

A Neurological Study of Language Disorder Performed by Handicapped People of Manggarai Society, Flores, Indonesia

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Abstract. The study focuses on language disorders that appear in linguistically handicapped persons. Many language disorders result from damage to an area of the brain responsible for linguistic processing, but some have no apparent physical cause. The study explores the relationships between language and mind, speech, and thought. In doing research, the researcher applied qualitative-descriptive research as a type of research. The researcher observed language-handicapped persons (eight people) who have difficulties producing language. It appeared that the respondents needed help to speak properly. Then, the researcher recorded the data by doing interviews and asking them to speak, read, and write certain sentences. After that, the researcher analyzed the data in order to find the reasons why those people have difficulties in producing proper language. In order to analyze the data, the researcher studied the theory of language disorder. The results of the study showed that out of the nine language disorders stated by experts, almost appeared in eight language-handicapped people investigated in the field, even though some of the subjects had more than one problem. The researcher concluded that the language disorder found in the subjects is related to the problem in their brain, but not because of a physical accident; it may be such a damaged brain.

Keywords: language disorder, disabled person, Manggarai society

1 Introduction

Language is considered an inherent component of the biological structure of the cerebral cortex [1], [2]. Conversely, developing cognitive impairment will inevitably harm their ability to understand and produce language. A person's brain exhibits lateralization, meaning that it possesses distinct functions in each of its two hemispheres. The motor functions responsible for activities such as speaking and manipulating objects are primarily localized in most humans' left hemisphere of the brain. There could be a link between the linguistic and technological capabilities of humans, suggesting that both play a role in the development of the brain's ability to communicate.

Friederici [3] studied the relationship between language and the brain. She researched the development of language in a child called Echa. On the first day of age, Echa could not produce language. She produced language in crying sounds. At the first month of age, Echa could move her head and tongue. It is to inform that Echa's brain begin to develop to instruct her body. The sound she always produces is schwa [ə], such as [ɣə]. At the age of three

months, Echa can move her tongue rapidly and produce consonant sounds. At the age of first year, Echa can produce combination sounds in the words *papa* and *mama*.

The study of Echa is about language development in a human's first life. It is also about the relationship between language and the brain. Echa found difficulty in producing language at the first age because of the slow growth of her brain.

In order to find the complete cause of the problems that arose above, the following questions can be formulated: Why do you not speak properly? Are there any relations between mind and language, brain and speech organs, language disorder, and brain damage? The study aims to find out the answers to the questions stated as the problem of the study. The researcher wants to discover the relationships between language and mind, speech and thought. It also explains the causes and effects of disorder in producing language.

There are some previous studies related to the relationship between the brain and language production [4]–[6]. The objective of these studies is to investigate expressive language issues in teenagers. Based on the content of the interaction, it was evident that language faults were present. These errors included a limited vocabulary, frequent errors in word choice, struggles with constructing lengthy phrases, an inability to initiate conversations, and trouble expressing joy about something.

However, different from those previous studies, the study about language disorders performed by handicapped people is still unique and distinctive. First, this study focuses not only on one case of language disorder but on some aspects of language disorders performed by some handicapped people in Manggarai society. The subjects of the study are physically normal persons, but they are disabled persons linguistically, and one subject may suffer from more than one language disorder. The study is the type of neurolinguistic study that analyzes and describes the relationship between language and mind. It is assumed that the language produced by someone is based on the condition and quality of mind. If there is a problem in mind, particularly in the left hemisphere, then there will be a negative performance in producing language [7], [8]. That is why the researcher does not focus the study only on certain types of language disorders but on all types of language disorders, not only the study of certain single disabled persons or subjects but of some disabled persons found in Manggarai society.

Then, the study was entitled "A Neurological Study of Language Disorder Performed by Handicapped People of Manggarai Society, Flores, Indonesia." A handicapped person refers to an individual who has a physical, mental, or sensory impairment that limits their ability to participate fully in daily activities or society. It is now called "person with disabilities" or "disabled person." Manggarai society refers to a group of Manggarai people in Flores, Indonesia, encompassing various social structures, institutions, and relationships among Manggarai members.

