Chapter 16
Lateralization of Function

To what extent are the functions of the right and left hemispheres different or asymmetrical?

Cerebral Lateralization
- The unequal representation of functions in the 2 hemispheres – the degree to which some brain function is more related to one hemisphere vs the other
- Much of the data comes from human clinical cases.
- Lateralization is typically not TOTAL but is a matter of degree. Normally our 2 hemispheres are in constant communication and both sides would be involved in all of our behaviors and mental processes.

Corpus Callosum
Most important commissure connecting the 2 hemispheres, allowing constant communication
Corpus Callosum

• Just the corpus callosum is cut, not the brainstem

Human Split Brain Research

Learning about right brain/left brain differences by testing patients without the main connection between the hemispheres.

• Seizure – period of excessive synchronized neural activity. Seizures may be caused by anything that disrupts the normal internal milieu of the brain.
• Epilepsy - Recurring seizures; about 1-2 in 100 people has epilepsy; it occurs in many forms

• Sometimes epilepsy is inherited ("primary epilepsy"). Seizures begin in the whole cortex at once & are due to inherited differences in brain chemistry (decreased GABA or abnormal GABA receptors).
• Most anti-seizure medications increase effects of GABA.
• In others epilepsy follows some brain injury ("secondary epilepsy"). Seizure activity begins at the injured spot (the "epileptic focus") & are called "focal or partial seizures". Focal seizures may be preceded by an "aura" related to the specific location of focus.
• Because the brain is so conductive, firing activity may spread from the focus to other brain areas during seizure.

Imagine someone with focal epilepsy originating in 1 hemisphere
**Cutting the corpus callosum** prevents spread of seizure activity from 1 side to the other.

- Became known as “split brain surgery” although the entire brain is not split.

Roger Sperry – Won 1981 Nobel prize for his research on these patients

**Left Brain** Sees a Ball

- "I see a baseball"

**Right Brain** Sees a Hammer

- But left hand can select the hammer, indicating hammer was perceived but couldn’t be verbally identified by right hemisphere.

https://www.youtube.com/watch?v=8C8qu8FnuAO

**Independent Functioning of the Hemispheres After Surgery**

- Different wishes; initially may show conflicting actions
- Can simultaneously do different tasks with each hand

http://www.youtube.com/watch?v=lfGwsAdS9Dc&feature=related
Left Hemisphere IS Our Interpreter

- Gazzaniga proposes the LH provides our inner voice narrative interpretation as we try to make sense of the world. Also provides the verbal reconstruction of our memories.

Lateralization

- Case studies of the effects of brain damage revealed language problems almost always associated with left brain damage.
- Left hemisphere is normally dominant for language-related abilities in ~92-95% of right-handers and ~70-85% of left-handers.
- The degree of dominance varies. Speech production is more lateralized than comprehension.
- Right hemisphere is dominant for other functions (e.g. spatial abilities, emotional).

<table>
<thead>
<tr>
<th>Table 14.2</th>
<th>Abilities That Display Central Lateralization of Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>GENERAL</td>
<td>APHASIC PROCESSING</td>
</tr>
<tr>
<td>VISUAL</td>
<td>*** Words, Letters, Pictures</td>
</tr>
<tr>
<td>AUDITORY</td>
<td>*** Language sounds, Phonemes</td>
</tr>
<tr>
<td>TOUCH</td>
<td>*** Tactile sensations, Text</td>
</tr>
<tr>
<td>MOVEMENT/MUSCLE</td>
<td>*** Complex motor movements</td>
</tr>
<tr>
<td>MEMORY</td>
<td>*** Verbal memory, Feeling</td>
</tr>
<tr>
<td>LANGUAGE</td>
<td>*** Reading, Writing</td>
</tr>
<tr>
<td>VISUAL/Spatial</td>
<td>*** Visual recognition of shapes, Geometry</td>
</tr>
</tbody>
</table>

Gestalt: The whole is different from the sum of its parts.

Lateralization in spatial abilities is severe.

The Wernicke-Geschwind Model

Wernicke's area and Broca's Area in Human Speech
Aphasia: language problems due to brain damage. Symptoms & severity relate to the location & extent of damage.

- The greater the damage in the vicinity of Broca’s area, the greater the difficulty producing speech: “Broca’s aphasia” or “nonfluent or productive aphasia”
  - Both spoken & signed language affected
  - Affects writing & gesturing too
  - Results in “telegraphic speech” (essential nouns & verbs); comprehension is good for nouns and verbs
  - But affects the use & understanding of those little grammatical words (like prepositions), endings, & meaning conveyed by word order and grammar


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  - http://www.youtube.com/watch?v=f2IiMEbMnPM case

Wernicke’s Aphasia or “Fluent Aphasia” or “Receptive Aphasia”

- Damage to Wernicke’s area more broadly affects speech comprehension/comprehensibility: can talk (sometimes excessively) but not make sense.
  - Anomia - can’t come up with the right word; uses made up words, mixed up phonemes, talks around in circles
  - Often can’t monitor own speech so don’t realize their speech errors
  - Often can’t comprehend and answer questions or follow instructions

  - http://www.youtube.com/watch?v=aVhYN7NTIKU
  - http://www.youtube.com/watch?v=bjLD5jzXpLE

Another Left Hemisphere Function

- Apraxia: difficulty demonstrating common motor actions on command
- Testing Praxis https://www.youtube.com/watch?v=WpFJvDiB5b8
- A moderate degree of apraxia
Contralateral Neglect: A Right Hemisphere Syndrome

- [http://www.youtube.com/watch?v=ymKvS0XsM4w&feature=channel](http://www.youtube.com/watch?v=ymKvS0XsM4w&feature=channel)

Rasmussen & Milner (1977)

(Normal Patients undergoing Wada Test)

<table>
<thead>
<tr>
<th>Hemisphere</th>
<th>No. of Cases</th>
<th>Left</th>
<th>Bilateral</th>
<th>Right</th>
</tr>
</thead>
<tbody>
<tr>
<td>Right</td>
<td>134</td>
<td>96%</td>
<td>0%</td>
<td>4%</td>
</tr>
<tr>
<td>Left or mixed</td>
<td>122</td>
<td>86%</td>
<td>15%</td>
<td>13%</td>
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</tbody>
</table>

Some evidence of a similar asymmetry in great apes and (from skull casts) in ancient man.