

DISSERTAÇÃO

GABRIOTTI, Rafaela Bepe ^[1], ZOMIGNAN, Rosângela ^[2]

GABRIOTTI, Rafaela Bepe. ZOMIGNAN, Rosângela. The Bilingual Brain: Brain processes during language acquisition. Revista Científica Multidisciplinar Núcleo do Conhecimento. Year 05, Ed. 08, Vol. 16, pp. 68-96. August 2020. ISSN: 2448-0959, Access link: <https://www.nucleodoconhecimento.com.br/education/bilingual-brain>

Contents

- SUMMARY
- INTRODUCTION
- 1. LANGUAGE ACQUISITION THEORIES
 - 1.2 BEHAVIORIST APPROACH
 - 1.3 NATIVIST APPROACH
 - 1.4 FUNCTIONALIST APPROACH
 - 1.5 CRITICAL PERIOD FOR LANGUAGE ACQUISITION
- 2. BRAIN LANGUAGE ACQUISITION PROCESSES
 - 2.1 LANGUAGE AND ITS CORTICAL ORGANIZATION
 - 2.2 RECOGNIZING THE SOUNDS OF PHONEMES AND WORDS
 - 2.3 LEARNING SPEECH
- 3. ASPECTS OF LANGUAGE ACQUISITION AND BILINGUALISM
 - 3.1 IMPLICIT LANGUAGE COMPETENCE AND EXPLICIT METALINGUISTIC KNOWLEDGE
 - 3.2 VOCABULARY AND THE BILINGUAL SPEAKER
 - 3.3 LANGUAGE CODE ALTERNATION AND LANGUAGE MIXING
 - 3.4 THE DIFFERENCES BETWEEN THE BILINGUAL BRAIN, COMPARED TO MONOLINGUAL
- 4. SOCIAL FACTORS AND LANGUAGE
 - 4.1 SOCIAL FACTORS AND LANGUAGE ACQUISITION
 - 4.2 SOCIAL FACTORS, LANGUAGE AND NEUROSCIENCE
- CONCLUSION
- REFERENCES

SUMMARY

This work is a study on language acquisition, brain processes involved during its acquisition and bilingualism. The aim of this research is to better understand how two languages are learned simultaneously, so that we can be better prepared to assist children during linguistic acquisition, as well as to support the teacher and family through theoretical foundation. Aspects such as the cortical organization of language, differences between the bilingual brain, compared to the monolingual brain, and influence of social interaction on linguistic learning are explained in this work to provide a broad view of bilingual language acquisition. For this study, we chose to use the bibliographic research of foreign literature, because not enough materials were found in the Portuguese that covered the areas of study contemplated. The results show how the brain processes language acquisition, showing the difference between learning two languages simultaneously, and sequentially, and presents how social factors and language are associated.

Keywords: language acquisition, neuroscience, bilingualism, social aspects, phonetics.

INTRODUCTION

Language acquisition is a very complex process that involves numerous cognitive, behavioral and social aspects. Over the centuries, scholars have tried to formulate theories that explain how the process of linguistic learning takes place. With advances in technology, the contributions of neuroscience were extremely significant to clarify, based on scientific brain scans, how language acquisition occurs. Currently new challenges and questions about the subject have arisen with the increasing need to speak two or more languages. According to Ramírez and Kuhl (2016), about two-thirds of the estimated world population understand or speak at least two languages.

With regard to bilingualism, there are still many questions about how the acquisition of two languages happens simultaneously, and many doubts about their effects on learning. In this study we will address the theme of language acquisition, presenting the brain processes involved, and make a parallel between the bilingual brain and the monolingual brain.

The study points out the hypotheses that language acquisition is easier in the first years of life, that if in the first years of life the child is exposed to two or more languages it learns them as mother tongues, not secondary languages, and that for the acquisition of two or more languages at the same time, the child needs different references.

The objective of this work is to better understand how two languages are learning simultaneously, in order to be better prepared to assist children during linguistic acquisition, as well as to know what to expect from this process and how to measure the use, supporting the teacher and the family through theoretical foundation.

The motivation for this study is based on pedagogical practice, in which, working with children in bilingual schools, being exposed to two languages, we could observe some patterns, such as the fact that the children understand the teacher in English, but only respond in Portuguese, sometimes mixing English words. We also observed that some children refuse to use English with their parents, with teachers as a reference of the English language. Acting for a few years in this universe allows us to bring concrete examples that can guide our research in order to make this reflection more concrete for the various audiences that make up this universe. By researching how two language acquisition happens simultaneously we aim to identify how the brain processes the acquisition of two languages at the same time, and analyze what brain processes are during language acquisition.

For this work we chose to use the bibliographic research of foreign literature, because not enough materials were found in the Portuguese that covered the areas of study contemplated. We believe that this will be a contribution to the scientific community by bringing information not yet widely available in the Portuguese.

This study will be divided into four chapters. The first will be a brief description of language acquisition theories. The focus of the second chapter will be to present the brain processes of language acquisition, such as phoneme recognition and speech, to later address the aspects of language acquisition and bilingualism, which will be the theme of the third chapter. The objective of the fourth chapter is to present how language acquisition is connected to social aspects.

1. LANGUAGE ACQUISITION THEORIES

According to Campbell and Wales (1970), language acquisition is the process in which children achieve fluent control of their native language. The authors state that the first attempt to document the linguistic development of a child was made by the German biologist Tiedemann (1787), who focused on starting a selection of normative data on child development. Campbell and Wales (1970) also point out that the greatest stimulus for the study of language acquisition comes from Darwin's theory of evolution, but that the author who most contributed to the subject began to be studied in more detail was the German psychologist Preyer (1882), who studied his son's development during his first three years of life, making detailed notes of their linguistic development.

According to Brown (2000), there are several questions about linguistic development regarding the time of language acquisition, and how its complexity and social function are understood and employed. The author states that, over the years, several theories of language acquisition have tried to answer them, and, despite exploring some contradictory aspects, present possible relationships between them.

In this chapter we intend to expose the main theories presented by Brown (2000), as well as the theory of the critical period of learning, so that later we can talk about brain processes during language acquisition.

1.2 BEHAVIORIST APPROACH

According to Brown (2000), the behaviorist approach focuses on the immediately perceptible linguistic aspects, that is, on (observable) responses to stimuli. Demirezen (1998) adds that the greatest principle of behaviorist theory is the analysis of human behavior, observing the stimulus-response interaction and the association between them. The author points out that through a process of trial and error, in which acceptable discourses are understood and reinforced, and the unacceptable ones are inhibited by the lack of reward, the child begins to make finer discriminations, until his speech approaches more and more to the speech of the community in which he is inserted. According to the author, for behaviorism, all learning is the establishment of habits, as a result of reinforcement and reward. According to him,

behaviorist theorists point out that: Language learning is a mechanical process that leads the learner to habit formation, whose underlying scheme is reflex conditioning. (DEMIREZEN, 1998, p. 137) (own translation).