In doing research, the researcher follows these procedures as follows. Firstly, the researcher observed language-handicapped persons (eight people) who have difficulties producing language. It appeared that the respondents could not speak properly. Secondly, the researcher recorded the data by conducting interviews and asking them to speak, read, and write certain sentences. After that, the researcher analyzed the data in order to find the reasons why those people have difficulties in producing proper language.

The results of the study showed that out of the nine language disorders stated by experts, almost appeared in eight language-handicapped people investigated in the field, even though some of the subjects had more than one problem. The researcher concluded that the language disorder found in the subjects relates to the problem in their brain.

2. Literature Review

2.1 Human Brain

The cerebral cortex is the central organ in the brain's upper region that governs cognitive processes and emotions [9]. The brain is the organ inside your head that controls how you think, feel, and move [10], [11]. Brain-dead is a state where your brain has stopped working properly even though your heart may still be beating. Brain-dead, in general-informal, is similar to stupid and uninteresting. Brain-dead is similar in meaning to Bird-brain, that is, stupid or thoughtless. Brain Box is a very intelligent person. Brain damage is damage to someone's brain caused by an accident or illness.

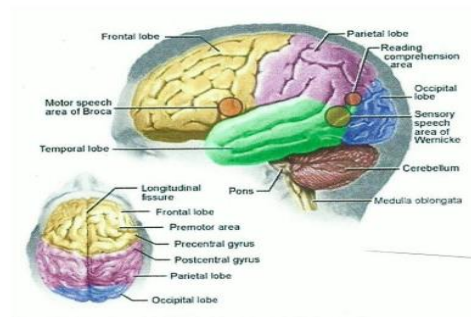


Figure 1. Human Brain

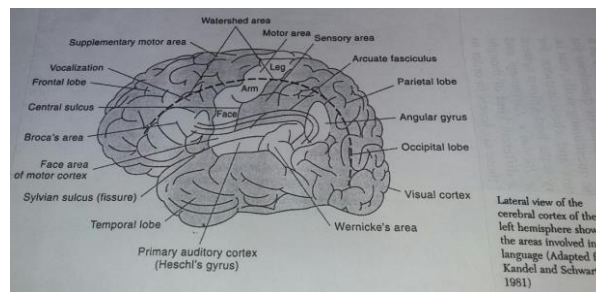


Figure 2. The Main Part of the Brain

As the brain develops, it is thought that different bodily functions (e.g., speech, hearing, sensations, actions) are gradually controlled by different brain areas. The development of control over different functions in different brain parts is known as cerebral dominance or lateralization.

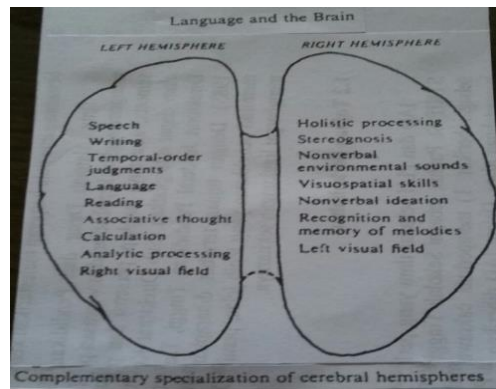


Figure 3. The Diagram of Left and Right Hemisphere

The areas of the cerebral cortex responsible for language are often located on the left side. Broca's Area, also called the speech center, is a particular area located in the left hemisphere. The term "speech center" refers to this Area because it plays a crucial role in producing speech and language. Damage to this Area of the brain leads to different types of Aphasia. Broca's Area is a part of the brain included in a massive area of damage suffered by an aphasic patient of P. Broca in the mid-19th century. Broca's Aphasia is characterized by grammarist and associated in clinical lore with lesions in this Area [12]. Another area in the left hemisphere is Wernicke's Area; it is thought to be involved in understanding language (language comprehension). Wernicke's Area is a part of the brain where lesions have been diagnosed as giving rise to it. Wernicke's Aphasia is a form of Aphasia characterized by fluent but meaningless speech [12].

