Week 6

- Tuesday:
  - Ogden Chapter 1 : Clinical Neuropsychology
- Thursday:
  - KW Chapter 11: Lateralization

Ogden Chapter 1: Clinical Neuropsychology

Aims of Clinical Neuropsychology

- Applied
  - diagnose, treat, rehabilitate people with neurological disorders
  - prevention
- Academic
  - how does the "normal" brain work by studying the damaged brain
- Training:
  - Subfield of Clinical Psychology

Assumptions of Clinical Neuropsychology

- Similarity of human brains
  - in adult brains, functions are generally localized the same places
  - Is this a good assumption with children?
- Formal Assessment & Tests can be better than casual/ informal observation
  - example: NP Testing can detect Alzheimer's disease before behaviors are obvious

Related Disciplines

Discipline	Focus	Subjects	Setting	Tests & Measures	Training
Cognitive Psychology	Mind	Healthy undergrads	Research University	Computer Reaction Time(RT)	Ph.D. experimental
Cognitive Neuropsychology	↕	↕	↕		
Clinical Neuropsychology	↕	↕	↕	IQ and specialized tests	Ph.D. clinical
Behavioral Neurology	↕	↕	↕		MD
Neurology	Brain	Patients with Neurological Disease	Hospital	Informal, behavioral, hands-on	MD

Brain Anatomy Notes

- Ogden calls the Secondary zones "Association cortex" whereas KW calls the Tertiary zones "Association cortex" (p. 11)
- How many parts in the brain?
  - Ogden says the brain has 3 parts:
    - cerebral hemispheres, cerebellum, and brain stem (p. 6)
  - KW says 2 parts:
    - brain stem, forebrain
- We'll stick to KW's definitions

Functional Systems

- (From Luria)
- Brain has numerous small modules (aka "subunit", "factor", "component") which combine to form *functional systems*
- Damage to small area of brain will therefore impact any functional system which uses that area

Compensation

- Functional systems require participation from many modules
- If module is damaged…
- Person may be able to find new way of performing task by using different module, or by re-training module(s) to perform task that the damaged module can not do
- Example
  - Normal:
    - A B C D E
  - Damage:
    - A B ~~C~~ D E
  - Compensation
    - A B R D E
- Example :
  - Howard Engel / Alexia sine Agraphia

Disconnection Syndrome

- When damage is not to the modules, but to the connections between them
- Odd patterns of behavior
  - Conduction Aphasia : can speak and understand, but can't repeat speech
  - Ideomotor Apraxia : can perform tasks spontaneously, but not to command
- Both examples due to damage to *Arcuate Fasiculus* which connects Wernicke's area to frontal lobes

NP Terms 1

- Deficit, Dysfunction, Impairment, Disorder
  - often used as synonyms
- Syndrome
  - group of related symptoms

NP Terms : Lesions

- Lesion
  - damaged area
  - *focal* or *diffuse*
- Infarct, Infarction
  - area of dead (or damaged) brain tissue
- Atrophy
  - reduction in size/health. shriveled / shrunken

NP Terms : Causes of Lesions

- Physical Injury / Trauma
  - open, closed head injury
- Stroke - blood flow interruption
  - ischemic
    - blockage (temporary or permanent)
  - hemorrhagic
    - bleed / burst vessel
- Infections
  - bacteria
  - viruses
    - herpes simplex encephalitis

NP Terms : Causes of Lesions

- Hematoma
  - pool of blood
- Edema : swelling due to fluid, injury, inflammation

- Mass effects
  - shifting of brain tissue causes pressure
  - death if brain stem is affected

NP Terms - Prefix, Roots, Suffixes

- Roots:
  - -phasia : speech
  - -graphia : writing
  - -lexia : reading
  - -praxia : purposeful motor actions
  - -gnosia : to know
- Prefixes:
  - a-, ano- : lack of (or impairment in)
  - dys- : diminished, malfunctioning
- Suffixes :
  - -itis : inflammation
  - -ectomy : removal of
  - -otomy : cut into

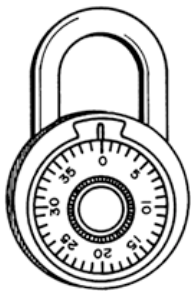
NP Terms 3 : Examples

- Modifiers
  - visual : sight
  - tactile : touch
  - prosopos : face
  - motor : movement
  - olfactory : smell

NP Terms : Combinations

- Examples:
  - Prosopagnosia
  - Anoagnosia
  - Visual Agnosia
  - Visual Anoagnosia
  - Ideomotor Apraxia

What is this object?



