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Aphasia and Dysphasia: Language Loss and Language Impairment due to Lesions in the Brain

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ABSTRACT

This thesis begins by explaining the theoretical content of *aphasia*, which is a speech disorder that affects the production and comprehension of spoken language and is normally caused by strokes, infections, and head injuries. Aphasia tends to occur when a part of the brain that is responsible for language processing has been injured. Most people tend to process language in the left hemisphere, but this is not always the case. Depending on the area of the brain that has been damaged, the symptoms of aphasia can vary and affect the patients differently. Apart from that, all the different types of aphasias receive their names taking into account the specific areas of the brain that have been harmed. An analysis of five videos of different aphasics (English and Spanish aphasic with Broca's aphasia; English and Spanish aphasic with Wernicke's aphasia; and a bilingual aphasic) was carried out to prove that the theoretical characteristics of these different types of aphasias coincided with the observable symptoms of the patients. The results show that most of the observable symptoms that the patients presented coincide with those mentioned in the theoretical background, even though some variances have been found.

Keywords: aphasia, dysphasia, brain plasticity, language dominant hemisphere, Speech-Language Therapy (SLT)

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List of Abbreviations

AD	Alzheimer Disease
ASHA	American Speech-Language-Hearing Association
CA	Crossed Aphasia
fMRI	Functional Magnetic Resonance Imaging
MIT	Melodic Intonation Therapy
MTA	Mixed Transcortical Aphasia
NAA	National Aphasia Association
PPA	Primary Progressive Aphasia
SLPs	Speech-Language Pathologists
SLT	Speech-Language Therapy
TBI	Traumatic Brain Injury
TCMA	Transcortical Motor Aphasia
TIA	Transient Ischemic Attack
TSA	Transcortical Sensory Aphasia

Glossary

Term	Definition
Alzheimer's Disease	A brain disease of unknown cause that is the most common form of, […] that results in progressive memory loss, impaired thinking, disorientation, and changes in personality and mood, and that is marked histologically by the degeneration of brain neurons especially in the cerebral cortex and by the presence of neurofibrillary tangles and plaques containing beta-amyloid.
Amphetamine	(1) Psychostimulant drug that speeds up the messages travelling between the brain and the body.
Anomia	(2) A condition in which someone cannot remember words they want to use.
Basal ganglia	(3) Group of nuclei (clusters of neurons) in the brain that are located deep beneath the cerebral cortex (the highly convoluted outer layer of the brain). The basal ganglia specialize in processing information on movement and in fine-tuning the activity of brain circuits that determine the best possible response in a given situation (e.g., using the hands to catch a ball or using the feet to run).
Biological process	(4) The processes that are vital for an organism to live, and that shape its capacities for interacting with its environment. Biological processes are made of many chemical reactions or other events that are involved in the persistence and transformation of life forms.
Broca's aphasia	Caused by damage to Broca's area. Patients know what they

	want to say but encounter difficulties when putting their thoughts into words.
Closed head injury	(5) Closed head injuries are subdivided into concussion and contusion. The first one occurs when a notable blow to the head affects the normal functioning of the brain. The second one is a bruise of the brain tissue.
Cognitive	Of, relating to, being, or involving conscious intellectual activity (such as thinking, reasoning, or remembering).
Conduction aphasia	Caused by damage to the arcuate fasciculus. Patients present an inability to repeat words or phrases.
Crossed aphasia	In 1899, this term was used to talk about language impairments when the damage occurred in the ipsilateral hemisphere than the dominant hand. Nowadays, this term is used to refer to aphasia occurring after a lesion in the right hemisphere.
Dichotic	Relating to or involving the presentation of a stimulus to one ear that differs in some respect (such as pitch, loudness, frequency, or energy) from a stimulus presented to the other ear.
fMRI	(6) A procedure that uses MRI technology to measure and map brain activity by detecting changes in the brain's blood flow and oxygenation.
Global aphasia	Caused by damage to the complete perisylvian area of the left hemisphere. Patients are unable to pronounce words, to understand spoken language, to read and to write.
Hemorrhagic stroke	(7) Occurs when an artery in the brain causes a concentration of blood around the brain tissue; this concentration of blood is

	known as “hematoma”, and it increases the pressure of the brain tissue. Hemorrhagic strokes can be classified into *subarachnoid hemorrhage* and *intracerebral hemorrhage*. The subarachnoid hemorrhage means that the bleeding is in the subarachnoid space, whereas the intracerebral hemorrhage means that the bleeding is within the brain tissue
Herpes simplex encephalitis	Inflammation of the brain that is caused especially by infection with a virus (such as herpes simplex or West Nile virus) or less commonly by bacterial or fungal infection or autoimmune reaction.
Ictus	(8) A sudden attack or stroke.
Input (brain)	(9) Pertain to stimuli, objects, or data that cause action. In the human brain, the inputs are in the forms of external and internal stimuli. Sensory cells are primarily involved in inputs such as seeing, touching, hearing and tasting. Motor cells and some cells in the brain also serve as inputs.
Ischemic stroke	(10) Can be caused by *embolism* or *thrombosis*. The former occurs when a material that is floating in the arterial system blocks a blood vessel. The latter occurs when the blood flow cannot run through our circulatory system due to a blood clot that has originated inside a blood vessel.
Mixed transcortical aphasia	Caused by damage to the surrounding area of Broca’s and Wernicke’s areas. Patients encounter difficulties when producing speech but their ability to repeat words and read aloud remains intact.

Neologism	A new word, usage, or expression.
Neural networks	A computer architecture in which a number of processors are interconnected in a manner suggestive of the connections between neurons in a human brain and which is able to learn by a process of trial and error.
Neurodegenerative	Relating to or marked by degeneration of nervous tissue.
Open head injury	(11) Takes place when the skull is fractured, the meninges are ruptured, and the brain is penetrated.
Output (brain)	(12) Pertains to action or information caused by processing the input. In the human brain, the output pertains to activities that cause you to control both internal and external muscles. It also includes sensory perception, decision-making, emotions, problem-solving, management of internal body functions such as heart rate, blood pressure, and temperature, and social behavior.
Paraphasia	Aphasia in which the patient uses wrong words or uses words or sounds in senseless combinations.
Perceptual learning	(13) Process by which the ability of sensory systems to respond to stimuli is improved through experience. Examples of perceptual learning include developing an ability to distinguish between different odors or musical pitches and an ability to discriminate between different shades of colors.
Piracetam	(14) A synthetic nootropic that may boost mental performance. Its positive effects on the brain seem more apparent in older adults, as well as people with mental impairment, dementia, or learning disorders, such as dyslexia.

Resonance	A quality imparted to voiced sounds by vibration in anatomical resonating chambers or cavities (such as the mouth or the nasal cavity).
Stroke	A disruption of the normal brain function caused by a pathological condition of the blood vessels. Strokes tend to occur when the brain does not receive enough blood flow.
Subcortical aphasia	Caused by damage to the basal ganglia, the thalamus, and the capsular white matter of the language-dominant hemisphere. The patients' speech is fluent, but they are unable to name objects, and they have a poor comprehension and repetition.
Thalamus	The largest subdivision of the diencephalon that consists chiefly of an ovoid mass of nuclei in each lateral wall of the third ventricle and serves chiefly to relay impulses and especially sensory impulses to and from the cerebral cortex.
Transcortical motor aphasia	Caused by damage to the frontal lobe. The patients' speech is non-fluent, but the phonology, grammar, lexicon, and semantics are not impaired.
Transcortical sensory aphasia	Caused by damage near the temporal-parietal-occipital areas. Patients have fluent speech, but the content of their message is empty.
Trauma	A serious injury to a person's body.
Wernicke's aphasia	Caused by damage to Wernicke's area. Patients have trouble with understanding speech, their speech is fluent, but it lacks meaning.
White matter	Neural tissue especially of the brain and spinal cord that consists

	largely of myelinated nerve fibers bundled into tracts, has a whitish color, and typically underlies the cortical gray matter.

Note. The definitions of all the different types of aphasias have been written by me, taking into account the theoretical background of my thesis. Then, the majority of the other definitions have been taken from the Merriam-Webster online dictionary (https://www.merriam-webster.com/). The definitions that have not been taken from the Merriam-Webster online dictionary have been retrieved from the following sources:

(1) https://adf.org.au/drug-facts/amphetamines/,

(2) https://dictionary.cambridge.org/es/diccionario/ingles/anomia,

(3) https://www.britannica.com/science/basal-ganglion,

(4) https://en.wikipedia.org/wiki/Biological_process,

(5) https://www.researchgate.net/publication/266558490_Aphasia_Handbook (p. 37),

(6) https://www.dictionary.com/browse/fmri,

(7) https://www.researchgate.net/publication/266558490_Aphasia_Handbook (p. 34-35),

(8) https://www.collinsdictionary.com/dictionary/english/ictus,

(9) https://human-memory.net/brain-network-system/,

(10) https://www.researchgate.net/publication/266558490_Aphasia_Handbook (p. 34),

(11) https://www.researchgate.net/publication/266558490_Aphasia_Handbook (p. 37),

(12) https://human-memory.net/brain-network-system/,

(13) https://www.britannica.com/topic/perceptual-learning,

(14) https://www.healthline.com/nutrition/piracetam#TOC_TITLE_HDR_9,

1 Introduction

The main goal of this paper is to gain knowledge about aphasia and to analyze several cases of real patients. Aphasia is a speech disorder that causes difficulties when it comes to producing language and understanding spoken language due to lesions in the brain (Merriam-Webster Dictionary, n.d.).

In the first section of my thesis, which is the theoretical background, I have collected theoretical information about the following key aspects regarding aphasia: the concept of brain plasticity and how it changes with age; the concept of cross-wired brains and handedness, which is a crucial factor to determine which the language-dominant hemisphere is; the causes of aphasia; the types of aphasia; the definition of dysphasia and its differences comparing it with aphasia; and Speech-Language Therapy, which is the most common treatment for aphasia.

The purpose of my thesis is to relate all the aspects of the theoretical background that can be seen above to practical and real cases of aphasics to see if the theory mirrors the reality of people who suffer from this condition. My study begins in the method section, in which I explain the materials and the procedure that I followed to carry out the analysis of the patients. The next sections are the results, in which I describe all the observable symptoms and significant characteristics of the patients, taking into account their production and their comprehension of spoken language; then the discussion, in which I comment if there are any variances between the theory and the practical cases; and finally, the conclusion.

1.1. Plasticity of the brain and age

1.1.1. What does “brain plasticity” mean?

Kolb (1995) defined *brain plasticity* as the brain’s capacity to change its structure and its function throughout our lives. The plasticity of the brain allows it to adapt itself to

environmental changes and changes within the organism (p. 4). The brain's plasticity can also change with experience. These changes can be self-evident or subtle. A self-evident change could be the acquisition of specific pieces of information, whereas a subtle change could be perceptual learning (Kolb, 1995, p. 5).

Experience includes external events and internal events, such as the effects of injury, aging, development, and thoughts (Kolb, 1995, p. 1). When the brain changes its structure and function due to experience, the nervous system is enabled to learn and remember information (Kolb, 1995, p. 5).

Brain plasticity is divided into two dimensions: *neural plasticity* and *functional plasticity*. Neural plasticity is the way the brain adapts to the environment; it is associated with biological processes. Functional plasticity is the way the brain responds to injuries, including changes in its behavior and the recovery process (Anderson, Spencer-Smith, & Wood, 2011, p. 2204; Kozlowski & Schallert, 1998, p. 89).

The brain is pliable throughout its lifetime, but its plasticity is more evident during development. As we get older, neurons die, and they cannot be replaced. However, we will not notice an important cognitive loss for decades because the brain changes its structure to compensate for this neuron loss (Kolb, 1995, p. 5).

1.1.2. How does the brain respond to injury?

When the brain is injured, it has to reorganize to restore the behaviors that have been lost (Kolb, 1995, p. 5). The brain can respond to injury in at least three ways. The first response is a compensation to adapt to the loss; it is the substitution of a new behavior to compensate for the lost one. However, it is crucial to know that this compensation does not mean a complete return of the lost function (Kolb, 1995, p. 41).

The second response is a partial restoration of the original behavior. If the behavior returns after some months, the restoration is more likely to be partial. This is the case of patients who present an important language impairment. For example, if a patient has severe difficulties moving the tongue or the mouth in order to produce speech, these symptoms may partly disappear and the patient would only have a mild language impairment, such as anomia (Kolb, 1995, p. 41).

