Week 7

- KW Chapter 11 : Lateralization
- KW28, O2 : Neuropsychological Assessment

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

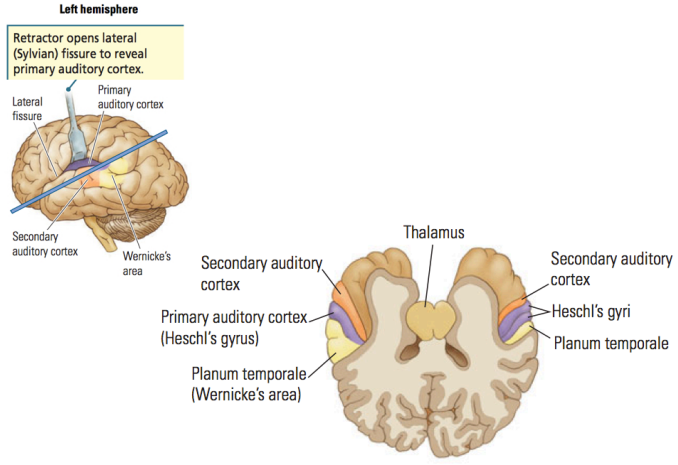
- Relative, not absolute:
  - both hemispheres active in most tasks
- Contralateral sites are more similar than different
  - "**site** is more important than **side**"
- Individual differences
  - genetics & environment, e.g. handedness

- Not just humans
  - animals show lateralization as well

History

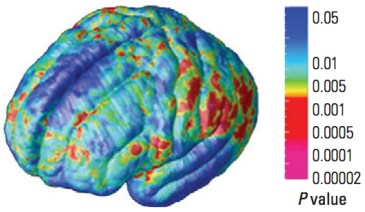
- Anatomic Asymmetry :
  - Pierre Gatiolet (1860s) noted LH develops gyri & sulci before RH
- Norman Geschwind & Walter Levitsky
  - asymmetry in *planum temporale* in temporal lobes
  - aka "Wernicke's Area"
  - average 1cm longer in LH than RH

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

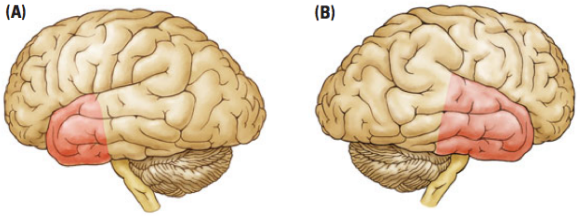


Forms of asymmetry

- Anatomic Asymmetry
- Neurotransmitter Asymmetry
- 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

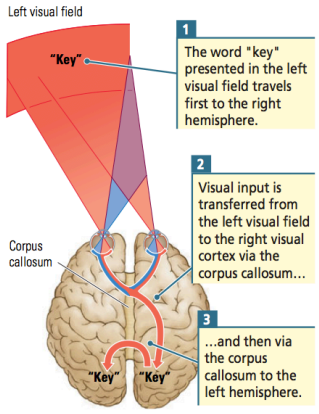


Double Dissociation : Test results

	Lobe Removed			
	LH		RH	
Test	Pre	Post	Pre	Post
FSIQ	123	109	114	103
VIQ	122	103	115	115
PIQ	121	114	110	**89**
Memory Quotient	**96**	**73**	121	101
Verbal Recall	**7.0**	**2.0**	16.0	12
NV recall	10.5	10.5	7.5	**5.5**
Drawing copy	94%	94%	86%	**78%**
Drawing recall	63%	63%	**31%**	**36%**

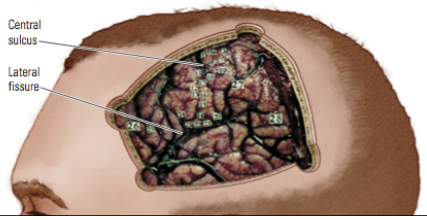
Split brain patients

- 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



Direct brain stimulation : 4 effects

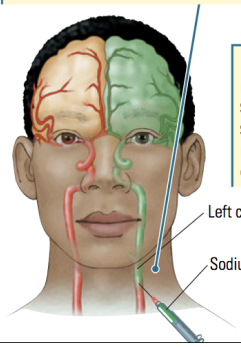
- somatosensory: movement, numbness, flashes of light, sounds
- experiential : fear, deja vu, dreaming states, memories
- increased action, e.g. LH : speech : increased talkativeness
- decreased action : LH, inhibition of behavior, e.g. inability to talk



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.



