

Neurolinguistics and Language Function

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Neurolinguistics is known as a study of relationship between brain and language. Human brain consists of three main parts such as forebrain (crucial part), midbrain (the smallest part), and hindbrain (the lowest part). Basically, human language centre is located in frontal lobe of human brain where the left and the right hemispheres are located. Language use sometimes is more dominant in the left hemisphere although the right hemisphere functions for language. Specifically, the areas that are involved in language are frontal lobe (Broca) and temporal lobe (Wernicke). The lesion on brain will scientifically cause language disorder which is known as aphasia. The types of aphasia are Broca's aphasia, Wernicke's aphasia, pure word deafness aphasia, conduction aphasia, anomia aphasia, apraxia aphasia, global aphasia, and aphasia reading and writing (dyslexia). The physical condition of a healthy brain is very important to prepare the activities of thinking and acting. Thus, the brain must be protected appropriately.

Keywords: neurolinguistics, brain, language, aphasia

Neurolinguistics is a field of study that comprises the linguistics and medical science that study about the relationship between language and human brain. How does the language process occur in human brain? Harry Whitaker (1971) is a well-known journal founder who explained neurolinguistics as technical term in the field for the use in academic field. Roman Jakobson (1896-1982) is known as an important person who plays an important role in studying and explaining the knowledge of neurolinguistics although he is not an expert of linguistics.

Neurolinguistics study is a study of understanding the functions of brain in processing the language activity. In this study, the researcher studies on how brain plays its role in processing the activities such as speaking, listening, reading, writing, and using the sign language for those who use the technique to communicate in their

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daily lives. The study is not only about the functions of the human brain, but it also focuses on the field in order to understand the difficulties in using language or language disorders that involve the activities of speaking, listening, writing, and using the sign language. Language process occurs when people utter the words or express the utterances, and they understand the process. How does it happen? This is the research question that is being discussed in this study.

Human Brain

Human brain consists of three parts which are known as forebrain, midbrain, and hindbrain as shown in Figure 1. Hindbrain is the lowest part located at the base of skull. It has two important structures, medulla and cerebrum. Medulla oblongata controls respiration, reflex movement, digestion, and heart beating. It also connects brain with spinal cord, and they are crossed. Cerebrum controls muscle spasticity, coordinates the muscle movements, and also controls body balance and body movements.

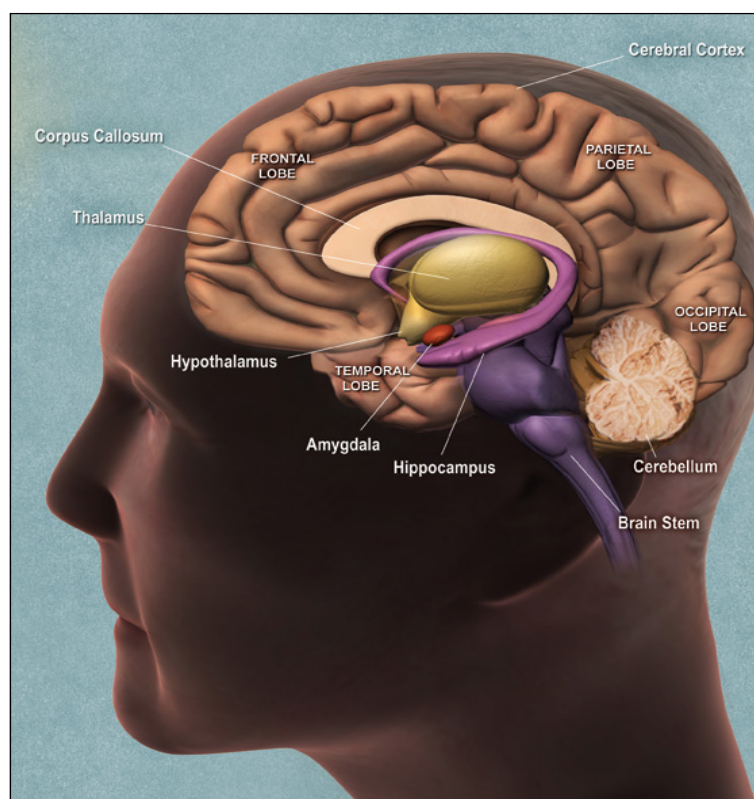


Figure 1. Structure of human brain.

