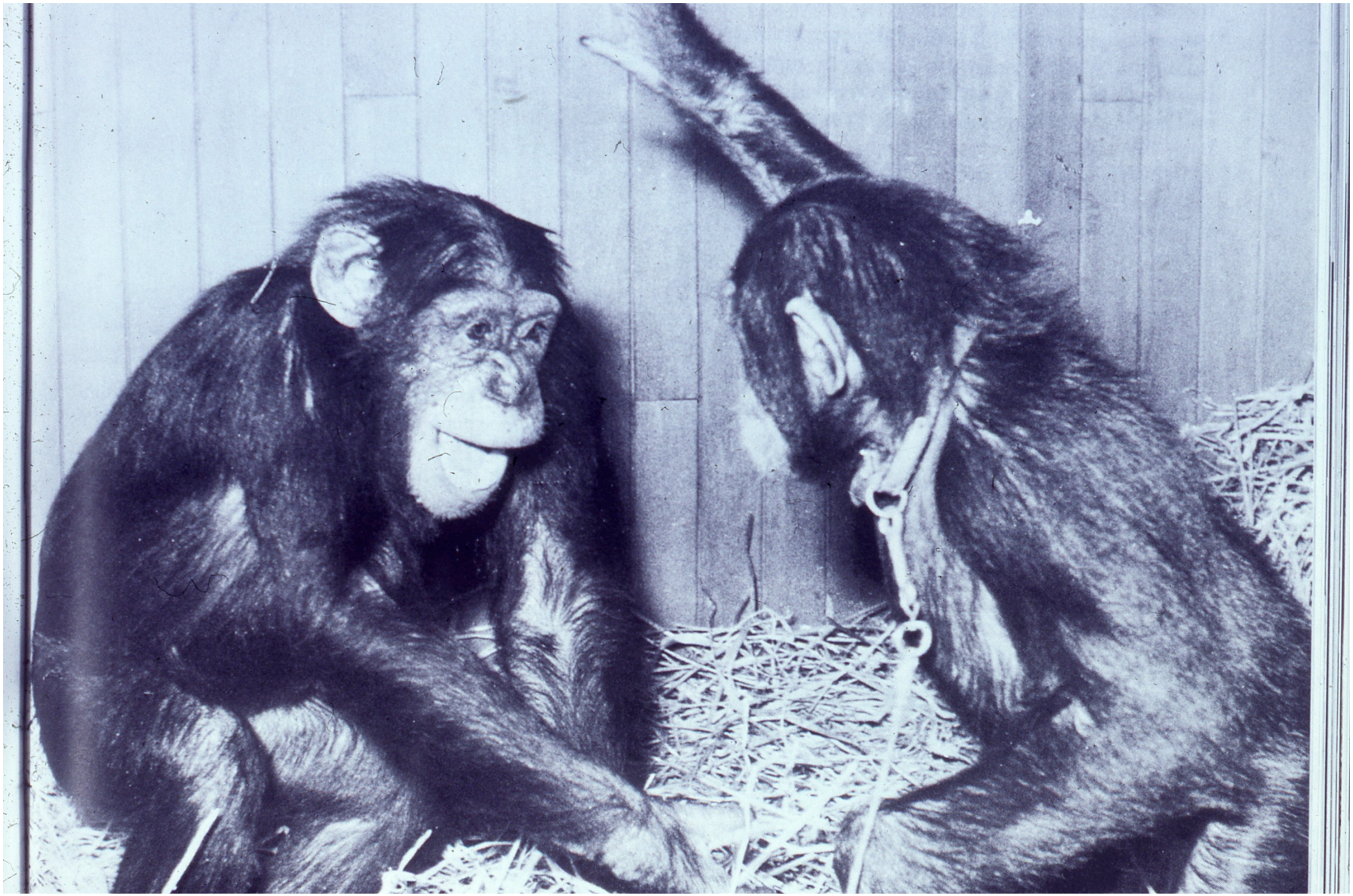
Smiling versus Laughing



Invitation to Play

Smiling versus Laughing

Smiling versus Laughing



Smiling versus Laughing

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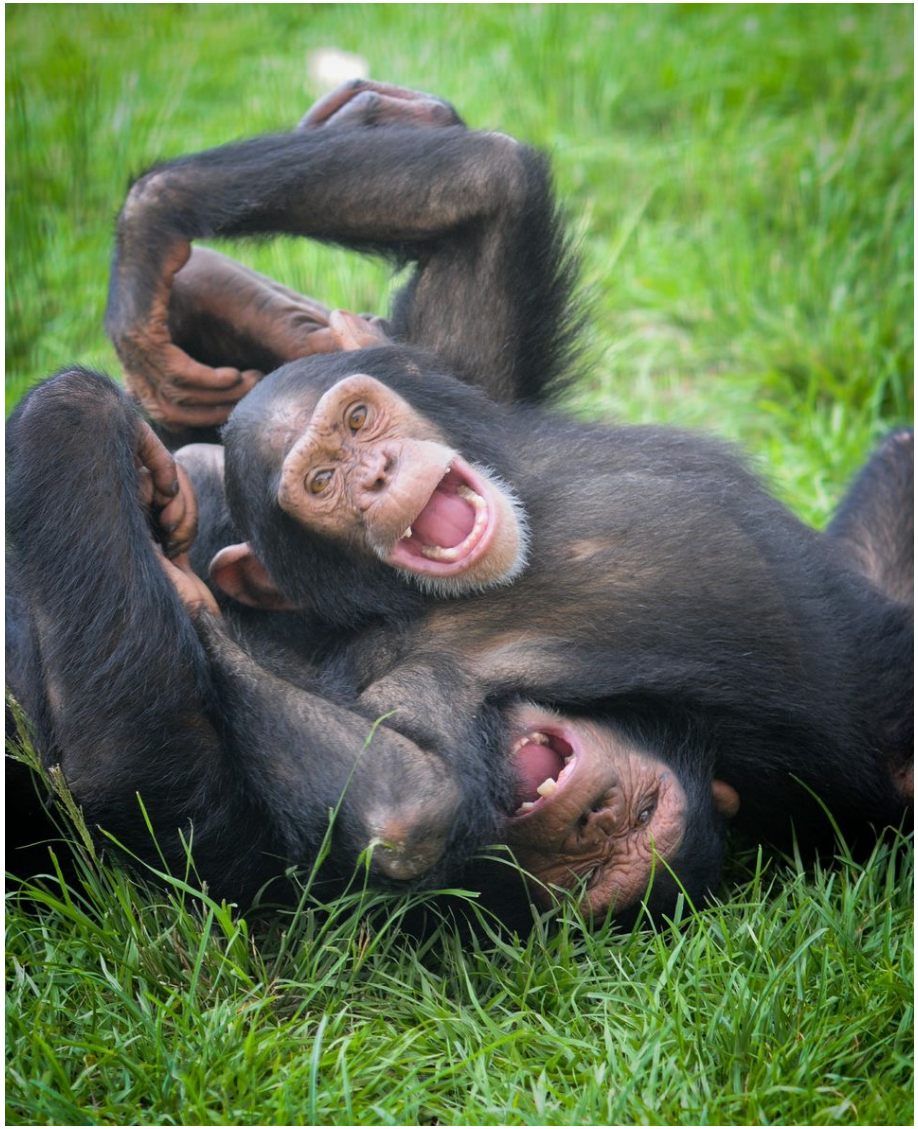

