
Contents

Evolution of Language	1
Communication	2
Music	3
Human Physiology	4
Human Brain	5
The Brain is an Expensive Tissue	6
Brain Myths	6
Brain Localization	6
Language Areas	6
Anatomy of Hemispheres	7
Motor and Sensory Homunculus: “Little Man”	7
Cortex	8
Brain Stem	9
Anatomy of the Four Lobes	10
Brains in other Primates	11
Technical Intelligence	12
Ecological Intelligence	12
Social Intelligence	12
Exam 3 Tweets	14

Evolution of Language

Communication

- The human style of communication
- Communication does not mean language
 - Transmitter giving data then another organism that can decode that data into meaningful things
 - Humans are the only organisms currently known to have intelligible conversations beyond assorted sounds and grunts
- Spoken usually using words, but people can whistle it, play it on instruments, sign it, write it
 - Rare cases of whistling with distance between the two people
- **Semantics:** words have meaning
- **Phonemic:** words composed of sound elements from a set
- **Grammatical:** set of rules for use of word classes. Reliably develops, related is the observation that creoles and pidgins around the world seem to converge on basic linguistic structure - but not evidence of a “universal grammar”
 - Can use **recursion** (linking clauses, embedding clauses within clauses) which sometimes depends on keeping track of multiple ideas, objects, intentions, or processes at the same time.
 - Example; as I am talking about how amazing this semester is, I also tell you how much I love Linux, coding, and all of this amazing system administration jargon. I then continue to talk about how the classes at CSUF relate to the coding I do for fun. See how I bounce from idea to idea, keeping a conversation flow?
- accents can fade away with time but sometimes it does stick around (professor’s mom still has a strong Ecuadorian accent but her friend has lost it)

Music

- Shaped human music
 - Based on aspects of language: prosodic tonality, emphasis, phrasing in tonal and rhythmic patterns
- Auditory cheesecake (Pinker) : a byproduct hypothesis
 - to describe music as “a delightful dessert” rather than the “main dish” of language. But though the view that music came only as a by-product of language was widely accepted at the time, Henry Wadsworth Longfellow challenged him with the idea that “music is the universal language.
- For mating (Miller)
 - Advertise mating qualities (not a sound theory)
- Coalitional signaling (Hagen & Bryant)
 - Is everything about mating?
 - Music is not solo performance
 - To bring attention to teams, group competition
 - Associated with warfare (drummer boys)
- Speech surrogate - useful for oral transmission of information (educational), useful for communication in special environments (across valleys/hills, among predators and prey)
 - More or less a replacement for speaking when it cannot be done effectively
- Animals do not respond to human music like humans do
 - Seals can bob to a tune but that isn't the same

Human Physiology

- Shaped the features of the human throat
 - redesigned to include a more versatile voicebox and resonant cavity, but consequently associated with increased risk of choking
 - Most animals can breath when eating and drinking
 - In first years of life, babies can eat/drink while breathing at the same time, at around two years of age, the larynx shifts to the adult position, allowing more fully formed speech to develop. This subsequently results in a higher likelihood of choking.

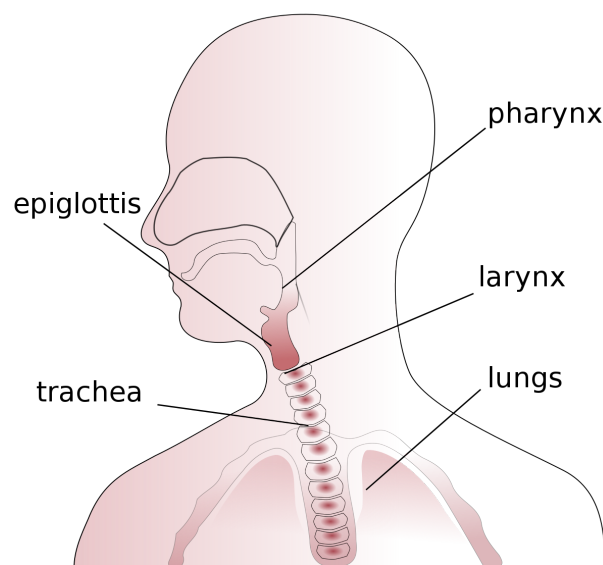


Figure 1: Human Throat Diagram

- Neanderthals had language abilities similar to humans
 - Australopithecines and early Homo **did not!**
 - Based on hyoid bone comparison
 - Paleoneurology, endocasts: encephalization quotient (EQ) and morphology hinting at developed language areas suggest this.