2.2 Some Diseases in the Brain

Some diseases, such as *multiple sclerosis*, affect the conduction of nerve impulses by eating away at the myelin coverings of axons. *Parkinsonism* and *Huntington's chorea* result from neurotransmitter imbalances affecting the functions of the basal ganglia. Other diseases, such as *myasthenia gravis*, result from decreased neurotransmitter receptor sites in muscles [13].

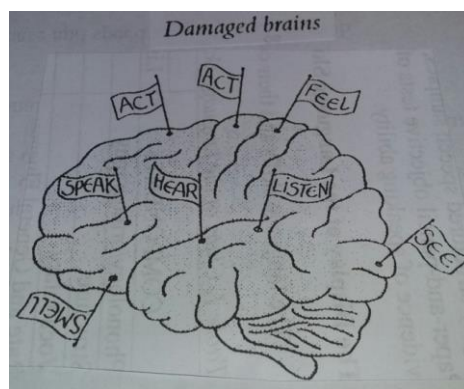


Figure 4. The Part of Damaged Brains

2.3 Damaged Brains

Stroke and head injury are the predominant factors leading to the death of cells in the cerebral cortex of generally healthy persons. A stroke is the result of either a blood clot blocking a blood artery in the brain or the bursting of a blood vessel due to weakened membranes. In both scenarios, adjacent cells perish due to a deficiency in blood circulation. In the event of a split, the released blood inflicts physical harm, leading to cell death. Frequently, stroke results in highly specific regions of cellular demise. Although head injuries typically result in a more extensive demise of cells, the consequences of both stroke and head injuries can still be quite comparable. These encompass deficiencies in language, planning and problem-solving, movement and sensation, vision, memory, and vision. Additionally, significant impacts on temperament and personality may ensue [14], [15].

As has been described, distinct regions of the body are controlled by the brain's two hemispheres: the right hemisphere regulates the left side of the body, while the left hemisphere regulates the right. In most cases, the two hemispheres divide the burden; however, language processing is an exception, as the left hemisphere is primarily responsible. A language deficit is, therefore, a reliable indicator of injury to the left hemisphere and, more precisely, to the left side of that hemisphere. Most people who have difficulty producing language will also have difficulty comprehending it and conversely. Many people who exhibit a deficiency in oral communication will also demonstrate a deficiency in written communication. Aphasias refer to impairments that impact spoken language. Disabilities that impair the capacity to comprehend written material are called *dyslexia* [13].

2.4 Brain and Language

The brain is the most potent organ in the human body. The human brain comprises two hemispheres, namely the right and left. Language is predominantly situated in the left hemisphere and also undergoes age-related development. This idea is in line with the idea stated by [16], who asserts that the human brain possesses an extensive supply of neurons required for an entire lifespan from the moment of birth and that this brain continues to develop. Neurons establish connections with one another through synapses, which are neuronal connections that manifest at specialized communication locations. In order to establish synaptic connections with other neurons, neurons undertake projection, during which the projection is enveloped by myelin, a lipid-rich substance. The advantageous function of this myelin is to secure the electrical signal carried by neurons and insulate the projections.

The maturation of the brain corresponds to the maturation of language skills in both the right and left brain. Moreover, two distinct regions comprise the human left hemisphere: Broca's Area and Wernicke's Area. Broca's Area, situated in the brain's left frontal lobe, is notably critical for speech production. Conversely, Wernicke's Area, situated in the temporal lobe, is specifically significant for word meaning processing. This idea aligns with the idea stated by [17], who affirmed that the upper portion of Broca's Area is involved in comprehending word meanings, whereas the central portion regulates expression. Conversely, Wernicke's Area facilitates the understanding of incoming language, including sign language, written text, and spoken speech.

