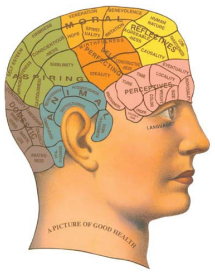
Psychology 207

"Exploring the injured brain"
University of British Columbia
Dr. Michael Souza

Lecture 02 (06 Sept 2013)
A brief history of neuropsychology

Learning objectives

- To consider evidence suggesting localization of brain function vs. distributed functions via complex networks.
- To start thinking about how advanced neuroimaging technologies and studies in patient populations give us valuable hints into brain function and organization



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Picture: http://www.mistershape.com/blog/archive/2005_10_01_archive.html

Cardiac Hypothesis:
Heart is centre of emotion = X

Brain Hypothesis:
Idea that brain is source of BEHAVIOR

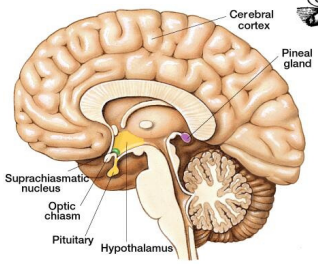
In search of the mind

Empedocles of Acragas (500 B.C.)
Cardiac hypothesis

Alcamaeon of Croton (490-430 B.C.)

Galen (129-199)
Brain hypothesis

Descartes (1596-1650)
Rationalism
Reflexes
Dualism
Role of the pineal gland



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Picture: http://en.wikipedia.org/wiki/File:Descartes-reflex.JPG
http://humanityhealing.net/2010/09/pineal-gland-the-transcendental-gateway/

Rationalism:
Truth though reason (observation)

Reflexes:
- brain is NOT necessary for reflexes, b/c quadriplegics still respond to tapping their knee (stronger response!)
- BUT brain can override reflexes, like dropping pie example
-knee -> spine -> knee (brain is farther away so doesn't respond as fast)

Dualism:
Brain (matter) and mind (not matter) are SO fundamentally DIFFERENT that they cannot be the same

Pineal Gland:
-Soal and Mind interact= WRONG!
- (F)- produces melatonin

Materialism: only physical matter is present. = Brain!

Undifferentiated Mass:
- Any part of the brain can participate in a particular function (ALL share function)

Localization of Function:
- CURRENT VIEW
- Each area has a particular function.

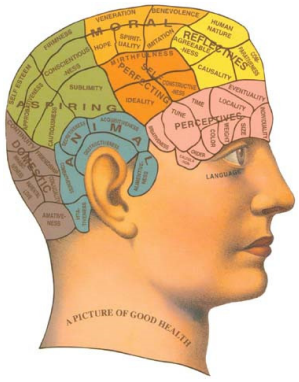
Phrenology:
- INCORRECT
Can map areas of the brain based on physical characteristics of the skull.

How is the brain organized?

Materialism

Brain organization
Undifferentiated mass?
Localization of function (LoF)?

Franz Josef Gall (1758-1828)
Phrenology



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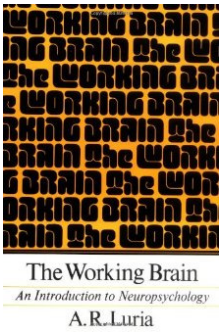
Picture: http://www.mistershape.com/blog/archive/2005_10_01_archive.html

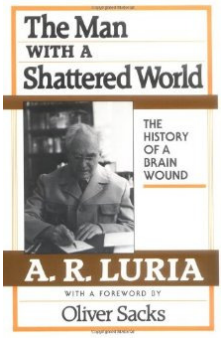
Networks:
areas of the brain that work together to function

Cognitive neuropsychology

Alexander Luria (1902-1977)
Injured soldiers on the battlefield
Cortical networks and systems

The push to localize functions





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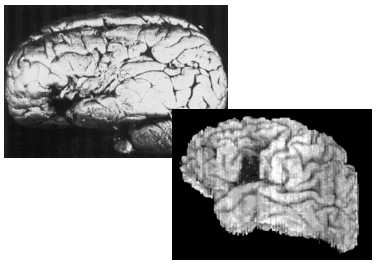
Broca's aphasia:
responsible for language
CAN'T talk, but can understand

Wernicke's aphasia:
CAN'T understand but can talk.

Evidence for localization of function (1)

Paul Broca (1824-1880)
Left inferior frontal lobe (Broca's area)
Damage → Broca's aphasia
Non-fluent output, intact comprehension

Carl Wernicke (1848-1904)
Left superior temporal lobe (Wernicke's area)
Damage → Wernicke's aphasia
Impaired comprehension, fluent output



