

Chapter 1 : Background The Development of Neuropsychology

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Case Report : LD

- History:
 - 21 year old male
 - Fell down 5 flights of stairs, suffered CHI
 - GCS of 3
 - CT revealed bleeding and swelling on RH, then LH
 - Craniotomy to relieve pressure
 - Successful physical recovery

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Case Report : LD

- Sequelae:
 - Amnesia for incident
 - NP Exam:
 - behavior : normal (?)
 - Pt and family report full recovery
 - tests:
 - impaired verbal memory
 - impaired attention
 - Unable to return to work as cook
 - can't multi-task
 - lost sense of smell and taste
 - Lost interest in socializing
 - Able to play golf at expert level

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Case Report : LD

- Issues:
 - Lawsuit & Settlement:
 - is he injured?
 - how can he be expert golfer but not work?
 - Rehabilitation & Recovery?
 - NP Testing shows "hidden" deficits
 - Brain imaging : limited utility

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GCS: Glasgow Coma Scale

- 13+ "Minor"
- 8-12 "Moderate"
- 3-8 "Severe"

Score	Eyes Open	Verbal	Motor
1	no	none	none
2	to pain	sounds	extension to pain
3	to voice	words	abnormal flex to pain
4	spontaneously	confused	flex/withdraw to pain
5	..	oriented	normal resp. to pain
6	obeys commands

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Brain Anatomy

- Two hemispheres (Left, Right)
- Cortex ("bark")
- Gyri, Sulci
- Right Hand Model
- CSF
- lateral and longitudinal fissures

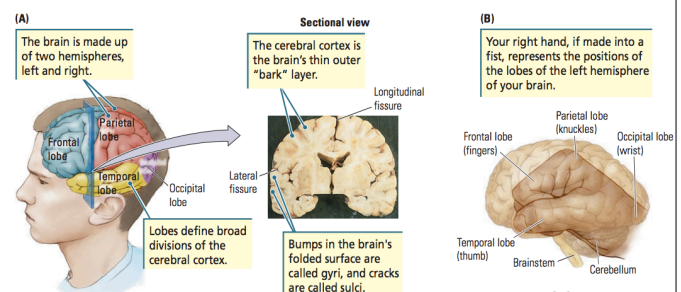


Figure 1.1

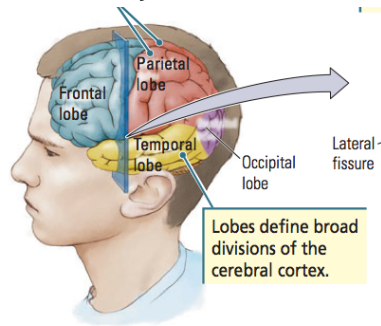
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Brain Anatomy

- Cortex divided into 4 lobes
 - Frontal
 - Parietal
 - Temporal
 - Occipital

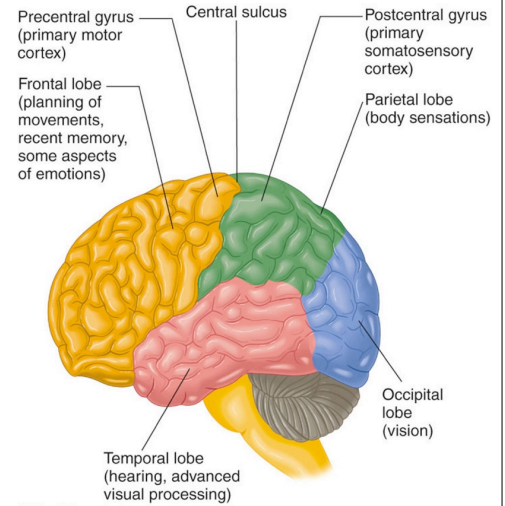


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Cerebral Cortex



© Wadsworth, Cengage Learning

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Evolution

- Phylogenetics or Phylogeny
 - study of evolutionary relationships between organism
- Ontogenesis or Ontogeny (aka morphogenesis)
 - development of organism from egg to adult

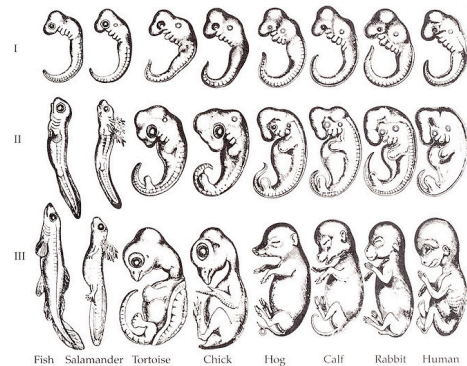
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Ontogeny Recapitulates Phylogeny

- idea that an organism's development from egg to mature individual is similar to evolutionary development of species.



