

CS 143 * Animal Cognition
Lecture 1: THE PRIMATES

The Order of Primates- All Latin names italicized; Genus name capitalized, species name not

- Great variety of primates! Over 80 species, w/varied habitats, foods, body sizes, social systems, etc.
 - Cognition studied in < 10, so “**the** primate mind” is a mis-representation
- Key cognitive features that characterize most primates include...
 - **Large Brains, Hand-Eye Coordination, Few Long-Dependent Young, Highly Social, Playful**
- **Prosimians** = *Prosimii*, The most primitive, least changed from original ancestral primates
 - Found mainly on Madagascar, also in Australasia & Africa; - Like ancestor, many are insectivores
 - Projecting snout, wet noses - depend more on smell than other NHPs
 - Multiple teats, though usually only 2 functional – shift to parental investment in few young
 - Powerful grasp but digits act in unison - Tethered lips, less facial expression than other NHPs
 - Smaller-brained than other primates, but still larger brained than “average” mammal
 - Some are social; Others relatively solitary, and most of those are nocturnal.
- **Anthropoids** = **Anthropoidea**: “True Monkeys”, Flat faces. Most **highly social** - Two major divisions:
 - **New World Monkeys** = Platyrrhines = *Platyrrhini* (“Round Nostrils”)
 - Mexico, Central & S. America; Variety of niches: Folivory, Frugivory, Insectivory, etc.
 - Hook grip, most less digit mobility than Old World, but better opposability than Prosimians
 - All have tails, many have prehensile tails (a New World trait only!)
 - All diurnal (except Owl Monkey) - All arboreal (tree-dwelling)
 - * We will be most interested in the Genus: **Cebus** = **The Cebids** = **Capuchin Monkeys**
 - Small animal, but largest relative brain size (per body weight) of any New World Monkey
 - Likes patchy, ripe fruit; arguably places higher cognitive demands than all-leaf diet
 - Best NW dexterity; Only NWM (probably) that regularly uses tools, Socially learned
 - Forms social coalitions (e.g. “Two-Headed” display) & other complex social relationships
 - **Old World Monkeys & Apes**, includes Humans = *Catarrhini* = Catarrhines (“Long Nostrils”)
 - Widely distributed (Asia, Africa, Humans everywhere) - All diurnal
 - Many have Ischial callosities (butt pads) – sit up and use hands
 - Better opposability, many have better precision grip than most New World Monkeys
 - Very malleable faces (especially compared to “tethered” lips of Prosimians)
 - * We will be most interested in certain Cercopithecines such as:
 - GENUS: *Macaca* (**Macaques**, many species), *Papio* (**Baboons**, many species), and *Cercopithecus aethiops* (**Vervet Monkeys**- known for predator-specific alarm calls)
 - Many of these genera terrestrial & social; relatively easy & exciting to study
 - SUPER FAMILY: **Hominoids** = *Hominoidea* = the Lesser and Great **Apes, including Humans**
 - Largest brains - Large bodies - No tails
 - FAMILY: Lesser Apes = Gibbons & Siamangs, monogamous, canopy dwellers
 - * We will be most interested in the **Pongids (Great Apes)** and the **Hominids (Humans)**:
 - FAMILY: *Pongidae* = Pongids, Great apes = *Pongo pygmaeus* (**Orangutan**), *Gorilla gorilla* (**Gorilla**), *Pan troglodytes* (**Chimp**), *Pan paniscus* (**Bonobo**)
 - Larger bodied, larger brains than Lesser Apes, some species sexually dimorphic
 - Longest-dependent young, nurse 4-6 years
 - These apes are the most closely related to Humans,
 - Especially *Pan*, then *Gorilla*, then *Pongo* (per DNA, shared traits, etc)
 - “Closely related” means have relatively recent “common ancestor” **NOT** “evolved from” (i.e. *Pan* too has evolved since our common ancestor!)
 - FAMILY: *Hominidae* = **Hominids** = Ancestral and Modern (*Homo sapiens*) Humans
 - Bipedal, non-opposable toes, upright pelvis
 - Restricted birth canal, have esp altricial, most long-dependent young
 - Neotenuous (e.g. adult skull more fetal like than in Pongids)
 - Most advanced opposability, very precise grip, best bi-manual dexterity
 - Vocal articulation, lateralized brain for language, much gestural communication
 - Largest brain - Large social groups, technology, diverse cultures