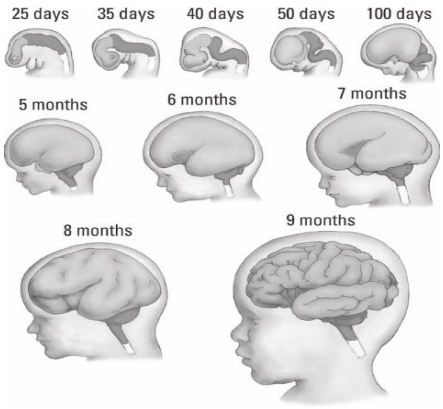
The third response is a complete restoration of the lost behavior. It is said that even though this option is theoretically possible, it is the least common of the three mentioned above in laboratory animals and human patients. Therefore, the expected recovery must be a partial recovery of the lost function accompanied by substitution of it (Kolb, 1995, pp. 41-42).

1.1.3. How does the "adult brain" differ from the "infant brain"?

When the brain is in its developing phase before birth (see Figure 1), it has a primordial difference regarding the organization of the brain that we can observe in the adult and infant brain: the cortex is uniform because it lacks much of its cytoarchitecture, which is "the cellular makeup of a bodily tissue or structure" (Merriam-Webster, n.d. b), and connections that can be observed in the adult cortex. This explanation infers that the quality of brain plasticity is more obvious during development than later in life (Kolb, 1995, p. 22).

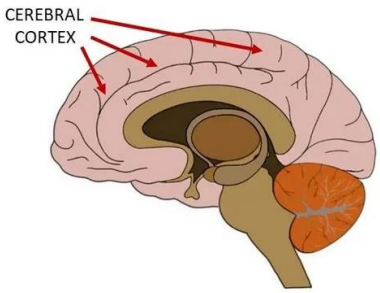
When the cortex (see Figure 2) is developing its adult input-output characteristics, the brain plasticity decreases, and it is restricted due to its gross connectivity. Once the general input-output organization of the brain has been established, it is more difficult to influence its connectivity and to reorganize it (Kolb, 1995, p. 22).

Figure 1 *The development of the brain before birth*



(Image retrieved from: https://www.researchgate.net/figure/Prenatal-development-of-the-human-brain-showing-a-series-of-embryonic-and-fetal-stages_fig2_227028480)

Figure 2 *Location of the cerebral cortex*



(Image retrieved from: https://neuroscientificallychallenged.com/posts/know-your-brain-cerebral-cortex)

1.1.4. Do infants recover better?

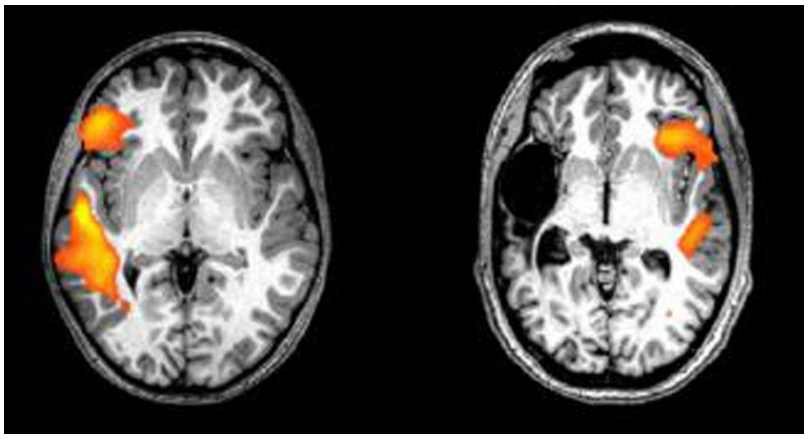
According to Kolb (1995), children who have suffered any type of damage to the language areas rarely develop aphasia later in life. Broca had also investigated this idea, and he found out that when children suffered any type of damage to Broca's area, they did not present aphasia afterwards (p. 76). It is especially complex to determine an exact age at which children do not develop aphasia after early brain injury. Although it is a debatable topic, Lenneberg (1967, as cited in Kolb, 1995, p. 76) and Lidzba et al. (2017) seem to emphasize that the age of 5-years is important for children suffering from a brain injury before and after the age of 5. Children below 5-years-old seem to fully recover their lost language functions or

seem to transfer their language center to the contralateral hemisphere (usually the right hemisphere). On the other hand, children who are older than 5-years-old do not tend to fully recover their lost language functions and they still have to deal with moderate or severe language impairments (Lidzba et al. 2017, p. 717).

Lenneberg (1967, as cited in Kolb, 1995, p. 76) also suggested the idea that language processes in the left hemisphere developed fast from ages 2-5 years, and then these language processes were slowed until puberty, when the development phase is already completed. Lenneberg thought that it would be possible to transfer the language functions to the right hemisphere if the damage in the brain took place during the development phase, and chronic aphasia would not be present. If the damage occurs after the development phase, the reorganization of brain functions is practically impossible, and the expectation for recovery is low (Kolb, 1995, pp. 76-77).

Newport (2018) also supports the idea of the language processes shifting from the damaged hemisphere to the intact hemisphere, as she states that people who have a left-side stroke just before or after birth have a full recovery of their language abilities, whereas if the same type of stroke is experienced in adulthood, the patients tend to present difficulties when producing and understanding language. Figure 3 shows an fMRI of the brain activity of a healthy person (left) and a stroke survivor (right) while doing a language-related task. As we can see, the areas of the brain that are responsible for producing and understanding language have shifted, as the healthy person processes language in the left hemisphere and the person who has had a stroke early in life does it in the right hemisphere.

Figure 3 *FMRI shows that language-processing areas can be shifted from the left hemisphere to the right hemisphere in babies who suffer a stroke*



(Image retrieved from: https://www.sciencenews.org/article/babies-language-brain-stroke)

Kolb (1995) also stated that children who suffered frontal lobe injuries could present some recovery of function. However, their intelligence after injury might be debilitated. Kolb also adds that children who have an early brain injury usually experience seizure disorders (epilepsy), whereas the development of this condition is not very common among adults (p. 80).

Critical periods during development also play a key role in children having either good or poor outcomes after an early injury. Critical periods are known as phases in which the neural networks are highly affected by environmental influences, which could be learning and instruction. It is believed that brain plasticity is increased during these periods (Anderson, Spencer-Smith, & Wood, 2011, p. 2200; Hensch, 2004, p. 550).

Even though the question of whether children have a better recovery than adults is complicated to answer, we certainly know that good and poor recovery depend on several factors: nature, size and location of the lesion, age at injury, gender, and environment (Anderson, Spencer-Smith, & Wood, 2011, p. 2209; Dennis, 2010, p. 1043). Although babies can function normally for months after they have suffered an early injury, their development

in adolescence can be severely affected by the apparition of deficits once they have more responsibilities to take care of, such as homework or planning daily activities (Anderson, Spencer-Smith, & Wood, 2011, p. 2206; Eslinger, Biddle, Pennington, & Page, 1999; Anderson & Moore, 1995).

1.2. Cross-wired brains and language centers for left-handed people

Before developing the contents of this section, it is important to note the function of the brain areas that will be constantly repeated throughout this section.

According to Friederici (2017), the *gray* and the *white matter* are responsible for all the cognitive abilities, among which we find language (p. 5). The brain is divided into the *right hemisphere* and the *left hemisphere*. The right hemisphere processes prosodic information, for example, the melody and intonation of a sentence, and other functions that are not related to syntax or semantics, such as spatial and face recognition, sense perception, emotions, and artistic functions. On the other hand, the left hemisphere processes the lexical and syntactic functions among other functions, such as mathematical, analytical, and logical processes (Friederici, 2017, pp. 16, 81; Mastin, 2012). Both hemispheres are connected by the *corpus callosum*, which makes the syntactic and the prosodic information interact (Friederici, 2017, p. 225).

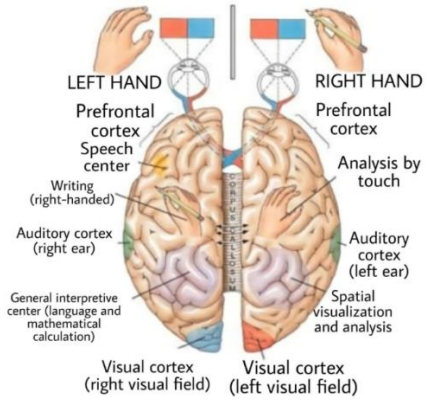
1.2.1. Cross-wired brains

The fact that the human brain is cross-wired means that the left hemisphere controls the movement of the right side of the body and the right hemisphere controls the movement of the opposite side (Mastin, 2012). From an anatomical point of view, cross-wiring in the human brain happens because all the nerve tracts in our central nervous system connect to the

contralateral sense organ or limb in the opposite hemisphere in the brain (Vulliemoz, Raineteau, & Jabaudon, 2005, p. 87).

Apart from movement, the auditory and visual inputs that humans receive through the eyes and ears are processed on the opposite side. That is to say, the image that the right eye sees is processed by the left visual cortex and vice versa (Vulliemoz, Raineteau, & Jabaudon, 2005, p. 87). Figure 4 shows how movements and the processing of visual and auditory information takes place in the same area (visual cortex, auditory cortex, etc.) but in the contralateral side of the brain.

Figure 4 *Cross-wired brains and the location of the visual, auditory and motor processing*



(Retrieved from: https://www.rightleftrightwrong.com/brain.html)

The *dichotic listening test* serves as evidence of the fact that brains are cross-wired and shows that language dominance in the left hemisphere is more common. The dichotic listening test supports the idea that anything that is perceived by the right side of the body will be decoded in the left hemisphere. If someone has earphones on and listens to two different words at the same time (one coming through the left ear and the other through the right ear), the individual would probably first identify the word that was perceived by the right ear, as it would be sent and processed in the left hemisphere (Yule, 2014, pp. 161-162).

Basically, the signals that are perceived by the left ear are sent to the right hemisphere and then to the left hemisphere, whereas the signals that are perceived by the right ear are sent directly to the left hemisphere. This is known as the *right ear advantage* (Yule, 2014, pp. 162-163).

1.2.2. Language dominant hemisphere and handedness

Friederici (2017, p. 8) and Knecht et al. (2000, p. 2512) state that the dominant hemisphere for language in most people is the left hemisphere. However, this is not always the case. Knetch et al. (2000) assure that handedness is a crucial factor to determine which is the dominant hemisphere (p. 2512).

Since the 19th century, when Paul Broca identified some language regions located in the left hemisphere in right-handed individuals, people started to think that the opposite view could be possible, that is to say, left-handed individuals showing a language dominance in the right hemisphere (Knetch et al., 2000, p. 2512). Nevertheless, Luria was one of the first neuropsychologists to say that this idea could not be 100% true since left-handed people could develop some form of aphasia even if the site of the lesion was in the left hemisphere (Luria, 1976, as cited in Knetch et al., 2000, p. 2512). Nowadays, our knowledge about the relationship between handedness and the language dominant hemisphere is achieved through studies of neurological patients.

Functional Transcranial Doppler ultrasonography (fTCD) is a new technique that has been used to confirm an existing relationship between handedness and the dominant hemisphere for language in healthy people. FTCD measures the velocity of the cerebral blood flow within the middle cerebral arteries, and it is very similar to fMRI in its functioning (Knetch et al., 2000, p. 2513; Deppe et al., 2000, p. 263-264).

Knetch et al. (2000) conducted a study in which they used the fTCD technique to measure lateralization in 326 healthy patients. As can be seen in Table 1, the results showed that as the incidence of right-hemisphere dominance increased, the degree of left-handedness also increased. The percentage of right-hemisphere language dominance increased from 4% in strong right-handed patients to 15% in ambidextrous patients and to 29% in strong left-handed patients (pp. 2512-2513).

Table 1 *Right-hemisphere dominance in parental left-handedness*

	Handedness of subject					
	-75 or lower (strong left-handers)		*Between –76 and 75*		*75 or higher (strong right-handers)*	
	+	-	+	-	+	-
Parental left-handedness *N*	14	43	13	88	10	145
Degree of handedness, median (quartiles)	-100 (-100, -90)	-100 (-100, -90)	-60 (-60, 50)	-10 (-52, 42)	100 (100, 100)	100 (89, 100)
Right-hemisphere language dominance (%)	29	23	15	17	10	4

Note. The degree of handedness has to be seen as a measure represented by a spectrum, in which –100 would represent strong left-handers and +100 would represent strong right-handers (from Knetch et al. (2000), p. 2513).

