

## **Brain and Language**

Dear MA Students:

Our present lecture is devoted to dealing with brain and language in order to understand how language is represented and processed in the brain. Therefore, it is quite crucial to know about the structure or anatomy of the brain. Such a study is referred to as neurolinguistics. This discipline is mainly concerned with the study of the function the brain performs in language learning and language use. Therefore, it includes research into how the structure of the brain influences language learning, how and in which parts of the brain language is stored, and how damage to the brain affects the ability to use language. Further, it provides information with respect to the parts of the brain involved in the production, comprehension and storing of language. So, we are going to provide a survey of the brain structure accompanied with the current relevant methods to study it. Moreover, some sufficient light is to be thrown on the different types of language disorder and disturbance.

All the above topics are tackled in order to answer the ongoing question : where is language? Before being indulged in/ with all these topics, it is important to initiate our lecture by shedding some sufficient light on the most important organ in our lecture , i.e. the brain. It is the organ of the body, in the upper part of the head , which controls thought and feeling. The brain consists of two main parts, the left hemisphere and the right one. As the brains develops, it is thought that different and various bodily functions (e.g. speech, hearing, sensations , actions ) are gradually brought under the control of different areas of the brain. The development of control over different functions in different parts of the brain is called cerebral

dominance or lateralization. Those parts of the brain which control language are usually in the left hemisphere. One area in the left hemisphere is known as Broca's area, or the speech centre, because it is an important area involved in speech. Damage to this area of the brain leads to different types of aphasia. By aphasia we are referring to the loss of the ability to use and understand language, usually caused by damage to the brain. This loss may be total or partial, and may affect spoken and/or written language ability. Consequently, there are different types of aphasia: agraphia refers to difficulty in writing; alexia is difficulty in reading; anomia is difficulty in using proper nouns; and agrammatism is related to difficulty in using grammatical words like prepositions, articles, etc. Another area called Wernicke's area is thought to be responsible for understanding language. However, the exact role of these two areas in language is not yet fully understood, as pointed out by many specialists.

The brain includes about 1400 grams of wrinkled pinkish-white nerve cells known as neurons. These cells constitute the basic information units of the nervous system. There is about ten billion neurons in the human brain, organized into networks of a great complexity. This complexity is ascribed to or is related to that every neuron can be connected to innumerable other neurons. Therefore, it can be said that the brain is a mass of interconnected or interlinked or interrelated neurons. However, the brain is more than neurons, i.e. there are many structures with many defined functions. The brain encompasses all the neurological structures above the spinal cord and appears to have evolved from the bottom up. At the highest level of the brain, there is the cerebral cortex. In fact, the human brain has the greatest proportion of cortex to brain mass of all animals. The cortex is a grey wrinkled mass that sits like a

cap over the rest of the human brain. The wrinkled feature is because the cortex is folded in upon itself. These folds are of two types determined largely by the direction of the folds : sulci involving areas where the cortex is being folded in , and gyri referring to the areas where the cortex is being folded out. It is important here to state that a close look at any available figure of the brain makes it clear that the human brain is not seen as a unified mass, i.e. as one entity. Actually, there is a fissure or groove that anatomically separates or cuts the human brain into two hemispheres : the left and the right. This fissure is known as the longitudinal fissure. Nevertheless, the two hemispheres are not completely disconnected or separated; there is a bundle of nerve fibers known as the corpus callosum. The major function of this callosum is to facilitate and enhance the communication between the two hemispheres. Although these two hemispheres can communicate , they show considerable functional distinctness. This means that each hemisphere is responsible for half the body-oddly enough , the opposite half. Thus, the left hemisphere is to control the right side of the body and the right the left. These contralateral responsibilities of the cerebral hemispheres account for the fact that people who suffer damage to one hemisphere of the brain, due to stroke, heart attack or accident , will have some deficits or may even have paralysis on the opposite side of the body. Cognitively, the left hemisphere seems to excel in analytic tasks such as arithmetic , whereas the right is concerned with tasks which involve an overall appreciation of complex patterns including the recognition of familiar faces and melodies.

In spite of this distinctness, complex mental activities involve the collaboration or coordination of the two hemispheres. A question may arise here: Where is language? In the left or in the right part of the brain? It is said that language is

in the left part of the brain for the right-handed persons and the opposite is fully true. However, language skills do not always fall neatly into this or that hemisphere. Research into this very specific area is still going on to reveal some unprecedented and unknown facts about our brain and the specific location of language.

