

# Notes: Lateralization

---

PDF

## Background

---

\_\_\_\_\_ - function is more dependent on one hemisphere (left/right) than the other

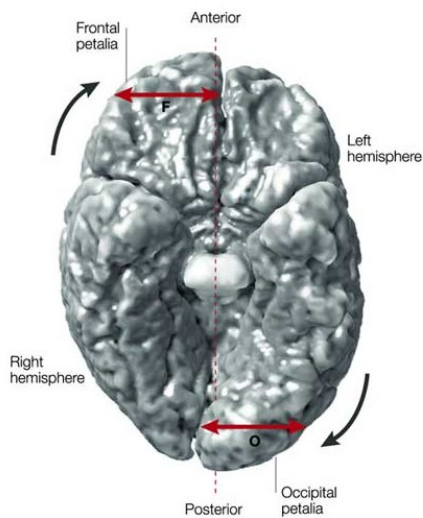
contralateral - across/different sides

ipsilateral - same side

Contralateral systems: vision, somatosensory, motor control (not hearing)

## Physiological Asymmetries

---



Note: left and right are reversed in the image

Right frontal lobe tends to extend farther forward, Left occipital lobe tends to extend farther back (Galaburda et al, 1978)

Evidence for this asymmetry in 60,000 year old fossils (Lemay, 1976)

Differences in neurotransmitters

greater dopamine and dopamine receptors in left globus pallidus (basal ganglia) (Glick, Ross & Hough, 1982)

greater norepinephrine in right thalamus (Oke et al, 1978)

cerebral \_\_\_\_\_

theory that one hemisphere leads or dominates the other in function

originated by Hughlings Jackson in 1860s

oldest, strongest version of the theory was that right hemisphere did little more than sensory processing

modern view tends to see hemispheres as being specialized/cooperative

# Language

---

problems with speech

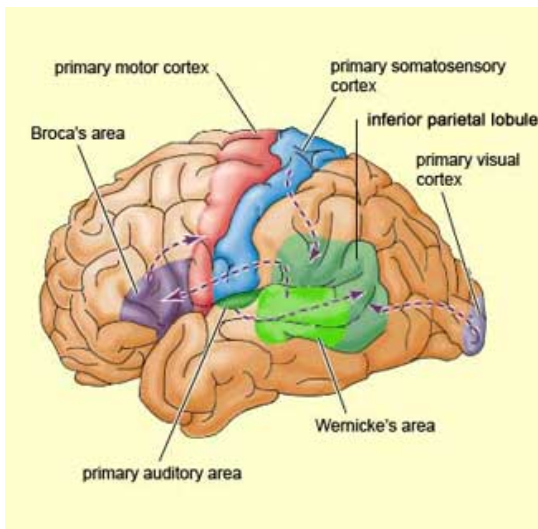
typically patients with aphasia have damage to \_\_\_\_\_ hemisphere

handedness

95% of right handed people have language in left hemisphere (Rasmussen & Milner, 1977)

left handed people usually have language in the left hemisphere

---



Source: [mybrainnotes.com/memory-language-brain.html](http://mybrainnotes.com/memory-language-brain.html)

Paul Broca & Carl Wernicke

- physicians in 1860's
- performed autopsies on people with aphasia
- noticed the reliability of damage to left hemisphere
- earliest evidence for lateralization in the brain

Lesions to Broca's area (Broca's aphasia)

- difficulties in speech production
- can still comprehend language

Lesions to Wernicke's area (Wernicke's aphasia)

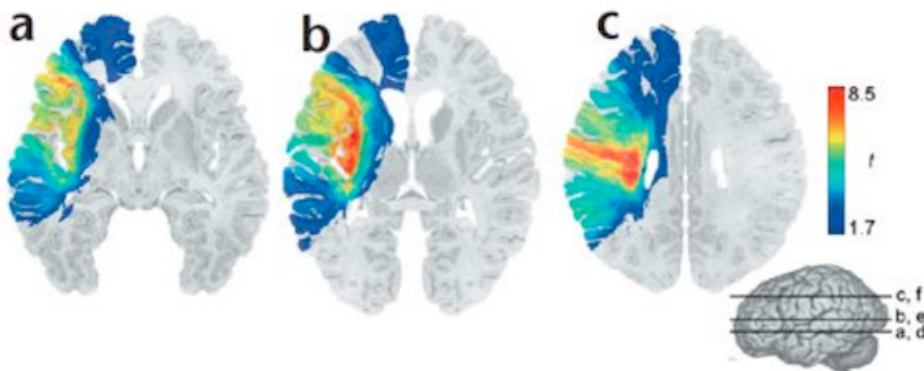
- difficulty in comprehending language
- fluid (but nonsensical) speech production

Videos:

Broca's aphasia - [old](#), [recent](#)

Wernicke's aphasia - [old](#)

---



above figure shows area which, if damaged, produced the greatest different between stroke patients and healthy individuals in fluency

101 stroke patients with left hemisphere damage

### Language & the right hemisphere

Better at identifying prosody (rythym & stress) - emotive content of language

Cannot understand long/complicated grammatical structures (Zaidel, 1978)

Can understand basic dichotomies ("The girl stood up" versus "The girl did not stand up")

Vocabulary is largely limited to concrete words (Zaidel, 1990)

Unable to identify phonological properties of speech (e.g. identify rhymes) (Levy & Trevarthen, 1977)