The smallest part of brain is the midbrain located above the brain stem. It functions for receiving the sensory signal from sense organ (receptor) such as eyes and ears. When someone turns his head to right, left, up, and down, his eyes still are able to focus seeing the object.

The most vital part of human brain is the forebrain. This area consists of three structures, thalamus, cerebral cortex hypothalamus, and corpus callosum. Thalamus functions as the connector for the sensory signal to the brain. All the sensory signals will be sent to the brain. The smallest brain structure is hypothalamus; however, it has the vital function. It is located in front of cerebrum and below thalamus. It controls the humans' motive and emotion such as eating, drinking, and sexual behaviour. It also controls body homoeostasis such as

body temperature, sleeping, and secretion of hormones from the certain glands at stomach and intestine. It also controls the physiology such as blood pressure and heart. This is the centre of brain that is connected to the autonomic nervous system.

The largest part of brain structure is cerebral cortex. It controls the experiences that happen consciously and human brainpower. These features make humans different from animals although they both have brain. Cerebral cortex consists of two structures that are quite same; however, they have different functions and are known as right hemisphere and left hemisphere. The structures are connected by corpus callosum that comprises axons. Axons function as the communication connector between the both parts of cerebral hemisphere.

Human brain has two hemispheres, right hemisphere and left hemisphere. Both of the hemispheres have different functions. Roger Sperry is a biopsychology expert who has proven that each hemisphere of human brain has different specialities. Since 1861, the left area of brain is considered as the dominant area of speaking and language ability. Nonetheless, based on the result of the researches since the last 20 years, it has shown that right area of brain also functions for the language ability and speaking.

Based on Figure 2, human brain is divided into two parts, right hemisphere and left hemisphere. Both sides of brain play different roles, the left side functions for critical thinking, and the right side functions for creative thinking.



Figure 2. Left and right hemispheres.

Right Hemisphere

Right hemisphere involves music, fantasy, literature intuition, painting, and understanding of saddening experiences. The right hemisphere also has particular functions. This hemisphere is able to use the language well by giving the intonation, stressing the uttered tones, and using gestures, hand movement, and facial expression as the way to make listener deeply understand the thought and feeling that have been expressed.

Besides stimulating elements of language suprasegment, the right side of brain is also the centre of creativity abilities. It tends to specify the academic subjects such as journalisms, arts, and oral communications.

Right hemisphere was known as the part that functions and knows others' behaviours. By having this kind of ability, someone will be able to arrange and use the utterances according to the particular occasions and time.

Left Hemisphere

Left hemisphere manages the processes such as language, logic, mathematics, writing, and understanding of the pleasant experiences (Kinsbourne, 1981). The linguistics speciality is located on the left hemisphere of brain. This hemisphere functions in monitoring the grammar ability, understanding the others' utterances, naming objects, repeating something, reading, and writing. Specifically, the areas that are involved in the language activity are frontal lobe (Broca), temporal lobe (Wernicke), and the area which is known as tertiary.

Some previous studies stated that right hemisphere comprises the limited and passive language potency, but can be active if it is needed. According to Caplan (1987), the patient who disposed the left hemisphere could not say anything. After a while, the patient had the limited vocabulary, and comprehended some messages of the conversation although the patient had the difficulty in producing the utterances. The patient who suffers the lesion on the right hemisphere will hardly recognize the intonation and understand the humour and figurative language.

For the serious epilepsy, corpus callosum that connects two hemispheres has to be disposed. By doing that, both of the hemispheres will be separated, and each of them controls only half of the body. Language ability of patient will be tested by using the separate hemisphere. The object that is shown in front of the left visual field depends on the right side. Sometimes, the reaction from the patient shows that the patient is able to name the object that is shown. This shows that right hemisphere can manage and control the easy naming problem, but it cannot control syntax. However, it is the results of the study that have been argued since the information can be transferred from one hemisphere to another using the alternative way without depending on corpus callosum.