Apart from the data that Knetch et al. (2000) collected in their study, Acharya and Wroten (2021), and Mastin (2012) assure that between 60% to 70% of left-handers show a left-hemisphere language dominance. Therefore, even though it is true that left-handers are more likely to process language in the right hemisphere than right-handers, most of the left-handers show a language dominance in the left hemisphere, similar to the majority of right-handers.

1.2.3. Crossed aphasia

Another concept that is relevant when talking about handedness and the dominant hemisphere for language is *crossed aphasia* (CA). According to Coppens, Hungerford, Yamaguchi, and Yamadori, crossed aphasia was first defined by Bramwell in 1899, and this concept was used to talk about language impairments when the damage occurred in the hemisphere generally associated with the dominant hand. Nowadays, this term is only used to describe aphasia when a right-handed person has suffered a lesion in the right hemisphere (2002, pp. 425-426).

Patients who suffer from crossed aphasia can have the same exact symptoms as people who suffer from aphasia due to a lesion in the left hemisphere. However, people with crossed aphasia could experience several unique symptoms. There are two subtypes of crossed aphasia: the *mirror-image CA* and the *anomalous CA*. The former is used to define aphasia when the symptomatology could also be experienced in aphasics with similar cerebral damage in the left hemisphere, whereas the latter is used to define aphasia when the symptomatology of a similar lesion in the right hemisphere would not be the same (Alexander, Fischette, & Fischer, 1989, as cited in Coppens, Hungerford, Yamaguchi, and Yamadori, 2002, p 427).

1.3. Causes of aphasia

If we look for the definition of aphasia in the Merriam-Webster Dictionary (n.d. a), we will find the following: “loss or impairment of the power to use or comprehend words usually resulting from brain damage (as from a stroke, head injury, or infection)”. In other words, any lesion to the brain can cause aphasia. Normally, what we understand as a lesion is any abnormality that affects the tissue of the brain, either caused by disease, stroke, or injury (Cleveland Clinic, 2018).

According to Ardila (2014), the causes of aphasia are: strokes, traumatic brain injuries, tumors in the brain, brain infections and neurodegenerative diseases. Strokes and traumatic brain injuries are considered the two most major causes of aphasia, the other mentioned etiologies can develop into some form of aphasia, but they are not seen as primordial causes (p. 44).

1.3.1. Stroke

A stroke, also known as "cerebrovascular disorder", is a disruption of the normal brain function caused by a pathological condition of the blood vessels. Strokes occur when the brain does not receive enough blood flow, the cause of it can be either a clot or a blood vessel that is preventing blood flow to the brain. The most important types of strokes are *ischemic stroke* and *hemorrhagic stroke* (Ardila, 2014, p. 30).

As noted earlier, strokes are one of the major causes of aphasia. As a matter of fact, one third out of 25.7 million people who are stroke survivors develop some form of aphasia after the incident (Ali et al., 2021, p. 1778) which would represent 33% of stroke survivors.

1.3.2. Traumatic brain injury

Traumatic brain injuries (TBI) take place when an emergent trauma damages the brain. TBIs occur when the head has been hit by an object violently, such as in a car accident, or when an object penetrates the skull and goes inside the brain tissue, such as in a gunshot wound. Aphasia is usually a consequence of a TBI if it has damaged any of the areas in the brain that are related to language. TBIs are divided into *closed* and *open* (Ardila, 2014, pp. 35-36, 38).

1.3.3. Tumor

A tumor originates with the creation of abnormal cells or with the sudden growth of a significant number of cells. If a tumor occurs inside the brain, it is called "primary brain

tumor". If the tumor is an accumulation of cancerous cells in the brain that have come from another part of the body, it is called "metastatic brain tumor" (Ardila, 2014, p. 38).

According to Shafi and Carozza (2012), the approximate percentage of people who experience aphasia resulting from a brain tumor lies between 30 and 50.

1.3.4. Infections

Infections occur when pathogenic micro-organisms such as viruses, bacteria, fungi, and parasites enter our bodies. Such infections interfere with cerebral blood flow; they influence the brain tissue in the sense that they alter the metabolic capacity of the cells and the characteristics of the cell membrane (Ardila, 2014, p. 40).

One of the most significant infections that can cause aphasia is *herpes simplex encephalitis* (virus); if the virus damages the cortical or subcortical regions of the brain, the patients may have difficulties expressing themselves because they struggle with word-finding (Ku, Lachmann, & Nagler, 1996, p. 170).

1.3.5. Neurodegenerative diseases

Among all the neurodegenerative diseases, Alzheimer's Disease (AD) is the most likely to result in aphasia. A person with Alzheimer's can experience a wide range of language impairment symptoms associated with degenerative aphasic syndromes if the AD has damaged any area of the brain that is responsible for the production and understanding of speech (Teichmann & Ferrieux, 2013, pp. 681-682). The type of aphasia that people with dementia suffer is known as "primary progressive aphasia" (PPA). PPA is characterized by the difficulty of remembering the names of objects and by the incorrect use of word endings, verbs tenses, conjunctions, and pronouns. These symptoms tend to appear gradually, and they usually aggravate over the years (Ardila, 2014, p. 43; Mesulam, 2001, p. 425).

1.4. Types of aphasias

When people think about aphasia, they usually believe that there are only two types: Broca's aphasia and Wernicke's aphasia. This could be because these two types are the most famous ones and the ones that appear if we do a simple internet search. However, there are other types of aphasia, which will be explained below along with Broca's and Wernicke's.

1.4.1. Broca's aphasia

In the 1860s, Paul Broca discovered that damage to the "anterior speech cortex" commonly known as Broca's area (see Figure 5), located in the left hemisphere, could result in having difficulties when producing spoken language. Broca's discovery helped shape the theory that the left hemisphere was closely related to language ability (Yule, 2014, p. 156).

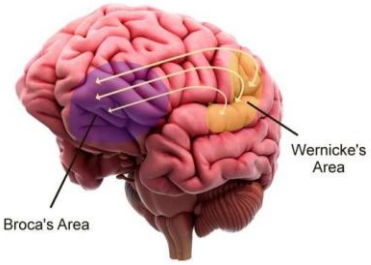
The most challenging event that people with Broca's aphasia experience is the difficulty of putting their thoughts into words. Patients know exactly what they want to say, but they struggle when they have to convert their mental images into spoken language (Acharya & Wroten, 2021). Their speech is non-fluent, slow, and interrupted with pauses; it is mainly built up with lexical words (nouns, adjectives, and verbs) and tends to lack grammatical words (articles, pronouns, and conjunctions). This type of speech is referred to as "agrammatical", meaning that they omit the basic grammatical markers (Yule, 2014, p. 160).

1.4.2. Wernicke's aphasia

In the 1870s, Carl Wernicke discovered that damage to the "posterior speech cortex", commonly known as Wernicke's area (see Figure 5), could result in difficulty to understand speech. Wernicke's discovery confirmed that the left hemisphere is responsible for the production of speech and that Wernicke's area is a crucial part of the brain which is responsible for speech comprehension (Yule, 2014, p. 156).

People who suffer from Wernicke's aphasia have trouble with speech comprehension. Their speech is fluent, and they tend to build grammatically correct sentences. Nevertheless, their speech lacks sense and meaning, and they tend to fill it with irrelevant or non-existent words, which hinder communication. Contrary to Broca's aphasia, patients who suffer from Wernicke's aphasia are not aware that they have a problem, sometimes they do not realize that the content of their speech lacks sense (National Aphasia Association, n.d.). Besides that, people with Wernicke's aphasia struggle with understanding what others are saying. If the speaker uses short sentences and simple words, it will be easier for them to understand. However, if the speaker uses too many words, makes the conversation last for more than 15-20 minutes, and changes the topic of the conversation, the patients' comprehension will decrease significantly (Ardila, 2014, p. 63).

Figure 5 *The location of the Broca's and Wernicke's language areas*



(Image retrieved from: https://www.researchgate.net/figure/Brocas-Area-Vs-Wernickes-Area-Source_fig1_256001173)

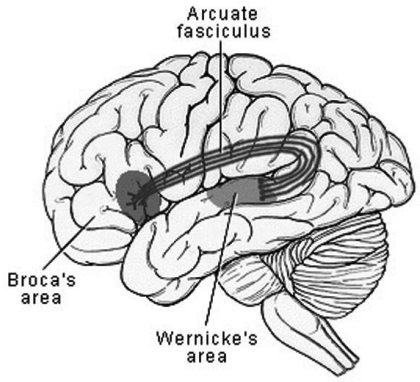
1.4.3. Conduction Aphasia

Wernicke stated that if there is a disconnection between the Broca's and Wernicke's areas, a conduction aphasia could develop. These two speech areas are connected by the *arcuate fasciculus* (see Figure 6); therefore, any damage to the connection, or the arcuate fasciculus, can lead to this aphasia (Acharya & Maani, 2021).

The most notorious symptom of this type of aphasia is the inability to repeat words or phrases. Their speech tends to be fluent, their articulation is good, and their comprehension is

not damaged. However, they might interrupt the rhythm of their speech with pauses and hesitations. Another common symptom is the mispronunciation of words (Yule, 2014, p. 161).

Figure 6 *The arcuate fasciculus as a connector of the Broca's and Wernicke's areas*



(Image retrieved from: https://www.researchgate.net/figure/Classical-representation-of-the-arcuate-fasciculus-connecting-Brocas-and-Wernickes_fig11_295856844)

1.4.4. Transcortical sensory aphasia

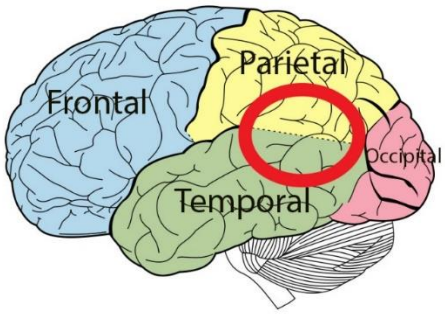
When the term "sensory" is used to describe a type of aphasia, it means that the patients do not present any difficulty in their articulation, but rather struggle with understanding written or spoken language (Byeon & Koh, 2016).

Transcortical sensory aphasia (TSA) is considered as a subclass of Wernicke's aphasia. It occurs when there is a lesion in the left hemisphere, especially near the temporal-parietal-occipital areas (see Figure 7). People who are diagnosed with this type of aphasia have the following symptomatology: their speech is fluent; it contains many verbal paraphasias and neologisms but the content of their speech is empty (Chantsoulis et al., 2016, p. 390). Butterworth (1979) carried out a study in which he analyzed the use of paraphasias and neologisms in the speech of a person with aphasia. In the following sentence: "I would *interm* league er barrack stuff then", the word "interm" is a neologism because the word does not exist in the English language. The words "league" and "barrack" are paraphasias because

even though they exist in the English language, they do not make sense in this context (p. 138).

Apart from that, they are good at repeating words or sentences, even if they are pronounced wrong or are in a foreign language (Chantsoulis et al., 2016, p. 390). People with TSA can also experience difficulties regarding their ability to read aloud, understand what they read, and write (Ardila, 2014, p. 82).

Figure 7 *The temporal-parietal-occipital region*



(Image retrieved from: https://commons.wikimedia.org/wiki/File:Temporoparietal_junction_diagram.jpg)

1.4.5. Transcortical motor aphasia

As opposed to sensory aphasia, when the term "motor" is used, it means that the patients have trouble with the articulation of sounds; in other words, their ability to produce speech is impaired (Byeon & Koh, 2016).

Transcortical motor aphasia (TCMA) tends to occur when the frontal lobe of the brain (see Figure 7) suffers any type of lesion. Patients with TCMA experience the following symptoms: their speech is non-fluent, meaning that they encounter trouble when it comes to producing language (uttering words), but the phonology, grammar, lexicon, and semantics are not impaired. Apart from that, their ability to read aloud and write is also faulty. On the other hand, their ability to comprehend language and repeat words is not impaired (Ardila, 2014, pp. 85-87).

1.4.6. Mixed transcortical aphasia

Mixed transcortical aphasia (MTA) is probably the least common type of aphasia. The most striking fact about this aphasic syndrome is that both Broca's and Wernicke's areas remain healthy, whereas their surrounding areas are damaged (see Figure 8), leaving the two language areas isolated from the rest of the brain (Ardila, 2014, p. 87; Cauquil-Michon, Flamand-Roze, & Denier, 2011, p. 575).