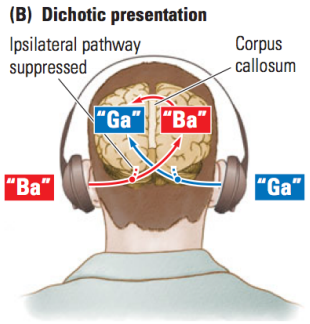
Injection into the right side produces sensory and motor symptoms on the left but no speech disturbance, unless the patient's right hemisphere is domininant for speech.

Asymmetry in the 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

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

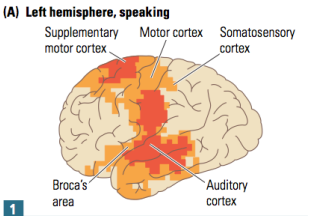
- Somatosensory system : almost 100% fully crossed
- Methods:
  - object identification by touch
- Findings:
  - LH disadvantage overall, but better at IDing letters
  - RH advantage overall

Asymmetry in the Somatomotor System

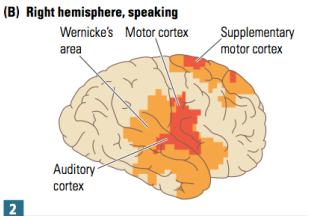
- Somatomotor system : almost 100% fully crossed
- Methods:
  - videotaping of face during speech
- Findings:
  - LH faster (right-side of mouth moves faster & more fully)
  - RH more expressive for emotions

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.



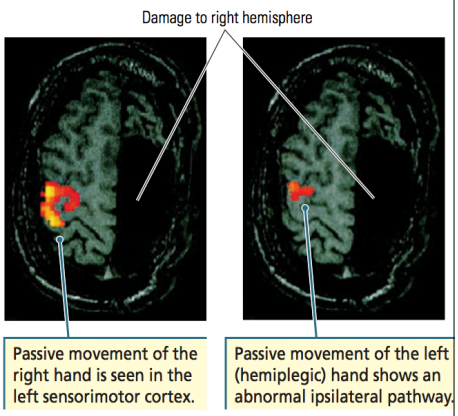
2 In the right hemisphere, the mouth area and auditory cortex are active but are less active than in the left hemisphere.

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



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?

O2 and KW28 : Neuropsychological Assessment

Overview of NP Assessment

- Goals
  - determine kind/location of brain pathology
    - *less common now due to Neuroimaging*
  - diagnose disease based on behaviors
    - *e.g. Alzheimer's Dementia*
  - establish baseline functioning before intervention
    - *e.g. before neurosurgery, lateralization of function*
  - distinguish between *organic* and *functional* disorders
  - diagnosis
  - track rehabilitation
  - research
    - *e.g. drug research to treat Alzheimer's*
    - *TBI from sports injuries*

Trends in NP Assessment

- Functional imaging
  - largely replaced use of NP to identify brain area(s) affected
- Computerized tests & cognitive neuroscience
  - most NP tests are old (1850s) and predate neuroscience
  - newer tests under development
- Money : insurance & managed care
  - USA healthcare system's problems
  - NP assessments are expensive ($2000+)

NP Assessment Procedures

- Referral
  - typically from MDs (neurologists, psychiatrists), Clinical Psychologists (PhDs) or therapists (Masters-level)
- Clinical Interview
- NP testing
  - 3 or more hours
  - issues of motivation, cooperation, fatigue
- Interpretation of results
- NP Assessment Report
  - current status
  - diagnosis
  - prognosis
  - recommendations

Approaches to NP Assessment

- Quantitative vs. Qualitative...
- Fixed vs. Flexible Battery...