Human Brain

- Brain size, activity, and demands
- Specialization, modular design, language areas, motor & sensory
- Brain anatomy and your portable model of the brain

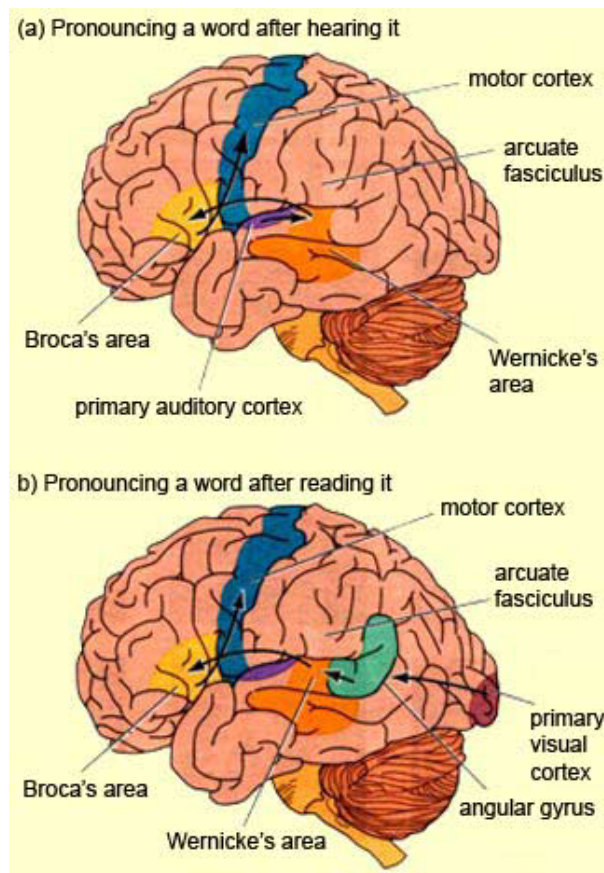


Figure 2: Brain Anatomy

- Encephalization Quotient (EQ), brain activity and metabolic demands
 - The ration of brain mass to overall body size
 - For example, a chihuahua has a higher EQ than a German Shepard does but a GS has been shown to be more “intelligent”
 - EQ lower for larger individuals
- Does larger EQ mean more intelligence
 - No size does not matter, just how you use it

-
- Where selection led to reduced body size (relative to other species of the same family or super-family, e.g), tends to be higher for small species. Causal arrow unclear.

The Brain is an Expensive Tissue

- Only 2% of our body mass
- Uses 16-20% of energy and oxygen consumed by body and requires constant supply of these resources
- Heart, kidneys, liver, and gastrointestinal tracts/stomach (gut) use about the same amount of energy and oxygen (combined)
- Cooking has likely allowed for selection of smaller gut which some hypothesize preceded and allowed selection for a larger brain (e.g Wrangham)
- Cooked food is more nutritious
 - Takes less energy to tear through and brings out nutrients

Brain Myths

- We only use 10% of our brain, a 1929 ad makes reference to this myth
- Recent movie that featured this: **Lucy** featuring Scarlett Johansson
- Even at resting state, we use a large portion of our brain
- Our brain is always online

Brain Localization

- **Phrenology**: functional areas of the brain (or behavioral tendencies) could be defined and identified based on external morphology
- Later localized views supported by evidence of language related to **aphasia** (inability to understand/express speech due to brain damage) and other selective deficits
 - Classic example of Phineas Gage (normal dude turns psycho due to brain being shot in the head by a rod)
- Selective deficits: concerning facial recognition, tools, auditory phenomenon (voice recognition, music), self-control

Language Areas

- Broca's Area: controls speech muscles via motor cortex

-
- Motor cortex: word is pronounced
 - Wernicke's Area: interprets auditory code
 - Angular gyrus: transforms visual representation into auditory code
 - Visual Cortex: receives written words as visual stimulation
 - Both of these areas were discovered with patients exhibiting aphasia
 - McGurk Effect: a perceptual phenomenon that demonstrates an interaction between hearing and vision in speech perception. The illusion occurs when the auditory component of one sound is paired with the visual component of another sound, leading to the perception of a third sound.