2.5 Localization of Function

It was in the nineteenth century that the first concentrated attempts to understand how language was organized within the brain through the study of aphasic patients. The initial cognitive function to be located within the human brain was the ability to produce expressive (communicated) speech [18]. A French surgeon named Pierre Paul Broca (1824-1880) positioned himself as one of the pioneers in the field of biological anthropology. Broca was

highly fascinated by the correlation between brain size and factors such as age, sex, IQ, race, and culture. Broca belonged to an anthropological society whose members examined the human skulls and occasionally conducted research on the brains of deceased medical patients. Through such research, they sought to attribute various behaviors to either the shape or size of the cranium or to sites of damage in the brain.

In 1861, Dr. Ernest Aubertin documented a case of a patient with a traumatic deformity in the front part of their skull. When Aubertin exerted gentle force on the frontal area while the patient was speaking, the patient would abruptly pause in the middle of a word, and then resume speaking as the pressure was released. Dr. Aubertin examined Leborgne. Aubertin affirmed this diagnosis. When Leborgne died, Broca performed the autopsy and confirmed a striking frontal lobe lesion in the Area of the third frontal convolution (gyrus) in the left hemisphere. Analysis such as Leborgne is now called a CT scan (computerized transaxial tomography). This sample was called Broca's Aphasia. This sample is shown below [18].

Broca's Aphasia: Yes....ah.....Monday.....er.....Dad and Peter H.....(his own name), and Dad....er....hospital....and ah....Wednesday....Wednesday, nine o'clock, ah doctors...two...an'doctors....and er...teeth....yah. (This is the patient's effort to explain that he came into the hospital for dental surgery). The patient's speech appears halting, sparse, and devoid of recognizable sentence structure. This non-fluent, agrammatic type of output is characteristic of Broca's Aphasia. By 1885, Broca proclaimed that for the vast majority of people, "nous parlons avec l'hémisphère gauche" (we speak with the left hemisphere) [16]. Gall had not lateralized language to either frontal lobe, but Broca clarified that we are usually left—lateralized for articulate language (la faculté du langage articulé).

Broca was also one of the first to relate lateralization of language to handedness. They assume that right-handers are left—lateralized and left-handers are right-lateralized. However, Broca related both handedness and lateralization of language to the precocious development of the left hemisphere.

The modern CT scan analysis also shows another area of the brain. This Area is named Wernicke's Area. Carl Wernicke (1848-1904), a German, studied along with Sigmund Freud (1856—1939) and Theodor Meynert (1833-1892). The Area of interest to Wernicke was contiguous with the cortical Area for hearing. Damage to this Area resulted in a complex of symptoms that differed greatly from those that Broca had observed. A typical example of Wernicke's Aphasia is illustrated in Table 1 below [17].

Table 1. The differences between Broca's Aphasia and Wernicke's Aphasia

Broca's Aphasia	Wernicke's Aphasia
Non-fluent	Fluent
Using language which seems sparse, labored, and agrammatic (missing important grammatical morphemes)	Using long, complicated utterances that do not make much sense, full of neologisms or nonsense words
Comprehension appears reasonable	The words seem to require revision in their capacity to comprehend both the speech of others and their own output
Broca's aphasics are acutely aware of their language problems	Individuals with Wernicke's aphasia lack awareness of their language impairment and may even exhibit denial of their illness
People with Broca's aphasia experience difficulties in interpretation	Wernicke's aphasics have much more comprehension problems. They may understand at least some words addressed to them but wander further and further astray as they respond.

3. Method

In doing research, the researcher applied qualitative-descriptive research as a type of research. The researcher works with friends in a team. Firstly, the researcher observed that language-handicapped persons have difficulties producing language. The researcher found eight people in Manggarai society categorized as disabled persons linguistically. Technically, the researchers found the subjects by visiting and approaching the subjects in the Area. The researchers met the subjects, interviewed them, and examined their ability to produce language; identified and justified their specific problems related to language disorders. By doing this procedure, the researchers feel certain that all respondents found in the field can represent the problems of language disorder, so the researchers chose these eight to become a sample of the handicapped population.