Quantitative vs. Qualitative

- Quantitative :
  - uses standardized tests
  - statistical analysis of data
  - "normal" functioning compared with normative data tables
  - can be administered by Psychometrist
    - often with a BA or BS degree!
- Qualitative :
  - administered by trained neuropsychologist
  - informal, results interpreted on the fly
  - "Only Luria can do Luria's assessment"
  - approach seen more in Neurology than Neuropsychology

Fixed vs. Flexible Battery

- Fixed :
  - All patients get same battery of tests
  - Pros: standardized, able to catch subtle problems
  - Cons: slow, expensive, lack of detail in some results
- Flexible :
  - tests given based on patient's status
  - interesting performance on one test : choice of a different test
  - Pros: faster, more detail in certain areas
  - Cons: may miss subtle issues

Neuropsychological Tests

- Hundreds exist
- How to choose?
  - Fixed vs. Flexible approach
- Common tests...

Fixed Batteries

- Halstead-Reitan
  - WAIS-III plus additional tests of memory, learning, motor and sensory skills
  - Approx 6 hours to administer
- Luria-Nebraska
  - Luria had a flexible battery based on theory of pluripotentiality (multiple brain systems could compensate to do the same tasks)
  - Had poor psychometrics. Test battery was improved and standardized at U. Nebraska
  - Approx 24 hours(!) to administer

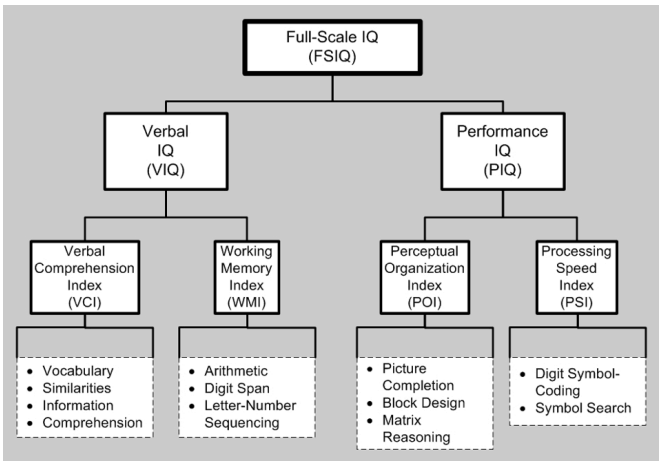
Halstead-Reitan Battery

- Full WAIS-III
- Additional tests:
  - Category test
  - Grooved pegboard
  - Rhythm
  - Speech comprehension
  - Finger tapping
  - Trail making
  - Grip Strength
  - Sensory-perceptual exam

Major Neuropsychological Tests

- General Intellectual Ability
  - Full-Scale IQ
    - Verbal IQ
    - Performance IQ
- Ability Areas
  - Issues
    - Lack of agreement, overlap
    - Do abilities map 1:1 to brain areas or systems?
    - Do NP tests map 1:1 to ability areas?

Wechsler Adult Intelligence Scale (WAIS-3)



Gardner's 8 Intelligences

- logical-mathematical (*)
- verbal-linguistic (*)
- spatial (*)
- musical
- bodily-kinesthetic
- naturalist
- interpersonal
- intrapersonal

NP Test Areas

- Abstract reasoning / comprehension
- Activities of Daily Living (ADLs)
- Attention
- Emotional
- Executive Control
- Language
- Memory
- Motor
- Problem Solving
- Orientation
- Reasoning
- Sensation/Perception
- Visuospatial

Issues with NP Assessment

- Every NP test requires multiple ability areas & brain systems
  - example: HRB grooved pegboard...
- Estimating Premorbid functioning…
- Individual differences & Norms...

Grooved Pegboard

- What abilities required?
  - verbal comprehension
  - memory
  - executive functioning
  - emotional
  - motor
  - sensory
  - others…?

