Speech and Language
What is Language?

- Comes from the word for “tongue”
- Combination of sounds for communication
- A symbolic system that is guided by rules
- Uniquely human?
- Nature vs. nurture? Innate vs. learned?
Components of Language

- **Phonemes**: Fundamental language sounds
- **Morphemes**: Smallest meaningful units of words
- **Lexicon**: Collection of all the words in a language
- **Syntax**: Rules of grammar
- **Semantics**: Meaning of words and sentences
- **Prosody**: Vocal intonations
- **Discourse**: Stringing sentences together to form a meaningful narrative
Bimodal Integration in Language

- Speech is more than vocalization
- 90% of speech is accompanied by gestures (visual)
- Cocktail Party Effect
  - We can hear speech better in a noisy environment if we see the lips
  - You can focus on one speaker only by observing the lips (bimodal integration)
- McGurk Effect
  - When we see and hear conflicting syllables, we hear the syllable that we saw
Language learning

- R/L distinction in Japanese speakers
- French R
- [Kh] sound in Arabic, Hebrew
- [Ch] sound in German

- Infants
  - Prefer to listen to speech
  - Can make sounds used in all languages
Language areas of the brain

- **primary motor cortex**
  - speech mouth movements
- **Broca’s area**
  - producing words
- **Primary auditory cortex**
  - hearing words
- **angular gyrus**
  - reading comprehension
- **supramarginal gyrus**
  - reading comprehension
- **Wernicke’s area**
  - understanding words
The Localization of Language

- Lesion studies in Humans

- **Wernicke-Geschwind Model**
  - Word sounds are sent to the Primary Auditory Cortex
  - Word meaning is represented in Wernicke’s Area
  - Word meaning is sent to Broca’s Area via the **arcuate fasciculus**
  - Broca’s Area sends instructions for speech articulation to the motor cortex
  - To read, visual areas send information to the angular gyrus and to Wernicke’s or Broca’s Area
Language Mapping During Surgery

- Wilder Penfield
  - Mapped language zones during surgery
- Effects of Cortical Stimulation
  - Total arrest of speech
  - Hesitation and slurring of speech
  - Speech distortion and repetition of speech
  - Confusion of numbers
  - Naming difficulties
  - Misnaming and perseveration
Speech Zones Mapped by Imaging

- Binder and colleagues

- Speech zones are widespread throughout the brain
Disorders of Language

- **Aphasia**
  - Disorder of language, writing (agraphia), or reading (alexia)
  - Does not include disorders that result from
    - Loss of sensory input
    - Motor paralysis or incoordination

Table 19.2 Summary of symptoms of language disorders

<table>
<thead>
<tr>
<th>Disorders of Comprehension</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poor auditory comprehension</td>
</tr>
<tr>
<td>Poor visual comprehension</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Disorders of Production</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poor articulation</td>
</tr>
<tr>
<td>Word-finding deficit (anomia)</td>
</tr>
<tr>
<td>Unintended words or phrases (paraphasia)</td>
</tr>
<tr>
<td>Loss of grammar and syntax</td>
</tr>
<tr>
<td>Inability to repeat aurally presented material</td>
</tr>
<tr>
<td>Low verbal fluency</td>
</tr>
<tr>
<td>Inability to write (agraphia)</td>
</tr>
<tr>
<td>Loss of tone in voice (aprosodia)</td>
</tr>
</tbody>
</table>
Disorders of Language

- Three Categories of Aphasia
  - Fluent Aphasia
  - Nonfluent Aphasia
  - Pure Aphasia
Fluent Aphasias

- Impairment in the reception of language

- **Wernicke’s Aphasia** or **Sensory Aphasia**
  - Deficits in classifying sounds
  - Word salad
    - Confusion of phonetic characteristics
  - Cannot write
  - Can read in some cases (if damage does not include angular gyrus)
Fluent Aphasias

- **Transcortical Aphasia** or *isolation syndrome*
  - Can repeat, understand, and name objects
  - Cannot speak spontaneously
  - Cannot comprehend words
Fluent Aphasias

- **Anomic Aphasia** or **Amnesic Aphasia**
  - Can comprehend, produce speech, and can repeat
  - Difficulty naming objects

- **Conduction Aphasia**
  - Can speak, name objects, and understand speech
  - Cannot repeat
  - Cannot perform guided speech commands
Nonfluent Aphasias

- **Broca’s Aphasia** or expressive aphasia
  - Can understand speech
  - Cannot produce or has difficulty producing speech

- **Transcortical Motor Aphasia**
  - Good repetition, poor spontaneous production

- **Global Aphasias**
  - Labored speech, poor comprehension
Pure Aphasias

- **Alexia**
  - Inability to read

- **Agraphia**
  - Inability to write

- **Word deafness**
  - Cannot hear or repeat words

- *Can be selective disorders*
### Table 19.3 Definition of aphasic syndromes

<table>
<thead>
<tr>
<th>Syndrome</th>
<th>Type of Speech Production</th>
<th>Type of Language Errors</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fluent Aphasia</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wernicke (sensory)</td>
<td>Fluent speech, without articulatory disorders</td>
<td>Neologism or anomias, or paraphasias, poor comprehension; poor repetition</td>
</tr>
<tr>
<td>Transcortical (isolation syndrome)</td>
<td>Fluent speech, without articulatory disorders; good repetition</td>
<td>Verbal paraphasias and anomias; poor comprehension</td>
</tr>
<tr>
<td>Conduction</td>
<td>Fluent, sometimes halting speech, but without articulatory disorders</td>
<td>Phonemic paraphasias and neologisms; phonemic groping; poor repetition; fairly good comprehension</td>
</tr>
<tr>
<td>Anomic</td>
<td>Fluent speech, without articulatory disorders</td>
<td>Anoma and occasional paraphasias</td>
</tr>
<tr>
<td><strong>Nonfluent Aphasia</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Broca (expressive), severe</td>
<td>Laborious articulation</td>
<td>Speechlessness with recurring utterances or syndrome of phonetic disintegration; poor repetition</td>
</tr>
<tr>
<td>Broca (expressive), mild</td>
<td>Slight but obvious articulatory disorders</td>
<td>Phonemic paraphasias with anomia; agrammatism; dysprosody</td>
</tr>
<tr>
<td>Transcortical motor</td>
<td>Marked tendency to reduction and inertia; without articulatory disorders; good repetition</td>
<td>Uncompleted sentences and anomias; naming better than spontaneous speech</td>
</tr>
<tr>
<td>Global</td>
<td>Laborious articulation</td>
<td>Speechlessness with recurring utterances; poor comprehension; poor repetition</td>
</tr>
<tr>
<td><strong>“Pure” Aphasia</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alexia without agraphia</td>
<td>Normal</td>
<td>Poor reading</td>
</tr>
<tr>
<td>Agraphia</td>
<td>Normal</td>
<td>Poor writing</td>
</tr>
<tr>
<td>Word deafness</td>
<td>Normal</td>
<td>Poor comprehension; poor repetition</td>
</tr>
</tbody>
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Source: After Mazzocchi and Vignolo, 1979.