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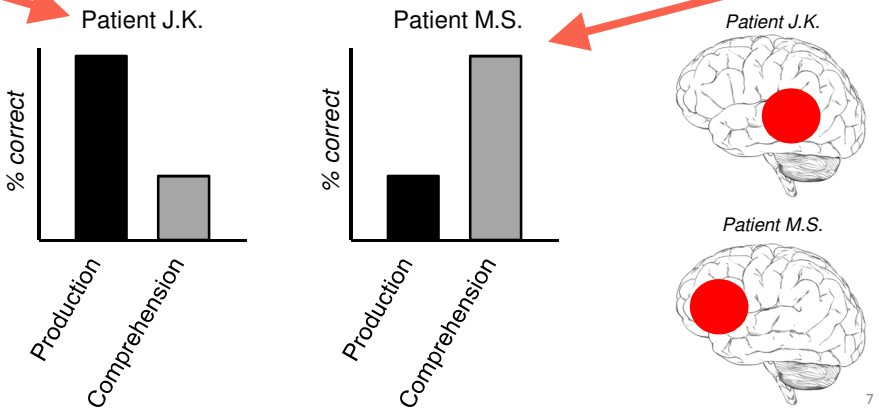
Picture: http://www.ling.upenn.edu/courses/Fall_2001/ling001/neurology.html
http://mindbrain.ucdavis.edu/labs/Miller/courses/npb-165-neurobiology-of-speech-perception

Double dissociations

Double dissociations provide stronger evidence that a function is at least in part localized to that region of injury. direct comparison between two traits with opposite results

Hypothetical test of language function for two patients with brain injury



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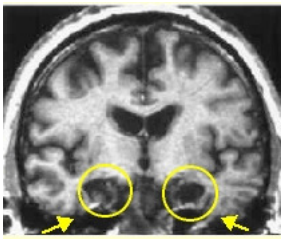
Damaged area is important for UNDERSTANDING, and nothing else

Damaged area is important for TALKING,and nothing else

-Could not create new memories

Evidence for localization of function (2)

Patient H.M. (1926-2008)
Chronic, debilitating epilepsy
Bilateral medial temporal lobe resection
Profound anterograde amnesia



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Picture: http://www.telegraph.co.uk/news/obituaries/4109336/Henry-Molaison.html

Resulted in alien-hand syndrome, in some cases, where body is acting put functions without the brain knowing.

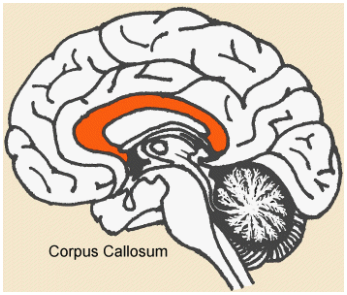
Evidence for localization of function (3)

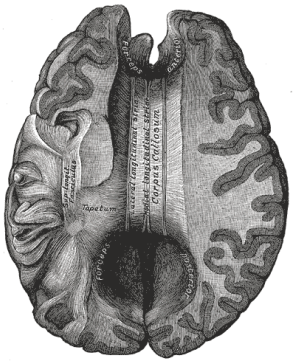
Resection of the corpus callosum (callosotomy)

Eliminating cross-hemisphere communication

"Split brain" patients

Hemispheric differences in processing?





Picture: http://en.wikipedia.org/wiki/Corpus_callosum
http://www.mult-sclerosis.org/corpuscallosum.html

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Stimulate different part of the brain, and person will move uncontrollably, etc.

Motor Cortex:
-move body parts

Parietal:
- see colours

Temporal:
-whole memories

Prefrontal:
-NOTHING!!!

Evidence for localization of function (4)

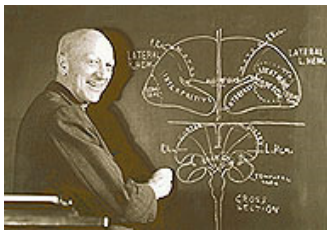
Wilder Penfield (1891-1976)

Cortical ablation for epilepsy

Stimulation of the human cortex

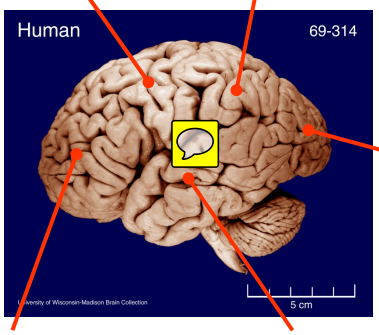
Sensory and motor homunculi

Association areas



MOTOR/PREMOTOR
Movements

PARIETAL
Somatosensory/visual hallucinations



OCCIPITAL
Visual hallucinations

PREFRONTAL
Nothing
→ 'silent cortex'

TEMPORAL
Visual/auditory Hallucinations
Whole memories

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Picture: http://www.mcgill.ca/mcgillfirsts/1950s/

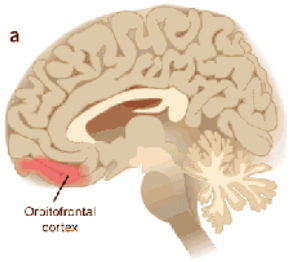
Damaged frontal area
- emotion, personality

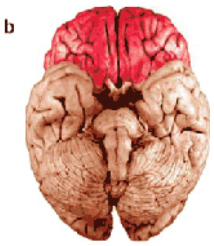
Evidence for localization of function (5a)

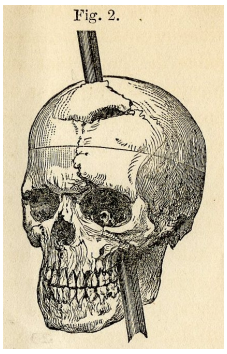
Phineas Gage (1823-1860)

Total ablation of orbitofrontal cortex (OFC)

[Variable] impact on emotion, personality







Picture: http://www.psych-it.com.au/Psychlopedia/article.asp?id=423
https://cms.www.countway.harvard.edu/wp/?tag=phineas-gage

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Prefrontal Leubotomy:
-Suggested that removing the connection between the frontal lobe and rest of brain, suggested to help eliminate mental illness, which was though to arise from this area of the brain.
- WRONG!!!