Anatomy of Hemispheres

- Contralateral control: the arrangement whereby the motor cortex of each cerebral hemisphere is mainly responsible for control of movements of the contralateral (opposite) side of the body.
- Corpus Callosum: a broad band of nerve fibers joining the two hemispheres of the brain.

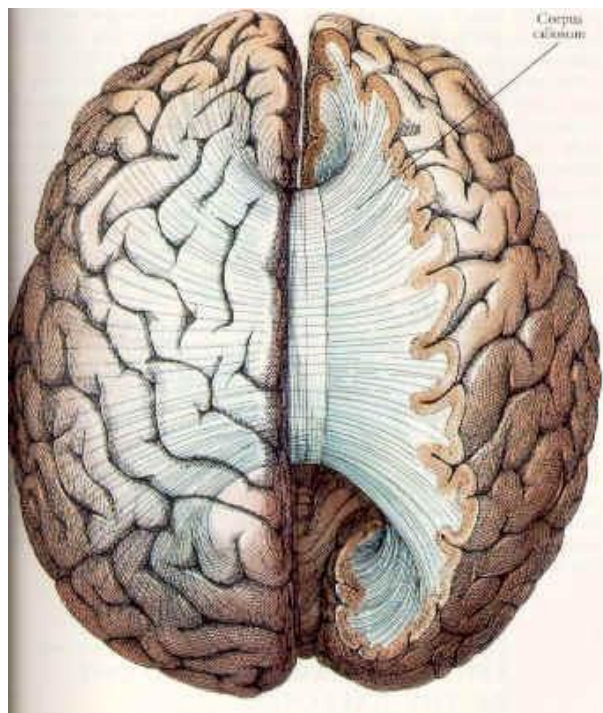


Figure 3: Bird's Eye View

Motor and Sensory Homunculus: "Little Man"

- What part of the body is the brain devoting more area towards?

-
- There is a little you inside you that controls you
 - Not taking it seriously
 - where we differentially have more or less neurons
 - hands, mouth

Cortex

- Each hand is attributed to a hemisphere
- Grey matter: tissue slightly greyer than the layer under it
 - Outer layer of the brain, much like skin on a hand (skin, then flesh)
- White matter: the inner part of the brain tissue
 - Made up of neuron's axons and myelin sheath
 - Carries information from one part of the brain to another
- Large cortex, small space
 - Brain tissue is curled to fit in the skull. Many of the structures inside the brain are C-shaped to fit in it
 - More folds will result in more neurons crammed in the same cavity
 - example: tar balls will condense a given amount data into a smaller space
 - example two: CPU registers are fast because they are so close to the CPU. Smaller brains may be smarter because information is more accessible than it was if the brain is larger.
 - The cortex has convolutions: mountain (**gyri**) and valleys (**sulci**) to fit inside the skull
 - Must be as large as possible, because it is the location of the cell bodies. More cells = more possibilities for processing information

Brain Stem

- **Brain Stem:** includes the **forebrain**, **midbrain**, and **hindbrain** to spinal cord
- The neurons that travel down the spinal chord then branch into the body to receive information from organs
- Hindbrain:
 - **Medulla:** the inner region of an organ or tissue, especially when it is distinguishable from the outer region or cortex
 - **Pons:** the part of the brainstem that links the medulla oblongata and the thalamus.
 - **Cerebellum:** the part of the brain at the back of the skull in vertebrates. Its function is to coordinate and regulate muscular activity.
- Midbrain:
 - **Reticular Formation:** a diffuse network of nerve pathways in the brainstem connecting the spinal cord, cerebrum, and cerebellum, and mediating the overall level of consciousness.
- Forebrain:
 - **Thalamus:**
 - * Sensory relay station
 - * Smell is the only sensory system that has no thalamic relay

