Language and Speech

Psychology 372
Physiological Psychology
Steven E. Meier, Ph.D.

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Language

• Is the ability to encode signals into communication.
• Is different from reading and writing.
• Does not have to be grammatically correct.
• Humans have an instinctive ability to speak – babble as young children
  • Do not write or other things
• Languages are learned but the capacity to learn language is genetic.

Background

• Most important source in the study of language has been the aphasias
  • Caused by focal brain lesions resulting from strokes or head trauma.
• Result
  • 96% of all individuals use the left hemisphere for language processing
    • Includes left handed people and American Sign Language
• Found two dominant areas for language
  • Broca’s area
  • Wernicke’s area

Wernicke-Geschwind Model

• Early model of language processing
• Contended
  • Two areas of the brain had the majority of processing related to processing acoustic images of words and articulation of speech.
  • Wernicke’s area
  • Broca’s area
  • Both areas interacted with association area.

Wernicke’s Area

• Is located in the posterior end of the Superior Temporal Gyrus
• Concerned with the integration and comprehension of speech

Broca’s Area

• Is adjacent to the Precentral Gyrus
• Is near areas that control facial expression, articulation and phonation.
Arcuate Fasciculus

- Is an axon pathway from Wernicke’s area and Broca’s area.
- In the Wernicke – Geschwind model, was considered unidirectional.
- Sent information from Wernicke’s Area to Broca’s Area.
- Today, know it is bidirectional.

Wernicke – Geschwind Model

Newer Models of Language and Speech

- Still include Wernicke’s and Broca’s areas.
- Arcuate Fasciculus is bidirectional.
- Three other areas are also important.
- All must work together for good language processing.

Higher-Order Association Cortex

- Left Frontal
- Left Temporal
- Left Parietal
- Are involved with mediating between concepts and language.

2. Cortex in Left Insular Region

- Is related to speech articulation.

3. Prefrontal and Cingulate Areas

- Implement executive control and mediation of memory and attentional processes.
Three Systems Interact in Language Perception and Speech Production

1. Language Implementation System
   - Broca’s area,
   - Wernicke’s area,
   - Areas of Insular Cortex
   - Basal Ganglia
   - Analyzes incoming auditory signals
   - Activates conceptual knowledge
   - Ensures phonemic and grammatical construction
   - Ensures articulatory control

2. Medialional System
   - Surrounds Language Implementation System
   - Includes regions of
     - Temporal, Parietal, and Frontal Association Cortices.
   - Works between the implementation system and Conceptual System

3. Conceptual System
   - Many regions throughout higher-order association cortex.
   - Supports conceptual knowledge.

Other Structures Involved with Language and Speech

- Left temporal and Inferotemporal Cortex
- Insular Cortex
- Supplementary Motor areas
- Right cerebral hemisphere

Left Temporal and Inferotemporal Cortex
- Allows access of words denoting various categories of things but not words denoting the actions of things or their relationship to other things.
- Example
- Damage to areas 38
  - Difficulty recalling names of unique places but not for common things
- Damage to areas 20 and 21
  - Difficulty recalling names of both unique and common names
- Left posterior Inferotemporal Cortex damage
  - Cannot recall particular word items – tools
  - Can recall words of natural or unique things

Insular Cortex
- Is important for planning or coordinating articulatory movements for speech
- Damage
  - Have difficulty pronouncing phonemes in proper order
  - Have no difficulty perceiving speech sounds
  - Recognize their own errors
  - Can find the word, but has problems producing it
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Frontal Cortex of Left Hemisphere

- Includes supplementary motor area
- Anterior Cingulate Region (Area 24)
- Important for many higher functions
  - Initiation and maintenance of speech.
  - Also attention and emotion
- Damage impairs the initiation of movement (akinesia)
- Causes speech to stop (Mutism)
- Patients with either cannot communicate by words, gestures, or facial expressions
- Is not aphasia
- Generally, they have an impairment of the drive to communicate

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Right Hemisphere

- Is important for communicative and emotional stress, timing, and intonation (prosody).
- Right anterior lesions
  - Produce inappropriate intonation
- Right posterior lesions
  - Have difficulty in interpreting the emotional tone of others speech.

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Pragmatics

- Also involved with the Right Hemisphere
- With damage, individuals have difficulty incorporating sentences into a coherent narrative or conversation and using appropriate language in particular situations
  - E.g., use inappropriate language in particular social situations
  - Do not understand jokes
  - Others

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Speech Disorders/Aphasia's

- Many different types of Speech Disorders
- Aphasia
  - Broca’s
  - Wernicke’s
  - Conduction
  - Global
  - Transcortical (Motor)
  - Transcortical (Sensory)
- Also have other types of communication disorders
  - Alexia
  - Agraphia