

A DISCUSSION OF THE CRITICAL PERIOD HYPOTHESIS AND ITS INFLUENCE ON FIRST-LANGUAGE ACQUISITION AND SECOND-LANGUAGE LEARNING¹

*A DISCUSSÃO DA HIPÓTESE DO PERÍODO CRÍTICO E SUA INFLUÊNCIA NA
AQUISIÇÃO DA PRIMEIRA LÍNGUA E APRENDIZADO DA SEGUNDA LÍNGUA*

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ABSTRACT

This paper analyzes some information about of the existence of a critical period for language acquisition/learning. Considering the process of language acquisition/learning as a fundamental one for the success of learners, this hypothesis takes into account the biological processes that happen during the acquisition of the first language and during the second language learning. By adopting a bibliographic review, this paper explores some studies by Lenneberg, from 1967 onwards. It is possible to acknowledge, despite the controversial feature of the topic, that this hypothesis affects the various language aspects independently and distinctly when considering first and second language.

Keywords: Lenneberg's hypothesis, biological development, foreign language learning.

RESUMO

Este artigo analisa a discussão sobre a hipótese da existência de um período crítico para a aquisição e aprendizado de língua. Considerando o entendimento do processo de aquisição e de aprendizagem da linguagem como fundamental para o sucesso do aprendiz, a hipótese reportada leva em consideração os processos biológicos durante a aquisição da primeira língua e a aprendizagem de segunda língua. Esta revisão bibliográfica explora estudos desde os estudos de Lenneberg em 1967 até o momento atual. Observou-se que, apesar da controvérsia envolvida no tópico, se mantém a hipótese da existência de um período crítico que afeta os variados aspectos da língua, de forma independente e distinta para primeira e segunda línguas.

Palavras-chave: hipótese de Lenneberg, desenvolvimento biológico, aprendizagem de língua estrangeira.

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INTRODUCTION

Regarding learning and teaching, method is commonly seen as the main concern of teachers and instructors. However, the process of learning a language, specially a foreign one, involves different and more complex aspects such as a range of biological factors mentioned by the critical period (CP) hypothesis (CPH). For instance, age, memory and maturation are significant factors in the learning process acknowledged by this hypothesis.

This paper deals, firstly, with the hypothesis and concepts brought up by Lenneberg in 1967. The linguist and neurologist proposed the idea of a CP, based on the imprinting process observed in animals. He wrote about the possibility of a timespan where the development of certain behaviors would be possible effortlessly. During the CP, and only then, an individual would be able to achieve language naturally and fully. Following his arguments, this paper proceeds covers authors analyzing, criticizing, and proposing alternatives to the CPH. It also considers Lenneberg's ideas since they were first presented, through empirical studies and new data available.

The CPH claims that an individual has many maturational processes during his or her life and that learning is only possible when a person is ready to receive a specific kind of input and process it in order to acquire or modify a behavior. It is a natural and biological process, which cannot actually be controlled. Therefore, it was possible to identify and answer relevant questions to language acquisition⁴ and teaching, such as how aging affects the learning process and how professionals can deal with learners' difficulties that arise with increased age. It is relevant to acknowledge the best time to start learning a second language. This awareness allows recognizing the phonological and cognitive limitations that older learners might face when learning a foreign language. Furthermore, this study provides teachers with a more accurate view of the process of acquiring and learning language, guiding the choice of activities and evaluation of each learner considering his or her background and experience with the target language.

The main objective of this paper is to interpret and explain the various approaches to the CP, exploring studies from 1967 to the present in order to observe how the hypothesis has evolved. Additionally, the paper aims to answer the aforementioned questions, explaining the difficulties in learning the first language after puberty and the differences between first- language acquisition and second-language learning. It concentrates on understanding the biological implications, together with other factors that affect the learning process, in order to help students of a second-language with their limitations and give teachers a different view of the learners of each age.