Brown (2000) states that the best-known behaviorist model is the one incorporated by Skinner in his classic *Verbal Behavior* (1957). Brown points out that Skinner's theory of verbal behavior was an extension of his theory of learning by working conditioning. In Skinner's model, verbal behavior (like all behavior) is controlled by its consequences. When the consequences are rewarding, behavior is maintained, and reinforced. When the consequences are negative, or nonexistent, the behavior is weakened until it is extinguished.

Arguing about language acquisition and behaviorist approach, Brown (2000) states that a theory based solely on stimulus-response, conditioning and reinforcement is not enough to explain more complex aspects, such as the ability to acquire language, as well as understand its development, and its abstract nature. According to him, Skinner's theory received much criticism, among them that of Chomsky (1959), of whom we will talk more next.

1.3 NATIVIST APPROACH

According to Brown (2000), the nativist or inatist approach emphasized precisely trying to understand the more complex aspects of language, such as children's ability to acquire language, to understand how it develops, and how abstract aspects of language are addressed. For nativists theorists, language acquisition is innate, that is, we are born with a genetic capacity that predisposes us to a systematic perception of the language around us, resulting in the construction of an internalized language system.

According to Brown (2000), the nativist hypotheses had considerable support, such as that of Lenneberg (1967) and Chomsky (1965). The author states that Lenneberg's (1967) proposals indicate that language is species-specific and that certain modes of perception and ability to categorize, with other mechanisms related to language, are biologically determined. Chomsky (1965) also adds by stating that there are innate language properties, which explain how a child can, in such a short time, have mastery of his mother tongue.

Campbell and Wales (1970), point out that for Chomsky (1968), the speed at which children

are able to infer grammatical rules underlying the speech to which they are exposed, and to be able to subsequently apply these rules in the construction of discourse they have never heard before, suggests that children are born with a knowledge of formal principles – regarded by Chomsky as universal – that determine the grammatical structure of their language. That is, the fact that children can learn grammatical structures through what they listen to, and apply to new contexts, promotes the nativist hypothesis.

For Brown (2000), the nativist approach deals more appropriately with deeper language acquisition aspects, such as meaning, abstraction and creativity, especially in contrast to the behaviorist approach. He further states that research has shown that the child's language, given a certain time, becomes a legitimate system. When comparing behaviorist and nativist approaches, the author explains that:

The child's language development system is not a process of developing fewer "incorrect" structures, it is not a language in which lower stages have more "errors" than later stages. Instead, the child's language, at any stage, is systematic, and the child is constantly formulating hypotheses based on the content received, and then testing such hypotheses in speech (and comprehension). With the development of language, these hypotheses are continually revised, reformed, or sometimes abandoned. (BROWN, 2000, p. 25 – own translation).

Brown also presents in his work the contributions of Berko (1958), who demonstrated that children do not learn the language as a series of separate items, but as an integrated system. She discovered with a simple test with invented words, that children as young as four, whose mother tongue was English, applied grammatical rules, already known – such as plural formation, gerund, past, third-person in singular and possessive – to new contexts.

Brown (2000) points out that nativist studies were free to construct hypothetical grammars about the child's language, and that these grammars, which consisted of the description of language systems, were broad formal representations of the deep structure – the abstract rules underlying superficial production – the structure that is not always openly manifested in speech. According to the author, this generative model was a separation of structural methodology, and allowed researchers to take enormous steps towards understanding the

language acquisition process.

In his study, Brown also presents the concept of the word pivot. He points out that the nativists analyzed that the first “phrases” of the children were composed of two words, and they belonged to different classes of words, chosen with purpose, and not randomly. The author points out that the first class of words was called the word pivot, because it allows numerous combinations with the second order of words, presenting the phrase model as: pivot word + word, as, for example, in the translated model: “My cap”.

According to Brown (2000), in subsequent years, Chomsky’s model, and the assumption that the generative rules, or linguistic “items”, are serially connected – with a connection to each pair of neurons in the brain, began to be contested. According to him, a new model emerged that indicated that linguistic performance should be the consequence of several levels of neural interconnections happening simultaneously (Parallel Distributed Processing – PDP), and not a serial process, with one rule being applied after another.

Brown states quoting Ney and Pearson (1990), and Sokolik (1990) that, according to the model presented by Parallel Distributed Processing (PDP) – which presents phonological, morphological, syntax, lexical, semantic, discursive, sociolinguistic and strategic properties – a phrase is not “generated” by a series of rules, but is actually the result of simultaneous interconnections of a multitude of brain cells, thus proposing , a different view from that presented by the nativist approach.

1.4 FUNCTIONALIST APPROACH

According to Brown (2000), with the increase in studies on the constructivist approach, research patterns began to change. First, the researchers began to realize that language was a manifestation of the cognitive and affective ability to deal with the world, with others, and with one’s own. Second, the generative rules, which were proposed by the nativists, were abstract, formal, explicit, and quite logical, but dealt specifically with the forms of language, and not with their deeper side, as the functional levels of meaning constructed in social interactions. Functionalism emphasized precisely the functions of language, which are defined by the author, as functions of using linguistic forms in a meaningful and interactive

way, within a social context. In other words, functionalism focuses on the function of language, the meaning of words and grammatical constructions employed during social interactions.

According to the author, functionalism came to question the grammar proposed by the nativists, who proposed the idea of phrase such as: pivot word + word. He points out that Bloom (1971), after analyzing data within contexts, concluded that children learn the underlying structures of sentences, not only superficial ones as word order, and that the idea of phrase as pivot word + word, failed to capture the various meanings that the child could attribute to his speech. Brown points out that: Bloom's research (1971), with those of Jean Piaget, Dan Slobin and others, paved the way for a new wave of study on the child's language, this time focusing on the relationship of cognitive development during linguistic acquisition, Brown (2000) (own translation). Brown also points out that, according to Piaget and Inhelder (1969), the child's overall development is the result of their interaction with the environment, with a complementary interaction between their developing perceptual cognitive abilities, and with their linguistic experience. According to the author, after the emergence of this new way of seeing linguistic learning, researchers began to formulate rules about language functions, and their relationship with language forms, paying more attention to the function of the child's discourse in their social interactions, but without invalidating some ideas proposed by the nativists, such as that linguistic learning is innate to the human being.