Fish Salamander Tortoise Chick Hog Calf Rabbit Human

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Brain - 3 part division

- Three divisions:
 - Forebrain
 - Brainstem
 - Spinal Cord
- These mirror phylogeny (somewhat)

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Brain

- Forebrain
 - Cerebral Cortex
 - Limbic System
 - Hippocampus
 - Cingulate Gyrus
 - Septum
 - Amygdala
 - Basal Ganglia
 - Globus Pallidus
 - Caudate
 - Putamen
- Brain Stem
 - Thalamus
 - Hypothalamus
 - Midbrain
 - RAS
 - Hindbrain
 - Medulla
 - Pons
 - Cerebellum

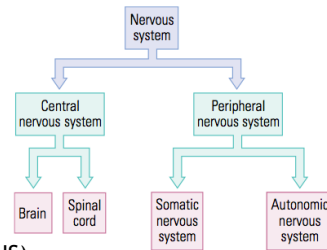
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Nervous System

- Assumption
 - Nervous system -> Behavior
- Nervous system:
 - Central Nervous System (CNS)
 - Brain
 - Spinal Cord
 - Peripheral Nervous System (PNS)
 - Autonomic Nervous System (ANS)
 - Sympathetic
 - Parasympathetic
 - Somatic Nervous System (SNS)
- Endocrine system



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The Brain Hypothesis

- The Brain is the seat of behavior
- c.f. The Cardiac Hypothesis

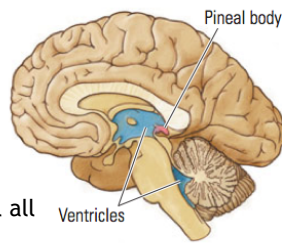
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Philosophy of Mind

- Aristotle (348-322 BCE)
 - non-material *psyche* connects through heart
 - similar to "soul"
 - psyche = "mind"
- Descartes (1596-1650 CE)
 - materialist
 - dualism : mind-body problem
 - mind->body in pineal gland
 - Followers claim that animals, children, mentally ill all lack minds



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Darwin, Wallace & Materialism

- Charles Darwin (1809-1892) and Alfred Russell Wallace (1823-1913)
 - studied structure and behavior of plants & animals
 - commonalities suggest relationships
 - Darwin : common descent

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Darwin vs. Wallace : Evolution of Language

- human evolution : millions of years
- human written language : thousands of years
- How could we have language?
- Wallace : divine gift
- Darwin : ... (return to this next chapter)

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Localization of Function

- Franz Josef Gall / Phrenology
 - Cortex is functional (not just covering for the pineal gland as per Descartes)
 - ignored data from clinical cases
 - good idea, poor execution
- Paul Broca - Broca's Area
 - data based on clinical patients

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Phrenology

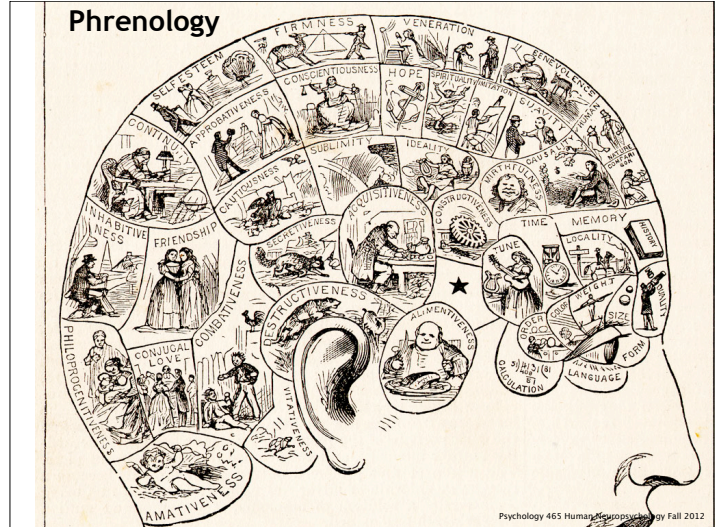
- A now discredited “science” from 1749 thru mid 1800s
- Theory:
 - Brain controls behavior
 - Brain areas are modular
 - Cranial bone (skull) conforms to shape of brain
 - Therefore, measuring skull shape --> cognitive and emotional abilities
- Data:
 - Data came from animal and human skulls
 - Human skulls : primarily of criminals
 - tended to ignore good data (data from brain damage)