Patients with MTA have severe problems when it comes to producing speech, they usually answer with single words, or they do not even utter a word. Their ability to write and understand spoken language is also severely impaired. However, in most cases, it has been shown that their ability to repeat words and read aloud remains intact, even though they do not understand what they read (Baumgaertner, 2015).

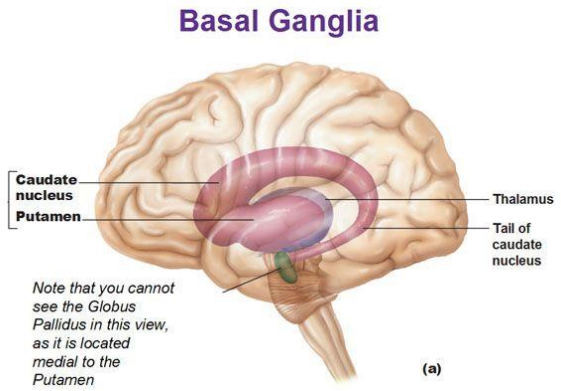
Figure 8 *The surrounding areas of Broca's and Wernicke's areas*

(Image retrieved from: https://www.psychdb.com/neurology/approach-aphasia)

1.4.7. Subcortical aphasia

Subcortical aphasia tends to emerge from damage to the basal ganglia, the thalamus, and the capsular white matter of the language-dominant hemisphere (see Figure 9). The characteristics of this type of aphasia vary depending on the location of the lesion; however, the most common ones are: inability to name objects, poor comprehension and repetition, fluent speech, and they can even present some visual and auditory impairments (Granadillo & Arciniegas, 2015).

Figure 9 *The basal ganglia and the thalamus*

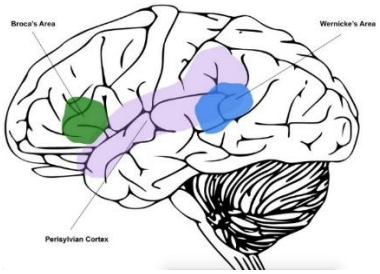


(Image retrieved from: https://www.pinterest.es/pin/475833516864332714/)

1.4.8. Global Aphasia

Global aphasia is the most severe type of aphasia. It is associated with damage to the complete perisylvian area of the left hemisphere (see Figure 10). This type of aphasia is considered to be a mixture of Broca's, Wernicke's, and conduction aphasia (Ardila, 2014, p. 94; Pai et al., 2011, p. 185). The two major causes of global aphasia are stroke and brain trauma. Global aphasics are unable to pronounce words and to understand spoken language. Their ability to read and write is also severely impaired. However, their intellectual and cognitive capabilities remain intact if these are not associated with language and speech (National Aphasia Association, n.d.).

Figure 10 *The perisylvian area*



(Image retrieved from: https://www.thenakedscientists.com/articles/science-features/mind-maps-tracking-language-across-brain)

1.4.9. Fluent vs Non-fluent Aphasia

All the different types of aphasia can be classified into two broad categories: fluent and non-fluent. The former means that the patients' speech flows easily but the message they want to convey lacks meaning, as in Wernicke's aphasia, conduction aphasia, transcortical sensory aphasia, and subcortical aphasia. On the other hand, the latter means that the patients' speech production is more difficult and halting but the message they want to convey is easier to understand, as in Broca's aphasia, transcortical motor aphasia, mixed transcortical aphasia, and global aphasia (Seladi-Schulman, 2020).

1.5. Differences between aphasia and dysphasia

Dysphasia is known as a speech disorder that causes trouble in the production and comprehension of spoken words. Dysphasics can also present some deficits when it comes to reading, writing, and gesturing (Vandergriendt, 2018). Among the causes of dysphasia, we can find strokes, which is the most common one, infections, head injuries, tumors, degenerative diseases, transient ischemic attacks (TIA), migraines, and seizures. The primordial difference among these different causes is the permanence that the brain damage has. If the apparition of dysphasia is due to TIA, migraines, or seizures, the damage tends to be temporary and the lost language functions can be recovered soon after the attack has been suffered. On the other hand, if the apparition of dysphasia is due to strokes, infections, head injuries, tumors, or degenerative diseases, the damage tends to be more permanent and severe (Vandergriendt, 2018).

1.5.1. Types of dysphasia

Dysphasia can be divided into three broad categories: *expressive types*, *receptive types*, and *global type*. If the type of dysphasia is expressive, it means that the patients have deficits

when it comes to producing speech, but their ability to understand others when they talk can remain intact. There are two subtypes of expressive dysphasia: Broca's dysphasia, and Transcortical dysphasia, which includes transcortical sensory dysphasia, transcortical motor dysphasia and mixed transcortical dysphasia (Vandergriendt, 2018; Danon-Boileau, 2005/2006, p. 22).

If the type of dysphasia is receptive, it means that the patients' ability to comprehend spoken language is impaired. However, they are able to speak, but their speech often lacks sense, and they usually think that others should be able to understand what they say. There are three subtypes of receptive dysphasia: Wernicke's dysphasia, Anomic dysphasia, and Conduction dysphasia (Vandergriendt, 2018; Danon-Boileau, 2005/2006, p. 23).

If the type of dysphasia is global, it means that the brain damage has extended to both language centers (Broca's and Wernicke's areas). Global dysphasics develop difficulties in both producing and understanding language (Vandergriendt, 2018).

1.5.2. Symptoms of dysphasia

The symptoms of dysphasia can vary from patient to patient, and often depend on the location and severity of the damage in the brain (Vandergriendt, 2018; Bel Marra Health, 2017). Table 2 shows the different symptoms that dysphasics can experience.

Table 2 *Symptoms of dysphasia*

Speaking symptoms	*Comprehension symptoms*	*Other symptoms*
Difficulty to find the words they need (anomia)	Trouble to understand others	Difficulty listening
Speaking slowly	Taking extra time to understand others	Difficulty writing or calculating
The utterances consist of only one word or are short sentences	Answer simple questions incorrectly	Difficulty with daily tasks (e.g., do the shopping or answer the phone)
The omission of grammatical words (articles, prepositions...)	Difficulty understanding complex grammar	

Making grammatical errors	Difficulty understanding fast speech
Incorrect word order	Difficulty to understand the meaning of words (e.g., taking figurative language literally)
Use words that lack sense	Not being conscious of making errors when they speak
The speech can be fluent, but its meaning is empty	

1.5.3. Aphasia vs. Dysphasia

The causes, symptoms and types of aphasia and dysphasia are the same. The most notorious difference is that aphasia is thought to be more severe, and it involves a complete loss of language functions, whereas dysphasia involves moderate or partial language impairments (Vandergriendt, 2018; Bel Marra Health, 2017). In fact, this is what the two prefixes indicate; the prefix *dys*- means "bad", "defective", or "other than it should be", whereas the prefix *a*- means a complete absence of the ability in question (Danon-Boileau, 2005/2006, pp. 20-21).

1.6. Treatment for aphasia

1.6.1. Speech-Language Therapy

Speech-Language Therapy (SLT) is the most known type of treatment for aphasia. SLT consists of the assessment and treatment of communication problems and speech disorders. The people who are in charge of assessing and treating speech disorders are *speech-language pathologists* (SLPs), but they are more commonly called speech therapists. The different techniques that are used in SLT are related to improving communication; and this includes articulation therapy and different activities related to language which can vary depending on the speech disorder that the patient has (Santos-Longhurst, 2019).

The first thing that a speech therapist has to do to treat a language disorder is assess it prior to deciding the type of treatment that will be most beneficial to the patient. The different activities and exercises that are done during SLT can be different if the patient is a child or an adult. For children, SLT is usually carried out in a classroom, either with more children who have the same language impairments or alone (Santos-Longhurst, 2019). The following list shows different activities that are normally used when doing SLT with children (Santos-Longhurst, 2019):

- Encourage them to talk through playing, using books, pictures, or other objects.
- Correcting the children's sounds and syllables in order to teach them how to articulate specific sounds.
- Teach parents/caregivers how to do SLT at home through strategies and homework.

As it happens with children, SLT for adults also have to be assessed by a speech therapist first before treatment. SLT activities for adults are oriented at improving their speech, language, and cognitive communication. Apart from doing exercises in SLT, therapy may also help the patients to train the action of swallowing if this function has been lost due to a medical condition such as Parkinson's disease (Santos-Longhurst, 2019). The following list shows different exercises that are normally used when doing SLT with adults (Santos-Longhurst, 2019):

- Activities to stimulate and improve cognitive communication. They are usually related to problem solving, memory, and organization.
- Teaching strategies to enhance social communication.
- Breathing exercises for resonance.
- Exercises to strengthen oral muscles.

According to Santos-Longhurst (2019), the amount of time that a person needs for SLT to be effective depends on individual factors such as age and type and severity of the language disorder, among others. It is believed that children who suffer from a speech disorder have more possibilities to improve their language deficits with age, whereas adults who try SLT tend to need long-term therapy to show an improvement.

1.6.2. Adding technology to SLT

The American Speech-Language-Hearing Association (ASHA) defined computer-based treatment as "the use of computer technology (e.g., touchscreen tablets) and/or software programs to target various language skills and modalities" (n.d.). There are a number of computer programs that store data about the patients' progress, which can be used for medical purposes (ASHA, n.d.).

An example of this type of computer program can be *Telelogos*, which aims to improve speech therapy with the use of technology. Its system is based on the following ideas: public awareness, reference, and evaluation. *Public awareness* refers to the information that users can find inside the program about speech-language therapy and learning disabilities. The function of the *reference section* is to offer all users the opportunity to contact a speech pathologist in case they need it. It is done through interactive country maps, the user can click on any area they are interested in, and the system will give them the contact details of available professionals in the area they chose. The *evaluation module* contains tests that are usually used by speech pathologists to keep track of their patients' performance and progress after they have done these tests (Glykas & Chytas, 2004, p. 530).

One of the tests that Telelogos offers serves to evaluate phonetic and phonological aspects. In order to assess these, the speech pathologist shows simple and composite pictures that appear on the screen and asks the child to name them. Apart from that, the test also

includes evaluation sheets in which the speech pathologist can write down the sounds that the child makes using the International Phonetic Alphabet (IPA) symbols. Once the child's speech production is recorded, the speech pathologist can revise the phonological profile of the child whenever they need. The phonological profile is always analyzed taking into account the age of the child, and in this way, the speech pathologist will be able to know if there are any abnormalities between the stage of phonological development and age (Glykas & Chytas, 2004, p. 534).

1.6.3. Other types of therapy

Apart from SLT, there are other types of therapy that can be used to treat aphasia. For example: *Output-Focused Therapy*, *Melodic Intonation Therapy* (MIT), and *pharmacotherapy*.

Output-Focused Therapy consists of finding the aphasic deficit that needs improvement and then using several techniques such as reading or repetition to encourage the patient to work their production of speech to reinforce the recovery of the lost function (Chapey, 1994, as cited in Albert, 1998, p. 1418).

Melodic Intonation Therapy is based on the idea that the prosodic aspects of language (such as intonation, stress, and melodic patterns) are processed mainly in the right hemisphere and, therefore, an individual that has aphasia due to a lesion in the left hemisphere can reinforce these patterns of spoken language. The objective of MIT is to stimulate the undamaged areas of the right hemisphere that still have the ability to produce language. To do this, the speech therapist asks the patients to intone simple phrases and they gradually increase the syllable length of the phrases (Albert, 1998, p. 1418; Ferguson et al., 1994; ASHA, n.d.).

When it comes to pharmacotherapy to treat aphasia, there have been many different types of drugs under study to see if they could show any improvement on the aphasics' symptoms. However, most of these studies have shown negative results: the patients' improvement was little or non-existent (de Boissezon et al., 2007, p. 114; Llano & Small, 2016, p. 1068).

De Boissezon et al. (2007) state that drugs to treat aphasia are more effective when they are combined with speech therapy than alone (p. 114). They believe that the drugs which have shown a better result in treating aphasia are piracetam and amphetamine which seem to increase cerebral plasticity, offering more possibilities for recovery (p. 123).

As has been explained, there are different types of therapy for aphasia apart from speech-language therapy. However, most of these therapies resemble SLT in their methodology, as output-focused therapy and MIT also aim to make the patients produce speech to reinforce their ability to speak through exercises and activities. Therefore, these other types of therapies could be considered as subtypes or derivatives of SLT as they all contain the same purposes.