The method of study to listen discotically was carried out to examine which hemisphere controls language. The subjects of the study were using the specific hearing aid, and they had to listen to two different words simultaneously. The word "two" was uttered at the left ear, and word "six" at the right ear. Most of the subjects of the study said that they could hear the word "six". This is because the hearing through right ear connects directly to left hemisphere where the language ability center is located. It was not about the preference to hear something using the right ear. The left ear is good at recognizing the non-linguistic sounds. When the different kinds of sounds are sounded simultaneously, the subjects of the study hear the sounds through left ear well compared to the right ear. In brief, the left hemisphere is more competent in processing the linguistic signs and is the dominant area of language.

Hence, the neurology experts agreed that most of the languages are located at one hemisphere. The discussion about the location of language continues. If the both sides of hemispheres have the same good abilities, someone will be able to practice the language grammatically and use the language well. This is because the left hemisphere of brain functions to receive and analyze the input before it is sent to the right hemisphere to be processed. Then, it is transferred to the left hemisphere as a process. This situation enables the ideas to be generated and produced.

As a result, human brain functions in practicing the principle of opposite direction. Briefly, the right hemisphere controls the body movements on the left side of human body, and the left hemisphere controls the right side of human body. This was proven when the research was carried out by the experts of neuropsychology and neurology, and the result of the research showed that one of the sides of human brain

dominates the other one. The researchers also claimed that the left hemisphere is more dominant than the right hemisphere.

Relation Between Brain and Language

The issue about human brain and language has been argued by the researchers for long time. In 384-322 B.C.E., Aristotle argued about the functions of brain. However, the indicator for this issue was argued after the findings by Broca and Wernicke in 1860. Based on the structure and the orientation, human brain consists of two areas that are important for language as shown in Figure 3. When the input is received in the form of utterances, the sounds are heard by temporal earlobe especially primary hearing. After the input is received, it will be detailed, digested, and rehashed. The language sounds will be sent to Wernicke's area to be interpreted.

In Wernicke's area, the language sounds are going to be separated into syllables, words, phrases, clauses, and sentences. After interpreting and understanding the actual message of the sounds, there are probably two ways. If the received input does not need to be conceived, the input will be kept in the memory. If the information needs to be conceived verbally, the interpretation will be sent to Broca's area through curve fasciculus.

In Broca's area, the process of recognition starts. After understanding the language sounds, Broca's area sends the message to the motor cortex to be implemented. The implementation process in the motor cortex is not moderate. For the basic utterances, the minimal 100 muscles and 140,000 chains of neuromuscular get involved in the process. The motor cortex considers not only the sets of words, but also the sets of sounds and features from the sounds which are uttered.

If the received input is not in the verbal form, the process takes place a bit different from the non-verbal input. The received input is not perceived by primary cortex of hearing, but it is perceived by visual cortex in occipital lobe. The input is not sent to Wernicke's area, but it has to be through angular gyrus that coordinates the understanding area with occipital lobe. At this stage, the same process takes place after the input is interpreted in Wernicke's area. Then, the input will be directly sent to Broca's area when the input needs verbal comprehension. If the input is a visual illusion, the input will be sent to the parietal lobe to be processed to the visualization.

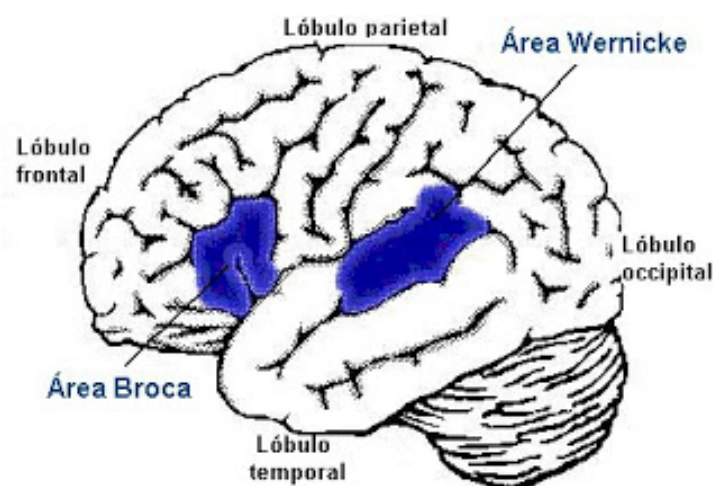


Figure 3. Placement of Broca's area and Wernicke's area inside of the brain.