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Phrenology



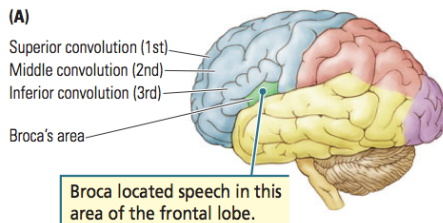
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Broca's Aphasia

- Patient ML
 - lost expressive speech, except to say “tan” and swear
 - “aphasia”
 - paralyzed on right side
 - could understand spoken speech
 - autopsy showed brain damage in LH



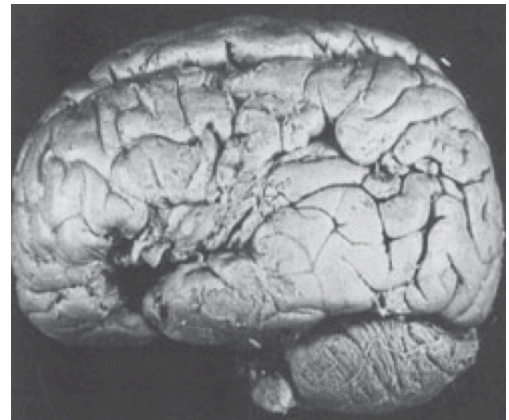
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Broca's Aphasia

- Autopsy picture



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Broca's aphasia

- Established two principles:
 - Localization
 - Lateralization

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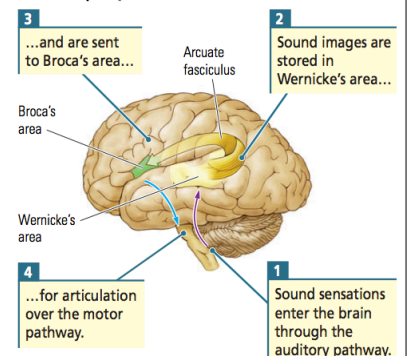
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Wernicke's Aphasia

- Symptoms
 - can speak, but nonsense
 - can not understand or repeat spoken speech
 - hearing is fine
 - no paralysis

(B) Contemporary version of Wernicke's model

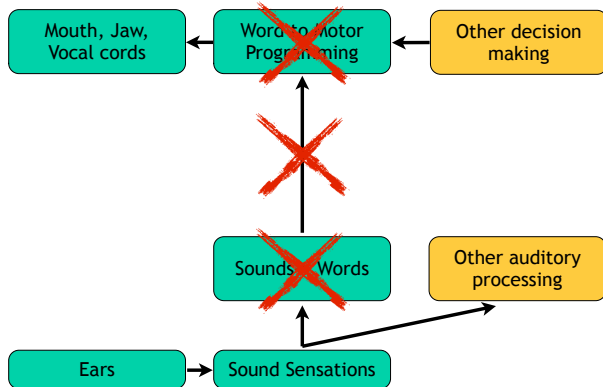


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Block Model of Aphasia (Wernicke-Geschwind model)

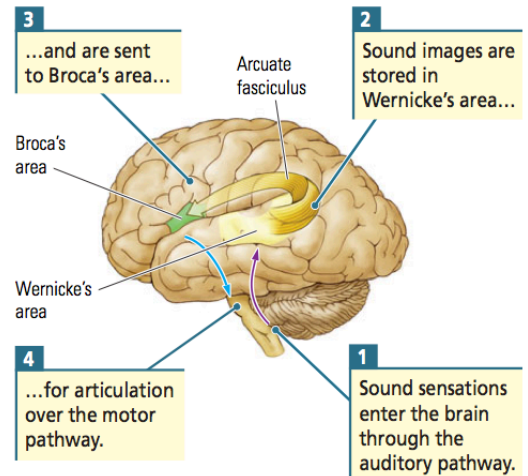


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(B) Contemporary version of Wernicke's model



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Sequential Programming & Disconnection

- Some abilities require multiple brain areas
- Areas operate in sequence
- Possible to damage the **connections** between areas w/o damaging areas
- "Disconnection" Syndromes

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Evidence against Localization

- Pierre Flourens
 - Animal experiments
 - removed portions of cortex
 - behavior initially reduced
 - followed by partial recovery
- Conclusion:
 - cortex is generalized, not localized

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Hierarchical Organization and Distributed Systems

- John Hughlings-Jackson
 - brain has hierarchy
 - higher levels of function depend on lower levels
 - damage can result in *dissolution* of behavior (opposite of *evolution*)