1.7. Research Questions and Hypotheses

Based on the theory that was collected, the research questions are as follows:

- 1) Do the symptoms of the Broca's aphasics in the videos coincide with the characteristics of this type of aphasia?
- 2) Do the symptoms of the Wernicke's aphasics in the videos coincide with the characteristics of this type of aphasia?
- 3) Do the symptoms of the bilingual patient in the video change in respect to monolingual aphasics?

- 4) Are there any differences between the Spanish and the English patient with Broca's aphasia?
- 5) Are there any differences between the Spanish and the English patient with Wernicke's aphasia?
- 6) Are there other interesting observable symptoms that have not been mentioned in the theoretical part?
- 7) Does the bilingual aphasic have the same difficulties with spoken language in his L1 and his L2?

The initial hypothesis before analyzing the videos is that the practical cases will mirror the theory that I collected in the theoretical background. Therefore, the null hypothesis is that the patients in the videos will not mirror the information in the theoretical background. However, I believe that the real cases will not mirror the theory 100% due to individual factors among the patients.

2 Method

2.1. Materials

The materials that were used to develop the method section of this thesis are YouTube videos. The aim of this section is to analyze and compare five different YouTube videos, which include: an English aphasic with Broca's aphasia, an English aphasic with Wernicke's aphasia, a Spanish aphasic with Broca's aphasia, a Spanish aphasic with Wernicke's aphasia, and a bilingual aphasic (Spanish/English). The first patient is called Mike, he is around 55-60-years-old, and he is from the United States; he is doing SLT with Megan, who is a speech-language pathologist. The second patient is called Borja, he is 42-years-old, and he is from Madrid, Spain; Marina Aldaz, Lola García, Eva Lorente, Laura Pasca, and Inés Peña, five

university students in the third year of the Psychology and Criminology degree have interviewed him to observe the aphasic symptoms that he has after he had suffered an ictus. The third patient is called Byron, he is around 65-70-years-old, and he is from the United States; he is doing SLT with Megan, who is the same woman that appeared in the first video with Mike. The fourth patient is called Félix, he is around 75-80-years-old, and he is from Spain; The fifth patient is called Hector Roman, he is around 40-years-old, and he seems that he could be from either Central or South America, but the interview was done in the United States; he does SLT with Danielle Tsibulsky, who is a therapist who works in the Sargent College of Health and Rehabilitation Sciences.

2.2. Procedure

In order to choose the five different videos, I wrote "Broca's aphasia", "Wernicke's aphasia" and "bilingual aphasia" in YouTube. Before I selected the final videos that I would analyze, I watched three or four of them to decide among them. The thing was that most of the videos offered a theoretical explanation of the type of aphasia, but I wanted to find real cases of people who suffer from those types of aphasias. When I found a video that included a real person, I watched it and I made sure that the video was longer than one minute so I could have significant content to analyze. Once the videos had been chosen, the next thing that I did to develop my analysis was a transcription of the videos, which can be seen in the appendices sections (see Appendices A – E). In order to do the transcriptions, I watched the videos pausing them every 5/10 seconds to be able to write all the utterances of the patients in the videos. The transcriptions were organized in tables to see it in a more visual way; these tables have three columns and the first one indicates the time slot during which the utterance takes place in the video, the second one indicates the name of the speaker, and the third one is the transcription of the words that the speakers said. I decided to transcribe the videos in the original language that the patients spoke, that is why two transcriptions are in Spanish, two in

English, and the last one contains both languages since the patient is bilingual. Once this had been finished, the next steps were:

- Watch each video around 10 times to write down the characteristics or the interesting symptoms that were observed.
- Describe and analyze the characteristics of the different aphasics regarding their speech production and their understanding of spoken language considering the theoretical background.
- Compare the different patients in three different sections: the English aphasic with Broca's aphasia with the Spanish aphasic with Broca's aphasia; the English aphasic with Wernicke's aphasia with the Spanish aphasic with Wernicke's aphasia; and the bilingual aphasic relating him with the other practical cases.
- State the differences (if there are any) among the patients considering the type of aphasia that they have.

3 Results

Even though theory has established and fixed different characteristics regarding the production and understanding of spoken language of all the different types of aphasias, every patient shows unique characteristics that can also be found in other types of aphasias. The key point is that the different types of aphasias can share some characteristics, and these are not restricted to just one type of aphasia.

In this section, there are five different subsections that describe the characteristics and observable symptoms of all the different patients that appear in the videos accompanied with significant examples of their utterances which illustrate the symptoms that are mentioned. The five different subsections offer a description of the symptoms of the patients in the

following order: the first subsection is about the English aphasic with Broca's aphasia; the second subsection is about the Spanish aphasic with Broca's aphasia; the third subsection is about the English aphasic with Wernicke's aphasia; the fourth subsection is about the Spanish aphasic with Wernicke's aphasia; and the fifth subsection is about the bilingual aphasic.

3.1. Video 1: English aphasic with Broca's aphasia

There are two participants in this video: Megan, and Mike. Mike had been diagnosed with Broca's aphasia, and he shows severe difficulties when it comes to producing spoken language (see Appendix A for the full transcription). He tends to use a lot of hesitation fillers when he speaks, as in: "Um, well, um, worked, um, Autodesk, um, seven, seven, sales. Sales. And worldwide. And very good, yeah." (Tactustherapy, 2017, 0:25) and "Um... Peterburg, um... peterberg, um... and um... Dr. Hinckley, and um..., and um..., myself, um... founder, founder for me." (Tactustherapy, 2017, 1:16). As can be seen in these quotes, he also uses a lot of lexical words, mainly nouns, like "Autodesk", "seven", "sales", and "founder". In some instances of the video, it seems like he really struggles to find the words he needs, so he ends his sentences with expressions like "it's... you know" (Tactustherapy, 2017, 2:20) or "I don't know, it's like um, words, yuk!" (Tactustherapy, 2017, 3:16).

On the other hand, Mike's comprehension of spoken language is not damaged, he seems to understand what other people are saying to him because his answers make sense. For example, when he is asked for his name, he says "I'm Mike Caputo" (Tactustherapy, 2017, 0:11); and when he is asked if he has any trouble with speech, he affirms it and he is conscious that he has been diagnosed with a speech disorder because when Megan asks him for the name of his condition, he says that it is called aphasia (Tactustherapy, 2017, 0:59).

3.2. Video 2: Spanish aphasic with Broca's aphasia

In this video, Marina, Lola, Eva, Laura, and Inés, a group of five female university students in the third year of the Psychology and Criminology degree, go to CEADAC (Centro de Referencia Estatal de Atención Al Daño Cerebral) to interview Borja, a 42-year-old patient who had been diagnosed with Broca's aphasia after he had suffered an *ictus*, which is a sudden attack or stroke. Apart from interviewing him, they also make him do some exercises to test his skills in math, reading, writing, and describing what he sees in different pictures after he had suffered the attack (see Appendix B for the full transcription).

From his answers, we can tell that he repeats the same word once or twice before he adds another new word to his speech and he uses a lot of hesitation fillers like "eh", "em", or "osea", as in: "Pues el 3 de se.. Se.. Septiembre, eh, estoy en, en partido del fútbol y no sé, estaba solo grupo de, em, a lo, la cabeza, y después, pues, eh, caer, y después los amigos, eh, llevar al, al hospital […] Eh, andar que no, pero en especie de cama, mujer, mujer, osea, osea..." (ProyectoLenguaje, 2018, 0:46). We can also see that he is good at repetition, when a student asks him to repeat the sentence "En el jardín de mi casa hay un árbol" (ProyectoLenguaje, 2018, 3:41), he repeats it clearly word by word even though he needs help from his speech-language pathologist, she says the words one by one first and then he imitates her. When he is asked to describe what he sees in the pictures, he does an error conjugating a verb, he confused the phoneme /r/ with the phoneme /d/ when he said: "las niñas saltadan las combas" (ProyectoLenguaje, 2018, 4:52) instead of "las niñas saltarán las combas". Moreover, his comprehension skills remain intact, because he is asked several questions during the interview and although his speech production is slow and often interrupted with pauses, he answers things that make sense considering the question that he has been asked. For example, they ask him if there is anything that we can do to inform

people about aphasia, and he says: “Pues, algo, osea, no sé. Pues... darle muchos, ayudar, a su familia, sí, sí, mucho, ayudar mucho, y, bueno y, eh, eso...” (ProyectoLenguaje, 2018, 8:54).

3.3. Video 3: English aphasic with Wernicke’s aphasia

Similar to Video 1, in this video there are also two participants: Megan, who is having the conversation with the patient, and Byron, a man who had been diagnosed with Wernicke’s aphasia (see Appendix C for the full transcription). Byron’s speech is fluent in the sense that he can talk for more than one minute without interrupting his speech with pauses or using hesitation fillers, as can be seen here: “We stayed with the water over here at the moment and talk with the people for them over there. They’re diving for them at the moment, but they’ll save in the moment held water very soon, for him, with luck, for him.” (Tactustherapy, 2015, 0:15). However, the content of his utterances is empty, the sentences he utters are not related, and his speech lacks sense and meaning.

Moreover, his comprehension skills are severely impaired. When Megan asks him “What were we just doing with the iPad?” (Tactustherapy, 2015, 0:35) he answers: “Uhh... right at the moment they don’t show a damn thing. Ha ha!” (Tactustherapy, 2015, 0:37); therefore, we can infer that he has not understood what he had been asked because the answer he gave is not related to the initial question. Apart from that, he also pronounces some words incorrectly, as in: “verly” (Tactustherapy, 2015, 0:47), he inserted an /l/ sound in the middle of the word “very”. Furthermore, it is thought-provoking that some sentences that he utters are grammatically correct while others are not. As an example, a grammatical sentence would be: “I would talk with Donna sometimes” (Tactustherapy, 2015, 0:51); and an example of an ungrammatical sentence would be: “Am I talk of anymore to saying.” (Tactustherapy, 2015, 1:19).

3.4. Video 4: Spanish aphasic with Wernicke's aphasia

In this video, there are also two participants: the speech-language therapist and an old man with Wernicke's aphasia whose name is Félix. Félix's speech is fluent, it flows easily, it is not interrupted with pauses, and he does not use hesitation fillers. However, his ability to comprehend spoken language is severely impaired. Throughout the video, he is asked several questions, but the things he answers do not make sense at all and the meaning of his utterances are empty, they lack meaning (see Appendix D for the full transcription). An example of this can be seen when the speech-language therapist asks him: "Y, los amiguitos que tenías cuando eras niño, ¿vivían todos en este pueblo también?" (Infogerontologia.com, 2016, 0:50) and he answers: "Claro que ha llegao' siempre, siempre nos hemos encontrado ahí desde que mi padre podía tener mi tío y Pedro y hacer todo por mis hijos pues, pues eso." (Infogerontologia.com, 2016, 0:53).

Apart from that, almost all the sentences that he utters are not grammatically correct in Spanish, and he uses a lot of words that do not exist, he makes up words as he is talking, creating jargon that may only be understood by him. An example of an ungrammatical sentence in Spanish is: "[…] toda la ciudad a mí en teoría me estará ahí que echarla a la resta ahora […]" (Infogerontologia.com, 2016, 1:41). Some examples of non-existent words in Spanish are: "rotosiles" (Infogerontologia.com, 2016, 1:19), "toles" (Infogerontologia.com, 2016, 1:23), and "aitado" (Infogerontologia.com, 2016, 1:39). Moreover, he tries to conjugate a verb but the endings that he uses to indicate the person and number of the verb are not correct: "Yo venime, vamo, vea." (Infogerontologia.com, 2016, 0:40).

3.5. Video 5: Bilingual aphasic (Spanish/English)

There are two participants in this video: Hector, who had been diagnosed with aphasia after he had a gunshot wound in the head; and Danielle, who is his speech-language therapist. In the video, we can see how they are doing a therapy session. The session was mainly done in

Spanish because he needed to improve his language skills in that language, which is his native language. However, he seems to be more fluent in English, which is interesting because it is his second language. His speech when he talks in English is fluent, as can be seen in: “It feels good, you know. I’m still here, you know. I’m a survivor.” (Boston University, 2010, 3:10).

In contrast, when he speaks Spanish, his speech is sometimes interrupted with pauses because he is thinking of the word he needs, and he struggles to find it. An example of this can be seen when Danielle asks him: “¿De qué te recuerda una afeitadora?” (Boston University, 2010, 0:37), and he answers: “Dos días. Porque yo tenía una pimple, so... y no puedes [he makes a gesture with his hand as if he was shaving his face], porque...” (Boston University, 2010, 0:42), in this utterance, the ellipses indicate the pauses that he does while he speaks. Apart from that, when he does not find the words he needs, he seems to use two different linguistic resources: instead of saying the Spanish word (in this case, “grano”) he utters the same word but in English, saying “yo tenía una pimple”; and when he does not find the verb in Spanish (in this case, “afeitar”), he tries to communicate that word using a gesture that symbolizes that action.