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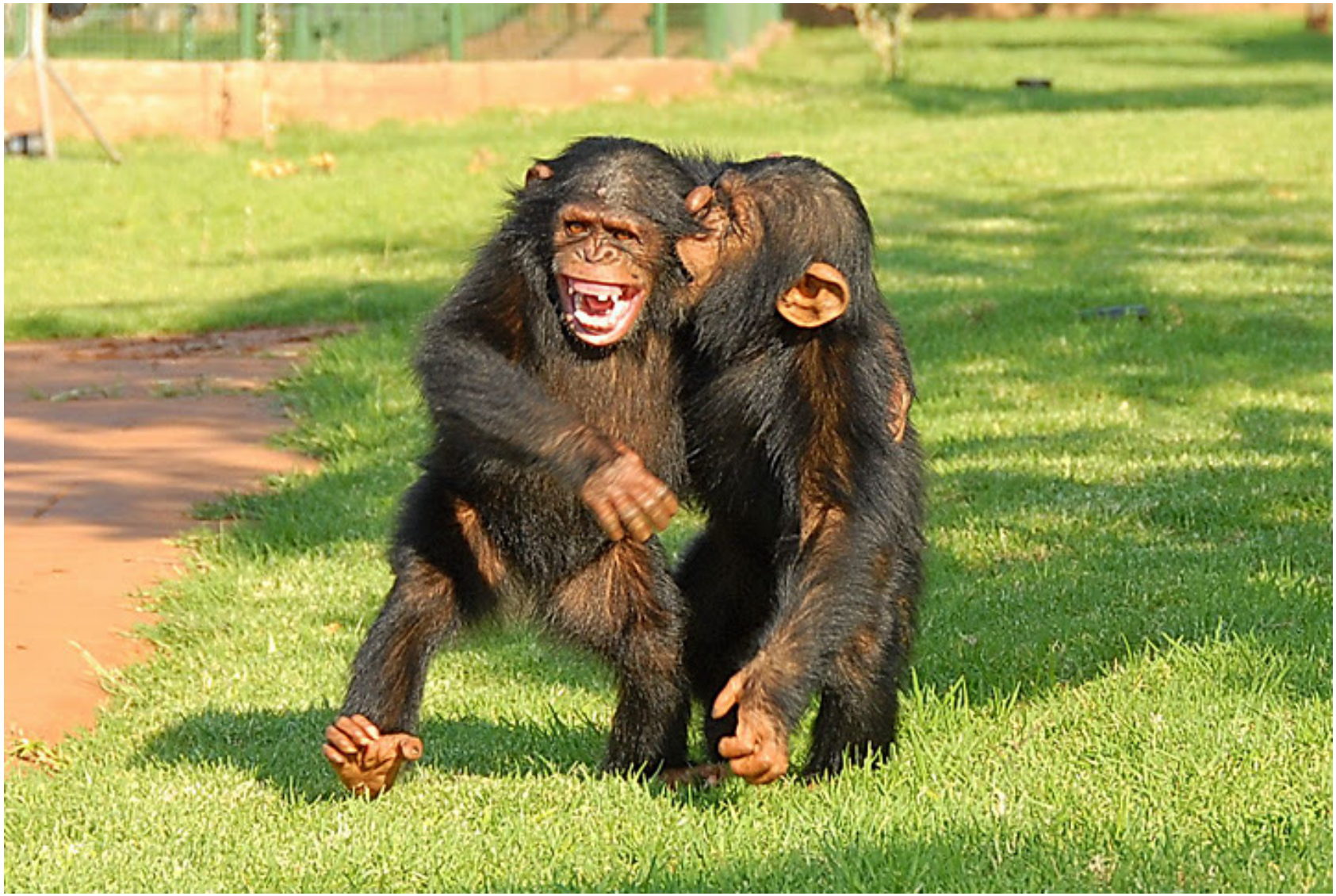

Human Play Faces

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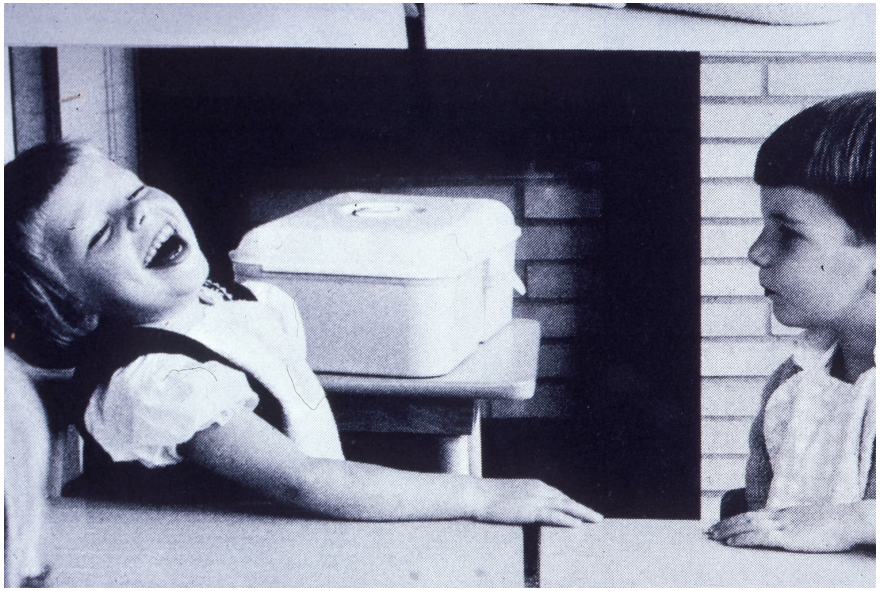