1.5 CRITICAL PERIOD FOR LANGUAGE ACQUISITION

After presenting the main approaches on language acquisition, we need to bring to the attention that learning languages in childhood is much easier than in adulthood, which we can affirm from experiences, experiences and observations. Hagen (2008) points out that the acquisition of children's language is extremely fast, and children become fluent in a period of three to four years, while adults often take decades to learn a new language, and even then, they do not always reach fluency. The author puts it that for children, learning a language happens naturally, effortlessly, while for adults it can be a laborious, difficult, and often frustrating process. Hagen also points out that children do not need to learn grammatical rules in order to acquire a language, and that the acquisition of the mother tongue happens

universally. According to him, all children, in all cultures, become fluent in their native language: Language acquisition is an age-sensitive process, which results from maturational and neuroanatomical changes, still poorly understood. (HAGEN, 2008) (own translation).

Hagen points out that Lenneberg's studies (1964-1984) on language loss in children contributed to the creation of the Critical Period Hypothesis, which states that around the first year of life, until adolescence, the human brain is prepared to acquire language without requiring special instructions, provided that the child is exposed to a rich linguistic environment. Its statement is based on a study done with children who suffered damage to the left hemisphere of the brain in its preverbal phase, and who had no significant damage thereafter.

According to the author, the reason why the human brain is better prepared to learn languages in the early years of life is a matter of physical and behavioral evolution. He likes the needs of a wildebeest cub to a human baby, explaining that a wildebeest cub, because it is easy prey, needs to learn how to move quickly, which occurs almost immediately after delivery. A human baby, born in a socially welcoming environment, depends on language to socialize and survive, which justifies the fact that it is among the first cognitive traits to emerge in childhood.

Hagen (2008) also states that the reason why adults have more difficulty acquiring a new language dates back to the Paleolithic period. The author points out that for a child to learn a language, it usually takes three to four years, and if we consider the culture of nomadic hominids, firstly they would not have the opportunity to learn a new language because they do not have enough time to show exposure to a new language, and secondly, because they have a very short life expectancy, of about 35 years of life, learning a second language in adulthood would be useless: Archaic humans had little opportunity to learn anything during adulthood, simply because adulthood did not last much longer than childhood and adolescence. (HAGEN, 2008) (own translation).

For Hagen, in a scenario like the one mentioned above, the brain's ability to learn a new language during adulthood, with the same speed and efficiency as a child learning his mother tongue, would be of no use, so it was not a skill that evolved universally in the human brain.

Hagen (2008, p.48) also presents that among the community of educators, there are advocates that the Critical Period Hypothesis does not exist, arguing that the brain is not restricted to a critical biological period, but to social and behavioral factors. For them, issues such as children being more uninhibited than adults, being more motivated to learn and more open to new interactions than adults, is what makes them more successful in learning a new language. Hagen counters these statements, noting that there are no empirical studies that support these ideas, as well as giving examples of adults who, however motivated to learn, however uninhibited, are still no match for children in language acquisition, in the same way that shy and introverted children still have more success in language acquisition, even if compared to motivated and outgoing adults.

While the *Critical Period Hypothesis* continues, in a way, controversy in educational and social studies, among the scientific community in general – and among the medical community in particular, in which facts about age and issues of loss and recovery of language impose on decisions on how to deal with serious medical conditions – it is accepted without debate. (HAGEN, 2008, p. 49 – own translation).

For Hagen, the need to learn a language during adulthood is still very recent in our evolutionary history to affect our brain architecture, and seen from this perspective, the acquisition of mother tongue by children, and acquisition of a new language by adults, is no longer a mystery, as it seemed in the past, but actually fits perfectly into the mosaic of the theory of evolution.

Kuhl (2010) points out that recent studies of brain imaging indicate that within the processes of linguistic learning there are still several critical periods, such as phonetic learning takes place just before the first year of life, while syntactic learning takes place between 18 and 36 months. Vocabulary development peaks at 18 months, but this seems not to be conditioned by age, and can be easily learned at any age. The author states that one of the researchers' future goals will be to document the "openness" and "closure" of these critical periods, for all levels of language, and understand how they overlap and why they differ.

2. BRAIN LANGUAGE ACQUISITION PROCESSES

The theories of language acquisition, exposed in the previous chapter, sought to understand and explain the complex processes involved in linguistic learning, but without the technology to which we currently have access, many of them proved flaws and were not able to answer all complex questions related to language.

Ramírez and Kuhl (2016) point to the difficulty in conducting behavioral tests on babies as a hindrance found by theories of ancient language acquisition, and state that recent studies done through brain scientific tests may indicate a new path in understanding language learning.

In this chapter we intend to briefly present the brain processes during language acquisition, so that later we can establish a parallel with the bilingual brain.

2.1 LANGUAGE AND ITS CORTICAL ORGANIZATION

According to Amunts (2008), the linguistic and neuropsychological concepts of language, developing, with the rapid development of imaging techniques, led to increased interest in neural mechanisms underlying language. Segregation of the cerebral cortex in cortical areas with its specific cytoplasm architecture, receptors, and connectivity provides organizational principles that can be correlated with brain function.

Motor and sensory functions occupy less than half of the cerebral cortex in humans. The rest of the cortex is occupied by the association areas, which coordinate events that arise in the motor and sensory centers. Three areas of association – the prefrontal, parietal-temporal-occipital and limbic – are involved in cognitive behavior: speaking, thinking, feeling, perceiving, planning, learning, memory and skilled movements. (KANDEL *et al.*, 2013, p.1349- own translation)

According to Ojemann (1991), language is processed serially, from its decoding in the posterior temporal cortex (Wernicke area) to its motor expression in the lower posterior frontal lobe (Broca area).

Kuhl (2010), cites that studies using fMRI scans showed that newborn babies showed no sign of brain activation in the motor area of speech (Broca area), while their hearing area (Wernicke area) responded robustly to stimuli. The studies conducted with 3-month-old babies have already indicated activation of the motor area in response to sentences, and the 6- and 12-month-old babies presented synchronized activation in response to speech in both the hearing area and the motor area, which indicates the possibility of a connection between perception and action regarding speech development from 3 months of life, when babies begin to produce vowel-like sounds, complementing Ojemann's (1991) statement regarding the sequence of language processing.