Moreover, when he talks in Spanish, his utterances tend to be non-grammatical, but if he talks in English, the sentences are grammatically correct. An example of this can be seen if we contrast these sentences: “No me recuerda en el mundo” (Boston University, 2010, 1:33) with “The doctor told me you know, I got a stroke, so they say yeah you have to learn how to talk, I had to learn all over again.” (Boston University, 2010, 0:30).

Table 3 below shows the comparison of the English and the Spanish aphasic with Broca’s aphasia taking into account the use of hesitation fillers, the lack of grammatical words, their comprehension skills, their trouble with word-finding, and whether they are good

at repetition. The bilingual aphasic is also included. From the table, you can see that the characteristics of the English and the Spanish aphasic are identical, even though we do not know if the English patient is good at repetition or not since he does not do any repetition exercise in the video. Regarding the bilingual aphasic, he presents the same difficulties as the others but with the slight difference that he presents more problems in his L1 (Spanish) than in his L2 (English).

Table 3 *A comparison of the Broca's aphasics*

Aphasic patient	Hesitation fillers	Lack of grammatical words	Comprehension skills	Trouble with word-finding	Good at repetition
English	Yes	No	Not damaged	Yes	-
Spanish	Yes	No	Not damaged	Yes	Yes
Bilingual	Yes	In Spanish but not in English	Not damaged	In Spanish but not in English	Yes

Table 4 below shows the comparison of the English and the Spanish aphasic with Wernicke's aphasia taking into account the use of hesitation fillers, their comprehension skills, whether they build grammatically correct sentences, the use of non-existent words, and whether their utterances lack meaning. The bilingual aphasic is also included. From the table, you can see that the characteristics of the English and the Spanish aphasic are identical unless the fact that the Spanish aphasic used a lot of invented words, whereas the English aphasic did not. Regarding the bilingual aphasic, he does not present the same speech impairments as the other two aphasics, since his comprehension skills are not damaged, he builds grammatically correct sentences, he does not invent any words when he speaks, and his utterances do not lack meaning.

Table 4 *A comparison of the Wernicke's aphasics*

Aphasic patient	Hesitation fillers	Comprehension skills	Grammatically correct utterances	Use of non-existent words	Utterances lack meaning
English	No	Damaged	Sometimes	No	Yes

Spanish	No	Damaged	Sometimes	Yes	Yes
Bilingual	Yes	Not damaged	Yes	No	No

4 Discussion

4.1. Broca's aphasia

The two patients that I analyzed with Broca's aphasia present the expected characteristics of this type of aphasia. People who suffer from Broca's aphasia have severe difficulties to put their thoughts into words even though they know exactly what they want to say (see section 1.4.1.). This can be seen in the English and the Spanish patient, as they use a lot of pauses when they talk, which suggests that they are trying to search for the word they need but, in the majority of cases, they cannot find it, so they end up using another word that indicates to the listener that their utterance stops there because they cannot remember the appropriate word. The two following utterances taken from the videos serves as examples of what is mentioned above: "And the, the, um, and they laugh, and and talked, and um, music, hear this this beautiful, it's... you know." (Tactustherapy, 2017, 2:20) and "Quieres hablar esto pues, pues, va, porque tengo hijos, 12 y 9, y es, es mal, porque tienes que hablar con ellos no puedo porque Borja no puedo, es difícil, después con coger los manos pues sí que, ¿sabes?" (Proyecto Lenguaje, 2018, 5:00). In these two utterances, we can see that both patients use a lot of hesitation fillers and pauses to have more time while they think of the words they need, but they cannot remember it and the words they use to stop their speech is exactly the same expression, but one is in English whereas the other is in Spanish: "you know" vs. "¿sabes?". The use of these words infers that the patients know that the listener has already understood the message they want to convey even though they have not finished explaining it.

Besides that, Broca's aphasics tend to build their sentences using lexical words (nouns, adjectives, and verbs) and they tend to lack grammatical words (articles, pronouns,

and conjunctions) (see section 1.4.1.). In the case of the English aphasic, he tends to repeat and overuse some articles, pronouns, and conjunctions like “and”, “it”, “I”, and “this”. On the other hand, the Spanish aphasic also repeats and overuses some grammatical words like “y”, “lo”, “la”, and “pero”. Therefore, even though theory states that they tend to lack grammatical words, in these cases it is not 100% true; it is true that the variety of nouns and verbs that they use in their utterances is a lot much higher than the variety of pronouns, articles, and conjunctions that they use in their speech.

In this case, there are no observable differences between the production and the understanding of speech of the English aphasic with the Spanish aphasic. They both presented the same characteristics when it comes to the production of spoken language.

The first research question was whether the symptoms of the Broca’s aphasics coincided with the characteristics of this type of aphasia, and the results show that both patients present the characteristics related to Broca’s aphasia. The fourth research question was whether there was any difference between the English and the Spanish aphasic, and the results show that there were no observable differences between these two patients. The sixth research question was whether there were any observable symptoms that had not been mentioned in the theoretical part. In this case, there were none.

The hypothesis statement was that the practical cases would mirror the theoretical background. In this case, the hypothesis was accepted based on the analysis and the null hypothesis was rejected.

4.2. Wernicke’s aphasia

People with Wernicke’s aphasia have severe difficulties when it comes to understanding speech. However, their speech is fluent, and they tend to build grammatically correct sentences (see section 1.4.2.). In the case of the English aphasic, this is true since he does not

tend to interrupt his speech, he can be talking for minutes even though his speech lacks sense. An example of that can be seen in: “We will sort right here and they’ll save their hands right there for them.” (Tactustherapy, 2015, 0:31). This utterance makes no sense when it comes to meaning, but still, it is grammatical. In the case of the Spanish aphasic, his speech is fluent, but his utterances are not grammatical at all, and they are meaningless. An example of that can be seen in: “Hombre pues sí, porque todas estas viviendas que tienen los niños en abre y tos esas nivelan eran unos rotosiles.” (Infogerontologia.com, 2016, 1:14).

Moreover, people with Wernicke’s aphasia tend to fill their speech with non-existent or irrelevant words (see section 1.4.2.). In the case of the Spanish aphasic, this can be seen in the utterance above, the sequence “los niños en abre” and the word “rotosiles” do not exist and are not grammatical in Spanish. In this sense, the English aphasic did not invent any word. Even though his speech was senseless, all the words that he used in his speech do exist in English.

Other characteristics that I found regarding the English patient with Wernicke’s aphasia are that he inserted an /l/ sound in the word “very”; he said “verly” (Tactustherapy, 2015, 1:01) and that he was confused with the meaning of the word “pretty”. At the beginning of the video, Megan says “Hi Byron! How are you?” (Tactustherapy, 2015, 0:08) and he answers: “I’m happy. Are you pretty?” (Tactustherapy, 2015, 0:10). In this case, the word “pretty” does not make sense since it is either related to physical appearance or it could be a quantifier meaning ‘very’, and in either case, is not related to well-being.

The main differences that can be seen between the English aphasic and the Spanish aphasic are that the English aphasic did not use any non-existent words in the English language whereas the Spanish aphasic used a lot of words that do not exist in the Spanish language. Apart from that, when analyzing the videos and writing the transcriptions, the

English aphasic was easy to understand whereas the Spanish aphasic was so difficult to understand because he used many words that sounded very unfamiliar in Spanish. However, it appears that this can be because his aphasia is in a very advanced phase and is extremely severe. Besides that, the Spanish aphasic with Wernicke's aphasia is the oldest patient that I analyzed, and I consider that age also plays an important role in the severity of the aphasic symptoms.

The second research question was whether the symptoms of the patients with Wernicke's aphasia coincided with those mentioned in the theoretical background, and the results show that the practical cases mirror these characteristics. The fifth research question was whether there were any differences between the English and the Spanish aphasic; in this case, the main difference is that the English patient did not use any non-existent word in the English language whereas the Spanish patient used a lot of invented words. The sixth research question was whether there was any other interesting observable symptom that was not mentioned in the theoretical background; in this case, there was an interesting symptom regarding the speech of the English aphasic: the insertion of the /l/ sound in the middle of the word 'very'.

The hypothesis statement was that the practical cases would mirror the theoretical background. In this case, the hypothesis was accepted based on the analysis and the null hypothesis was rejected.

4.3. Bilingual aphasia

The last patient that I analyzed was a bilingual aphasic. His native tongue is Spanish, and his second language is English; however, there is no indication from the video at what age the patient started learning English. In the video, he is doing speech-language therapy in Spanish because it is the language he needs to improve (see Appendix E for the full transcription). At

the beginning of the video, his speech-language therapist shows him a picture of a razor, and he is asked to say the name of that object in Spanish. However, what he says is: "Um, es una Jane" (Boston University, 2010, 0:12), he cannot remember the Spanish word. This can be seen in several instances of the video; when he does not find the word that he needs in Spanish, he thinks of the English equivalent to complete his utterance, as in: "Dos días. Porque yo tenía una *pimple*, so..." (Boston University, 2010, 0:42). Another resource that he uses when he cannot find a word in Spanish is using gestures, in an instance of the video, he wants to say the word "afeitar", but he cannot remember this verb in Spanish, so he does a gesture to indicate that. Apart from that, he also struggles to remember the accurate words in Spanish if they have a similar ending. In the video, the therapist shows him another picture of a dresser and he says "tocador". After that, the therapist shows him the picture of the razor again, and when he sees it, he says "tocador" and when his therapist tells him that the ending of the word is very similar and does a gesture as if she was shaving, he can finally access the correct word in Spanish and he says "afeitadora".

Besides that, some of his utterances in Spanish lack meaning, as in: "No me recuerda en el mundo" (Boston University, 2010, 1:33). The interesting point is that he is very fluent in English, and he builds sentences that make sense and are grammatically correct in that language, as in: "Like three weeks now I'm learning English but more talking in Spanish." (Boston University, 2010, 2:53) and "It feels good, you know. I'm still here, you know. I'm a survivor." (Boston University, 2010, 3:10).

The fact that this patient with bilingual aphasia has more difficulties to express himself in Spanish, which is his native tongue, rather than in English, which is his L2, is very peculiar. However, as Fabbro (2001) states, people with bilingual aphasia do not present the same difficulties with the same degree of severity in the languages that they speak (p. 203).

The third research question was whether the symptoms of a bilingual aphasic changed in respect to monolingual aphasics. The results show that the main speech problems that the patient has when he speaks in his first language, Spanish, are typical characteristics of aphasics, since they have been also mentioned in the analysis of the patients with Broca's and Wernicke's aphasia. The seventh research question was whether the bilingual aphasic had the same difficulties with spoken language in his L1 and his L2, and the results say that he presents more problems when he speaks in his L1 (Spanish) than when he speaks in his L2 (English). In fact, when he speaks English, he barely presents any symptom that could be related to aphasia. Since this is a unique case, there is very limited information on bilingual aphasics, and this case study only concludes that the symptoms of the bilingual aphasic were more similar to those presented by the Broca's aphasics rather than by the Wernicke's aphasics. Because there is limited background information on this topic, this was not included in the hypothesis and this neither accepts nor rejects the hypothesis statement.

4.4. Limitations of the Study and Implications for Further Research

The main constraint that this study has is that the number of analyzed videos is five. In order for the study to be more significant, the number of analyzed videos should increase to say that the results are effective, more languages should be studied instead of just focusing on English and Spanish aphasics, and other types of aphasia should be taken into consideration since this study only offers the analysis of Broca's and Wernicke's aphasics. Noticeably, the data that are mentioned in the results section only serve as an academic analysis to develop the practical part of my thesis rather than a scientific study. Therefore, they cannot be extrapolated to all the people who suffer from aphasia.

5 Conclusion

Aphasia is a speech disorder that affects a great number of people all over the world on their speech production and understanding. For this reason, it is a medical condition that has been extensively studied, and it is very difficult to add new theories or find new approaches to its treatment, as it is a scientific topic that has been deeply under investigation for years. The study of this thesis was designed to apply the existent theory of this speech disorder to several practical cases to test if the main symptoms that define the different types of aphasia, in this case Broca's and Wernicke's (which are the most common ones), were observable in the speech characteristics that the patients presented. Most of them presented the expected symptoms regarding the type of aphasia that they suffer, even though all the theoretical characteristics were not fully observable, since every individual can develop unique traits.

