

# Outlines of Neurolinguistics

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## **Abstract:**

*Neurolinguistics (NL) is the study of the representation of language in the brain. It measures brain activity to probe these representations. The study might happen directly or indirectly. Human visual is considered as a very powerful phenomenon. Human beings are able to recognize more than one item within milliseconds. NL 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. The aim of the paper is to figure out what is Neurolinguistics and what are the best methods that enable any linguist to study this subject i.e. ERPs and what are the constraints and challenges that many research scholars confront while studying the field of Neurolinguistics.*

## **Keywords:**

Brain; Language; Imaging techniques; Neurolinguistics; Neurology ; Neuron.

## **1. Introduction:**

Most people around the world, all religions, and most people in most countries of most times believe that people can survive the destruction of their bodies. Now, culture is differing according to the fate of the body. Some culture believes that they are going to heaven after death, some descending to hell. Others may occupy other bodies and so on.

To elaborate that the mind is what the brain does. The mind reflects to the working of the brain just like computation reflects the working of a computer. As curious people, we want to know, how the language represents in the brain. What we find more attractive for that? And what is the basis of NL? Additionally, how to study NL and what the best methods for that?

Generally, language is an intricate talent and it's not surprising that the science of language should be a complex discipline. It includes the study of how language itself work including: Grammar, the assembly of words, phrases, and sentences; phonology, the study of sounds; semantics, the study of meaning; and pragmatics, the study of the use of language in conversation.

Our principle way of communication with the world is through language. Language is the medium through which we express our feelings to the outer world. The neural basis of our language and communicating ability is an interesting aspect of study and researchers have unearthed vital information pertaining to the language processing ability of the brain. The whole process of thinking and speaking is a bit complex task though it seems rather simple to us. In short, we are actually executing all the minor details like jaw movement, construction of the semantics, and the

sound generation everything in split second that we fail to recognize the complex task that the brain handles so effectively. Researchers have found out that we produce about one sound every tenth of a second and yet with only an error margin of one sound error per million sounds. This astounding performance speaks of the power and the capacity of the human brain.

NL 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 structured and how it functions) with linguistic theory (how language is structured and how it functions). The main aim is to analysis the interconnection between language and the brain and to examine the question asked by Obler and Gjerlow(1999) about what linguistic problems of brain damaged people can tell us concerning the ability of the human brain to express and comprehend words and phrases.

Language processing is what takes place whenever we understand or produce speech; a mundane task, but one of extraordinary complexity. NL is the technical term for this field, introduced into academic usage by Harry Whitaker (1971), who founded the leading journal that bears this title. At that time, he noted that a it is a key assumption of NL that ‘ a proper and adequate understanding of language depends upon correlating information from a variety of fields concerned with the structure and function of both language and brain, minimally neurology and linguistics’.

Representational computation conveys the idea that thinking supported by linguistic expressions involves a second order level of manipulation. In this regard, perception and episodic memory provide a first-order ‘internal’ representation of the ‘external’ world ( Ingram, 2007)

As an interdisciplinary field, NL draws methodology and theory from fields such as neuroscience, neuroanatomy, neurology, neurophysiology, etc. Thus, the humanities as well as medical , natural and social sciences as well as technology are represented in NL discipline as well.

## **2. Brain:**

The brain, perhaps the most precious body part, soft and slightly floppy, somewhat like a pink-gray jello. It protected against damage by hard skull bone and by a special cushioning fluid (Parker, 2012). The important thing is the cerebrum or the fore brain, which is under the posterior part of the brain involved in movement and balance. The large wrinkled at the top. This is where most of our thoughts, feelings, and ideas take place.

It is the central of comprehending, understanding, and competence. It consists of millions of synapses that connect thousands of thousands neurons in which it becomes a very complicated network of computing device and empty files that requires for activation while learning new things and does charge forward to work in a systematic and logical way. It is the central of the power of human being that enable us to analyses , feedback, and making decisions regardless decisive or not to achieve our life tasks. Logical areas and analyses areas found in the brain which are common in what we all call

fight and fright in such horrible situations and in such stress matters for example during exam time. So many process if not all have been done in the brain except the reflex arc that happen dramatically, automatically and more spontaneously at the exact happening situation at any point of dangerous and/ or entertaining time.

While acquiring a language as example, we call any one of an empty brain files to accept such new information in. In further, while we are in need to feed back by any information or anything known and has learnt, we have to go back to the memory and recall all relevant data that we are in need to get and to use them in the exact and correct real feedback and needful time.

For human at least there are two separate things, there is our material bodies and there is our immaterial minds. Mind machine respond in certain way “fight and fright” to certain actions i.e., if you tap somebody in the knee.