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The Split Brain Studies

- Joseph Bogen and Phillip Vogel, neurosurgeons
- Cut corpus callosum to reduce seizures
- Patients: in many ways, normal
- Experiments showed:
 - both hemispheres operate somewhat independently
 - LH and RH different modes, strengths
 - LH
 - spoken language
 - analytic, sequential, details
 - RH
 - visual, spatial
 - holistic, gestalt

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Conclusions re: localization

- “Distributed Hierarchy”
- Distributed
 - cognitive functions localized in more than one place
 - multiple systems interact
- Hierarchy
 - Higher level behavior is made up of lower level parts
 - parts are often relatively independent
- Dissociation (see next slide)

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Dissociation

- Single or simple dissociation:
 - Lesion to brain area L1 causes behavior problem B1
 - Lesion to other area L2 does not cause B1
- Double Dissociation:
 - Lesion to brain area L1 causes B1 but not B2
 - Lesion to other area L2 causes B2 but not B1

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The Neuron Hypothesis

- Anatomical observations
- Electrical stimulation
 - led to behavior
- Connections between neurons
 - created to store information
- Neurotransmitters
 - chemicals which convey impulse from neuron to another

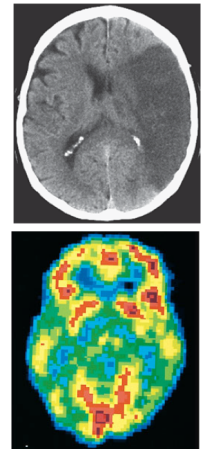
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Neuroimaging

- Visualizing the brain *in vivo*
- CT : Computed Tomography
 - xray
 - cheap(er), quick
 - low resolution
- PET : Positron Emission Tomography
 - radioactive injection
 - tag chemicals to image



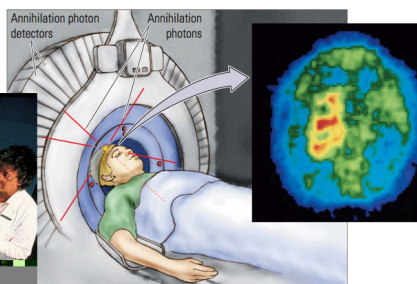
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PET Scanner

A small amount of radioactively labeled water is injected into a subject. Active areas of the brain use more blood and thus have more radioactive labels.



Positrons from the radioactivity are released; they collide with electrons in the brain, and photons (a form of energy) are produced, exit the head, and are detected.

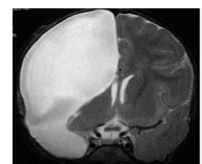
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Neuroimaging

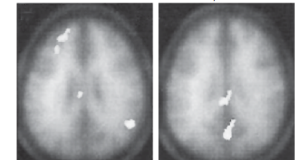
- MRI : Magnetic Resonance Imaging
 - magnetic fields
 - detailed
 - expensive
- fMRI : Functional MRI
 - metabolism in real time



(B) fMRI responses

Normal readers

Dyslexics

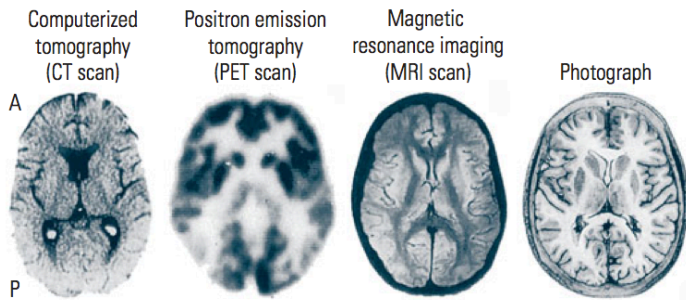


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Comparison of Neuroimaging images



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Neuropsychology and related fields

- MS/MA
- Ph.D.
 - Experimental
 - Neuroscience
 - Cognitive Science
 - Psychology
 - Biopsychology, Cognitive, Developmental, Educational, Forensic, Personality, Social...
 - Counseling
 - Clinical
 - Neuropsychology
- M.D.
 - Neurology
 - Psychiatry

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Clinical Neuropsychology

- Old School
 - localize site of lesion by way of behavioral testing
 - "Well, your brain is broken!"
- New School
 - diagnose disease by behavioral testing
 - provide clinical guidance re: ADLs, vocational
 - track recovery & rehabilitation
 - uses neuroimaging for finding lesions
 - forensic
 - research : behavioral testing
 - drug research
 - TBI
 - etc...

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