



LANGUAGE LATERALISATION; A NEUROLINGUISTIC ANALYSES OF FUNCTIONAL EXCLUSIVITY OF BRAIN

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ABSTRACT

Neurolinguistics studies the brain mechanisms that underlie linguistic competence and language performance. The brain is the most complicated organ of the body which controls motor and sensory activities and guides our thought processes. The cerebral hemispheres of the brain exhibit contralateral control of functions. Functional topography of the brain is asymmetric with the left and the right hemisphere specialized for different functions. This Lateralization of functions is genetically and neurologically conditioned. Lateralization refers to any cognitive function that is localized to one side of the brain. The Language faculty resides in the Left hemisphere which is pre-programmed for language acquisition. Language was the first scientifically proven cognitive element to be localized in the brain. Evidences from the study of brain mapping, brain elasticity, split brain patients, dichotic listening and Aphasics signal the polarity of functions in the Brain hemispheres. Selective impairment following brain damage points to a highly modularized language capability.

Keywords: Language, Lateralization, Neurolinguistics

INTRODUCTION

Neurolinguistics is the study of the biological and neural foundations of language. It is the study of the neural mechanisms in the human brain that controls comprehension, production and acquisition of language. Neurolinguistics studies the physiological mechanisms by which brain processes information related to language.

STRUCTURE OF BRAIN

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The study of neurolinguistics centers on the analysis of the most complex organ of the human body; BRAIN. The brain is encased in the skull and it consists of a complex network of billions of fibers that interconnect approximately 10 billion nerve cells. The Brain is layered; the surface of the brain is the called Cortex or the gray matter, beneath the Cortex is the white matter. The Cortex receives messages from all sensory organs and initiates all voluntary actions of the body. Cortex is thus, an intellectual decision-maker and a storehouse of our memories.

The brain is divided into two parts called cerebral hemispheres; the right hemisphere and the left hemisphere. These Cerebral Hemispheres are connected by a network of 2 million fibres called the Corpus Callosum, which permits the left and the right hemispheres to communicate.

The hemispheres exhibit contralateral control the functions, the left hemisphere controls the right side of the body and the right hemisphere supervises the left side.

LATERALIZATION AND LANGUAGE

Each Cerebral hemisphere is specialized for different functions. Left hemisphere specializes in temporal and spatial sequencing and analytic processes. Left hemisphere is dedicated to language processing, grammatical complex phrases and associative thinking. The Grammar that represents our knowledge of language resides in the Gray matter on the left side of the brain. So, language is localized in the left hemisphere.

Right hemisphere deals with more holistic processes such as navigation, music and face recognition. The right hemisphere is efficient in processing non-speech sounds, recognition of intonation patterns and for visual-spatial processing.

Right brain is better than the left in recognizing faces, in matching patterns and in spatial orientation. Left hemispheric is superior for language, for mathematical thinking, for perception of rhythm and for temporal-order judgements.

The process where each hemisphere of the brain has expertise for the performance of certain functions is known as Lateralization. The process of Lateralization is maturational which means that a normally functioning human being is pre-programmed genetically for the specialized functioning of the cerebral hemispheres of the brain. Lateralization takes time to develop, it begins when the child is about two years old and the polarity of functional efficiency is completed between the age of five and the onset of puberty.



Lateralization of language is therefore, an evolutionary process and a precursor for the acquisition of language. The fact that language acquisition begins and ends at about the same time as does Lateralization, convincingly establish a parallel between the two. Furthermore, evidence supports that it becomes more difficult to acquire language after the age of 13, which is referred to as the critical age for language acquisition. The Lateralization of brain is also complete at around the same age.

Relationship between language and left hemisphere has been scientifically supported in all those human beings who are right-handed. Interestingly, in left-handers, where the left hemisphere is not specialized for language, it is the right hemisphere that takes up the job. However, Lateralization is indispensable, it takes place irrespective of the fact whether a person is right-handed or left-handed!

ELASTICITY OF BRAIN AND LANGUAGE ACQUISITION

There has been much debate regarding the elasticity of brain to acquire language. Though the Lateralisation of language to the left hemisphere is a process that begins early in life, language is less lateralized initially with the right hemisphere also playing some role. It has been scientifically proven that despite the fact that Lateralisation is genetically preconditioned, the brain in humans is elastic until 14 years of age. This implies that the other hemisphere takes over the function for which it is not normally specialized in the event of brain damage. But this switching of responsibility between the cerebral hemispheres develops only if the condition of Brain malfunctioning occurs before the end of the process of lateralization. Thus, Brain is elastic till the Critical age. If either of the two, left or right hemisphere has a problem, the other hemisphere takes over the function until 14 years of age.