## Split-brain patients

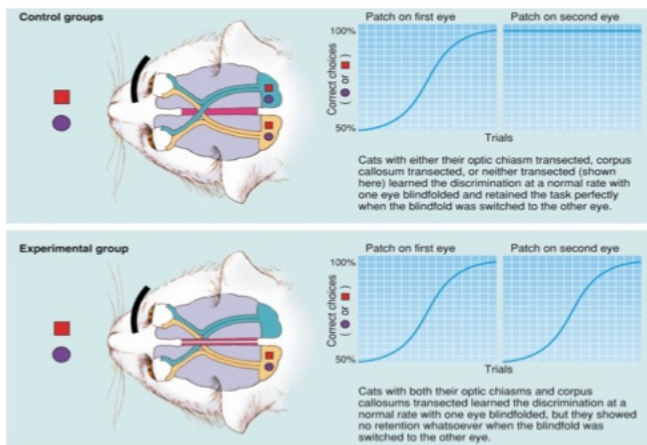
---

\_\_\_\_\_ can be surgically cut (commissurotomy)

done either experimentally (animals) or to treat epilepsy (humans)

effects in human patients are obvious/subtle

### In cats (Myers & Sperry, 1953)



Details at [derby.ac.uk/ostrich](http://derby.ac.uk/ostrich)

Four different treatments in the experiment:

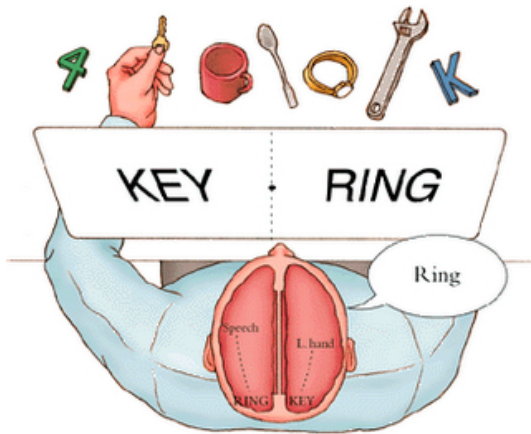
- A. no surgery
- B. cut the optic chiasm
- C. cut the corpus callosum
- D. cut both optic chiasm and corpus callosum

One hemisphere learned as fast as both hemispheres still connected

Learning could be transferred across corpus callosum

---

### In humans (Gazzaniga)



Details at [derby.ac.uk/ostrich](http://derby.ac.uk/ostrich)

Patients have corpus callosum cut as epilepsy treatment

Different objects/words could be presented to each hemisphere

Subject could verbally report if presented to the left hemisphere, but not to the right hemisphere

Subject could demonstrate object use if presented to either hemisphere (Gazzaniga et al, 1962)

Source: [brainmind.com/Brain3.html](http://brainmind.com/Brain3.html)

2 hemispheres are functioning independently within a person

Videos: [Gazzaniga w/ Alan Alda](#), [Other](#)

## Wada Test

used to \_\_\_\_\_ before brain surgery

anesthetize one hemisphere of the brain at a time with barbiturate (sodium amobarbital)

physician knows that the drug has its effect when temporary, contralateral paralysis is observed

can impair speech in conscious subjects

modern alternative is to use fMRI (Rutten et al, 2002)

## Other

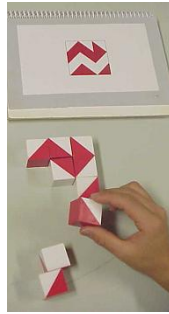
### Visuospatial / Object Recognition



Figure 1. Example of matching-by-physical-identity stimuli.



Figure 2. Example of matching-by-functional-identity stimuli.



patients with right hemisphere lesions have difficulty recognizing objects if they are not in their standard form (Warrington & Taylor, 1973)

right hemisphere lesions are impaired at matching by perceptual similarity  
 left hemisphere lesions are impaired at matching by semantic similarity (Warrington & Taylor, 1978)

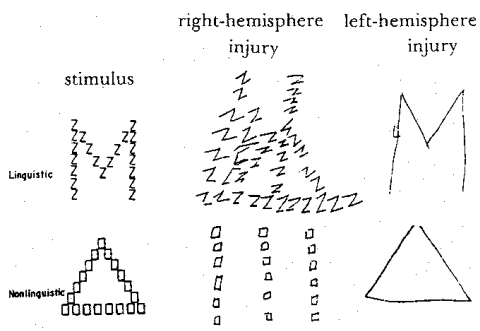
left hand can accurately perform WAIS block design task, right hand is clumsy

left hand could draw 2D representations of 3D structures, right has difficulty (Gazzaniga, 1970)

patients with right hemisphere lesions have difficulty judging line orientation (Benton et al, 1975)

left hand is better at feeling an object and matching it to a visual display (Witelson, 1974; Gibson & Bryden, 1983)  
 experiment was performed in healthy individuals, examining two objects simultaneously

## Global versus Local



right hemisphere damage causes loss of big picture  
 left hemisphere damage causes loss of local details  
 (Review: Robertson & Lamb, 1991)

Processing of metaphor, gist and inferences across text are associated with the right hemisphere (Beeman & Chiarello, 1998)

## Other

patients with right hemisphere lesions have difficulty  
 judging whether they have previously viewed a face (Yin, 1970)  
 interpreting emotional expression of faces (Bowers et al, 1985)

problems initiating movement *out of context*

movements *in context* can be routines that don't rely on cortex  
associated with damage to left hemisphere

---

ignoring one side of the body / space / objects

typically associated with damage to right parietal lobe

---

## Videos

---



<http://www.youtube.com/watch?v=dFs9WO2B8uI>

Theory of right for global, left for local

By psychiatrist and writer Iain McGilchrist ([full video of lecture](#))



<http://www.youtube.com/watch?v=QTrJqmKoveU>

Narrative experience of stroke in the left hemisphere and what right hemisphere consciousness is like

---

Copyright 2013 - Michael Claffey