Trouble or Language Disturbance

The brain is a priceless gift from God to mankind because this is where it lays the human mind that distinguishes humans and animals. Brain injury will affect person that experiences it. Human brain that is injured might not be representative human brain that is normal. Studies that have been made by members of the neurology of two counties involved in the planning and understanding of the language such as in Broca's and Wernicke's area. When an injury occurs in Wernicke's area, it will cause the patients' speech understanding to be lost while for patients suffering from injuries to the Broca's area, it will cause obstruction of speech production. Next, we will discuss language-related disorder affecting the brain. Language disorder is also known as aphasia. From results of previous studies, several types of aphasia were found involving the relationship of language and the brain. The types of aphasia are Broca's aphasia, Wernicke's aphasia, pure word deafness aphasia, conduction aphasia, anomia aphasia, apraxia aphasia, global aphasia, and aphasia reading and writing (dyslexia).

Broca's Aphasia

Paul Broca is a neurologist from France who has made a study of a patient suffering from problems understanding and using language or commonly known as aphasia. Broca's area is not only a role in the motor system, but it also involves a very complex language skills such as word processing, grammar, sentence discerning whether active and passive sentences, subject, predicate, object, and statement. The area distinguishes sentences in Broca "Abu kick ball" in this verse which Abu kicks and the ball is kicked. Broca's area is located in the posterior frontal lobes of the cerebral cortex and it is close to Wernicke's area. Both are found only on one hemisphere of the brain, which is the left brain hemisphere. Both serve to control the language ability.

People who suffer damage or injury to the Broca area can understand the language very well, but it cannot form words or reproduce sounds. This is because the Broca's area is in relation to other area of the human brain which is called Wernicke's area. This area is in relation to the process and understanding of language. Adults who suffer from Broca's aphasia will be able to see his speech as the speech of children who are in the telegraph stage.

Study or experiment was conducted on a patient suffering from Broca's aphasia. The results of this study found that patients understand those exposed to it, that is, "The apple that boy is eating is red" if "the boy" is a person who commits an act of eating. The opposite happens when the sentence was changed to "The girl that the boy is looking at is all"; the same patient cannot imagine who the perpetrator is the act of looking. As a man who did not suffer a brain injury in Broca's area, we are able to understand both the text and are able to analyze this sentence. With Broca's aphasia, patients evidently had lost knowledge of syntax which makes it difficult for him to understand and make a speech. But what is fascinating is that the patient can sing using the same words but cannot produce the same speech.

Wernicke's Aphasia

Wernicke's area is taken from the name of a German neurologist Carl Wernicke. Injury to this area causes language disorder to happen and it is known as Wernicke's aphasia. Wernicke's aphasia is characterized by a similar speech but unsubstantiated talk (nonsense speech). Pronunciation and grammar are correct but any word spoken by the patient does not contain meaning. This is because the patient's speech is like normal speech, until the listener thinks that he mishears the speech of the patient, which is why he could not understand the purpose of the patient. For example, we see the previous research done before, the patient of Wernicke's aphasia may say,

Before I was in the one here, I was over in the other one. My sister had the department in the other one. My wires don't hire right, atau I'm supposed to take everything from the top so that we do four flashes of four volumes before we get down low.

Often, patients of aphasia provide substitute words for the right words based on the same sounds, association, or other characteristics. Take "chair" for example, it is replaced with the word "Shair" (sound alike), "table" (association), "throne" (meaning related), "wheelbase" (not categorized), and "You sit on it. It's a..." (missing word). In conclusion of Wernicke's aphasia is an individual understanding of speech that is gone but not hearing in the sound of language and music.

Pure Word Deafness Aphasia

Another aphasia that involves in brain injury is aphasia pure word deafness. This type of aphasia happens when an injury occurs in the area leading to the Wernicke's area from auditory field. These patients could not identify the correct words sound like a patient can recognize the melody of new song that the patient hears, but the patient cannot recognize the lyrics.