### 2.1. Different between Human Being Brain and Machine

Human beings do much more for actions any other machine. Human beings are not limited to reflex of actions. They are capable of coordinated, created of spontaneous things as we can use language for instance. Truly enough that may use of language can be reflexive and as a simple example use some basic things of a language “ HOW ARE YOU?” and I say “ I AM FINE, HOW ARE YOU?”. But sometimes I use whatever I could use as “ HOW ARE YOU?” and spontaneously the answer might be “ I AM PRETTY WELL.” So I could get chance to choose. A machine is really incapable for such choice. Hence, we are not mere machines.

### 2.2. What does your brain do?

The brain does involve very low level internal instructors and this called sub-cortical structures because they are below the cortex. While they are underneath the cortex, so for instance, many of us, we have here the diagram of the brain. The medulla is responsible for heart rate and respiration. It is very deep within the brain and if gets damage, your life also will die. The cerebellum is responsible for body balance and muscular coordination and to give you again a feeling for the complexity of the system. The cerebellum contains approximately 30 billion neurons. The hypothalamus is responsible –here- for the feeding, hunger, thirst, and to some extends sleep. All these parts of the brain are essential and many of them are implicated in interesting psychological processes. But the action is the cortex. The cortex is the outer layer and the outer layer is all crumpled up. If you take out somebody cortex and flattened it out the earth, it will be to feet square. It will be like a rug. Totally of 80% of your brain volume is the cortex.

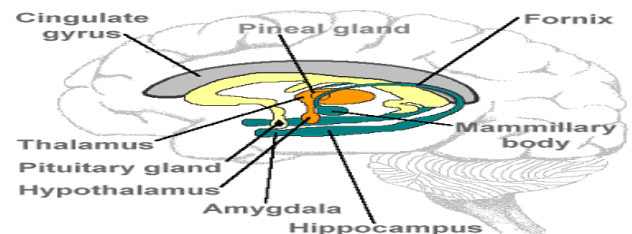


Fig. (1) The Brain

### 3. The nervous system

The nervous system (NS) is the system that controls and integrates the functions of the human body. It works in such a manner that the inner organs function evenly, inspite of the ever changing external and internal environment. Certain functions are rather initiated by nervous

system e.g. contraction of skeletal muscle. It receives, stores, and releases messages, affecting varied physiological functions, starting from microscopic cell, tissue, organ to the organ system ( Goyal et al.2009).Thus, the whole human body is continuously governed consciously and unconsciously by the nervous system. NS consists of neurons and its fibres, dendrites and its axons. It detects and responds to changes inside and outside the body. Together with the endocrine system, it controls important aspects of body function and maintains homeostasis. Nervous system stimulation provides an immediate response while endocrine activity is, in the main, slower and more prolonged.

#### 4. Neuron:

The nervous system consists of a vast number of cells called NEURONS supported by a special type of connective tissue, *neuroglia* ( Goyal et al.2009). Each neuron consists of a cell body and its process, one axon and many dendrites. Neurons are commonly referred to as nerve cells. Bundles of axons bound together are called nerves. Neurons have the characteristics of irritability and conductivity. The physiological units of the nervous system are nerve impulses or action potentials, which are akin of tiny electrical charges.

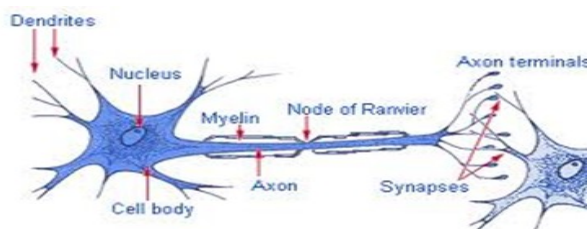


Fig. (2) The Neuron

Neuron, then are the smallest interesting part of the brain, the neuron. It is the basic

building blocks of thoughts combine to other mental structure. It is actually the basic unit of the brain. A neuron has three major parts, the dendrites, the tentacles and the axons.

#### 4.1.The synapse and neurotransmitters:

There is always more than one neuron involved in the transmission of a nerve impulse from its origin to its destination, whether it is sensory or motor. There is no physical contact between these neurons. The point at which the nerve impulse passes from one to another is the synapse. At its free end, the axon of the presynaptic neuron breaks up into branches that terminate into small swellings called synaptic knobs, or terminal buttons. In the autonomic nervous system, efferent impulses travel along two nerves (preganglionic and postganglionic) and across two synapses to the effectors organs e.g. smooth muscle and glands, in both sympathetic and the parasympathetic divisions.