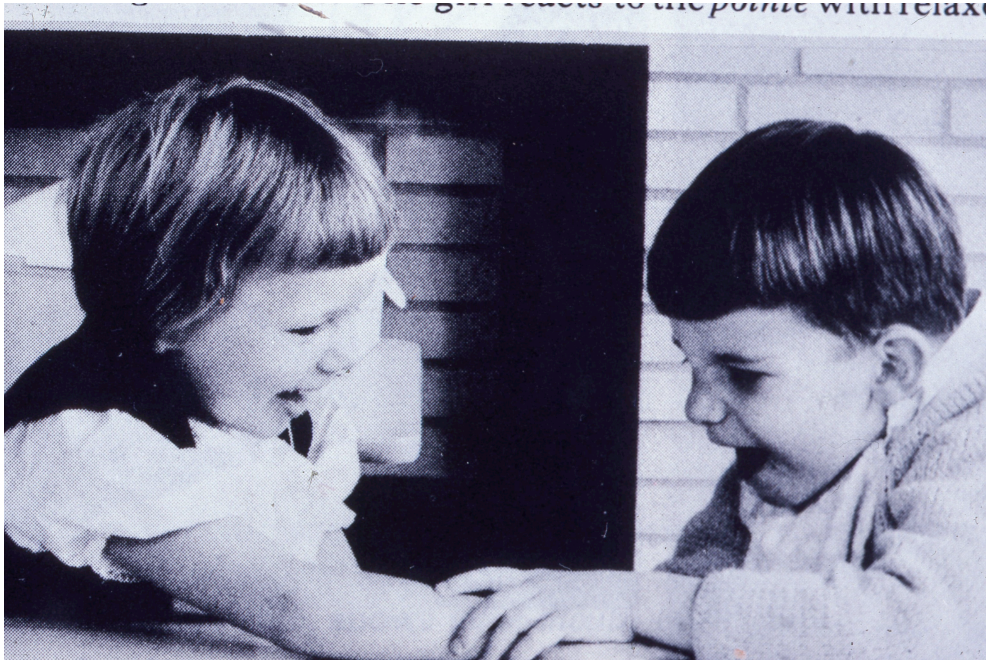

Threat Displays & Anger

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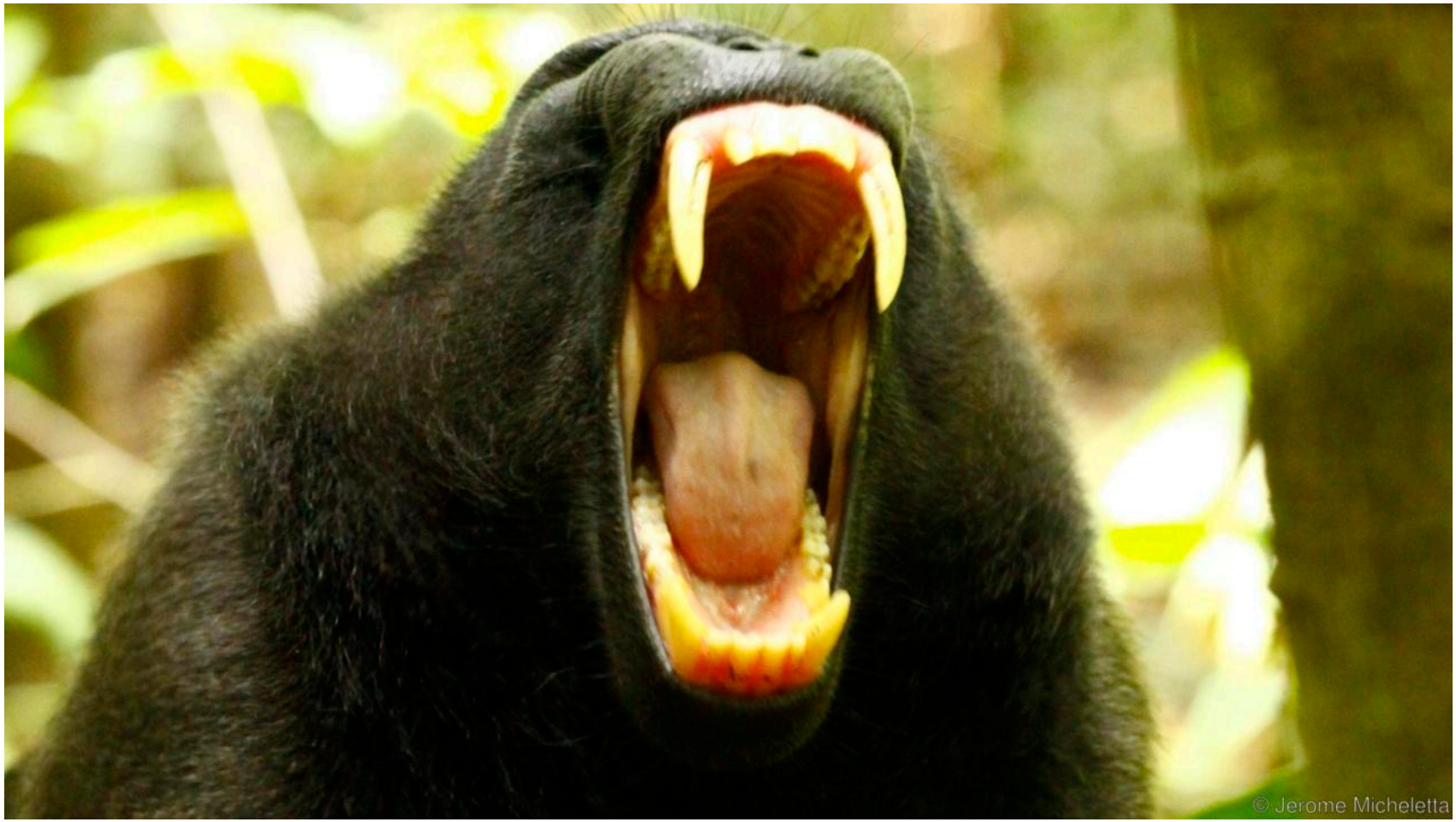

Threat Displays & Anger

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Threat Displays & Anger

Six Primary Facial Expressions of Emotions

OR Seven Primary Facial Expressions of Emotions?