Quoting Caramazza (1988); Ojemann (1991) explains that the cortical area dedicated to language is not unique, but compartmentalized in separate systems that process the different aspects of language, and that this discovery occurred through studies on brain lesions. In addition, the author points out that studies on injuries also indicate that there are separate areas to deal with different languages. He points out that the studies of Paradis (1977), present that there are lesions in polyglots, which leave only one of the languages intact, language that may not even be his mother tongue, or his most used. Ojemann (1991) states that this separation of areas dedicated to different languages was evident both in the frontal cortex and in the temporal-parietal.

According to Ojemann (1991), language is usually lateralized in the left hemisphere of the brain, with a 5% variant of people with bilateral cortical areas. The author also points out that according to Dennis and Whitaker (1976), after an injury in the left hemisphere, or in the parietal lobe, during childhood, the language will develop in the right hemisphere, but although functional, it will not be totally normal, suffering as to its syntax competence.

Ojemann (1991) states that, in addition to the cortical area dedicated to language not being unique, but compartmentalized in separate systems, the various components of the cortical system of language function seem to be activated in parallel. According to him, this activation in parallel includes the essential areas of the frontal and temporal-parietal lobes, as well as the most widely dispersed neurons belonging to the language system. He points out that changes in the frequency of cortical neuronal activity also reflect how systems are activated in parallel, and each cortical system is activated according to its language function, including areas containing the most widely dispersed neurons.

As presented above, the language acquisition process takes place sequentially, involving several parts of the brain, among them the most used being the Wernicke area, auditory area and broca area, motor area. Next we will see how the listening area responds to speech stimuli, in order to recognize the sounds of phonemes and words, to sequence try to reproduce the learned sounds, initiating the speech process.

2.2 RECOGNIZING THE SOUNDS OF PHONEMES AND WORDS

Long before the children produce their first words, they learn the sound patterns underlying the phonetic units, words, and phrase structure of the language they hear. (KANDEL *et al.*, 2013 - own translation)

According to Kuhl (2010), the recent increase in neuroscience-related research examining language processing in children through brain scans has made it possible to document the effect of learning on the brain. The author points out that the phonetic level of language - which is the level of the physical nature of the production and perception of the sounds of human speech, focused on the significant part of the linguistic sign and not on its content - is especially accessible to experimental studies, and that neural learning markings on the phonetic level can be documented surprisingly early during the development process.

According to Kuhl (2010), neuroscience studies using imaging and speech techniques can examine whether the brain systems involved in speech production are activated when babies hear someone speak. The author presents the main available brain scans: Electroencephalogram (EEG), Event-Related Potentials (erp), Magnetoencephalography (MEG), Functional Magnetic Resonance Imaging (fMRI), and Near Infrared Spectroscopy (NIRS), and explains that each is used according to the study's need, or can be used together, and the largest difference between them is due to the temporal and spatial resolution offered by the temporal and spatial resolution offered , by the cost of the exam, and by the age indication.

Kuhl (2010), points out that the perception of phonetic units of speech - vowels and consonants that form the word - is one of the most studied linguistic skills in childhood and adulthood, and that these studies provide critical tests to theories of language development

and its evolution. She puts it, research on phonetic perception in the first year of the child's life shows how computational, cognitive and social skills come together to form an extremely powerful learning mechanism. According to Kuhl, this mechanism does not resemble Skinner's behaviorist model of operating conditioning, nor to Chomsky's proposed model of parameter and rule construction. According to her, the learning processes, employed through exposure to the language, are complex and multi-modal, and playing is part of this learning, because it provides attention to items and events in the real world, such as faces, actions, and voices of the people around them.

Kuhl (2010, p.716) states that each language uses a unique set of 40 distinct elements, called phonemes, that can change the meaning of the word, as in the example in English: "cat" and "bat". If we think about Portuguese, we also have the example "pot" and "boat", among others. For the author, children are exposed to more phonetic variants than they will use, so they have to form the appropriate grouping for their language. She points out then, that the baby's task in his first year of life is to try to discover the composition of the phonetic group (composed of 40 distinct categories of phonemes) of his language, before learning the words - which will depend on these units.

According to Kuhl (2010), a necessary step for the development of the child's language is to learn which phonetic units are relevant to the languages to which they are exposed, and at the same time, to decrease, or inhibit, their attention to phonetic units that do not distinguish words in their language. The author explains, citing one of her previous studies Kuhl (2004), that this fact leads her to state that an implicit learning process compromises the neural circuitry of the brain with the properties of native language speech, and that this impairment has two-way effects - increases the learning of patterns compatible with the phonetic structure learned (such as that of words), while decreasing the perception of patterns that are not part of the learned system.

As for word learning, Kuhl (2010) points out that the new experiments show that before 8 months, babies can already identify words uniquely. The author explains that through their sensitivity to the transient probabilities between adjacent syllables, they can detect possible candidates for words. Simply put, babies have the sensitivity to distinguish, by probability, the syllables that may form the word. According to Kuhl, for babies, the probability of transition between syllables that form the same word is higher, that is, it is easier to

distinguish the syllables that form the same word, than to distinguish the syllable that will form the following word, for example (adapted to Portuguese), in the words “beautiful baby” it is easier to distinguish the sounds “be” and “baby”, and “lin” and “do” , than the sounds between the syllables, “bê” and “lin”.

According to Kuhl (2010), babies have a basic implicit learning mechanism that allows them, from birth, to detect statistical structures in speech and other media. She also states that the sensitivity of babies to this statistical structure can influence the learning of phonemes and words.

2.3 LEARNING SPEECH

According to Horwitz and Wise (2008), spoken language is the most complex sound found, and on the range of spectral and time details transmitted by speech, we can detect phonemes, syllables, stress, and variations in amplitude and tonal peaks.

According to Kuhl (2000), babies not only learn the perceptual characteristics of the language, but become native speakers, which requires imitation of the speech patterns to which they are exposed. She states that learning speech depends critically on listening to the vocalization of others and on oneself. Kuhl points out that perception and production are extremely dependent on each other and explains that it is for this reason that patterns learned early in life become difficult to change later, giving as an example the fact that people who learn a second language after puberty produce it with the accent of their native language, even after a long time of study.

According to the author, imitation is responsible for making the connection between perception and speech production. She states that at 12 months of life, a baby's spontaneous speeches reflect her imitation of ambient language patterns. And that this fundamental ability to mimic sound patterns is observed even before, during 12, 16 and 20 weeks of life.

Kuhl (2000) points out that the first theories on speech perception held that speech was perceived with reference to its production, but that recent development data suggest a different conclusion, arguing that at the beginning of life, perceptual representations of speech are stored in memory, and that subsequently, these representations will guide the

motor development of speech.

