Lecture 12: Language, Mind & the Brain

INDV 101 -- Mind, Self and Language
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Psycholinguistics: The study of how language is processed

Psycholinguistics

- Language comprehension
- Language production
- Language acquisition

Psycholinguistics

at different levels:
- sounds
- words (Lexical Access)
- sentence (Sentence Processing)
- discourse

Neurolinguistics: Language and the Brain

Neurolinguistics

- Where do we process language in the brain?
- How is language processed?
- What happens if the brain is damaged?
The brain

- The human brain: around three pounds

Basic structures

- The outer layer of the brain, visible in the last slide, is the cerebral cortex
- This part of the brain is responsible for most higher cognitive functions
- Damage to the brain can result in severe impairments in cognitive function

Another view

The cortex and subcortical structures

Hemispheres

- The brain is divided into two (roughly symmetrical) hemispheres

Connections

- The two hemispheres are connected by the corpus callosum

Laterization

- Some things that the brain does are lateralized: performed primarily by one hemisphere as opposed to the other
- In the case of language, the dominant hemisphere is the left hemisphere for the great majority of right-handed people

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<tr>
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<th>left</th>
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<tbody>
<tr>
<td>right-handed</td>
<td>96%</td>
<td>4%</td>
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<tr>
<td>left-handed</td>
<td>70%</td>
<td>15%</td>
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The cortex

- The cortex is a kind of folded sheet; the folded configuration allows for more surface area inside the confines of the skull.
- Structures:
  - Gyrus (plural gyri): a bump or convolution
  - Sulcus (plural sulci): groove or ‘valley’ between gyri

Lobes

- The brain has four major lobes:
  - Pink: Frontal
  - Blue: Parietal
  - Green: Temporal
  - Yellow: Occipital

Brodmann Areas

Function

- Certain areas of the brain are known to be responsible for motor control and for sensory processing.
- These areas define a kind of map on the cortical surface, where different areas of the cortex correspond to different parts of the body.

Motor (left); sensory (right)

On the way to language
How is brain function studied?

- Aphasic patients
- Neuro-imaging
  - PET scan
  - fMRI
- Event Related Potentials

Language areas

- According to a picture that has developed over a long period of time, primarily through the study of aphasia, there are two primary language areas
  - Broca’s Area
  - Wernicke’s Area

Broca’s and Wernicke’s Areas

Aphasia

- Prior to the advent of neuroimaging, brain studies were restricted to cases in which patients showed language disorders after e.g. strokes
- Early approaches to characterize the relationship between lesion (damage) location and behavior concentrated on production versus comprehension

Symptoms

- Broca’s Aphasia (Paul Broca)
  - *Agrammatism*: halting speech, consisting typically of short utterances
  - Primarily production problems
  - Absence of function words and of e.g. pieces of morphology (e.g. past tense, plural, etc.)
  - At least at a first glance, relatively good comprehension of language
Example

- Labored speech:

  - Ah ... Monday ... ah, Dad and Paul Haney [himself] and Dad ... hospital. Two ... ah, doctors ... and ah ... thirty minutes ... and yes ... ah ... hospital. And, er, Wednesday ... nine o’clock. And er Thursday, ten o’clock ... doctors. Two doctors ... and ah ... teeth. Yeah, ... fine.

Symptoms 2

- Wernicke’s aphasia (Carl Wernicke)
  - inability to grasp the meaning of spoken words
  - easy production of connected speech
  - normally-intoned stream of grammatical markers, pronouns, prepositions, articles, and auxiliaries
  - difficulty in recalling correct content words, especially nouns (anomia)
  - words may be meaningless neologisms (paraphasia)
  - Comprehension impaired

Example

- Note the nature of the difficulties here:

  Examiner. What kind of work have you done?
  
  -- We, the kids, all of us, and I, we were working for a long time in the... You know... it’s the kind of space, I mean place rear to the 
  spedawn...

  Examiner. Excuse me, but I wanted to know what kind of work you 
  have been doing.

  -- If you had said that, we had said that, poomer, near the fortunate, 
  porpunate, tamppoo, all around the fourth of martz. Oh, I get all 
  confused.

Basic Picture

- The picture that emerged in light of these differences focused on production (impaired with Broca’s aphasia) and comprehension (impaired in Wernicke’s).
A Further Claim

- It appears that components of language are affected differently in aphasia.

For example...

- Another view, which correlates with neuroimaging findings, is that Wernicke’s Area is crucial for **lexical** matters, and
- Broca’s for **syntax**.

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**fMRI** = Functional Magnet Resonance Imaging

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**fMRI images**
Basics of fMRI

- Uses extremely strong magnetic field
- Measures changes in local blood flow
- Excellent spatial resolution
- Hemodynamic (= blood-related) response is slow in comparison with neuronal activation.

Psycholinguistics--Production

- Speech Errors (slips of the tongue)

Spoonerism

- Work is the curse of the drinking classes.
- ...noble tons of soil... (noble sons of toil)
- You have tasted the whole worm. (wasted the whole term)
- I have in my bosom a half-warmed fish. (half-formed wish)
- ...queer old dean... (dear old queen, referring to Queen Victoria).

Language perception

- Sound perception
- Word recognition, Lexical access
- Semantic activation
  - priming effect
- Sentence comprehension
  - Garden Path

The McGurk Effect

- http://ccms.ntu.edu.tw/~karchung/Phonetics%20II%20page%20seventeen.htm

Sentence comprehension

THE HORSE RACED PAST THE BARN FELL
THE MAN THAT CAUGHT THE FISH

THE MAN THAT YOU SAW