The researcher recorded the data by conducting interviews and asking the respondents to speak, read, and write certain sentences. It appeared that the respondents could not speak properly. After that, the researcher analyzed the data in order to find the reasons why those people have difficulties in producing proper language. In order to analyze the data, the researcher studied the theory of language disorder proposed by Sleeper [22]. Some theories of language disorder by certain experts helped the researchers find the answers to the problems that have been formulated in the previous part of the research; those are why people don't speak properly and what type of language disorder appears in the disabled person.

4. Findings and Discussion

Data Display on Linguistic Handicap

The data related to the types of linguistic handicaps discussed above can be seen in the table below (Table 2). Note that the data are collected from the field through observation, interviews, and questionnaires. The researcher met the subjects and, interviewed them, and examined their ability to produce language, identified and justified their specific problems related to language disorders. Table 2 below shows the data on linguistic handicaps performed by handicapped people in Manggarai society.

Table 2. Data display of linguistic handicap performed by handicapped people of Manggarai society

No	The Respondents			The Linguistic Problems		Annotation
	Name	Age	Address	Description	Category	
1	D. S. Jafry	16	Pau, Langke Rembong	Cannot articulate	Dysarthria	Autism
				Cannot write	Dysgraphia	
				Cannot read aloud	Dyslexia	
2	K. F. Ndolu	19	Wae Rana, Kota Komba	Cannot articulate	Dysarthria	Autism
				Cannot write	Dysgraphia	
				Cannot read aloud	Dyslexia	
3	Y. Hambut	20	Lada, Rahong Utara	Cannot articulate	Dysarthria	Autism
				Cannot write	Dysgraphia	
				Cannot read aloud	Dyslexia	
4	F.G. Eda	11	Cimpar, Wae Ri'i	Tend to speak quickly	Cluttering	Cluttering person
5	D. Odi	20	Pacar, Macang Pacar	Cannot speak fluently	Stammering & Stuttering	Stammering person
				Cannot read smoothly		
6	S. N. Gampung	17	Lempe, Langke	Cannot read	Dyslexia	Dyslexic person

Rembong						
7	M. F. Jema	23	Golo Dukal, Langke Rembong	Mispronounce certain letters	Lisp	Lisper
8	M. F. Kurniawati	13	Nunang, Sano Nggoang	Cannot articulate Cannot speak properly Cannot read	Dysarthria Stammer Stuttering	Dysarthria, stammering, stuttering person

4.1 The Case of Stammering and Stuttering

D. Odi is a student of the English Study program. She needed help in speaking fluently. It happens particularly when the words are initialized with consonant sounds. Odi experiences challenges initiating speech due to disturbances in breathing, vocalization, and articulation, encompassing the functions of the throat, palate, tongue, lips, and teeth. When the event occurred to Odi, she must be helped by touching her back to be fluent. She may make certain movements in her hands. The Odi may be an example of a stuttering person, as stated by Sleeper [22]. Stuttering is a speech problem characterized by the repetition and extension of words, sounds, and syllables, which disrupts fluency. A person with a stutter fails the speaking test. Affected in Odi's speech are irregular rhythm, distorted articulation, and fluency. Truncating syllables, repeating phrases, and omitting or misarticulating sounds are possible.

4.2 The Case of Aphasia

The observers did not detect a person with Aphasia during their observation. Nonetheless, Aphasia is associated with stroke patients. The affected individual may experience challenges with language expression (speaking), language comprehension, or both of them. Damage location and magnitude are determinants of the severity of this medical condition. Aphasia may progress or deteriorate over some time; however, it can occasionally be irreversible.