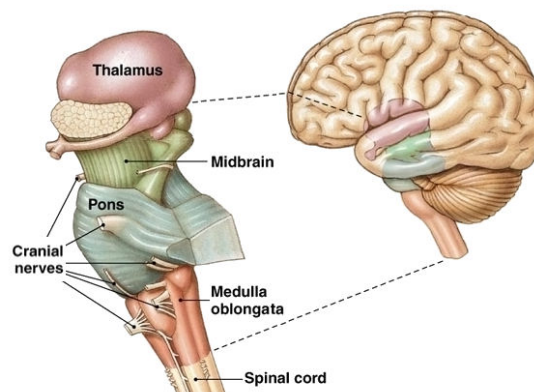


Figure 4: Brain Stem Diagram

Anatomy of the Four Lobes

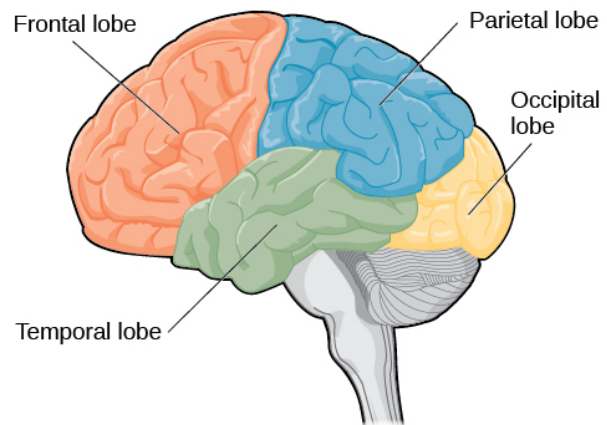


Figure 5: Lobe Diagram

- intricate details will be omitted from the exam, just know the basic anatomy

Brains in other Primates

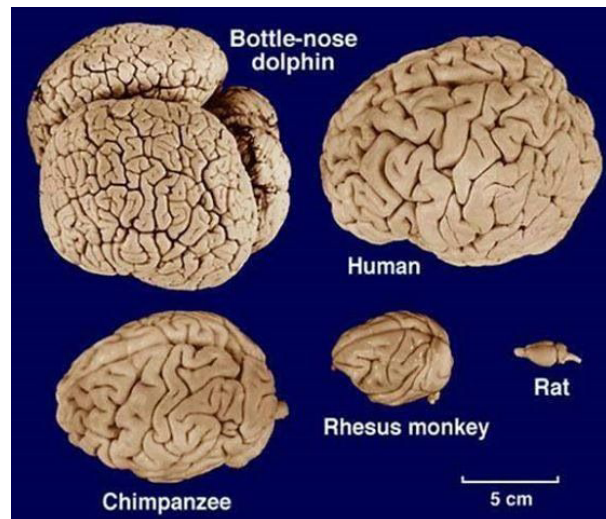


Figure 6: Brain Comparisons

Technical Intelligence

- Tool use
- Extractive foraging
 - breaking bones to extract bone marrow
- Culture
- technology and cumulative cultural evolution
 - Oldowan
 - Acheulean
 - Rapid evolution since
- Engineering
 - Learned, improvised

Ecological Intelligence

- Navigate and find food in complex environment
 - primates: evidence of mental maps
 - * object location
 - * birds-eye view, mental rotation
- Complex extraction techniques
- Art of tracking
 - Knowledge
 - Awareness (information acquisition)
 - Inference, deduction
 - Dynamic hypothesis testing

Social Intelligence

- Language and culture
- Machiavellian, Theory of Minf for strategic interaction: cooperation or exploitation
- Correlates with group size: For memory of alliances in complex networks, rivalries, debts, credits
 - Meat for sex (chimps)
 - Will groom as well as the groomer was groomed before

-
- Even chimps have “service economy”
 - Dolphins are very social and have large complex brains 1500-1700 cc; Wolves are very social yet have smaller brains 120cc
 - What about small brained hominids
 - *Homo sapiens* ~ 950-1800cc
 - *Homo floresiensis* ~ 400cc
 - *Homo naledi* ~ 450cc

Exam 3 Tweets



Figure 7: Screenshot 1