O1 : Cerebral Lateralization

- Historical
  - Broca's Area (1861)
  - Wernicke's Area (1874)

- Data from Split-brain studies

- Normal Language dominance (left hemisphere):
  - 92% of right handers
  - 69% of left handers

O1 : Cerebral Dominance Myths

- LH was considered "dominant"
  - Consciousness
- RH considered specialized for "creativity"
  - Subconscious
- People : either "Right-brained" vs. "Left-brained"

- Problems
  - data from split brain patients
  - unfair importance of language

- Modern understanding
  - both hemispheres participate in most tasks
  - LH and RH are more specialized for certain tasks

Plasticity

- Brain can recover from big injuries in childhood
  - example: hemispherectomy
  - up to age 12, perhaps 15 - yes
  - adults : ? not clear ?

- Example in people who went blind:
  - before age 12 : no visual dreams or imagery
  - after age 12 : report visual dreams & imagery

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

- Reality:
  - due to high interconnection between brain systems, may not be this simple.
  - dysfunction in another area (L3) may cause both patterns

Neuropsychology as Scientist-Practitioners

- Interplay of Research vs. Clinical Practice
- Finding (double) dissociations is hard
  - Research is limited by
    - lack of lesions
    - unclear lesions
      - (easier now with neuroimaging)
    - patients able to participate in research
    - patients willing to participate
    - etc.

Roles of Neuropsychologists

- Clinical
  - seeing patients
  - diagnosing disorders
  - recommending treatments
  - tracking progress
- Consulting
  - e.g. assessment prior to surgery
- Forensic
  - competency hearings / ability to stand trial
  - lawsuits, damages due to accidents/injuries
- Research
  - drug research
  - epidemiological
  - ...

KW11 : Lateralization

Case History: "MS"

- MS : 25 year old female
- long history of epilepsy (about 1 seizure/month)
- cause: cyst in L temporal lobe

- Surgery to remove it was success, but...
  - infection set it
  - caused widespread damage to LH

- Results:
  - unable to comprehend or speak language
    - except "I love you"
  - "Global Aphasia"
  - But could still sing songs and recognize right/wrong lyrics

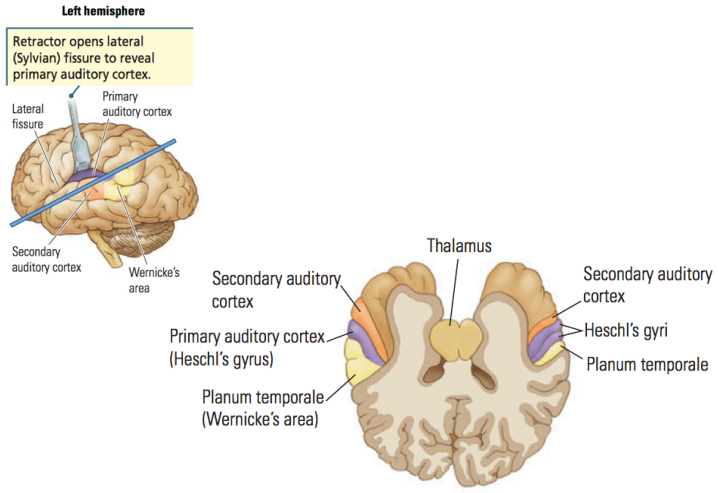
Principles of Laterality

- Relative, not absolute:
  - both hemispheres active in most tasks
- Contralateral sites are more similar than different
  - "**site** is more important than **side**"
- Individual differences
  - genetics & environment, e.g. handedness
  - females & left-handers are less strongly lateralized than right-handers & males
- Not just humans
  - animals show lateralization as well

History

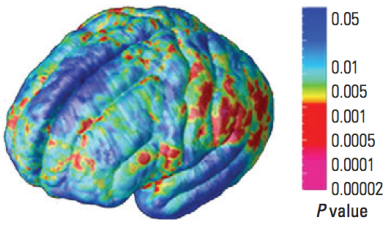
- Anatomic Asymmetry :
  - Pierre Gatiolet (1860s) noted LH develops gyri & sulci before RH
- Norman Geschwind & Walter Levitsky
  - asymmetry in *planum temporale* in temporal lobes
  - aka "Wernicke's Area"
  - average 1cm longer in LH than RH