The author also explains that, in related studies, it was possible to verify that babies have the ability to connect oral movements to the sounds they hear. According to her, studies with 20-week-old babies have shown that they pay more attention to the faces of people making the movement of the pronunciation of the sound of a vowel compatible with the sound they are hearing, than the faces in which the heard sound and oral movement are incompatible. Kuhl (2000), argues that as a result of these studies it is possible to point out that the polymodal representations of the babies' speech probably contain information about the visual, as well as auditory aspects of speech.

3. ASPECTS OF LANGUAGE ACQUISITION AND BILINGUALISM

In our culture we sometimes hear questions about the benefits of bilingualism. Although several studies have already pointed out that the bilingual brain, by constantly accessing two linguistic codes, presents greater development of executive functions and greater plasticity Ramírez and Kuhl (2016) and Abutalebi *et al.* (2004), some people question whether it can bring possible delays in language development.

According to Ramírez and Kuhl (2016), while behavioral research indicates that children exposed to two languages simultaneously present a slight delay in their phonetic perception, other studies indicate that the path of linguistic development in monolingual and bilingual children is identically equal. For the authors, such ambiguous results are due to the quantity and quality of exposure to languages, or the difficulty in conducting behavioral research in preverbal babies.

Ramírez and Kuhl (2016) also place that an alternative to behavioral research are brain imaging. According to the authors, recent studies show that the bilingual brain at 12 months is within the expected process of learning two languages, which indicates that it is at the same degree of development expected as a monolingual brain, which at 12 months is in the same phase, but learning only one linguistic code. They also point out that the quality and amount of exposure to language has extreme relevance in the learning process, as well as this process is critically dependent on social interactions, and the quality of speech heard by

children. The authors state that for a bilingual child to have a good linguistic development in both languages, it must necessarily have been exposed to both in an equally quantitative, and qualitative way.

In this chapter we will present aspects of linguistic processing in bilingual brains such as: implicit linguistic competence and explicit metalinguistic knowledge, vocabulary acquisition, alternation of linguistic codes and language mix, as well as the differences between the bilingual brain, compared to the monolingual.

3.1 IMPLICIT LANGUAGE COMPETENCE AND EXPLICIT METALINGUISTIC KNOWLEDGE

When we talk about bilingualism, we need to point out that there are bilinguals who were born being exposed to two languages, and there are bilinguals who learned the second language later. According to Mohades *et al.* (2011), there are two types of bilingual speakers: simultaneous speakers, who have been exposed to two languages since birth, and sequential speakers, who learned the second language after the age of 3.

According to Paradis (2008), there is a great difference between the learning of simultaneous bilingual and consecutive bilinguals. For the author, simultaneous bilinguals have implicit linguistic competence, while the consecutive ones have explicit metalinguistic knowledge.

Paradis states that implicit linguistic competence is composed of language components that can be described according to rules such as phonology, morphology, syntax, and morphosyntactic properties of the lexicon. And explicit metalinguistic knowledge is formed by the linguistic components to which we are aware of use, for example, vocabulary.

Paradis (2008) defines implicit linguistic competence as being acquired incidentally, that is, unconsciously. It states that it is stored implicitly, and used automatically, being resonated by procedural memory, while explicit metalinguistic knowledge is consciously learned, being stored explicitly by declarative memory.

Paradis (2008), further points out that fluency and accuracy are not indicators of implicit linguistic competence, and that controlled processing is not only slower, but also varies more when compared to automatic processing.

Hagen (2008) points out that Paradis's (2004) study on implicit linguistic competence and explicit metalinguistic knowledge is very promising because it explains why sequential bilinguals have more difficulty learning a second language and having more hesitant and less fluent speech.

In this chapter we will emphasize the processes of language acquisition by simultaneous bilinguals.

3.2 VOCABULARY AND THE BILINGUAL SPEAKER

Ramírez and Kuhl (2016) claim, citing Hoff *et al.* (2012), and Hoff and Core (2013), which although several studies point out that bilingual speakers have a smaller vocabulary in each language than monolingual speakers, many other studies indicate that the child's language skills reflect the amount of language to which they were exposed, and since bilingual speakers divide their time between two languages, and consequently end up hearing less than each language, compared to a monolingual speaker, this fact is expected.

According to the authors, it is important to point out that the studies consistently show that bilingual speakers do not stand behind monolingual speakers, in relation to vocabulary, if we consider the two languages. They state that by adding the amount of vocabulary of the two languages together, bilingual speakers have vocabulary equal to or greater than that of monolingual speakers, and that the same happens with their grammatical knowledge, that is, bilingualism does not cause the child to be harmed as to their repertoire, on the contrary, it expands its possibilities, since the child can use two languages to express himself.

Ramírez and Kuhl (2016) point out that in studies with bilingual children in which brain activity was tested in response to words, it was discovered that brain activity is related to their experience with each language. And as mentioned earlier, Ramírez and Kuhl (2016) state that for a bilingual child to have a good linguistic development in both languages, it necessarily needs to have been exposed to both equally quantitatively, and qualitatively.

As seen earlier, Kuhl (2010) states that although vocabulary development peaks at 18 months, it does not seem to be conditioned by age, and can be easily learned in any age group. Meisel (1989) also points out a strategy used by bilingual speakers: the alternation of

linguistic codes, which we will see below.

3.3 LANGUAGE CODE ALTERNATION AND LANGUAGE MIXING

According to Meisel (1989), although often confused, there is a difference between the alternation of linguistic codes and the mixture of languages. The author uses the term “alternation of linguistic codes” to describe the ability to select the language to be used, according to the interlocutor and regarding the context. The mixture of languages is given by the author as an indiscriminate combination of elements of each language.

For the author, the alternation of linguistic codes is a common phenomenon among bilingual individuals, usually occurs at the lexical level, and is widely used as a “relief factor” when linguistic material is more easily accessible in one language than in the other, for example when talking about some subject where we have vocabulary dominance in a language, as in the example “I went to a restaurant and I ate artichoke.” (I went to a restaurant and ate artichoke.), where food vocabulary was more accessible in Portuguese than in English. According to Mcclure (1977), the alternation of linguistic codes also occurs when the term “borrowed” from the other language is an idiomatic expression, with no precise and culturally proper equivalent.

According to Meisel (1989), the alternation of linguistic codes is a pragmatic competence of bilingual speakers, and occurs consciously. The speaker chooses to use the words of one or another linguistic code, correcting himself when necessary, intentionally, which is different when it comes to the mixture of languages, which according to Mcclure (1977, p.7,8) occurs so that grammatical words, morphology and syntax are abruptly interrupted, as in the example given by the author: “I put the forks en las mesas.” (I put the forks on the tables.) half of the sentence is in English, and the other half in Spanish.