4.3 The Case of Cluttering

That is F.G. Eda. He is 11 years old. He needs help to produce words. He tends to speak quickly in order to overcome his cluttering. He may be able to speak more quickly than more slowly. His speech is hindered by his tendency to speak too rapidly, which causes irregular rhythm and distorted articulation.

Moreover, sounds may be omitted or misarticulated, consonants might be truncated, and words may be repeated. Eda is an example of a cluttering person. Ward [21] stated that congestion impairs the individual's fluency, leading to accelerated speech with distorted articulation and irregular rhythm. A cluttering syndrome is distinguished by either an abnormally rapid or irregular speech delivery or both.

4.4. The Case of Autism

That is D. S. Jafri. He is sixteen years old. He is always alone. His hobbies are reading books and listening to music. He cannot articulate words and sentences. He is often mute and uses uncommunicative language. Jafri is one example of an autistic person. Besides that, [1] and [24] said that Autism is a syndrome characterized by a withdrawal from conversations with other people; it appears to be caused by a physical dysfunction of the brain and is more prevalent in men than in females. Due to their linguistic withdrawal, autistic children may harbor an aversion towards language that humans use. Individuals with autism cannot establish connections between their knowledge and linguistic activities. Although they may possess a low IQ, individuals may have exceptional abilities in music and painting.

4.5. The Case of Lisp and Dysarthria

That is M. F. Jema. She is twenty-three years old. Jema cannot pronounce the letter 'r' in Indonesian. She is an example of lisper. As an articulation disorder, lisp is characterized by the individual pronouncing the English letters "z" and "s." [25]. In severe instances, the individual may experience tongue protrusion from the oral cavity while articulating specific letters, such as when generating the theta [θ] phoneme. Additionally, a lisp may result from hearing loss, defects in the structure or dentition of the mouth, or a cleft palate. In doing observation, the observers found four persons suffer from dysarthria they are, D. S. Jafry (16), K. F. Ndolu (19), M. F. Kurniawati (13), and Y. Hambut (20). They cannot articulate words, phrases, or sentences. Consonant articulation errors contribute to their sluggish, swollen, and difficult-to-understand speech. Dysarthria is a speech impediment caused by a specific brain injury-related weakness or failure of the muscles of the face, mouth, and respiratory system. Dysarthria is caused by muscle weakness or disorder in the face, mouth, and respiratory system, which is specifically the result of an injury to the brain.

4.6 The Case of Apraxia

The observers were unable to locate the individual affected by this particular case. Apraxia is a speech motor condition resulting from brain injury affecting the areas responsible for speech production. Individuals afflicted with this ailment experience difficulty articulating their intended message accurately and consistently. Consequently, there are instances when they express themselves in a manner inconsistent with their original intention. Additionally, individuals need help with the cadence and synchronization of verbal communication [19].

4.7 The Case of Dysgraphia

Although it is common for many individuals to have subpar handwriting, dysgraphia is a more severe condition. The term dysgraphia is sometimes linked to dyslexia. However, it is possible to have a reading disability without writing problems, and both can exist. The observers found three persons related to this illness: D. S. Jafri, K. F. Ndolu, and Y. Hambut. When writing, individuals may occasionally exhibit letter or number reversals, write words in reverse, write letters in a non-sequential manner, and have untidy handwriting. Dysgraphia is a learning condition characterized by challenges conveying thoughts through writing and graphs. Consequently, these challenges impede the individual from writing at a fast pace in order to prevent mistakes.

4.8 The Case of Dyslexia

Dyslexia is a broad term occasionally used to refer to any persistent difficulty in acquiring reading skills, such as struggles in recognizing letter forms and phrases [26]. The observers found four persons suffering from this illness: S. N. Gampung, Y. Hambut, D. S. Jafry, and K. F. Ndolu. They encounter challenges in various reading-related tasks, including phonological awareness (identifying or generating rhyming words), counting syllables in words, hearing and manipulating sounds in words, phonological processing (distinguishing different sounds in words), learning the sounds of letters (phonics), remembering names and shapes of letters, rapidly naming letters, and transposing the order of letters. Dyslexia is a neurologically based specific learning disability characterized by challenges with spelling and decoding abilities as well as difficulties with accurate and fluent word recognition [26]. These challenges generally arise due to an unexpected deficiency in the phonological aspect of language, which is not correlated with other cognitive skills or the implementation of successful classroom instruction. The consequences may include diminished reading experience and difficulties

with reading comprehension, both of which can hinder the development of vocabulary and fundamental understanding.