⁴ For the purpose of understanding the usage of the terms *learning* and *acquisition* in this thesis, Timpe-Laughlin's (2016) and Limacher's (2017) concepts were considered. Language learning implies conscious effort, involving teaching and the pace is controlled by an instructor. On the other hand, language acquisition is based on neural-psychological, subconsciousness process controlled by the child. In this paper, the terms are used for both first and second languages with similar meaning, aiming the process of acknowledging language aspects by formal instruction or not, according to the usage by different authors.

Aiming to explore the experiments and data on language learning and aging, this paper is organized into three parts. The first section provides a historical overview of the CP, explaining how Lenneberg create his hypothesis and concepts. Nevertheless, many authors have tried to understand and explain concepts that were not clear enough for discussion, and they continue with Lenneberg's hypothesis (LH). Following the discussion, the second section explores the hypothesis of a CP for first-language acquisition. In order to observe and analyze the hypothesis, cases of deaf children and late learners were used by many authors in favor and against LH. Finally, the third section explores the evidence that second-language acquisition is just as affected by aging as native language acquisition. Discussions are around the similarities between first and second language, differences in learning between adults and children, the range of aspects of the target language and the importance of early exposure. Regarding teaching and learning, aspects that affect this process are explored in order to select important features to be considered in the classroom to help students to achieve a successful result.

It is possible to observe that age has a fundamental role in explaining success or failure in learning a language. Although some authors disagree about many aspects, such as the existence of a single CP with a finite timespan, there is no doubt that age is important to be considered in the learning process. Considering the results of this study, it is important to acknowledge the controversial aspect of the CPH. There is a need for more empirical evidence, so there will be more accurate information in order to obtain a concrete and more punctual conclusion, finding relevant answers for the language learning process.

CRITICAL PERIOD HISTORICAL OVERVIEW: LENNEBERG'S HYPOTHESIS

This section aims to describe and compare both historical and biological aspects about the existence of a CP for language learning. The starting point of this review is Eric Lenneberg, who was the pioneer on the CPH. Many authors have been writing about such topic in order to put it up to date, once the first considerations about the CP were written around 1960s. Clearly, it is a very controversial topic, many aspects cannot be traced and it is impossible to be certain about its veracity. Other aspects, such as the end of the CP cause doubts because of evidence that can either support or disapprove the hypothesis. It goes without saying that Lenneberg made great contribution to language learning, as every author mentioned in this review based his or her studies based on LH.

Lenneberg (1967) attempts to connect his studies about language learning to *imprinting*, which is only possible during a short period of the animal's infancy and it depends on some stimulation to be acquired. This behavior originated the term CP, and describes the development of a specific behavior that is fundamental to a healthy growth of certain birds. Lenneberg (1967, p.175) gives an example of *imprinting*: "The chick will follow that moving object to which it is exposed during the CP, and it will continue to follow that object during most of its 'childhood'." Gray (1958) explain

that *imprinting* is the recognition of a parent, the phenomena is a social demand which some species of birds develop as early as after hatching and right after it starts to decline.

Authors relate the animal behavior to human behavior, saying that many CP characteristics are common between species. Lenneberg, agreeing with these ideas, adopted the analogy to explain and understand some behaviors and, for instance, language acquisition. Due to recent studies and new discoveries, some authors have changed the term to refer to LH. Goswami (2004) says that the “*critical period*” is related to the idea of losing the opportunity to learn a skill forever. In his studies, he brings the term “*sensitive period*”, indicating when a skill is learned more easily but not exclusively during this time, therefore presenting a more flexible idea. For that same reason, Redmond (1993) affirms that *sensitive*, *optimal* and *vulnerable* have been more popular in the scientific literature.

Lenneberg (1967) provides as evidence people recovering from aphasia and hemispherectomy as well as children with Down’s syndrome. Lenneberg (1967, p. 179) describes the beginning of the CP, around the age of 2, as “a lack of maturation”. He noticed that the maturation would start, triggering the most sensitive period to language acquisition. The termination of this period, around the age of 13, is described as “a loss of adaptability and inability for reorganization in the brain” linked with the end of the lateralization of functions.

