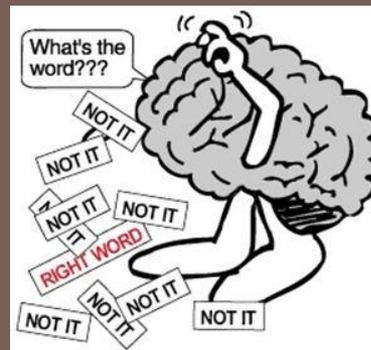# SLHS 1402 THE TALKING BRAIN

Spring, 2017

What is neurolinguistics?

- Neurolinguistics studies the relation of language and communication to different aspects of brain function, i.e., it tries to explore how the brain understands and produces language and communication.

- This involves attempting to combine theory from neurology/neurophysiology (how the brain is structured and how it functions) with linguistic theory (how language is structured and how it functions).

The Speech Chain

Speaker

Listener

Ear

Sensory
nerves

Brain

Brain

Feedback
link

Sensory
nerves

Vocal
muscles

Sound waves

Ear

Motor
nerves

Linguistic
level → Physiological
level → Acoustic
level → Physiological
level → Linguistic
level

Neurolinguistics

- **Interdisciplinary enterprise**
  - Linguistics, philosophy
  - Neuroanatomy, neurology, neurophysiology, psychiatry, neurobiology, radiology, genetics
  - Chemistry
  - Cognitive science, artificial intelligence
  - Psychology, anthropology, speech pathology and audiology
  - Computer science

- Thus, the humanities, as well as medical, natural and social sciences, as well as technology are all represented.

Different views on the relation between brain and language

- **Localism** tries to find locations or centers in the brain for different language functions.

- **Associationism** places language functions in the connections between different areas of the brain, making it possible to associate, for example, perceptions of different senses with words and/or "concepts".

- **Dynamic localization of function** assumes that functional systems of localized sub-functions perform language functions. Such systems are dynamic, so that they can be reorganized during language development or after a brain damage.

Different views on the relation between brain and language

- **Holistic theories** consider many language functions as handled by large parts of the brain working together.

- **Evolution based theories stress the relation** between how brain and language evolved over time in different species, how they develop in children and how adults perform language functions.

Sample Questions in neurolinguistics

- What happens to language and communication after brain damage of different types?

- How did the ability to communicate and the ability to use language develop in the evolution of the species? How can we relate this development to the evolution of the brain?

- How do children learn to communicate and use language? How can we relate their acquisition of language to the development of their brains?

Questions in neurolinguistics

- How can we measure and visualize processes in the brain that are involved in language and communication?

- How can we make good models of language and communication processes that will help us to explain the linguistic phenomena that we study?

- How can we make computer simulations of language processing, language development and language loss?

- How can we make experiments that will allow us to test our models and hypotheses about language processing?

Language Disorders

- Acquired vs. Developmental
  - Aphasia is an acquired language disorder, often defined as a focal lesion (i.e. a lesion of specific areas).
  - Acquired language disorders are also caused by **progressive neurological diseases,** e.g. dementias.
  - **Developmental language disorders** are found in children without any specific lesion event, such as **SLI (specific language Impairment**), and **developmental reading and writing problems, including dyslexia.**

Language evolution

- The development of language and speech and prerequisites for language and speech in the evolution of the species also need to be considered by neurolinguists.

- The changes in the structures and function of the brain are compared to the ways of living of different species.

- Animal communication systems are studied under natural conditions, especially those of primates, and experiments with primates being taught human communication systems are carried out.

Tools

For a neurolinguist, an essential source of knowledge is the possibility of measuring brain activity during language tasks in normal and lesioned brains. Static pictures of the brain, where lesion sites can be seen, such as the **CT scan** (computer tomography scan), which constructs a 3-dimensional picture of a lesion from X-rays of many planes of the brain, or the **MRI** (magnetic resonance image) is standard information in hospitals today.

Tools

The measurement of dynamic activity in the brain during language tasks by methods such as **PET, fMRI and MEG.**

PET = positron emission tomography,

fMRI = functional magnetic resonance imaging,

MEG = magnetoencephalography.