OR Seven Primary Facial Expressions of Emotions?

contempt

lip corner tightened and raised on only one side of face

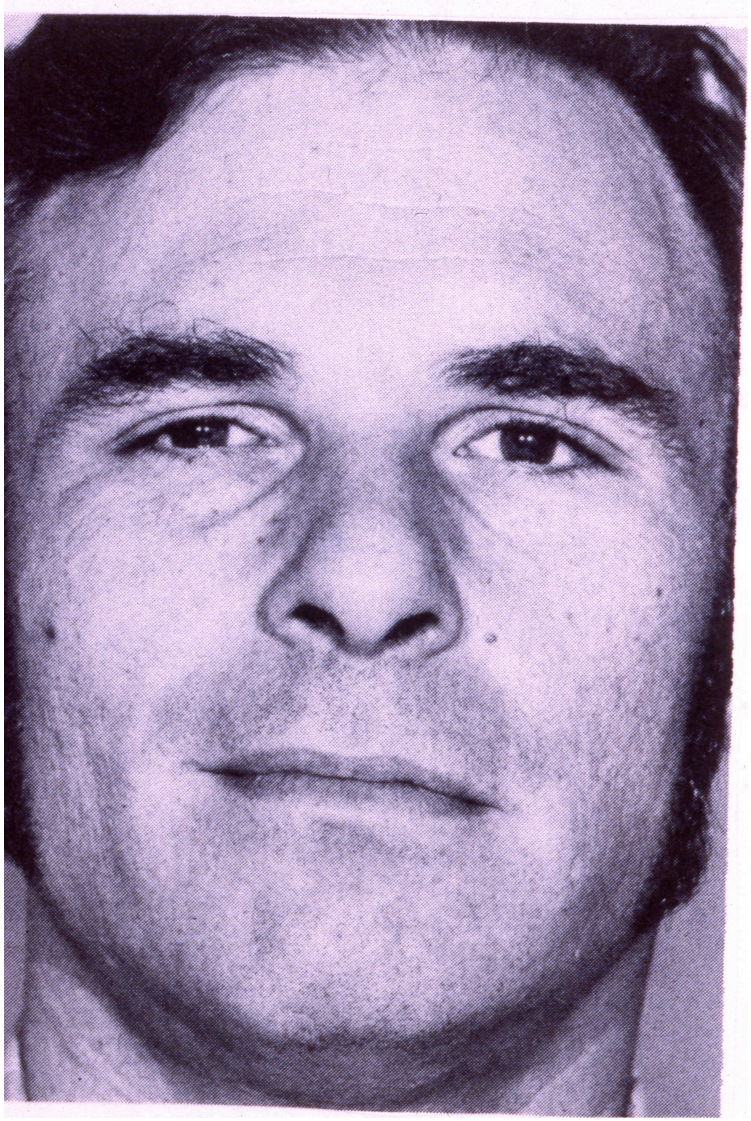
PRECISION FORESNICS ©

OR Seven Primary Facial Expressions of Emotions?

Contempt

- Eyes neutral
- Lip corner pulled up and back on one side only (contempt is the only unilateral expression)

OR Seven Primary Facial Expressions of Emotions?