In addition to the structures in the human cortex, each hemisphere has substructures known as lobes which, like the hemispheres, can be located with reference to prominent fissures ; sulci and gyri. A close look at any available figure of the left hemisphere from outside shows that the central sulcus , also referred to as the fissure of Rolando, starts from the top of the cortex to another fissure or groove known as the lateral fissure or Sylvian fissure. These two features are important in the delineation of the cerebral lobes. The frontal lobe is in front of the central sulcus and the parietal lobe is behind it. The temporal lobe refers to the area beneath the lateral fissure. As for the last or the fourth lobe, the occipital , it is the area to the rear of the angular gyrus, which has a very distinctive role in reading.

Now , a question may quickly arise about how one can investigate the brain. Definitely ,this is not easy to answer since such a task requires using some techniques that are not always at one's disposal. The problems of investigating the processing of language in the brain are not insurmountable. Update studies have utilized many recent techniques which have developed and facilitated the investigation.

The first technique is related to the autopsy or post mortem studies. A famous name in this respect is Paul Broca , who is quite well-known for his already stated contribution. This technique was often carried out with patients who are hospitalized displaying or suffering some neurological

disturbance. Careful observations were made of the patient's behavior and subsequent to his or her death, the brain was examined and studied to determine which parts of the brain were damaged. This technique was an important one although its results were too late. The second technique is that of using Computerized Axial Tomography, also called CT scanning. It is a relatively new technique which uses a narrow beam of X-rays to obtain some brain slices. It proves to be very successful concerning identifying brain lesions and tumors.

Nowadays, some new techniques have emerged to study the brain in action. Three significant techniques can be mentioned ; PET , dichotic listening studies and split brain studies. It is important to indicate that PET together with the previous ones were mainly concerned with getting information about language representation in the brain through investigating the brain itself, whereas the last two techniques examine the behavior that can be associated with the a particular brain area or hemisphere.

The Positron Emission Tomography (PET) focuses on one of the brain's most interesting properties – it is extremely hungry for oxygen. The brain consumes 20% of the oxygen the body uses at rest although it accounts for 2% of total body weight. What can be concluded from this technique is that the areas of the brain that are most active require more oxygen. In this technique the subjects inhale a minute quantity of some radioactive gas, or are injected with a safe dose of radioactive fluid which soon renders the blood radioactive. Then, the subjects place their heads in a device fitted with gamma-ray detectors. Since the blood is momentarily radioactive, the detectors are able to register the intensity of radiation in various parts of the brain, which in turn reflects the amount of blood going to those areas. Cerebral metabolic activity can be modeled

by a computer program which displays pictures with bright colors –reds and yellows –representing areas of high or intense activity, and dull blues showing parts or areas of low or weak activity. Using this technique , one can really visualize what is going on in the brain of the subjects while speaking , reading or even being indulged in some other activities. For example, when the subjects speak, much blood flows to the left hemisphere and to Broca's area in particular. On the other hand, when the subjects read , another area is activated since much blood flows to the occipital lobe which is responsible for visual processing , to the angular gyrus, and to other areas of the left hemisphere of the brain. These studies are to confirm that the left hemisphere of the brain is primarily responsible for language.

The other important technique which is to support that each hemisphere is connected or wired to the opposite or contra side of the body including the head. This technique is related to the dichotic listening studies. For example, all the input to the right ear goes directly to the left hemisphere of one's brain. So, if the left cerebral hemisphere is concerned with language processing in right-handers, these persons ought to process language much better through the right ear. This is known as the right ear advantage (REA). It is said that the REA shows a great advantage for words, numbers and the Morse code, whereas the left ear shows an advantage for the perception of melodies and songs.

The last technique is concerned with split brain studies which are all intended to support the fact that the left hemisphere of the brain carries most of the responsibility for language processing in right –hand individuals. However, a question that may be asked now is : if the left hemisphere is connected to the right ear, why is it possible to understand speech directed to the left ear? Such a case is actually related to

two reasons. The first is that the auditory pathways to the brain are not completely crossed- That is to say there are some secondary links or channels between each hemisphere and the ear the same side of the body. The second reason is that after the right hemisphere receives information from the left ear, it can be transferred to the left hemisphere via the corpus callosum , which constitutes a major term in the split brain studies. In fact, evidence concerning the significant role of the corpus callosum comes chiefly from the study of patients who have had this pathway surgically severed. Studies investigating the effects of this surgery on recognition are referred to as split brain experiments. These experiments have provided new and important knowledge about the functioning of the brain.

Having covered all the techniques involved , we are only left with the language disorder or disturbance, which I highly appreciate it to be prepared by one of you following the alphabetical order in the list of names.

THANK YOU ALL.