5. Conclusion

The focus of the study is on language disorders performed by disabled persons. Language disorder is a serious abnormality underlying the use of spoken, written or signed language. Many language disorders result from damage to an area of the brain responsible for linguistic processing, but some have no clear physical cause. In studying language disorders, the researchers observed that language-handicapped people have difficulties producing language. It appeared that the people could not speak properly. Researchers recorded the data by doing interviews and asked them to speak, read, and write certain sentences. After that, the researchers analyzed the data in order to find the reasons why those people have difficulties in producing proper language. Then, the researchers studied the theory of language disorder. Some theories of language disorder by specific experts helped the researcher find the answers to the problems that have been formulated in the previous part of the research; those are why people don't speak properly and what type of language disorder appears in the disabled person.

The results of the study showed that out of the ten language disorders stated by experts, almost appeared in eight language-handicapped people were investigated in the field, even though some of the subjects had more than one problem. The researchers concluded that the language disorder found in the subjects is related to the problem in their brain, but not because of a physical accident; it may be such a damaged brain.

Considering the research results, the researchers want to deliver some suggestions or recommendations for future research on the same subject. Those are as follows. The next researcher who is interested in studying language production may continue to do more research on handicapped persons. To find a complete and accurate study result, you may also consult with an expert in neurology subjects or neurolinguistics. To help the linguistically handicapped person, it is important to study their problem in producing language, analyze the problems, consult with experts in linguistics and neurology, and help the handicapped regularly step by step to improve their linguistic ability.

The result of the investigation must be supported by more medical studies on the nervous system of the brain in order to see the relationship between language and the brain, language disorder and the damage in the brain, and language comprehension or production and the damage to the brain.

References

- [1] N. Oesch, "Social Brain Perspectives on the Social and Evolutionary Neuroscience of Human Language," *Brain Sci.*, vol. 14, no. 2, pp. 1–24, 2024, doi: 10.3390/brainsci14020166.
- [2] B. Mariani *et al.*, "Prenatal experience with language shapes the brain," *Sci. Adv.*, vol. 9, no. 47, pp. 1–7, 2023, doi: 10.1126/sciadv.adj3524.
- [3] A. D. Friederici, "The brain basis of language processing: From structure to function," *Physiol. Rev.*, vol. 91, no. 4, pp. 1357–1392, 2011, doi: 10.1152/physrev.00006.2011.
- [4] N. Dronkers and J. Ogar, "Brain areas involved in speech production," *Brain*, vol. 127, no. 7, pp. 1461–1462, 2004, doi: 10.1093/brain/awh233.
- [5] J. Abutalebi, P. A. D. Rosa, A. K. C. Gonzaga, R. Keim, A. Costa, and D. Perani, "The role of the left putamen in multilingual language production," *Brain Struct. Funct.*, vol. 125, no. 3, pp. 307–315, 2013, doi: 10.1016/j.bandl.2012.03.009.
- [6] A. Pitkäniemi *et al.*, "Hodological organization of spoken language production and singing in the human brain," *Commun. Biol.*, vol. 6, no. 1, pp. 1–12, 2023, doi: 10.1038/s42003-023-