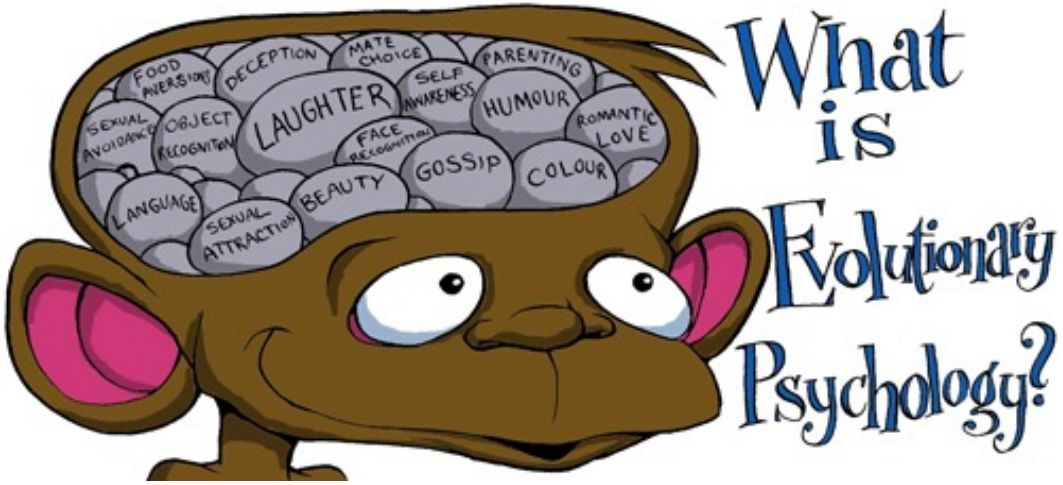


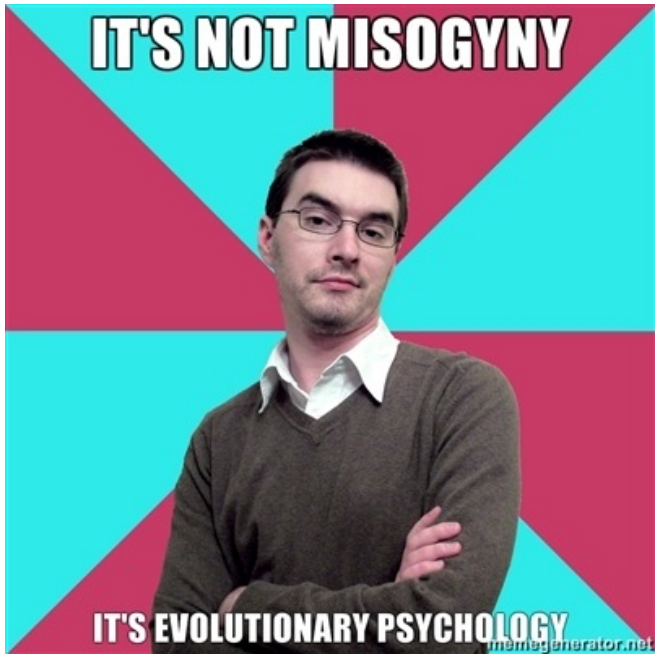
Affect Blends

Affect Blends

Affect Blends

WHY has Evolutionary Psychology been so Controversial?





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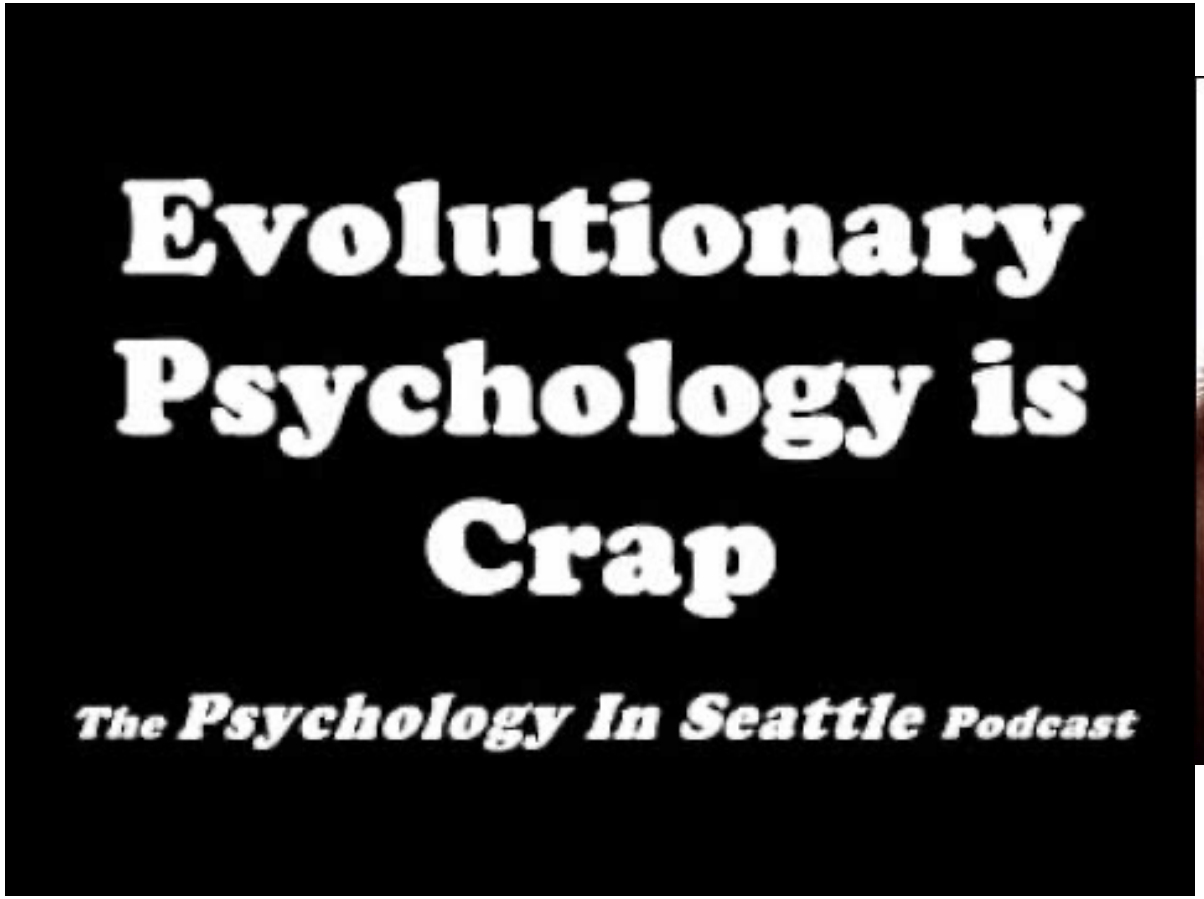

WHY has Evolutionary Psychology been so Controversial?

- Religious Objections (anti-evolution in general)
- Political Objections (fear of finding differences)
- Simplistic thinking about a “gene for behavior”
- Confuses conscious intentionality of human behavior with *actual* causes
- Association in the minds of critics with atheism, sexism, racism

WHY has Evolutionary Psychology been so Controversial?

- It often contradicts long-standing ways of thinking in western society and in academic social science.

What are the Sacred Cows?

(In Western dualistic religious & philosophical thought)

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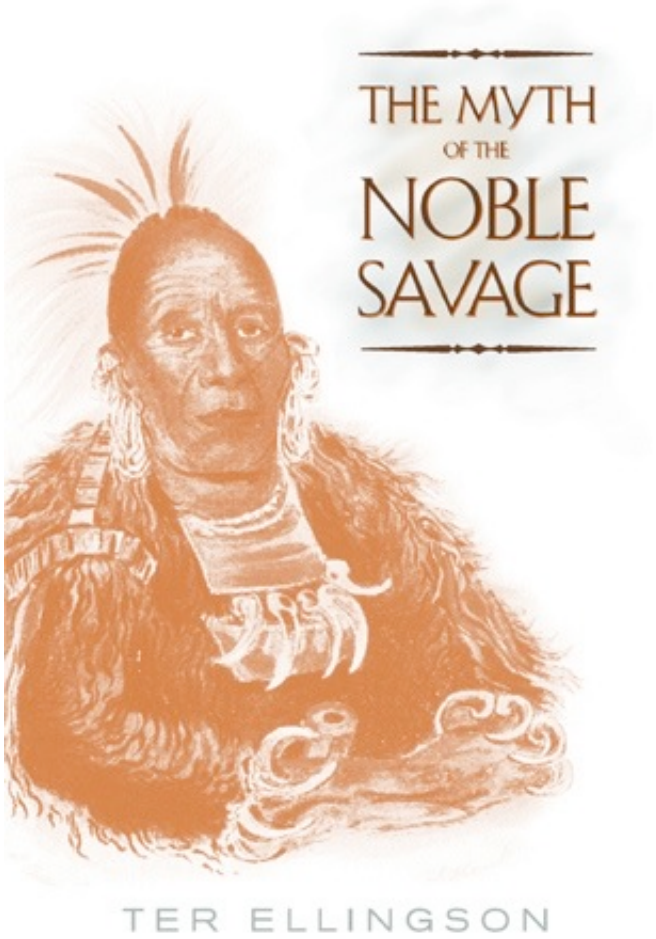
(In Western dualistic religious & philosophical thought)