Meisel (1989) points out that the mixture of languages is often cited in the same way as the alternation of linguistic codes, not being clear in the literature when an author is speaking of one or the other. According to him, the mixture can occur for two reasons: if the child has greater competence in one language than in another, or if the adults around him mix the language codes freely in his speech. During classroom practice, we noticed a case of a three-

year-old student whose father was Dutch, who also spoke Portuguese and English. We realized that the student's speech was very confusing, often incomprehensible. By observing his interactions with the father, we could hear him addressing his daughter using the three languages intermittently in less than 5 minutes. This observation makes us reflect on the mixture of languages to which she was exposed, and the result of her confused speech. Without having knowledge of the Dutch language, we could not say whether the student was mixing the three languages, or if she had any speech development problems, and unfortunately, with her move to another school we could not continue to follow her linguistic development.

3.4 THE DIFFERENCES BETWEEN THE BILINGUAL BRAIN, COMPARED TO MONOLINGUAL

As we mentioned earlier, Ramírez and Kuhl (2016) point out that about two-thirds of the estimated world population understand or speak at least two languages. Given this fact, the author states that bilingualism has become the norm, not the exception.

By constantly accessing two linguistic codes, the bilingual brain has greater development of executive functions and greater plasticity, when compared to monolingual brains Ramírez and Kuhl (2016) and Abutalebi *et al.* (2004). Our goal in this subchapter is to briefly present some of the characteristics that differentiate the bilingual brain from the monolingual brain.

One of the different aspects of the bilingual brain is its phonological awareness. Ramírez and Kuhl (2016) point out that bilingual children acquire two phonetic systems, which implies in manipulating the sounds of language more, so exposure to two languages increases their phonological awareness. The authors point out that continuous access to two languages helps the child in their linguistic development and literacy, by facilitating the understanding of the relationship between sound and symbol, grammatical understanding and vocabulary learning.

Another point at which the bilingual brain distinguishes itself from the monolingual brain, is how much its metacognitive and metalinguistic abilities. Ramírez and Kuhl (2016), state, citing Bialystok (2007), that the constant need to manage attention between two languages causes the child to reflect more on language, which leads to increased metacognitive and

metalinguistic abilities.

The authors also draw our attention to the development of executive functions in bilingual brains. According to Ramírez and Kuhl (2016), the primary processes of the executive function system are: shifting focus of attention, flexible thinking (cognitive flexibility), and updating information in working memory. According to the authors, the researchers indicate that the experience of using two languages, and constantly having to manage attention on which language to use for each context, increases brain connections, making them more robust in terms of executive functions throughout life. Kuhl (2010) also points out that specific cognitive abilities such as attention focus control and inhibiting control – which are part of executive functions – are also associated with exposure to more than one language.

Another differential pointed out by bilingualism is neuroplasticity. Abutalebi *et al.* (2004), cite studies conducted by Mechelli *et al.* (2004), which indicate that plastic alterations induced by bilingualism have been reported in young adults in the left inferior parietal lobe and in its right part. The authors also state that the age of acquisition of the second language and its proficiency is correlated with increased gray matter in the same location. Abutalebi *et al.* (2004), also point out that neural plasticity, both functional and structural, results from the experience with two languages, and that neuroplasticity in these regions depends on how well and how often a second language is used.

It is also important to note that there are differences between the bilingual brain of simultaneous speakers, who have been exposed to the two languages since birth, and sequential, who learned the second language after 3 years.

According to Conboy and Mills (2005), studies indicate that when the second language is acquired after childhood, it is mediated by neural systems not identical to that of the mother tongue, but that when the two languages are acquired simultaneously, during childhood, they are mediated by the same brain systems. The authors also state, citing Paradis (1990) and Vaid and Hall (1991), that studies with adult bilinguals have suggested that simultaneous bilinguals demonstrate greater lateralization of the second language in the right hemisphere than sequential bilinguals, which indicates that the right hemisphere should be related to the process of simultaneous language acquisition, rather than in the process of acquiring sequential language or monolingual speakers.

During classroom practice, we could also observe other examples of language mixing at grammatical levels such as word order exchange and gerund formation. In one case we observed a student who brought a toy and said: “It’s a car black.”, applying the word + adjective order of the Portuguese, when assembling its structure in English, which should be the opposite: adjective + word (black car). In another case, we asked a student to share her toys with her friend (share), her answer was “I’m already sharando.”, using the English word “share” in the gerund structure of the Portuguese language.

Although the mixture of languages mentioned above occurred probably because the children observed had greater competence in Portuguese than in English, and perhaps because these children are sequential bilingual, and not simultaneous, Meisel (1989) points out that after several tests conducted with children from 12 months to 4 years analyzing language phenomena such as word order and verb-nominal agreement, it is possible to affirm that an individual, exposed to two languages from an early age, can differentiate two linguistic codes, without going through a phase of confusion between them.

4. SOCIAL FACTORS AND LANGUAGE

It is evident that language acquisition exists only with one purpose: socialization. There would be no need to learn a language code if we didn’t need to communicate with the people around us. As mentioned at the beginning of this study, HAGEN (2008) points out that human babies, unlike other species, are born in a socially welcoming environment, and depend on language to socialize and survive.

Language is the characteristic that defines human beings, and living without it creates a totally different world, as is experienced so painfully by patients with aphasia after a stroke. (KANDEL, 2013, p. 1354 (own translation).

As language is a tool for social interaction, and for our survival as humans, we cannot fail to analyze the influence of social factors on language learning.

In this chapter we intend to present how social factors have been seen in language acquisition studies, briefly present Vygotsky’s vision – a great theorist of language studies and social interactions – on the subject, and present what neuroscience has discovered about

language and social interaction.

4.1 SOCIAL FACTORS AND LANGUAGE ACQUISITION

According to Ochs and Schieffelin (1982), processes on language acquisition and socialization have been mistakenly regarded as separate domains. According to the authors, processes on language acquisition are generally seen as relatively unaffected by social factors such as social organization and beliefs of the place where the individual is inserted, and these factors are generally referred to as “context”, that is, something that can be separated from language and learning.

Vygotsky, a great theorist who developed theories about the interrelation of individual and social processes in mahn and steiner learning and development (2012), had a different view, stating that the development of thought and language are fully connected with social interaction and the means in which the talking individual is inserted. Shabani (2016) points out that Vygotsky’s theories propose that the origin of the construction of knowledge should not be sought in the mind, but in the social interaction co-constructed between individuals of different levels of knowledge. The author points out that according to Vigotsky, the construction of knowledge is a socioculturally mediated process, affected by physical and psychological tools and artifacts, and language is the main tool of thought.