6 References

Acharya, A., & Wroten, M. (2021, August 1). *Broca Aphasia*. National Center for Biotechnology Information. https://www.ncbi.nlm.nih.gov/books/NBK436010/

Acharya, A., & Maani, C. (2021, August 1). *Conduction Aphasia*. National Center for Biotechnology Information. https://www.ncbi.nlm.nih.gov/books/NBK537006/

Albert, M. L. (1998). Treatment of aphasia. *Archives of Neurology*, *55*(11), 1417-1419. https://doi.org/doi:10.1001/archneur.55.11.1417

Ali, M. et al. (2021). Predictors of Poststroke Aphasia Recovery. *American Heart Association, 52*(5), 1778-1787. https://doi.org/10.1161/STROKEAHA.120.031162

American Speech-Language-Hearing Association (n.d.). *Aphasia: Treatment.* Retrieved March 15, 2022, from https://www2.asha.org/PRPSpecificTopic.aspx?folderid=8589934663&section=Treatment

Anderson, V., & Moore, C. (1995). Age at injury as a predictor of outcome following pediatric head injury: A longitudinal perspective. *Child Neuropsychology*, *1*(3), 187-202. https://doi.org/10.1080/09297049508400224

Anderson, V., Spencer-Smith, M., & Wood, A. (2011). Do children really recover better? Neurobehavioural plasticity after early brain insult. *Brain*, *134*(8), 2197-2221. https://doi.org/10.1093/brain/awr103

Ardila, A. (2014). *Aphasia Handbook*. https://www.researchgate.net/publication/266558490_Aphasia_Handbook

Baumgaertner, A. (2015). Mixed transcortical aphasia: repetition without meaning. In A. Raymer, & L. Gonzalez (Eds.), *The Oxford Handbook of Aphasia and Language*

Disorders. Oxford University Press. https://books.google.es/books?id=T3I8DwAAQBAJ&lpg=PT311&ots=Zmo9SrvXRA&dq=mixed%20transcortical%20aphasia&lr&hl=ca&pg=PT311#v=onepage&q=mixed%20transcortical%20aphasia&f=false

Bel Marra Health. (2017, March 17). *Aphasia vs. dysphasia: Differentiating symptoms and causes*. https://www.belmarrahealth.com/aphasia-vs-dysphasia-differentiating-symptoms-causes/

Boston University. (2010, September 21). *Lost in Translation* [Video]. YouTube. https://www.youtube.com/watch?v=v3qphH5j304&ab_channel=BostonUniversity

Butterworth, B. (1979). Hesitation and the production of verbal paraphasias and neologisms in jargon aphasia. *Brain and language*, *8*(2), 133-161. https://doi.org/10.1016/0093-934X(79)90046-4

Byeon, H., & Koh, H. W. (2016). Health science students' perceptions of motor and sensory aphasia caused by stroke. *Journal of physical therapy science*, *28*(6), 1772-1774. https://doi.org/10.1589/jpts.28.1772

Cauquil-Michon, C., Flamand-Roze, C., & Denier, C. (2011). Borderzone strokes and transcortical aphasia. *Current neurology and neuroscience reports*, *11*(6), 570-577. https://doi.org/10.1007/s11910-011-0221-z

Chantsoulis, M. et al. (2016). APPLICATION OF FUNCTIONAL NEUROMARKERS FOR CONSTRUCTING PROTOCOLS OF NEUROTHERAPY AND MONITORING THE SUCCESS OF TREATMENT IN CHRONIC CROSSED TRANSCORTICAL SENSORY APHASIA: A CASE STUDY. *Acta Neuropsychologica 14*(4), 389-400. https://doi.org/10.5604/17307503.1230927

Cleveland Clinic. (2018, July 5). *Brain Lesions.* https://my.clevelandclinic.org/health/diseases/17839-brain-lesions

Coppens, P., Hungerford, S., Yamaguchi, S., & Yamadori, A. (2002). Crossed aphasia: an analysis of the symptoms, their frequency, and a comparison with left-hemisphere aphasia symptomatology. *Brain and language*, *83*(3), 425-463. https://doi.org/10.1016/S0093-934X(02)00510-2

Danon-Boileau L. (2006). *Children without language: from dysphasia to autism* (J. Grieve, Trans.). Oxford University Press. (Original work published 2005).

de Boissezon, X. et al. (2007). Pharmacotherapy of aphasia: myth or reality?. *Brain and Language*, *102*(1), 114-125. https://doi.org/10.1016/j.bandl.2006.07.004

Dennis, M. (2010). Margaret Kennard (1899–1975): not a 'principle' of brain plasticity but a founding mother of developmental neuropsychology. *Cortex*, *46*(8), 1043-1059. https://doi.org/10.1016/j.cortex.2009.10.008

Deppe, M. et al. (2000). Assessment of hemispheric language lateralization: a comparison between fMRI and fTCD. *Journal of Cerebral Blood Flow & Metabolism*, *20*(2), 263-268. https://doi.org/10.1097/00004647-200002000-00006

Eslinger, P. J., Biddle, K., Pennington, B., & Page, R. B. (1999). Cognitive and behavioral development up to 4 years after early right frontal lobe lesion. *Developmental Neuropsychology*, *15*(2), 157-191. https://doi.org/10.1080/87565649909540744

Fabbro, F. (2001). The bilingual brain: Bilingual aphasia. *Brain and language*, *79*(2), 201-210. https://doi.org/10.1006/brln.2001.2480

Ferguson, J. H. et al. (1994). ASSESSMENT-MELODIC INTONATION THERAPY. *Neurology*, *44*(3), 566-568. https://doi.org/10.1212/WNL.44.3_Part_1.566

Friederici, A. D., & Chomsky, N. (2017). *Language in our brain: the origins of a uniquely human capacity*. MIT Press.

Granadillo, E., & Arciniegas, D. (2015). Poststroke Subcortical Aphasia and Neurobehavioral Disturbances Without Motor or Sensory Deficits. *The Journal of Neuropsychiatry and Clinical Neurosciences, 27*(2), 165-167. https://doi.org/10.1176/appi.neuropsych.14060138

Glykas, M., & Chytas, P. (2004). Technology assisted speech and language therapy. *International Journal of Medical Informatics*, *73*(6), 529-541. https://doi.org/10.1016/j.ijmedinf.2004.03.005

Hensch, T. K. (2004). Critical period regulation. *Annual Review of Neuroscience 27*, 549-579. https://doi.org/10.1146/annurev.neuro.27.070203.144327

Infogerontologia.com. (2016, October 26). *Afasia de Wernicke. Caso clínico. Dailymotion* [Video]. YouTube. https://www.youtube.com/watch?v=4corrSyDsJ0&ab_channel=infogerontologia.com

Kertesz, A. (1979). *Aphasia and associated disorders.* Grune and Stratton.

Knecht, S. et al. (2000). Handedness and hemispheric language dominance in healthy humans. *Brain*, *123*(12), 2512-2518. https://doi.org/10.1093/brain/123.12.2512

Kolb, B. (1995). *Brain plasticity and behavior*. Lawrence Erlbaum Associates.

Kozlowski, D., & Schallert, T. (1998) Relationship between dendritic pruning and behavioral recovery following sensorimotor cortex lesions. *Behavioural Brain Research 97*(1-2), 89-98. https://doi.org/10.1016/S0166-4328(98)00030-8

Ku, A., Lachmann, E. A., & Nagler, W. (1996). Selective language aphasia from herpes simplex encephalitis. *Pediatric neurology*, *15*(2), 169-171. https://doi.org/10.1016/0887-8994(96)00154-3

Lidzba, K. et al. (2017). The time window for successful right-hemispheric language reorganization in children. *European journal of paediatric neurology*, *21*(5), 715-721. https://doi.org/10.1016/j.ejpn.2017.06.001

Llano, D. A., & Small, S. L. (2016). Pharmacotherapy for aphasia. In *Neurobiology of language* (pp. 1067-1083). Academic Press. https://doi.org/10.1016/B978-0-12-407794-2.00085-7

Mastin, L. (2012). *Handedness and the brain*. Right, Left, Right, Wrong! https://www.rightleftrightwrong.com/brain.html

Mesulam, M. M. (2001). Primary progressive aphasia. *Annals of neurology*, *49*(4), 425-432. https://doi.org/10.1002/ana.91

Merriam-Webster. (n.d. a). Aphasia. In *Merriam-Webster.com dictionary*. Retrieved January 5, 2022, from https://www.merriam-webster.com/dictionary/aphasia

Merriam-Webster. (n.d. b). Cytoarchitecture. In *Merriam-Webster.com medical dictionary*. Retrieved January 24, 2022, from https://www.merriam-webster.com/medical/cytoarchitecture

Newport, E. (2018, February). Developmental Plasticity and Language Reorganization After Pediatric Stroke. In *2018 AAAS Annual Meeting*. AAAS. https://www.sciencenews.org/article/babies-language-brain-stroke

National Aphasia Association. (n.d.). *Global Aphasia*. Retrieved January 15, 2022, from https://www.aphasia.org/aphasia-resources/global-aphasia/

National Aphasia Association. (n.d.). *Wernicke's (Receptive) Aphasia*. Retrieved January 8, 2022, from https://www.aphasia.org/aphasia-resources/wernickes-aphasia/

Pai, A. et al. (2011). Global aphasia without hemiparesis: A case series. *Annals of indian Academy of Neurology*, *14*(3), 185. https://doi.org/10.4103/0972-2327.85890

Proyecto Lenguaje. (2018, April 20). *Afasia. Entrevista a un paciente con afasia motora (de Broca) y ejercicios* [Video]. YouTube. https://www.youtube.com/watch?v=4XBfnNGsf8M&ab_channel=ProyectoLenguaje

Santos-Longhurst, A. (2019, May 9). *What Is Speech Therapy?*. Healthline. https://www.healthline.com/health/speech-therapy

Seladi-Schulman, J. (2020, January 29). *How to Identify the Different Types of Aphasia*. Healthline Media. https://www.healthline.com/health/dementia/types-of-aphasia

Shafi, N., & Carozza, L. (2012). Treating cancer-related aphasia. *The ASHA Leader*, *17*(9), online-only. https://doi.org/10.1044/leader.FTR3.17092012.np

Tactustherapy. (2017, June 14). *Broca's Aphasia (Non-Fluent Aphasia)* [Video]. YouTube. https://www.youtube.com/watch?v=JWC-cVQmEmY

Tactustherapy. (2015, September 9). *Fluent Aphasia (Wernicke's Aphasia)* [Video]. YouTube. https://www.youtube.com/watch?v=3oef68YabD0&ab_channel=tactustherapy

Teichmann, M., & Ferrieux, S. (2013). Aphasia(s) in Alzheimer. *Revue Neurologique*, *169*(10), 680-686. https://doi.org/10.1016/j.neurol.2013.06.001

Vandergriendt, C. (2018, September 18). *What Is Dysphasia?*. Healthline. https://www.healthline.com/health/dysphasia

Vulliemoz, S., Raineteau, O., & Jabaudon, D. (2005). Reaching beyond the midline: why are human brains cross wired?. *The Lancet Neurology*, *4*(2), 87-99. https://doi.org/10.1016/S1474-4422(05)00990-7

Yule, G. (2014). *The Study of Language*. (5th ed.). Cambridge University Press.

Appendix A

Table 5 *Video 1: English aphasic with Broca's aphasia*

Timestamp	Speaker	Transcript
0:09	Megan	Can you tell us your name?
0:11	Mike	I'm Mike Caputo.
0:13	Megan	And Mike, when was your stroke?
0:15	Mike	I was, um, seven years ago. And...
0:23	Megan	And what did you use to do?
0:25	Mike	Um, well, um, worked, um, Autodesk, um, seven, seven, sales. Sales. And worldwide. And very good, yeah.
0:41	Megan	And who are you looking at over there? When you turn your head.
0:44	Mike	That's my wife.
0:46	Megan	Okay. And why is she helping you to talk?
0:50	Mike	Um... She is... Speech. Um...
0:54	Megan	So you have trouble with your speech?
0:57	Mike	Yeah, yeah.
0:57	Megan	And what's that called?
0:59	Mike	Aphasia.
1:01	Megan	And so why don't you work now?
1:04	Mike	Um... I, I, well, I do!
1:09	Megan	What do you do now?
1:11	Mike	Voices of hope aphasia.
1:13	Megan	What is voices of hope?