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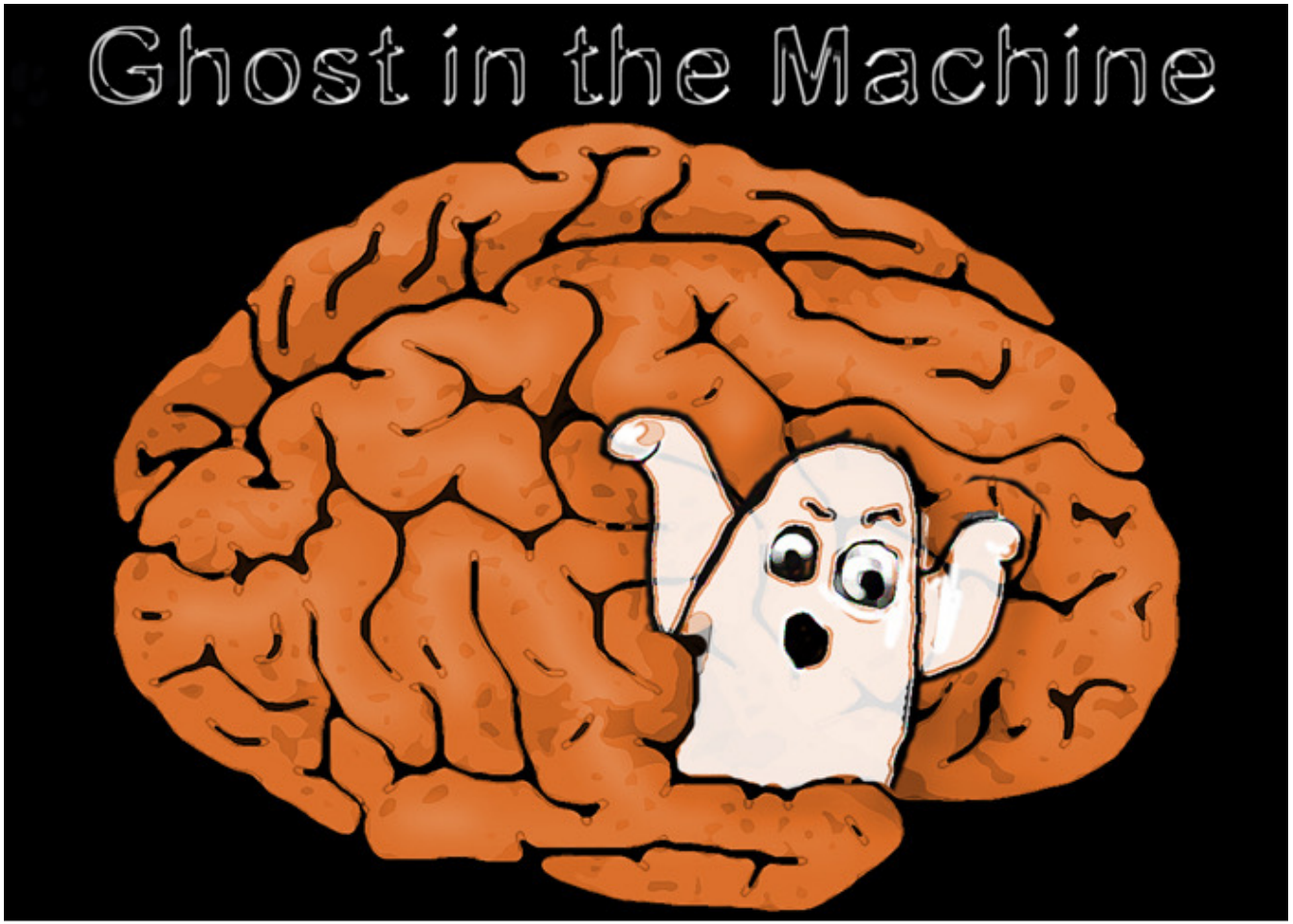


What are the Sacred Cows?
(In academic social science)

- The Uniqueness of Human Beings
- The Dominant Role of Culture in Shaping Human Experience
- An Aversion to Biological Thinking
  - PLUS a misunderstanding of genetics & evolutionary theory

The Evolutionary Model of the Mind

(The specialized mentality “Modular” Mind”)

vs.

The Standard Social Science Model of the Mind

- There is no real "Human Nature" at all
- Humans are unique in nature; they have no genetically determined instinctive patterns of behaviors like those found in animals.
- The mind has only unspecialized general learning mechanisms and cognitive processes
- Everything we "know" is learned, and everything is equally learnable; humans are completely malleable
- The mind is like a hard drive on a computer before the software is installed from outside; we are shaped by our culture.
- The mind is "Domain-General:" It is essentially one organ that is flexible enough to perform *all* cognitive tasks
- If something is innate, it must be observable at birth. Anything that shows up later in life must be due to experience

Problems with the SSSM

- Belief in the SSSM is only possible if you dismiss the importance of biology and are willing to think illogically about evolution.
- Contrary to common opinion, the SSSM view of the mind is *not* morally superior; in fact, it is a totalitarian's dream.
- The SSSM fails to understand the nature of developmental genetic programs.
- Evolution by natural selection has *always* favored specialization; this should also be true for the human mind.
  - -Important adaptive problems cannot be left to chance. A domain-general, unspecialized mind simply could not have been counted on to behave correctly on a consistent basis.