Perceptual & Motor Constraints on Primate Cognition

VISION - Primary Primate Sensory Modality

- Extensive, elaborated “wetware” (brain circuitry) is devoted to visual processing;
- Heavily integrated w/other sensory-motor processes (See Cross-Modal Coordination, below)
- In flattened face, have **forward-facing eyes** (rather than lateral, as in many prey species)
 - Overlapping fields of view produces retinal disparity for excellent **Depth Perception**
 - For navigating environment and identifying & manipulating objects
 - Probably originally for hunting insects; Also for locomotion through 3D arboreal habitat
 - Cognitive mapping of environment can develop entirely visually (e.g. navigate visual simulation)
 - Other good mappers, like Rats, have to actually run maze;
 - **High Acuity** (detail resolution, e.g. for food finding and reading facial expressions)
 - **Color** especially in Old World Monkeys and Apes (e.g. for ripe fruit & some social signals)
- Includes development of sophisticated visual representational abilities, including...
 - Specialized for **Face Perception**
 - Faces salient, well-remembered, limbic-linked; Recognize individuals
 - Also particularly sensitive to head/eye direction
 - e.g. Some cortex cells respond best to head/eyes pointed toward vs. from subject
- Vision and other Sensory Modalities are integrated with **Motor feedback & control**...
 - e.g. **Mouth/Face** richly enervated for articulate action & rep'd in disproportionately large sensori-motor cortex
 - Manipulate food (e.g. shelling seeds, selecting parts); Also in social interactions (e.g. groom, kiss, call)
 - Calling elaborated in Humans, involving refined feedback control for articulate speech
 - Primate Facial Expressions highly variable, elaborate muscle structure enables subtle movements
 - Prosimian's tethered lips restrict, but Apes have nearly same face musculature as Humans
- Other Sensory Modalities, integrated with above, include...
 - Excellent **Vestibular** system for balance & movement (Acrobatic locomotion thru 3D arboreal habitat)
 - Fine **Hearing**: Detect range from 20Hz to 20kHz, Best sensitivity between 500-5,000Hz
 - But cannot move pinna (External ears; Used by many mammals to aid localization & signal attention)
 - Most Primates produce, and process, mammalian-typical call repertoires (<100 calls)
 - Humans have elaborated this modality for Speech perception & memory, huge symbolic repertoire
 - Relatively poor Olfaction (smell) compared to other mammals
 - Tho still plays a role in mating & feeding, still heavily linked to Emotion/Motivation
 - **Touch** sensitivity varies, but excellent in Fingers (see below) and Tongue
 - The Tongue is most sensitive, discriminating surface of the primate body
 - **Hands** are principal interface between a Primate and its world – eat, groom, explore, wield, etc!

THE HANDS -

- Primates show progressive development of truncal uprightiness (per pelvic/leg joint)
 - Upper limbs mobile, pivoting, including laterally and over head
 - An arboreal adaptation, to climb, swing, jump through trees
 - Leads to freeing of hands and facultative bipedalism (obligatory in Humans)
- **Grasping** (“**prehensile**”) hands/feet via **opposability** of *Pollux* (thumb) and of *Hallus* (big toe)
 - Retain primitive pentadactyly (5 fingers), but esp Old World have enhanced, free motility of digits
 - All Primates have fangernails: Made of keratin, replacing claws (on most digits, in most species)
 - These help protect sensitive, acute tactile pads (fingertips) on underside
- The Hand is hugely represented in both perceptual and motor maps in brain
 - Indicative of capacity for detailed discrimination and fine motor coordination
 - Also show neural development of “**Active Touch**” = integrated system of perception & response
 - e.g. Some cortical cells NOT fire if object moved across hand, DO if monkey actively grasps object
- **Hand-Eye Coordination** is especially well-developed to maneuver through and manipulate environment
 - Unlike rats, who have good manual dexterity, but cannot see own hands
- Hand activity often organized around **Objects**
 - e.g. Food, other's bodies, tools, etc; the latter, of course, esp developed in Humans