Evidence for localization of function (5b)

Frontal lobotomies (leucotomies)

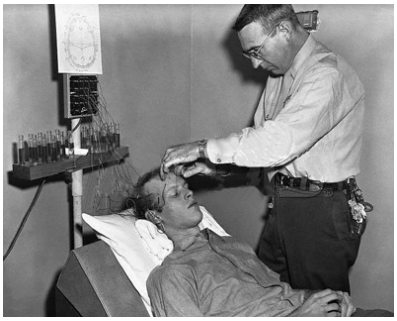
First published report in 1936

Nobel prize in 1949

"Prefrontal leucotomy is a simple operation, always safe, which may prove to be an effective surgical treatment in certain cases of mental disorder"

Egas Moniz
1874-1955

Walter Freeman
1895-1972



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Picture: http://scienceblogs.com/neurophilosophy/2007/07/inventing_the_lobotomy.php

Areas in brain are fine, but CONNECTION between areas are disconnected.

"Disconnection syndromes"

Information flow between regions is disrupted, impaired

Dysexecutive syndromes

Frontal lobes cannot regulate brain activity in other regions to support goal-directed behavior

Picture: http://thesplinteredmind.blogspot.com/2006/03/adhd-dealing-with-distractibility.html
http://www.wired.com/dangerroom/2008/04/were-used-to-th/

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PET scanner: (F)
- check for neuro-chemical and blood flow in brain
- areas that are more active have more blood flow
- eg: Parkinson's disease see how much dopamine in the brain
- Alzymer's Disease see neural plaques in brain

MRI Scanner: (F)
- 90 sec. process
- track blood flow, during mental tasks.

TMS:
- simulation of how different parts of the brain serve different functions, based on physical taks compared to brain scans

Functional neuroimaging and recent trends

Michael Gazzaniga (1939-present)

Founder of cognitive neuroscience

PET scanner (1970's)

Neurochemicals

Blood flow and neural activity

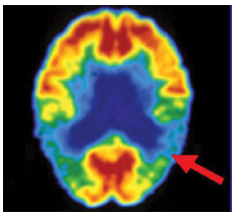
MRI scanner (1970's-80's)

Structure and [later] function

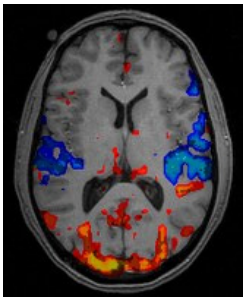
Transcranial magnetic stimulation

"Virtual lesions"

Pre-lesion knowledge of ability



Warm colours = more brain activity b/c more blood flow
Cool colours = decreased blood flow



Picture: http://cerncourier.com/cws/article/cern/28507/1/cernimag2-10-01
http://psychcentral.com/lib/2007/what-is-functional-magnetic-resonance-imaging-fmri/

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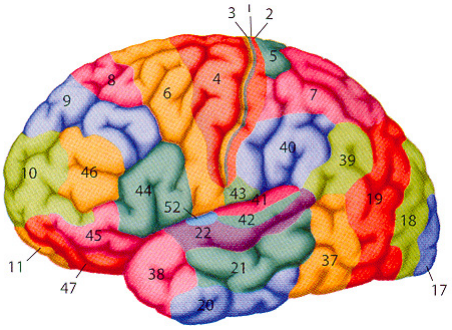
NOTE:
making connections btw. brain regions and how they interact.

A final thought on brain mapping

Localized and distributed processing

Brodmann's map

Luria's argument



Brodmann's cortical map

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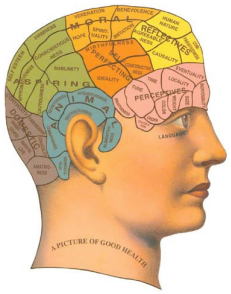
Picture: http://www.mrc-cbu.cam.ac.uk/people/jessica.grahn/neuroanatomy.html

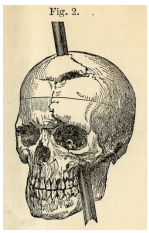
Lecture summary

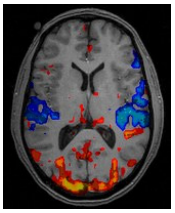
The brain is the seat of the mind – period

There is strong evidence for localization of function in the human brain but we must resist the urge to be 'modern day phrenologists'

Brain injury causes damage to network nodes and depending on the location, a function or set of functions may be impaired







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Next lecture: Brief neuroanatomy and neurochemistry (1 of 3)