An Evolutionary Model of the Human Mind

- Human beings have an essential universal structure that is both physical and mental.
- The mind does have a general-learning capacity, but this is augmented by hundreds of separate psychological mechanisms known as "modules."
- The mind is "Domain-Specific:" It is many highly specialized organs, not just one unspecialized organ.
- The mechanisms of the mind evolved over millions of years to meet persistent adaptive problems in the Environment of Evolutionary Adaptedness (EEA).
- The "Swiss Army Knife" model of the mind increases, rather than decreases, the flexibility of behavior.

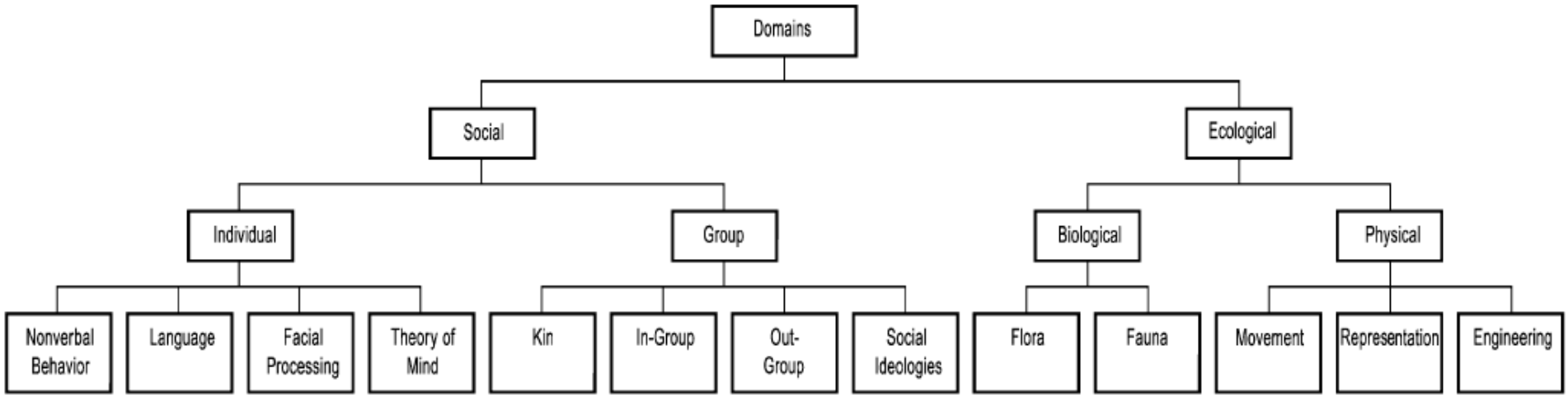
The "Specialized Mentality" Model of the Mind

- The mind is an organ that has been shaped by natural selection
  - Evolution favored a highly specialized mind
- The mind consists of multiple highly specialized modules
- Narrow slices of environmental information are processed by specific modules & each module copes with specific adaptive problems
- Survival was too precious to be entrusted to "consciousness" and trial-and-error learning

Domains of the Mind

* General-Purpose learning
* Language
* Social Intelligence
* Technical Intelligence
* Natural History Intelligence

Domains of the Mind



What about Culture?

“Evoked Culture”

- Culture results from the interaction of evolved human nature and the local resource situation
- ALL cultures exist to manage long-standing human problems of adaptation:
  - How to enforce cooperation?
  - How to manage status & rank?
  - How to limit violence by recognizing what causes it?
  - Building community through myths & legends
  - Recognizing and organizing kin relationships

Culture is an Adaptation

- Culture is a by-product of human nature – not the thing that *shapes* human nature
- Cultural transmission enhances reproductive fitness by allowing us to profit from the experience of other people
- *Meme* – the unit of cultural inheritance
  - Memes have fitness – just like genes

Important Evolution Concepts

- Survival of the Fittest
- Reproductive Fitness
- Adaptation
- Natural Selection
- Sexual Selection
- Decay through Disuse
- Species
- Genotype
- Phenotype
- Spandrel
- Lamarckian Evolution
- Unit of Selection
- Group Selection
- Meme

Natural Selection – It Still Operates

Natural Selection

- *Principle of Variation*: There must be variations in phenotype
- *Principle of Heritability*: Part of the variation between individuals must be heritable
- There must be competition between individuals for scarce resources, and some variants allow their bearers to compete more effectively
- Consequences of the above: Some individuals leave more offspring behind than others
  - The frequency of genes in a population change over time.

Sexual Selection

Intrasexual Selection:

- Members of one sex (usually males) compete amongst themselves for mates

Intersexual Selection: (Female Choice)

- females choose males with particular characteristics

The strength of sexual selection depends upon the degree of competition For mates, how much each sex invests in offspring, & the ratio of Sexually receptive females to males. In humans, male reproductive Success is much more variable than female success.

Ismael the Bloodthirsty

(Ismail Ibn Sharif, 1672-1727) Sultan of Morocco

1171 children by at least 500 women

Ghenghis Khan

(c. 1162-1227)

First Great Khan of the Mongol Empire

1 in 200 men direct descendants of Genghis Khan

By Razib Khan | August 5, 2010 12:38 am

In 2003 a groundbreaking historical genetics paper reported results which indicated that a substantial proportion of men in the world are direct line descendants of Genghis Khan. By direct line, I mean that they carry Y chromosomes which seem to have come down from an individual who lived approximately 1,000 years ago. As Y chromosomes are only passed from father to son, that would mean that the Y is a record of one's patrilineage. Genghis Khan died ~750 years ago, so assuming 25 years per generation, you get about 30 men between the present and that period. In more quantitative terms, ~10% of the men who reside within the borders of the Mongol Empire as it was at the death of Genghis Khan may carry his Y chromosome, and so ~0.5% of men in the world, about 16 million individuals alive today, do so. Since 2003 there have been other cases of "super-Y" lineages. For example the Manchu lineage and the Uí Néill lineage. The existence of these Y chromosomal lineages, which have burst upon the genetic landscape like explosive stars sweeping aside all other variation before them, indicates a periodic it "winner-take-all" dynamic in human genetics more reminiscent of hyper-polygynous mammals such as elephant seals. As we do not exhibit the sexual dimorphism which is the norm in such organisms, it goes to show the plasticity of outcome due to the flexibility of human cultural forms.