Asymmetry in Auditory Cortex



Major anatomical asymmetry

- RH is slightly larger & heavier
- LH has more gray matter
- Temporal lobes : the most asymmetric
- Neurotransmitters show asymmetry too
- Details affected by sex & handedness



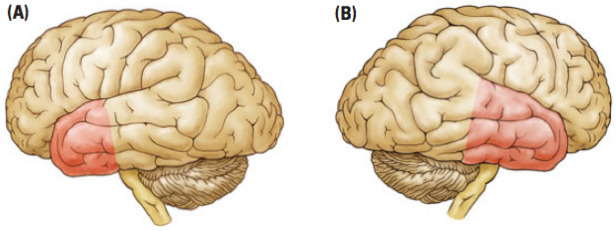
Forms of asymmetry

- Anatomic Asymmetry
- Neurotransmitter Asymmetry
- Neuronal Asymmetry
  - dendritic morphology
- Genetic Asymmetry
  - gene expressions differ between LH and RH

- Behavioral / Functional Asymmetry

Double Dissociation Example

- Two patients, each had temporal lobe removed to help with intractable epilepsy
- (A) : patient PG - Left temporal lobectomy
- (B) : patient SK - Right temporal lobectomy

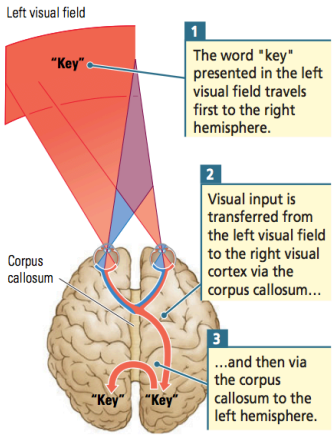


Double Dissociation : Test results

	Lobe Removed			
	LH		RH	
Test	Pre	Post	Pre	Post
FSIQ	123	109	114	103
Verbal IQ	122	**103**	115	115
Non-Verbal IQ	121	114	110	**89**
Memory Quotient	**96**	**73**	121	101
Verbal Recall	**7**	**2**	16	12
NV recall	10.5	10.5	7.5	**5.5**
Drawing copy	94%	94%	86%	**78%**
Drawing recall	63%	63%	**31%**	**36%**

Normal function: before surgery

- LH can read words from R visual field in normal patients due to connections via corpus callosum
- Commissurotomy: cutting both corpus callosum and anterior commissure

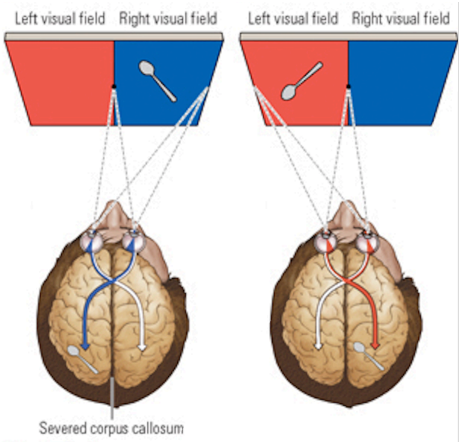


Asymmetry in the Visual System

- Visual system : almost 100% perfectly crossed
- Methods:
  - Tachistoscope - presents stimuli to one visual *field* at a time
- Findings:
  - LH advantage for verbal stimuli
  - RH advantage for faces and other visuospatial stimuli

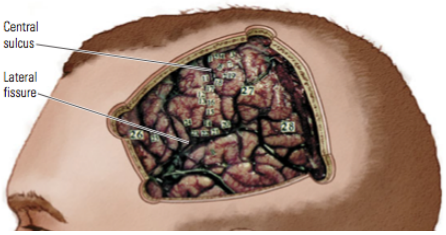
After split-brain surgery

- Spoon in RVF
  - subject says "Spoon"
- Spoon in LVF
  - can not name it.
  - can identify it by touch left hand



Direct brain stimulation : 4 effects

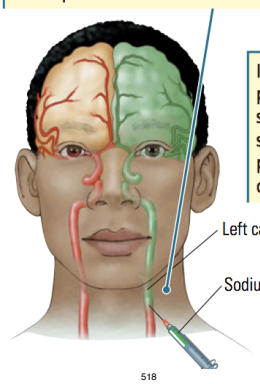
- somatosensory: movement, numbness, flashes of light, sounds
- experiential : fear, deja vu, dreaming states, memories
- increased action, e.g. LH : speech : increased talkativeness
- decreased action : LH, inhibition of behavior, e.g. inability to talk