However, recent discoveries have shown that in cases where the left hemisphere has surgically been removed due to clinical reasons prior to the end of the critical age, language behaviour is negatively affected. These clinical cases show specific linguistic deficits though their cognitive abilities remain intact. They have difficulty with certain grammatical constructions. Thus, language processing appears to be more characteristic of the left hemisphere than others as language does not develop normally in children with early left hemisphere brain lesions.

The human brain is predisposed to specialize for language in the left hemisphere so much so that the Surgical removal of the left hemisphere in adults will inevitably result in severe loss of the language function.



LANGUAGE IN SPLIT BRAINS

The split brain is a peculiar condition in a patient where information in the left hemisphere is inaccessible to the right hemisphere. Since, sensory information arrives in the opposite side of the brain from the side of the body that sends it, the split-brain patients can easily identify, name and describe any item that is placed in their right hand. On the contrary, an item placed in the left hand of a split-brain patient is difficult to be named as the information is not relayed to the left brain for linguistic naming.

Studies of split brain patients reveal that in human brain the two hemispheres are distinct and have functional exclusivity.

EXPERIMENTAL TECHNIQUES SUPPORTING LATERALISATION

The experimental techniques not only reveal that language is lateralized in the left hemisphere but also prove that the left hemisphere is not superior for processing all kinds of sound. It specializes only in processing of linguistic sounds.

Imaging techniques are used to map the brain and establish that language faculty is independent of other intellectual abilities. Techniques such as EEG (electroencephalography), MEG (magnetoencephalography), PET (positron-emission tomography) and MRI (magnetic resource imaging) scans also reaffirm the Lateralisation of functions in the Human Brain. Experimental techniques like electrical stimulation studies and Dichotic listening also show that the functioning of the two hemispheres is not symmetrical.

LANGUAGE IN APHASICS

Aphasia is language disorder that results from damage to specific brain regions. It is an acquired language disorder affecting all modalities such as speech, writing, reading and listening.

Aphasiology is the study of effects of brain injuries on language processing. The scientific study of aphasia provides evidence that language is basically a left- hemisphere function. The lesions to the left hemisphere result in Aphasia, while damage to corresponding right hemisphere does not result in this anomaly. Often people with Aphasia are otherwise healthy, with unimpaired intellect and cognitive functioning. Hence proven, that both hemispheres are not equally involved with language.



Furthermore, there are specific areas in the left hemisphere dedicated to specialized language functions. Damage to the front part of the left hemisphere called Broca's area (Paul Broca, 1864) results in speech problems, faulty syntax, and word finding pauses.

Lesions in the back portion of the left hemisphere, Wernick's area (Carl Wernick, 1874) hinders comprehension. These Aphasics are fluent speakers but produce semantically empty utterances.

Anomic Aphasics have difficulty in finding the word they wish to speak and Jargon Aphasia produce nonsensical utterances as these aphasics commit phonemic substitution errors. Aphasics who lose their language completely are said to suffer Global Aphasia.

Therefore, damage to different parts of the left hemisphere of the brain results in different kinds of linguistic impairment. These anomalies suggest that the cerebral hemispheres are further compartmentalized and each compartment exhibits functional exclusivity.

BRAIN MODULARITY

The brain is divided into distinct anatomical faculties that are responsible for specific cognitive functions including language. The language Faculty is modular. It is independent of other cognitive systems that interact but develop singularly. The genetic basis for an independent language module is supported by studies of aphasia, SLI's and of Savants. Children suffering specific language impairment (SLI) only have damaged linguistic ability and suffer no other cognitive deficits or any perceptual problems. Language Savants are people who are intellectually handicapped but show extraordinary language skills.

This evidence supports that language faculty is an autonomous, genetically determined brain module. The linguistic ability is separate from other cognitive systems and is itself a complex system with various components.

CONCLUSION

The human brain is very complex and works intricately for a harmonious functioning of the cognitive systems. The neurophysiological evidence supports that language faculty is uniquely human and genetically transmitted capability which works in collaboration but is independent of other mental faculties. Brain is not a uniform mass and linguistic abilities are functions of localized brain areas. The left hemisphere is endowed for language functions and an injury to these areas disrupts linguistic competence.



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