Sexual Selection for Conspicuous Male Traits

Sexual Selection for Conspicuous Male Traits

Sexual Selection for Conspicuous Male Traits

Sexual Dimorphism

Sexual dimorphism refers to the extent to which the two sexes in a species differ in size or appearance

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Sexual dimorphism reflects the intensity of competition between males for access to mates

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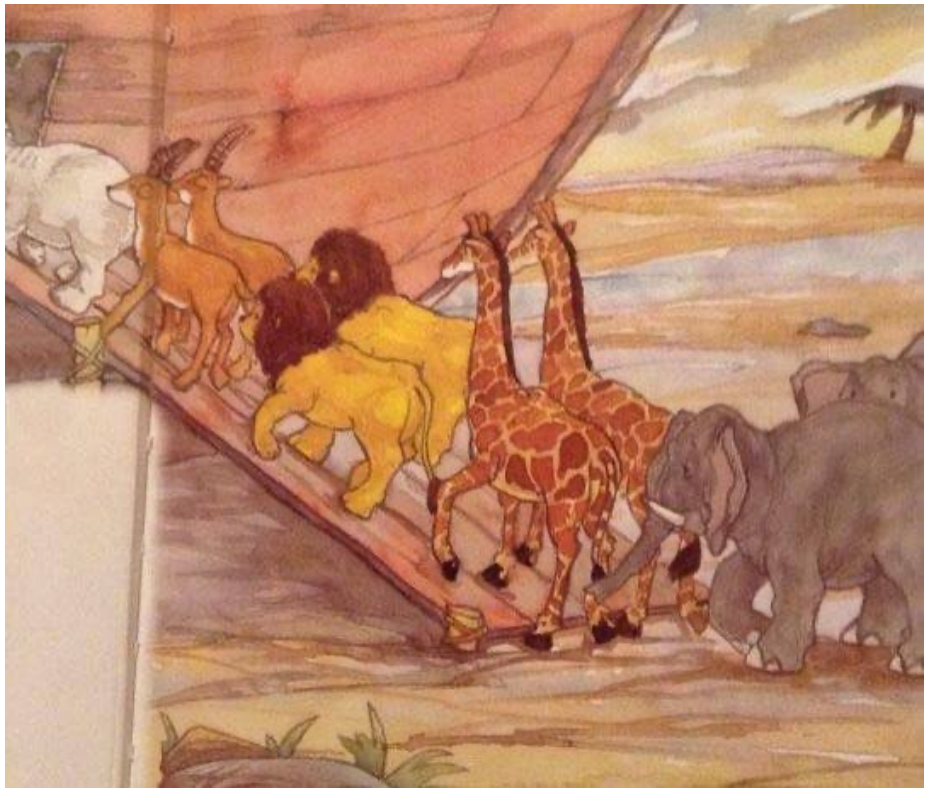

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Characteristics of Primates

COMMON FEATURES:

- Restricted to Tropics (except humans)
- opposable toe on foot, prehensile hands
- flat nails instead of claws; sensitive tactile pads with fingerprints
- low center of gravity; locomotion is hind limb dominated
- unspecialized olfaction; reduced in diurnal primates
- highly developed vision; binocular & stereoscopic; color in apes
- small litters, long gestation & juvenile periods
- large brains
- different teeth, especially unspecialized molars

Taxonomy of Primates

I. Strepsirrhines (Prosimians): Arboreal, nocturnal
   - Lemurs, Lorises

II. Halporrhines (Anthropoids): Diurnal

   Tarsiers

   Platyrrhines: New World Monkeys

   Catarrhines: Old World Monkeys

      Cercopithecaidea - Monkeys

      Hominoids: Apes

         Lesser Apes

         Great Apes

         Humans

Lemurs

Bushbabies

Loris

Tarsiers

New World Monkeys

Tamarins

New World Monkeys

Marmosets

New World Monkeys

Spider Monkey

New World Monkeys

Capuchin Monkey

New World Monkeys

Squirrel Monkey

New World Monkeys

Black Howler Monkey

Old World Monkeys

Colobus Monkeys

Old World Monkeys

Langurs

Old World Monkeys

Macaques

Old World Monkeys

Vervet Monkeys

Old World Monkeys

Blue Monkeys

Old World Monkeys

Baboons

Lesser Apes

Gibbons

Lesser Apes

Gibbons

Lesser Apes

Siamangs

Great Apes

Orangutans

Great Apes

Gorillas

Great Apes

Bonobos

Great Apes

Chimpanzees

Great Apes

Humans

Primate Social Organization

The range of social arrangements is quite broad:

Solitary Orangutans – territorial unimale polygyny

Monogamous pair-bonded Gibbons

Polyandrous Tamarins

Chimpanzees - Multimale Polygyny

Gorillas – True Harems

Large communities with both male and female hierarchies & alliances: Baboons, Chimps, Macaques

Dispersal

Parental Investment

Primate females *always* provide extensive care for young; males do so only in a few species.

When do males *NOT* care for offspring?

- When they can easily acquire additional mating opportunities
- When caring for their offspring does not appreciably increase offspring fitness

Female Primate Reproductive Strategies

DAD or CAD? Who do you choose?

OBTAIN RESOUCES: Females must maintain a minimum nutritional level to ovulate and conceive

GAIN ACCESS TO HIGH QUALITY MATES

ACHIEVE STATUS: High-ranking females reproduce more successfully, have better access to resources, and their offspring Thrive better.

MAKE SHREWD INVESTMENT DECISIONS: Tradeoffs are Necessary among offspring & between number of offspring & Quality of care.

https://www.youtube.com/watch?v=roqc0HcO9KU

Male Primate Reproductive Strategies

Sexual Dimorphism when males compete (intrasexual selection)

Traits favored for fighting: large size, fighting ability, weapons (Intrasexual Selection)

Large Testes for sperm competition in promiscuous multi-male Multi-female groups.

Exaggerated displays of quality & expensive physical traits

Monogamous pair bonding (high paternal investment)

Infanticide

Sexual Selection for Conspicuous Male Traits

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