Wada Test

- sodium amobarbital injection

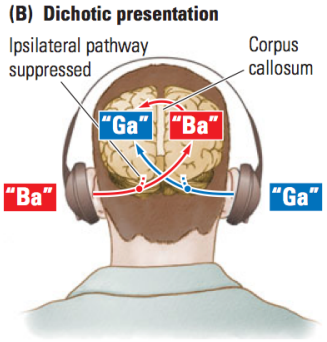
When the left carotid artery is injected, the left hemisphere is briefly anesthetized; so the person cannot speak, move the right arm, or see on the right visual field. Although the right hemisphere is awake, for most people it is nondominant for speech, and the patient can neither speak nor later report on the experience.



Injection into the right side produces sensory and motor symptoms on the left but no speech disturbance, unless the patient's right hemisphere is domininant for speech.

Asymmetry in the Auditory System

- Auditory system : not fully crossed - both hemispheres receive projection from both ears
- Methods:
  - Dichotic listening tasks
- Findings:
  - LH advantage for speech
  - RH advantage for melodies
  - inconsistent - greatly affected by individual Ss factors such as attention, practice



Asymmetry in the Somatosensory System

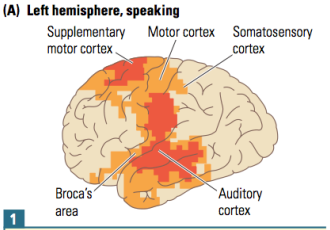
- Somatosensory system : almost 100% fully crossed
- Methods:
  - object identification by touch
- Findings:
  - LH disadvantage overall, but better at IDing letters
  - RH advantage overall

Asymmetry in the Somatomotor System

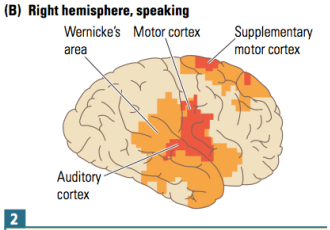
- Somatomotor system : almost 100% fully crossed
- Methods:
  - videotaping of face during speech
- Findings:
  - LH faster (right-side of mouth moves faster & more fully)
  - RH more expressive for emotions

Neuroimaging and Asymmetry

- Neural activation (from PET, fMRI…) consistent with localization / lateralization



1 Speaking activates the mouth, tongue, and larynx representations in the motor and somatosensory cortex, the supplementary motor area, the auditory cortex, and the language zones in the left hemisphere.



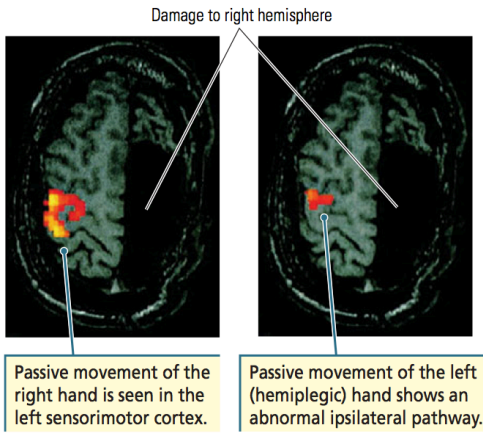
2 In the right hemisphere, the mouth area and auditory cortex are active but are less active than in the left hemisphere.

Asymmetry : Theory & Models

- Specialization models
  - LH and RH have unique abilities, not shared
  - LH : speech, language, motor movement, tracking information serially on short timeframes
  - RH : visuospatial, holistic, parallel, slower timeframes
  - viz "Stroke of genius" video?
- Interaction models:
  - LH and RH both capable of same abilities, but don't
    - LH and RH work on different *aspect* of same task (e.g. LH=speech meaning, RH=speech emotion)
  - Each H inhibits the other
    - evidence : hemispherectomy can improve functioning

Asymmetry : Plasticity

- 17 patients with hemispherectomy were examined
- in some patients, movement of left hand showed activation in the Left (ipsilateral) hemisphere



Passive movement of the right hand is seen in the left sensorimotor cortex.

Passive movement of the left (hemiplegic) hand shows an abnormal ipsilateral pathway.

Preferred Cognitive Mode

- Given difference in LH and RH abilities
- Might individuals differ in strengths/weaknesses, and ability to choose or prefer one H to the other?