#### 5. Neuroanatomy of the language:

Although, ( Broca- Wernicke-Lichtheim) BWL model was formulated around the turn of the previous century ( Ingram, 2007), it continues to provide a useful organizing framework for contemporary cognitive NL. The continued utility of the BWL model derives from its basis in notions of functional neurology that were new at that time, but are now regarded as foundational: notions involving: a) functional relation between primary, sensory, and motor areas of the cerebral cortex, b) secondary association areas, and c) the structural and functional connections of both of these to other 'higher' cortical

regions and to the sub-cortical structures of the brain. Based on Ingram, 2007, The BWL model and the later functional neuropsychological theories which succeeded it are based on the 'pre-theoretical' understanding for language and its structure. (Grodzinsky, 1990). It is generally agreed that the period of scientific study of the brain and language relations began with the identification of 'the language centres' of the cerebral cortex in the latter half of the nineteenth century, when a disciplinary boundaries for the study of brain, mind and language remained fluid.

#### **6. Different views on the relation between brain and language:**

**Localism:** tries to find locations or centres in the brain for different language functions.

**Associationism :** places language functions in the connection 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 recognized during language development or after a brain damage.

**Holistic theories:** consider many languages 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.

#### **7. Neurology of language:**

Since speech is a distinctively human characteristic, when we study its organization in the nervous system we are looking at something which is of the essence of human nature, and of the relationship between the brain and the mind. Moreover, we can't consider the effects of the brain lesions upon language without encountering the general problem of cerebral representation and localization. At two points, therefore, the neurology of language touches fundamental problems of neurology.

Charcot 1887 said that a word is a complex composed of four fundamental elements, an auditory image, a visual image, one articulatory and the other graphic. Such views and theories for this real are there such as localizationsism, holistic and empiricist. Truly enough, no time to go through all of these schools and it has to be left for those who are specialized in each one separately.

Speech involves a three-term relationship, or a description at three levels, and an understanding of the relationship between them: these are the psychological, the physiological, and the anatomical.

#### **8. Constraints and challenges in the study of NL:**

There are many constraints in the field of NL that the research scholars are still suffering as well as struggling in order to implement any task in the field. These constraints are:

- 1- Lacking of the materials i.e, medical device, Labs, and other language technology devices,
- 2- Difficulties in designing the paradigm,

- 3- Dilemma in eliciting the accurate subjects,
- 4- Cost of the scanning,
- 5- Failing in collaboration with such institutes,
- 6- As interdisciplinary, lacking for the guide-ship.

#### **9. The best methods to study NL:**

Several methods and techniques have been used in the study of NL such as CAT-scans (Computerized Axial Tomography), PET-scans (Positron Emission Tomography) and MRI's (Magnetic Resonance Imaging). In these techniques, people's brains are "x-rayed" and computer programs convert the pictures into maps we can recognize. CT-scans are good at localizing many sorts of lesions. ERPs (event related potentials). MRI scans can demonstrate some of the lesions that CAT-scans cannot. PET-scans can provide ongoing pictures of the changes in brain activation over time. However the pictures PET-scans provide are much fuzzier than those of MRI's. DMDX (Forster, 1970), is another technique that psychologist as well as linguist use it for measuring the interaction between the brain and the stimuli in terms of reaction time and accuracy.

#### **10. The future of NL:**

As the science of NL is currently in a growth-spurt, research in the linguistics and sociolinguistics of bilingualism has led to improved testing of bilinguals with languages impairments. For example, several decades ago, all "languages mixing" was considered inappropriate. Now, language-impaired bilinguals can be evaluated based on norms for their culture for bilingual code-switching. As our

ability to measure language processing times on-line continues to improve, this too will benefit NL research. Not only will we be able to distinguish between frank breakdowns of certain phenomena and sparing of others, we will also be able to discriminate between tasks that take longer than normal to perform and tasks that are performed at normal speeds. This will open up the possibility of a subtler set of dissociation that will give us new information about distinctions among linguistic entities as they are represented and processed in the brain.

#### **11. CONCLUSION:**

And so far, Language, then, represented in the different centre areas of the brain. There are two major areas in the brain for a language. The first one called Wernicke's area which is responsible about comprehension and the other one is called Broca's area which is responsible on the production. NL is the study of the neural mechanisms in the human brain that control the comprehension, production, and acquisition of language, directly and indirectly. The evidence of this investigation has been done via the recognition on the stimuli by using the mentioned related imaging techniques and language technologies i.e., DMDX. One of the most difficulties to study NL is that the lacking for the materials to implement any related task in the domain. Lacking for the materials and medical device along with the huge cost of scanning are, also, the constraints that the researchers now a days are struggling to work in the realm of NL. Without these facilities, the scholars try to avoid working in such domain because they are not able to ensure and reassure their data analyses as accurate as well.

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