1:16	Mike	Um... Peterburg, um... peterberg, um... and um... Dr. Hinckley, and um..., and um..., myself, um... founder, founder for me. And um... I um, members, um, members, um, the, the, um, members, probably seven six zero people.
2:05	Megan	So 60 people are part of Voices of Hope, which is an aphasia support group that you founded, and Dr. Jackie Hinckley is part of that.
2:16	Mike	Yes.
2:18	Megan	Okay. Great.
2:19	Mike's wife	It's not a support group.
2:20	Mike	No, it's programs. It's, it's, um, three month, three days, um, um, Monday, Wednesday, Friday. And the, the, um, and they laugh, and and talked, and um, music, hear this this beautiful, it's... you know.
3:08	Megan	Great. Can you tell me, what does it feel like to have aphasia?
3:16	Mike	Um it's, it's hard, it's um... well, it's um, speech, it's like, um, words that don't understand. Brain is good, you know, um, but it's, um, speech like um, I don't know, it's like um, words, yuk! [laughs]
3:54	Megan	Alright, thank you so much.
3:57	Mike	Good! Bye-bye.

Appendix B

Table 6 *Video 2: Spanish aphasic with Broca's aphasia*

Timestamp	Speaker	Transcript
0:46	Borja	Pues el 3 de se.. Se.. Septiembre, eh, estoy en, en partido del fútbol y no sé, estaba solo grupo de, em, a lo, la cabeza, y después, pues, eh, caer, y después los amigos, eh, llevar al, al hospital ellos rico hablar seguro pero hablar no, mejor así. Eh, andar que no, pero en especie de cama, mujer, mujer, osea, osea, Borja o bebe en la mano estas siete y letras porque nada nada, y después ya con aquí, antes, no pero, erre, erre. Lucha, lucha, y hablar nada de nada, no puedo nada, y después en casa, después de un hospital, luego en casa, yo estudiar letras porque nada nada, y después ya con aquí después pero ahora antes hace nada, erre, erre, sí, esa, yo estar bien aquí, y escribir nada, no puedo, ahora mejor, pero antes, no puedo, y leer, leer, antes ostras, ¿qué pasa? Así de bateo, ¿pero qué pasa? Pues no sé, y ahora mejor.
3:22	Borja	Cuando escriba algo digo ¿está bien, o no? No sé.
3:41	Girl 1	En el jardín de mi casa hay un árbol grande.
3:49	Borja	En
3:52	Borja	El
3:59	Borja	Jardín
4:02	Borja	De, de

4:04	Borja	Mi
4:06	Borja	Casa
4:09	Borja	Hay, hay
4:18	Borja	Un árbol can
4:27	Borja	Las niñas ven dos amigos
4:35	Borja	Las niñas vieron los perros
4:52	Borja	Las niñas saltadan las combas
4:58		Question:¿Qué ocurrió cuando llegaste a casa después del hospital? [appears on screen]
5:00	Borja	Quieres hablar esto pues, pues, va, porque tengo hijos, 12 y 9, y es, es mal, porque tienes que hablar con ellos no puedo porque Borja no puedo, es difícil, después con coger los manos pues sí que, ¿sabes? Y mucho, muchísimo, pero, lucha, lucha, lucha, mejor, después, así es eso ya mejor
5:52		Question: ¿Qué se siente? [appears on screen]
5:52	Borja	Quiero hacer, creo, eso quiero, mejor, porque tienes hijos, y difícil, porque ayudar a ellos.
6:20	Borja	Porque el, no sé, el, miedo, el miedo, sí, es miedo, ahora, ahora mejor, pero antes miedo todo, todo. Quiero, alegría, quiero, eso quiero, un hijo porque tienes hijos, en fin.
6:44		Comment: Se trata de una enfermedad que te obliga a vivir en el día a día [appears on screen]
6:45	Borja	Es, es, tu quieres, mañana, yo mañana, bueno, ahora, mañana, no quieres, semana, no todo.

6:56		Comment: Los planes a largo plazo se vuelven complicados [appears on screen]
6:58	Borja	Es así. Bueno, quieres, a Asturias me voy, sabes, pero, sabes, pero es me voy a Asturias es miedo también, es difícil, nos vamos ahí que está ahí distancia y que aquí tienes una casa Madrid, ¿sabes? Tienes un hospital, todos, amigos, todos, después nos vamos y después es miedo también porque tienes pueblo, dices, joder, es miedo eso, es mucho eso.
7:51		Comment: Pero rendirse no es una opción. [appears on screen]
7:53	Borja	Hombre, hay días, joder, pero no, eso no.
8:02		Comment: Y también queda tiempo para el humor. [appears on screen]
8:02	Borja	Y comprar algo en Madrid, acción, osea, actuación a la casa, y un hombre con un jalo y son hola no sé qué, tú, tienes un bol de menos de, ostras, no puedo, y, y, y, dice, ¿qué pasa? Que no, hablar, no, joder... ayer, hostia, sí, digo, pues no, ictus, ¡no jodas! [they all laugh] pero tranquilo que está vez mejor, vale vale adiós.
8:54		Question: ¿Qué se puede hacer para dar a conocer esta enfermedad? [appears on screen]
8:54	Borja	Pues, algo, osea, no sé. Pues... darle muchos, ayudar, a su familia, sí, sí, mucho, ayudar mucho, y, bueno y, eh, eso, sí, porque y osea ver a ellos, y yo tranquilo, vamos, sí

	porque tú estás solo también, es verdad.

Appendix C

Table 7 *Video 3: English aphasic with Wernicke's aphasia*

Timestamp	Speaker	Transcript
0:08	Megan	Hi, Byron! How are you?
0:10	Byron	I'm happy. Are you pretty? You look good.
0:13	Megan	What are you doing today?
0:15	Byron	We stayed with the water over here at the moment and talk with the people for them over there. They're diving for them at the moment, but they'll save in the moment held water very soon, for him, with luck, for him.
0:29	Megan	So we're on a cruise and we are about to get to...
0:31	Byron	We will sort right here and they'll save their hands right there for them.
0:35	Megan	And what were we just doing with the iPad?
0:37	Byron	Uhh... right at the moment they don't show a damn thing. Ha ha!
0:42	Megan	With the iPad, that we were doing? Like here?
0:47	Byron	I'd like my change for me and change hands for me. It would happy. I would talk with Donna sometimes. We're out with them. Other people are working with them and them. I'm very happy with them. This girl with verly good. And happy and I play golf and hit up trees. We play out with the hands. We save a lot of hands on hold for peoples, for us. Other hands. I don't know what

		you get, but I talk with a lot of hand for him. Sometime. Am I talk of anymore to saying.
1:21	Megan	Alright, thank you very much!
1:23	Byron	Thank you very much, I appreciate it, and I hope the world lasts for you.
1:27	Megan	Thank you, it's been a pleasure. Bye-bye!
1:29	Byron	Have a good day!

Appendix D

Table 8 *Video 4: Spanish aphasic with Wernicke's aphasia*

Timestamp	Speaker	Transcript
0:12	Therapist	Mira, ¿quiénes son estos?
0:16	Félix	Uy estos, una es cabale de leyra.
0:19	Therapist	Esta es tu hija, que se llama... ¿Cómo se llama tu hija?
0:21	Félix	Pues poca gaza, una grande de estas lo, lo cogían.
0:26	Therapist	A ver si te sale, venga, que esto, tu hija se pondrá muy contenta si la nombras, hombre.
0:30	Félix	Tú cógelo.
0:30	Therapist	Vamos, a intentarlo, vamos. Esto sí que lo hemos de conseguir. Venga, José, ay Félix, él es José Luís, beeee ne.
0:39	Félix	Beeeee ne.
0:39	Therapist	Hombre, ¿ves? Claro.
0:40	Félix	Yo venime, vamo, vea.
0:42	Therapist	¿Cuál era tu casa de todas estas, Félix?
0:45	Félix	Desde aquí, desde aquí.
0:46	Therapist	¿Desde aquí la veías?
0:47	Félix	Desde aquí, de las dos manos.
0:50	Therapist	Y, los amiguitos que tenías cuando eras niño, ¿vivían todos en este pueblo también?
0:53	Félix	Claro que ha llegao' siempre, siempre nos hemos encontrado ahí desde que mi padre podía tener mi tío y

		Pedro y hacer todo por mis hijos pues, pues eso.
1:07	Therapist	¿A qué juegos jugabas?
1:14	Félix	Hombre pues sí, porque todas estas viviendas que tienen los niños en abre y tos esas nivelan eran unos rotosiles. Que estas las dos citas de ahí y toles y haces más alto.
1:26	Therapist	Félix, y, ¿a los amigos que tenías en el pueblo cuando eras pequeño no los sigues viendo ahora?
1:30	Félix	Pues, aparete a todas las del pueblo, todas las tablas de aquí todas que vieron que pele, es que no hay plan, no hay aitado, no hay tapada, y toda la ciudad a mí en teoría me estará ahí que echarla a la resta ahora y que se soltaran y salieran de las velas a un lugar tan bello y las cogidas pero aunque, aunque se dan cuenta de nuestros...
1:58	Therapist	¿Ha cambiado?
2:00	Félix	Mucho, porque unos gastan mucho y otros no cambian y para un berenjenal, un meledro. Pero en fin.

Appendix E

Table 9 *Video 5: Bilingual aphasic (Spanish/English)*

Timestamp	Speaker	Transcript
0:03	Danielle	¿Estás listo?
0:04	Hector	Ah, sí.
0:05	Danielle	Okay, vamos a empezar entonces, con esta [she shows him an image] ¿qué es eso?
0:12	Hector	Um, es una Jane.
0:16	Danielle	Ajá, ¿otra palabra? Una af...
0:19	Hector	Una afeitadora.
0:21	Danielle	Eso, una afeitadora.
0:23	Danielle	Hector had a gunshot wound to the head. He now has difficulties with language, something we call aphasia.
0:30	Hector	The doctor told me you know, I got a stroke, so they say yeah you have to learn how to talk, I had to learn all over again.
0:37	Danielle	¿De qué te recuerda una afeitadora?
0:42	Hector	Dos días. Porque yo tenía una pimple, so... y no puedes [he makes a gesture with his hand as if he was shaving his face], porque...
0:53	Swathi	Our goal is to develop therapies for individuals with bilingual aphasia. The way we're trying to do that is by providing therapy for the weaker language.
1:02	Danielle	He is stronger in English now than he is in Spanish

		which is his native language. So, it's something that he really wants to work on is increasing improving his level of Spanish so we have a group of 10 pictures and with each picture he is asked to identify it in the hopes that he will strengthen the semantic network in his brain so that word will become more easily accessible.
1:28	Danielle	[Showing an image] Tocador. No te recuerda de... ¿qué?
1:33	Hector	No me recuerda en el mundo.
1:37	Danielle	So, dijiste que "tocador" no te recuerda del mundo, de un cumpleaños, y vidrio. ¿Bien?
1:44	Hector	Ajá.
1:46	Swathi	If I told you that a canoe is a small sized boat that goes in water, that one person can sit in. That information stays longer in your brain than if I just said "canoe".
1:55	Danielle	All those things trying to strengthen the connections to that word in his brain so you can retrieve it.
2:00	Danielle	¿Y cómo se llama esto?
2:01	Hector	Uh, tocador.
2:04	Danielle	Es muy parecido, la palabra.
2:07	Danielle	He still is focused a lot on the way words sound so "tocador" and "afeitadora" at the end of that word it sounds really similar to him and so something about that similarity, like phonetically, makes it very difficult for him to access the right word.

2:25	Danielle	¿Para qué se usa? Para... [she moves her hands as if she was shaving her face]
2:30	Hector	Ah, como, ah, afeitadora. Afeitadora.
2:37	Danielle	Exacto. Piensa en para qué se usa.
2:39	Hector	Afeitadora.
2:40	Danielle	Ajá. Muy bien.
2:41	Swathi	So we assess our patients' progress every week for when we'll stop therapy. So almost all our patients we see in therapy have to improve by a certain amount before we say that the therapy is effective.
2:53	Hector	Like three weeks now I'm learning English but more talking in Spanish.
3:00	Danielle	You can see that he is improving, he gets really excited when he remembers a word or that he knows he's had difficulty with.
3:05	Hector	Una... afeitadora.
3:08	Danielle	Exacto, otra vez.
3:09	Hector	Afeitadora.
3:10	Hector	It feels good, you know. I'm still here, you know. I'm a survivor.