



# Language and Speech

Psychology 372

Physiological Psychology

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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.

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## 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

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## 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.

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## Wernicke's Area

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

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## Broca's Area

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

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### Arcuate Fasciculus

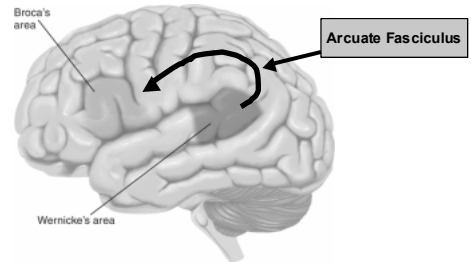
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- Is a axon pathway from Wernicke's area and Broca's area
- In the Wernicke – Geschwind model, was considered unidirectional.
  - Sent information from Wernicke's Area to Broca's area
- Today,
  - Know it is bidirectional

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### Wernicke – Geschwind Model

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### Newer Models of Language and Speech

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- 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.

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### Higher-Order Association Cortex

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

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### 2. Cortex in Left Insular Region

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- Is related to speech articulation

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### 3. Prefrontal and Cingulate Areas

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- Implement executive control and mediation of memory and attentional processes

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### Three Systems Interact in Language Perception and Speech Production

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#### 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

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#### 2. Mediation System

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

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#### 3. Conceptual System

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

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#### Other Structures Involved with Language and Speech

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

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#### Left Temporal and Inferotemporal Cortex

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- 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

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#### Insular Cortex

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- 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

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- 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

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- 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

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- 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

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

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