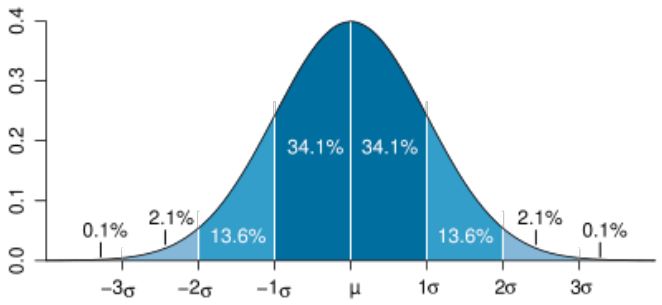
Sensitivity vs. Specificity

- Sensitivity:
  - can a test measure detect a dysfunction?
- Specificity:
  - does a low score on a test indicate general, or specific problem?
- Example:
  - very poor performance on Grooved Pegboard test
  - sensitive : to general dysfunction
  - specific ? to what?

Interpreting Scores

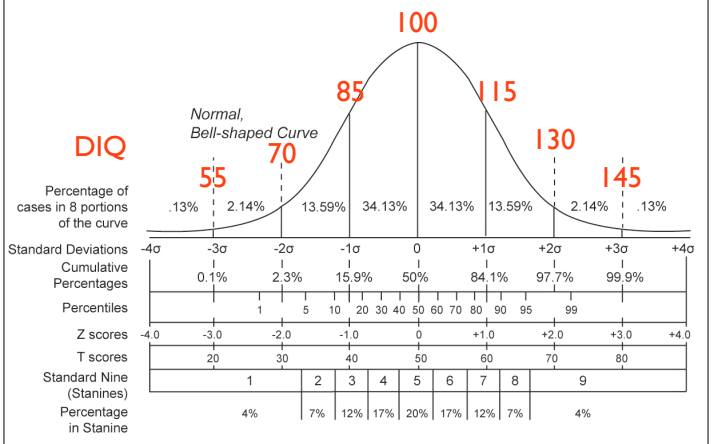
- What is "abnormal"
- Basic Definitions
  - test score that is statistically very low compared to *expected score*
  - test score that is in the *impaired range*

Normal Distribution



Many measures show a normal distribution

Standard Scores



Standard Scores

	Z scores	IQ scores	T scores	Scaled Scores
Mean	0.0	100	50	10
SD	1.0	15	10	3
Example: top 3%	1.9	129	19	16
Example: top 1%	2.4	136	74	17

top 3% is 97 percentile, a Z score of approximately 1.9, IQ score of 128.5, T score of 19, and scaled score of 15.7

Defining "Impairment"

- One approach:
  - below 15%ile
  - Z score of -1.0 or lower
  - IQ score of 85 or lower

Premorbid Ability

- Interpretation to "expected score"
- Rarely have pre-test data
- Methods:
  - use statistical normative data
    - corrections:
      - age, gender, amount of education, ethnicity, language
  - informal - estimate by career, family members, work samples, etc.
  - Tests that are insensitive to brain damage
    - over-learned information
- Problems:
  - normative data - often lacking
  - individual differences

Individual Differences

- Many factors influence "normal" performance
- Genetics: Age, Gender, Ethnicity
- Environment :
  - language
  - education
  - career
  - family
  - etc.

Effort & Malingering

- Motivation & Effort are known to affect test performance
- Reasons for low effort?
  - attention, money, release from obligations…
- Detecting Malingering
  - Hiscock's Forced Choice Digit Memory test

FCDMT

- Normal scores: 100%, even in severely amnesic patients
- Malingering scores : often 50% or lower
- Lower than 50%?
  - logically...

Careers in neuropsychology

- Clinical Neuropsychology - subfield of Clinical Psychology
- Ph.D. (or PsyD) with about 2000 hours clinical training
- Internship : 1 year (about 2000 hours)
- Post-doc : minimum 1 year (about 2000 hours clinical training)
- Employment -- usually in hospital or clinic, sometimes forensic (legal), often joint with Univ.
- Pay -- good, often better than typical clinical psychologist, not as good as MD.