Mahn and Steiner (2012) also explain that for Vygotsky, the way social activity becomes internalized during the learning process helps the development of language and thought processes.

Ochs and Schieffelin (1982) point out that in studies conducted, when observing the interaction between children and their guardians, in several societies, it was possible to notice that the main concern of those responsible was to ensure that children could understand and present behaviors appropriate to social interactions, which, according to the authors, is mostly possible through language. They also propose that pre-linguistic and linguistic behaviors should be examined in order to determine how they are continuously and selectively affected by the values and beliefs of members of their society.

The authors propose two perspectives on language and socialization: the first points out that

language acquisition processes are deeply affected by the process of becoming a competent member of society. The second perspective exposes that the process of becoming a competent member of society is carried out by language, in acquiring knowledge about its function, its social distribution, and interpretations about socially defined situations, through language exchanges in specific social situations.

Ochs and Schieffelin (1982) conclude, in their research, observing the interaction between children and their guardians, that the process of language acquisition and the process of acquiring sociocultural knowledge are closely linked. According to them, through social participation, the child develops a variety of skills, intuitions and knowledge, allowing them to communicate in culturally preferred ways, and they also argue that these faculties are integral parts in the process of becoming a competent speaker.

4.2 SOCIAL FACTORS, LANGUAGE AND NEUROSCIENCE

According to Ramírez and Kuhl (2016), language learning during childhood is critically dependent on social interactions. They point out that babies learn better through frequent social interactions, and of good quality.

Kuhl (2010) also states that social brain systems are fully involved in the language acquisition process, and that in fact, they are necessary to explain natural language learning. Citing his previous studies, Kuhl (2007) proposes that social interactions create a vastly different learning situation, in which additional factors, inserted in a social context, influence learning. The author states that social interactions can increase attention, information capture, sense of relationship and activation of brain mechanisms connecting perception and action.

Kuhl (2010) presents that during studies done with babies interacting with guardians, it was possible to notice that the social cues given by the tutor, such as staring and pointing to a reference object, can help children segment words from the speech in progress, facilitating the phonetic learning of the sounds contained in these words. In his study Kuhl also proved, through event-related Potentials (PRE) exams, that children who were more socially engaged demonstrated greater learning of both phonemes and words.

Citing Hari and Kujala (2009), the author states that social interactions should activate brain mechanisms to evoke a sense of relationship between the self and the next, just as social understanding systems connect perception and action.

CONCLUSION

In the preceding pages, we seek to examine language acquisition, present the brain processes involved, and draw a parallel between the bilingual brain and the monolingual brain. Based on the main theories of language acquisition, we were able to briefly expose the brain processes involved in the process of linguistic learning, and talk about the nuances of bilingualism, as well as the influence of social factors on language acquisition.

From this study, we conclude that language acquisition is easier in the first years of life, because this is the critical period in which the brain is better prepared to learn linguistic codes, which is explained by biological and evolutionary factors. However, it is important to point out that although it is easier to learn a language in the first years of life, the ability to learn is inherent to the brain at all ages.

We can also affirm that when the child is exposed to two or more languages simultaneously from birth, both will be learned in the same way, using the same brain mechanisms, and their learning will occur in a natural and implicit way, and if bilingualism occurs sequentially, that is, after the mother tongue has already been acquired, the second language will be learned explicitly, and will depend on metalinguistic knowledge. We also conclude that the acquisition of language in sequential bilinguals follows the patterns already formed by the mother tongue – which explains, for example, the fact that adolescents and adults have a native language accent when speaking the foreign language.

Confirming our hypotheses, we conclude that, while the alternation of linguistic codes is the ability to use languages according to the public and context, being a strategy used by bilingual speakers. On the other hand, language mixing can occur if the same linguistic reference uses in your speech, two or more languages in a mixed way, which demonstrates how important the quality of reference speech is for language acquisition.

We also emphasize that speech acquisition and social interactions are closely connected, and

that one depends on the other, since there would be no need to develop speech if we did not need to interact with people around us, and that social interaction without speech is quite compromised, as it is possible to verify in people with aphasias.

We were able to compare the bilingual and monolingual brain, and use theoretical foundations to explain questions about bilingualism, such as its concern to generate delay in speech development, or decreased vocabulary, overthrowing myths, and showing differentials of the bilingual brain, in order to support the teacher and family, with regard to the doubts that arise about these subjects.

With this study, it was possible to present in a very brief way, several aspects about language acquisition and bilingualism by the bias of neuroscience, but this subject provides several challenges, and new studies can contribute to the deepening of the topics addressed here in order to better understand the complex process of language acquisition.

According to Kuhl (2010), neuroscience studies over the next decade will lead the theoretical work on language acquisition, and these advances will promote the science of language learning, which will bring potential clarifications about human learning mechanisms more comprehensively.

This study aimed to clarify how two languages are learning simultaneously, and brought contributions to the academic community by seeking the results of research that is not yet translated to Portuguese. Many questions about language acquisition and bilingualism still persist, as it is a subject related to social aspects and with many variants, but we hope that future research will continue to provide clarification on the subject.

REFERENCES

ABUTALEBI, J., CANINI, M., ROSA, P. A. D., GREEN, D. W., WEEKES, B.S. The Neuroprotective Effects of Bilingualism Upon the Inferior Parietal Lobule: A Structural Neuroimaging Study in Aging Chinese Bilinguals. University of Hong Kong, San Raffaele University & San Raffaele Scientific Institute, Milan, IBFM-CNR (National Research Council), Milan, University College London, United Kingdom. – 2014.

AMUNTS, K. Architectonic Language Research - in Handbook of the Neuroscience of Language. Edited by STEMMER B. and WHITAKER. H. A., - Academic Press - 2008.

BERKI, J. The Child's Learning Of English Morphology. - 1958.

BIALYSTOK, E. Acquisition of Literacy in Multilingual Children: A Framework for Research. Language Learning - 2007.

BLOOM, L. Why not pivot grammar? Journal of Speech and Hearing Disorders - 1971.

BROWN, H. Douglas. Principles of Language Learning and Teaching. White Plains, NY - Longman - 2000.

CAMPBELL, R., WALES, R. The Study of Language Acquisition. Penguin Books. - 1970.

CARAMAZZA A. Some Aspects of Language Processing Revealed Through the Analysis of Acquired Aphasia: the lexical systems. Annu. Rev. Neurobiology - 1988.

