Lecture 20 (March 14th) : Language & Lateralization
Lecture Outline

1) Evidence for Lateralization
   (i.e., Hemispheric Specialization)

2) Language: Lesion Studies Demonstrating the Left Hemisphere’s Dominance for Language - Broca’s Aphasia, Wernicke’s Aphasia

3) Right Hemisphere’s Role in Language

4) Split-Brain Patients and Lateralization

5) Development of Language Lateralization

6) Other Non-Language Lateralizations
LANGUAGE (Humans)

Psychologists, Philosophers, Linguists,
Cognitive Scientists, Neuroscientists

AGE-OLD debate: What constitutes a “language”?
- Communication? Gestures? Exist in Animals?
- Intelligence Needed? No, because: “William’s Syndrome”
- Common View:
  semantics (symbols, meaning):
  “open class” words (e.g., nouns and verbs)
  AND
  syntax (structure):
  ”closed class” words (e.g., prepositions and conjunctions)
DEVELOPMENT OF LANGUAGE
(just briefly)

Chomsky vs. Bates

Acquisition of *complete* language abilities has a critical period
The Story of “Genie” (1970, Susan Curtiss, UCLA)
LATERALIZATION (HEMISPHERIC SPECIALIZATION): Left and Right hemispheres involved in different functions

Ways to Study Lateralization:

(1) People with Lesions in One Hemisphere

(2) Isolate Activity in One Hemisphere
   Capitalize on *Contralateral Input in Sensory Systems*
   Each hemisphere of the brain receives from:
   - the opposite side of the body *(Left-Side vs. Right-Side)*
   - the opposite visual field *(Left Visual Field (LVF) vs. RVF)*
   ….. but this is *not perfect*, because the *commisures* connect the two hemispheres (e.g., Corpus Callosum)

So, what would be perfect for Method (2)?
   *Split Brain Patients*
   (severed Corpus Callosum, come back to later today)
Language is (Generally) *Left Hemisphere-Dominant* (in right handers)

**LESION (STROKE) STUDIES** (Broca & Wernicke, 1800s):
Left Hemisphere Lesions -> APHASIA

**BROCA’S AREA** (frontal lobe)

**BROCA’S APHASIA**
- Mainly, problems in language *production*
- Problems in *comprehension* of complicated sentences (e.g., “The man was killed by the lion”)

Because…….trouble with “**closed class**” words (prepositions and conjunctions), involved in **SYNTAX**

…… which is (partly) why have labored speech production!

- Less trouble with production/comprehension of “**open class**” words (nouns and verbs), involved in **SEMANTICS**

So, semantics okay, syntax impaired

But, they can sing ok!

Melodic Intonation Therapy
WERNICKE’S AREA (temporal lobe)

WERNICKE’S APHASIA
- Trouble with *comprehension*
- Can produce fluent/fluid speech, but often non-sensible and/or the grammar is incorrect.

BROCA’s and WERNICKE’s APHASIA in Deaf Individuals (American Sign Language, ASL) (Bellugi, Salk Institute)
Other Aspects of Language Are Right Hemisphere-Dominated
Specifically, production and comprehension of prosody

The story of “The President’s Speech” (Oliver Sachs): LH vs. RH aphasics

But for Chinese (tonal) languages, prosody is a LH function! WHY? Aspects of language that are critical for understanding semantics of language get “captured” by the LEFT HEMISPHERE (Ma = Horse/Mother/Scold/Numb)

More evidence from Contralateral Input Method:
Visual Motion Processing in DEAF vs. HEARING subjects

First, remember….
Left Visual Field (LVF) -> RH
Right Visual Field (RVF) -> LH

In hearing people, visual motion performance better in LVF (RH)
In deaf signers, visual motion performance better in RVF (LH)

Bosworth & Dobkins, 1999
If language is (mainly) LH, how can we talk about things that are “experienced” (i.e., received) by the RH?

Answer: **Connections between hemispheres** allow information received by the RH to be sent to the LH (so you can talk about it)

1) **corpus callosum** (massive)
2) **anterior commissure** (connects parts of frontal cortex)
3) **hippocampal commissure** (connects hippocampi)

7-13 msec transmission
But what if you are a Split-Brain Patient?
Testing Split Brain Patients using Contralateral Input Method
(pretty close to Perfect Isolation)

2) However, can use their Left Hand to *feel* for the object they saw in their LVF, because both involve the RH.

1) Can only name the word or item in the RVF (i.e., LH).

LOTS OF QUESTIONS
Testing Split Brain Patients using Contralateral Input Method (con’t)

3) What happens when shown a movie in the LVF (RH)?

How does the “emotional” content of the film get to the LH so you can talk about the emotion?

Maybe via the amygdala, which is interconnected with the hippocampus, and then this signal travels to the LH through the “hippocampal commissure”

…or maybe via the amygdala -> hypothalamus -> sympathetic NS!
Development of Language Lateralization

Babbling infants (6 months) use the Right Side of their mouths more than the Left Side (Petitto et al. 2002).

What happens when those same babies SMILE?
(will come back to this idea in two slides)
Non-Language Lateralizations

The best documented difference between LH and RH:
(from studies of people with LH vs. RH strokes
and from fMRI studies of people with intact-brains)

LEFT HEMISPHERE: specialized for local visual processing
RIGHT HEMISPHERE: specialized for global visual processing

What Letter?

B   B
B   B
B   B
B   B
B   B
B   B
B   B
B   B
B   B

Draw this house

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Non-Language Lateralizations (con’t)

RIGHT HEMISPHERE: “holistic” (or “global”, last slide), emotional, creative

1) Facial Expressions of Emotion

And…. when infants (6 months) SMILE, they use the Left Side of their mouths more than the Right Side (Petitto et al. 2002).

2) Creativity?

Are Left-Handers (RH dominant people) more creative? (controversial)

LEFT HEMISPHERE: Analytical, sequential

Music?: RIGHT or LEFT HEMISPHERE?
Right: “Melodic Intonation Therapy” (and “creativity”)
Left: Language-like nature of music

Iain McGilchrist:
https://www.youtube.com/watch?v=dFs9WO2B8ul&feature=youtu.be
Ideas that don’t really come from a lot of data!
Go forth, and think critically!