- 05152-y.
- [7] M. Parpiyeva and M. Jurayeva, "Problems of Linguoculturological and Neurolinguistic Study of Phonetic Means," *Am. J. Philol. Sci.*, vol. 03, no. 02, pp. 49–59, 2023, doi: 10.37547/ajps/volume03issue02-09.
- [8] S. Aglioti, A. Beltramello, F. Girardi, and F. Fabbro, "Neurolinguistic and follow-up study of an unusual pattern of recovery from bilingual subcortical aphasia," *Brain*, vol. 119, no. 5, pp. 1551–1564, 1996, doi: 10.1093/brain/119.5.1551.
- [9] S. Pinker, *The language instinct: The new science of language and mind*. London: Penguin Books, Ltd, 1997.
- [10] X. Du *et al.*, "Brain structure associated with automatic thoughts predicted depression symptoms in healthy individuals," *Psychiatry Res. - Neuroimaging*, vol. 232, no. 3, pp. 257–263, 2015, doi: 10.1016/j.psychres.2015.03.002.
- [11] K. C. R. Fox, R. N. Spreng, M. Ellamil, J. R. Andrews-Hanna, and K. Christoff, "The wandering brain: Meta-analysis of functional neuroimaging studies of mind-wandering and related spontaneous thought processes," *Neuroimage*, vol. 111, pp. 611–621, 2015, doi: 10.1016/j.neuroimage.2015.02.039.
- [12] E. Zurif, D. Swinney, P. Prather, J. Solomon, and C. Bushell, "An on-line analysis of syntactic processing in broca's and wernicke's aphasia," *Brain Lang.*, vol. 45, no. 3, pp. 448–464, 1993, doi: 10.1006/brln.1993.1054.
- [13] G. T. M. Altman, *The Ascent of Babel: An Exploration of Language, Mind, and Understanding*. Oxford: Oxford University Press, 1997.
- [14] O. Gosseries, H. Di, S. Laureys, and M. Boly, "Measuring consciousness in severely damaged brains," *Annu. Rev. Neurosci.*, vol. 37, pp. 457–478, 2014, doi: 10.1146/annurev-neuro-062012-170339.
- [15] L. R. Zhao and A. Willing, "Enhancing endogenous capacity to repair a stroke-damaged brain: An evolving field for stroke research," *Prog. Neurobiol.*, vol. 163–164, pp. 5–26, 2018, doi: 10.1016/j.pneurobio.2018.01.004.
- [16] A. A. Beharelle *et al.*, "Left hemisphere regions are critical for language in the face of early left focal brain injury," *Brain*, vol. 133, no. 6, pp. 1707–1716, 2010, doi: 10.1093/brain/awq104.
- [17] P. Pinel and S. Dehaene, "Beyond hemispheric dominance: Brain regions underlying the joint lateralization of language and arithmetic to the left hemisphere," *J. Cogn. Neurosci.*, vol. 22, no. 1, pp. 48–66, 2010, doi: 10.1162/jocn.2009.21184.
- [18] J. B. Gleason and N. B. Ratner, *Psycholinguistics*. Fort Worth: Harcourt Brace Jovanovich College Publishers, 1993.
- [19] W. Lanier, *Speech Disorders*. New York: Gale, Cengage Learning, 2010.
- [20] D. Ward, *Stuttering and Cluttering: Frameworks for Understanding and Treatment*. New York: Psychology Press, 2006.
- [21] A. A. Sleeper, *Speech and Language*. London: Taylor & Francis, 2007.
- [22] T. Hutchins *et al.*, "Mean Length of Utterance (MLU)," *Encycl. Autism Spectr. Disord.*, pp. 1813–1814, 2013, doi: 10.1007/978-1-4419-1698-3_1110.
- [23] A. Ambalegin and F. Hulu, "Efl Learners' Phonological Interference of English Articulation," *JURNAL BASIS*, vol. 6, no. 2. Universitas Putera Batam, p. 145, 2019, doi: 10.33884/basisupb.v6i2.1415.
- [24] B. Indrarathne, "Accommodating Learners With Dyslexia in English Language Teaching in Sri Lanka: Teachers' Knowledge, Attitudes, and Challenges," *TESOL Q.*, vol. 53, no. 3, pp. 630–654, 2019, doi: 10.1002/tesq.500.