CHOMSKY, N. Language and Mind. New York - Harcourt, Brace & Wold - 1968.

CHOMSKY, N. A Review of B. F. Skinner's Verbal Behavior. Language. - 1959.

CHOMSKY, N. Aspects Of The Theory Of Syntax. Cambridge: M. I. T. Press - 1965.

COMBOY, B. T., and MILLS, D. L. Two Languages, One Developing Brain: event-related potentials to words in bilingual toddlers. Center for Research in Language, University of California, San Diego. School of Speech, Language, & Hearing Sciences, San Diego State University, Department of Psychology, Elmore University, USA. - 2005.

DENNIS, M., WHITAKER, H. Language Acquisition Following Hemi Decortication. Linguistic Superiority Of The Left Over The Right Hemisphere. Brain Lang. - 1976.

HAGEN, L, K. The Bilingual Brain: Human Evolution and Second Language Acquisition - University of Houston-Downtown - Evolutionary Psychology - INSS 1474-7049 - Volume 6(1). 2008.

HARI, R. and KUJALA, M. V. Brain Basis Of Human Social Interaction: From Concepts To Brain Imaging. *Physiol.* – 2009.

HOFF, E. & CORE, C., What Clinicians Need To Know About Bilingual Development. *Seminars In Speech And Language.* 2013.

HOFF, E., CORE, C., PLACE, S., RUMICHE, R., SEÑOR, M., & PARRA, M. Dual Language Exposure And Early Bilingual Development. *Journal Of Child Language.* – 2012.

HORWITZ, B., WISE, R. J. S. PET Research of Language. – In *Handbook of the Neuroscience of Language.* Edited by STEMMER, B. and WHITAKER, H. A., – Academic Press – 2008.

KANDEL, E. R., SCHWARTZ, J. H., JESSEL, T. M., SIEGELBAUM, S. A., HUDSPETH, A. J. *Principles of Neuroscience Fifth Edition* – 2013.

KUHL, P. K. Early Language Acquisition: Cracking The Speech Code. *Nat. Rev. Neuroscience* – 2004.

KUHL, P. K. Is Speech Learning “Gated” by the Social Brain? *Dev. Sci.* 10 – 2007.

KUHL, P. K., A New View of Language Acquisition. Department of Speech and Hearing Sciences and Center for Mind, Brain and Learning. University of Washington, Seattle, WA. – 2000.

KUHL, P. K., Brain Mechanisms in Early Language Acquisition. Institute for Learning & Brain Sciences, University of Washington, Seattle, WA – 2010.

KUHL, P. K., DAMASIO, A. R., Language. In KANDEL, E. R., SCHWARTZ, J. H., JESSEL, T. M., SIEGELBAUM, S. A., HUDSPETH, A. J. *Principles of Neuroscience Fifth Edition* – 2013.

LENNEBERG, E. *Biological Foundations of Language.* Malabar, FL: R.E. Krieger. – 1984.

LENNEBERG, E. *Biological Foundations of Language.* New York: John Wiley & Sons – 1967.

LENNEBERG, E. *New Directions in the Study of Language.* Cambridge: M.I.T. Press. – 1964.

MAHN, H., STEINER, V. J., Vygotsky and Sociocultural Approaches to Teaching and Learning. Handbook of Psychology, Second Edition - 2012.

MCCLURE, E. F. Aspects of Code Switching in the Discourse of Bilingual Mexican-American Children. University of Illinois at Urbana-Champaign - 1977.

MECHELLI, A., CRINION, J. T., NOPPENY, U., O'DOHERTY, J., ASHBURNER, J., FRACKOWIAK, R. S., et al. Neurolinguistics: Structural Plasticity In The Bilingual Brain. Nature, 431, 757. - 2004

MEISEL, J. M. Early Differentiation of Languages in Bilingual Children. Available in HYLTENSTAM, K., OBLER, L. K. Bilingualism Across the Lifespan: Aspects of Acquisition, Maturity and Loss. Cambridge University Press - 1989.

MOHADES, S. G., STRUYS, E., SCHUERBEEK, P. V., MONDT, K., CRAEN, P. V. de., LUYPAERT, R. DTI Reveals Structural Differences in White Matter Tracts Between Bilingual and Monolingual Children. Vrije Universiteit Brussel (VUB), Universitair Ziekenhuis (UZ Brussel), Flemish Ministry of Education and Training, Belgium - 2011.

NEY, J. and PEARSON, B. A. Connectionisms as a model of Language Learning: Parallels in Foreign Language Teaching. Modern Language Journal - 1990.

OCHS, E., & SHIEFFELIN, B. B. Language Acquisition and Socialization - Three Developmental Stories and Their Implications. - 1982.

OJEMANN, G. A. Cortical Organization of Language. Department of Neurological Surgery, University of Washington, Seattle, Washington. - Published in The Journal of Neuroscience - 1991.

PARADIS, M. Bilingualism and Aphasia. Stud. Neurolinguistics. - 1977.

PARADIS, M. A Neurolinguistic Theory of Bilingualism. Amsterdam/Philadelphia: John Benjamin Publishing Co. - 2004.

PARADIS, M. Language and Communication Disorders in Multilinguals. Department of Linguistics, McGill University. Cognitive Neuroscience Center, Université du Québec à

Montréal, Montreal – Canada – 2008.

PARADIS, M. Language Lateralization in Bilinguals: enough already! Brain and Language – 1990.

PIAGET, J. and INHELDER, B. The Psychology Of The Child. New York: Basic Books – 1969.

PREYER, W. Die Seele des Kindes. Leipzig – 1882.

RAMÍREZ, N. F., Ph.D., KUHL, Patrícia K., Ph.D. Bilingual Language Learning in Children – University of Washington – 2016.

SHABANI, K. Applications of Vygotsky's Sociocultural Approach for Teachers' Professional Development Cogent Education – 2016.

SKINNER, B.F. Verbal Behavior. New York – Appleton-Century-Crofts – 1957.

SOKOLIK, M. E. Learning Without Rules: Pdo And A Resolution Of The Adult Language Learning Paradox. Tesol Quarterly – 1990.

TIEDEMANN, D. Beobachtungen über die Entwicklung der Seelenfähigkeiten bei Kindern. Altenburg. – 1787.

VAID, J., & HALL, D. G., Neuropsychological Perspectives On Bilingualism: Right, Left, And Center. In A. Reynolds (Ed.) – 1991.

^[1] Postgraduate in neuroscience applied to education.

^[2] Guidance counselor. Master's degree in Social Communication. Graduation in Letters – Portuguese and English.

Sent: April, 2020.

Approved: August, 2020.