Conduction Aphasia

When people have a pretty good understanding of speech but are relatively weak to repeat the words, they are known as conduction aphasia patients. Patients will replace the same sound with the sound of a real word. For example, to "teethe" (first teething), it is replaced with said "teeth", and to "bubble" (bubble), it is replaced with the word "bupple" (no new word meanings, but according to the way, sounds combine to form the English word). Some may repeat four or five digit range, for example 4-5-9-2, 3-8-4-2-7, but could not repeat simple sentences with rhythm of three syllables. For example, "Joe is here, Betty sang".

Anomic Aphasia and Apraxia Aphasia

Anomic aphasia involves in trouble of finding words that coincide with spontaneous speech, although understanding of language and repeated words are good. For example, the difficulty of finding the right name for an object. This phenomenon is experienced by most people at certain times such as "Hand me that ... uh ... uh ... thing over there". Apraxia aphasia is patients who failed to respond reasonably to verbal instructions. These patients are unable to perform match movement with sensory motor by hand even though they understand the direction. For example, the patient could not pick a pen that fell on the floor spontaneously.

Global Aphasia

The cause of injury in the left hemisphere or critical injuries in connection areas of language that demonstrate most or all affecting aspects of language in a patient is called global aphasia. Injuries that occur in the brains of patients can result in physical and verbal disorder. Physically, the patient would experience paralyzed right side of the mouth that becomes distorted and the elasticity of tongue will not be sufficient. These patients will experience a slight speech understanding and it causes the patient to use stereotypical arrangement of sounds (used repeatedly in the same form). A woman who had suffered a stroke cannot spoke more than a sentence with four syllables that are unfounded, that is "*ga dak la doh*".

Aphasia in Reading and Writing (Dyslexia)

Last aphasia is recognized as aphasia in reading and writing, and it is known as dyslexia. This aphasia is the cause of disturbance in reading and writing. There are several types of dyslexia. It happens when an individual is non-proficient in reading and writing. Dyslexia can be observed since childhood in the acquisition

of reading and writing proficiency. Hemisphere dominance of visual perception defects and the effects of poor teaching methods cause the child to start reading or writing from behind (e.g. “deer” into “reed”), wrong letters (b \diamond d, p \diamond q, u \diamond n, and m \diamond w).

Dyslexia can be divided into two types: One of it is alexia that causes disturbance in reading to the patients, and the other is agraphia resulting in patients experiencing trouble writing. However, there are individuals or patients suffering from both conditions simultaneously. For people who suffer from “pure agraphia”, the patient cannot write using his or her hand and yet still it can be used for other purposes. For example, someone who has suffered a stroke in the left hemisphere or other cause of injury may read simple sentences “How are you?”, but the patient cannot write the sentence when noted in the article. There are also patients who are not able to read phrase but are able to write phrases for records. Patients suffer from a condition called “alexia without agraphia” (patients will be unable to read the new note that he or she just wrote). There are also individuals who are experiencing, where he can speak his voice but when speech is heard from recorder to him, he could not understand the speech himself.

Conclusions

The human brain is different from the brain possessed by animals. The human brain is heavier but measurement of its size cannot be used to determine the ability to speak because there are more important features such as quantitative and qualitative. Based on qualitative explanation of the human brain above, the human brain consists of front, middle, and back areas. Cerebral hemisphere of the brain is divided into right and left hemispheres and it can be concluded that both the right and left hemispheres have interrelated roles in processing information. Cortex of the left hemisphere is considered to be more important because it handles a number of functions such as language, thinking, planning, problem solving, motor and sensory system operates, vision, understanding the language, and others. The right hemisphere is more on creative thoughts such as art, music, holistic, oral communication, and others. In case of injury, especially on the right brain hemisphere, it can cause disturbance of language known as aphasia. Thus, the physical condition of a healthy brain is very important to prepare the activities of thinking and acting. Thus, the brain must be protected appropriately. Greek proverb has it that “a healthy mind lies in a healthy body”.

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