University of Djelfa **Module: Psycholinguistics**

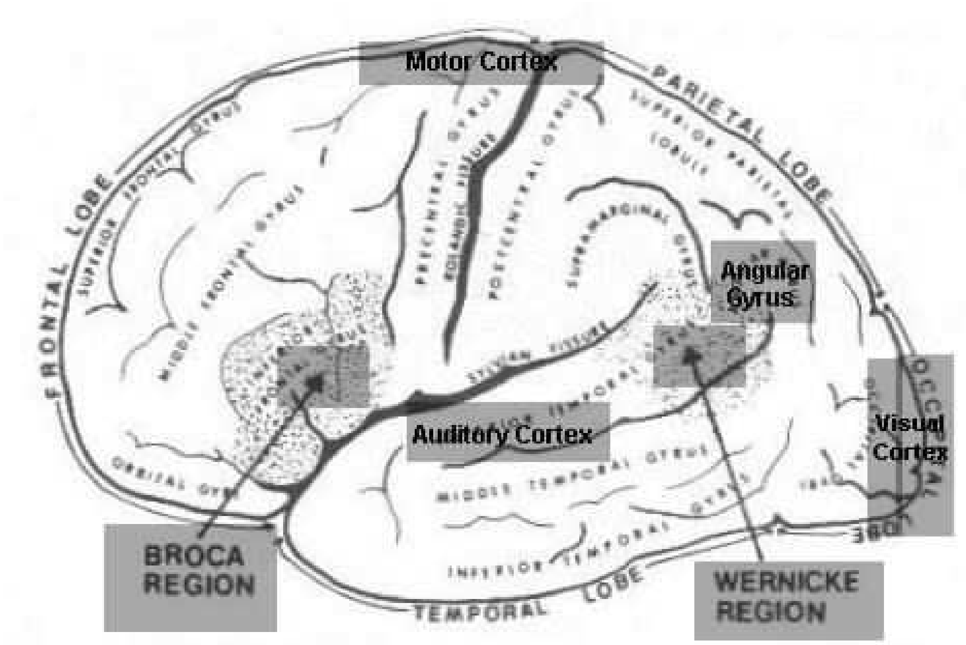
Level: Master 1 **Lecturer: Dr. A. Ahmed Kadi**

Lecture Four: Language and The Brain

I) - Neurolinguistics:

The human brain consists of 10 billion nerve cells (neurons) and billions of fibers that connect them. These neurons or grey matter form the **cortex**, the surface of the brain, and the connecting fibers or white matter form the interior of the brain. The brain is divided into two hemispheres, the left and right cerebral hemispheres. These hemispheres are connected by the **corpus callosum**. In general, the left hemisphere of the brain controls the right side of the body and vice versa.

The **auditory cortex** receives and interprets auditory stimuli, while the **visual cortex** receives and interprets visual stimuli. The **angular gyrus** converts the auditory stimuli to visual stimuli and vice versa. The **motor cortex** signals the muscles to move when we want to talk and is directed by **Broca's area**. The nerve fiber connecting Wernicke's and Broca's area is called the **arcuate fasciculus.**



Lateralization refers to any cognitive functions that are localized to one side of the brain or the other. Language is said to be lateralized and processed in the left hemisphere of the brain. Paul Broca first related language to the left side of the brain when he noted that damage to the front part of the left hemisphere (now called **Broca's area**) resulted in a loss of speech, while damage to the right side did not. He determined this through autopsies of patients who had acquired language deficits following brain injuries. A language disorder that follows a brain lesion is called **aphasia**, and patients with damage to Broca's area have slow and labored speech, loss of function words, and poor word order, yet good comprehension.

Carl Wernicke also used studies of autopsies to describe another type of aphasia that resulted from lesions in the back portion of the left hemisphere (now called **Wernicke's area**.) Unlike Broca's patients, Wernicke's spoke fluently and with good pronunciation, but with many lexical errors and a difficulty in comprehension. Broca's and Wernicke's area are the two main regions of the cortex of the brain related to language processing.

Aphasics can suffer from **anomia, jargon aphasia,** and **acquired dyslexia**. Anomia is commonly referred to as "tip of the tongue" phenomenon and many aphasics experience word finding difficulty on a regular basis. Jargon aphasia results in the substitution of one word or sound for another. Some aphasics may substitute similar words for each other, such as table for chair, or they may substitute completely unrelated words, such as chair for engine. Others may pronounce table as sable, substituting an s sound for a t sound. Aphasics who became dyslexic after brain damage are called acquired dyslexics.

In addition, split-brain patients (those who have had their corpus callosum severed) provide evidence for language lateralization. If an object is placed in the left hand of split-brain patient whose vision is cut off, the person cannot name the object, but will know how to use it. The information is sent to the right side of the brain, but cannot be relayed to the left side for linguistic naming. However, if the object is placed in the person's right hand, the person can immediately name it because the information is sent directly to the left hemisphere.

Dichotic listening is another experimental technique, using auditory signals. Subjects hear a different sound in each ear, such as boy in the left ear and girl in the right ear or water rushing in the left ear and a horn honking in the right ear. When asked to state what they heard in each ear, subjects are more frequently correct in reporting linguistic stimuli in the right ear (girl) and nonverbal stimuli in the left ear (water rushing.) This is because the left side of the brain is specialized for language and a word heard in the right ear will transfer directly to the left side of the body because of the contralateralization of the brain. Furthermore, the right side of the brain is specialized for nonverbal stimuli, such as music and environmental sounds, and a noise heard in the left ear will transfer directly to the right side of the brain.

A Neurobiological Perspective:

Chomsky's theory does not attempt to describe the relationship between universal grammar and physical structures in the brain. Where are the switches of the grammar located, and how do they operate in conjunction with other areas? Ultimately, we cannot fully account for the mysteries of language acquisition unless we also address the issues from a neurobiological perspective.

Research has at least identified certain areas of the adult brain that are typically responsible for specific aspects of language, and these can serve as starting points for understanding children's brains. The left hemisphere appears to be critical in most right handers and many left handers. As early as the 1860s, neurologist Paul Broca observed that patients who suffer stroke damage on the left side of the brain are far more likely to exhibit language loss than those who suffer damage on the right side. More recent studies suggest that about 97% of the population exhibits left-hemisphere dominance for language.

Broca worked with an adult stroke patient whose speech production was so impaired that the patient repeated a single word ("tan") over and over - yet the patient's comprehension abilities remained largely intact. The neurologist identified a lesion on the patient's left frontal lobe, just above the Sylvian fissure. Later referred to as "Broca's area," this part of the brain probably plays an important role in the production of grammatically correct sentences.

Not long afterward, another neurologist named Carl Wernicke presented very different findings from two stroke patients whose speech production remained relatively fluent (albeit characterized by circumlocutions), but whose comprehension was severely impaired. In these patients, he identified lesions just below the Sylvian fissure, in a location now known as "Wernicke's area" that is considered to play a role in the comprehension and production of meaning.

Lesions to the right hemisphere are not usually associated with language loss, but there is evidence that the right hemisphere plays a role in emotion. Cognitive scientist Sheila Blumstein and her colleagues, for example, demonstrated that the right hemisphere appears to be dominant for processing linguistic intonation (in order to distinguish a question from a statement, for example). Scientists have also hypothesized that the right hemisphere has the potential to assume some language functions if the left hemisphere is damaged.

End of Lecture Four!