The maturation process is said to be an important feature of language learning by many authors. Lenneberg (1967) observed that *the need* for communication cannot explain the language process because it is a subjective matter and it is very changeable during the course of the two first years of life. A specific maturational state is required to learn every new ability and language learning is not different. Lenneberg (1967) states the importance of maturational process by recognizing the strict natural limits during the biological cognitive development.

As a result of maturation, Lenneberg (1967, p. 375) calls this cognitive process *language readiness*. At this state, children are ready to receive what the author calls *raw material*, which is the language spoken around them, in order to transform the actual *latent structure* into *realized structure*. This process goes on until stability is set to a new maturational state. The author justifies that at the end of the maturational process, around puberty, cognitive functions are stable and strongly structured, which makes it impossible to build new connections, therefore, one would not be able to learn a language after this point.

Lenneberg (1967) believes that, besides maturation, cerebral lateralization is also a determinant of the CP age-limit. Although brain lateralization cannot be completely traced, there is no doubt that all parts of the brain interact at all times. Additionally, it is well known that the left hemisphere operates most of the language functions, with only a small part of language function occurring in the right side. Nevertheless, through observations and studies on massive lesions on both hemispheres in early life, Lenneberg (1967) realized that before the age of 2 there is no dominance in all processes. After the ages of 2 and 3, the maturational process begins with the lateralization of functions and then

the CP starts. The left hemisphere is ready to receive and process language input and, from this moment on, there is a decrease in language function on the right hemisphere. Lenneberg (1967) says that this process finished with the total brain maturation at puberty and, as Curtiss (1977) observed, the language acquisition function is processed by the right hemisphere alone.

Despite the fact that language primarily function on the left side of the brain, Lenneberg (1967) claims that if the left hemisphere is damaged, the right one is flexible enough to go back to its early functions. Singleton (1989) takes into account brain plasticity and agrees with Lenneberg, in case of lesion in one hemisphere, the aspects that were previously function by the damaged side are transferred to the other healthy hemisphere. Singleton (1989) observed that this transference caused fewer problems for children than for adults, evidencing that the more advanced the maturational process, the less flexible the brain is.

Meanwhile, analyzing Basser's data from 1962 presented by Lenneberg (1967, p. 152) on right hemisphere injuries, which would cause more damage in adults than children, Krashen (1973) observed that all cases related injuries that happen before the age of 5. In the author's point of view, this fact might prove that some lateralization can be seen far earlier than what Lenneberg claims. Kristen notices that the data on transference of speech is also based on cases of injuries before the age of 5. Furthermore, the author share some observations from studies on children with unilateral brain damage in 1960s. The results showed similar damage in adults and children. Krashen (1973) summarizes the studies made on children injured after 5: the effects on both hemisphere were the same as in adults. Against Lenneberg's ideas, she concludes that lateralization is actually concluded by the age of 5 or even earlier.

Throughout discussions as the one mentioned previously, new concepts were added to the LH. A less fixed idea of the period is brought by authors such as Goswami (2008), Lopes and Maia (2000) and Birdsong (2006). For instance, Redmond (1993) sees it as a biological structure that is sensitive to specific input during a specific time. Lopes and Maia (2000) present it as a sensitive period when all senses, including motor and psychological, are at their more expressive moment for the first time. In addition, they believe that more than one CP is possible through life and so does Birdsong (2006), who defines it as a temporal span. These definitions try to explain the different ideas that emerge from LH, adjusting it to new analysis and to the discussions made through the years.

Lenneberg's assumption about a specific age for the beginning and end of language-acquisition is the target of great discussion. According to Lenneberg (1967), the CP begins around the age of two, however, Singleton (1989) notices, in Lenneberg (1967, p. 180) work, that it is possible to observe language attempt between 4 and 20 months. Lenneberg (1967), in his acquisition timetable, described the language development at this stage as "babbling to words", leading Singleton to the conclusion that elements of language are being produced prior to the age of 2, as Lenneberg previously said.

Some author justify the end of the CP saying that when one reaches puberty, there is a loss of plasticity, completion of brain lateralization and the end of the maturation process. Not only does

Krashen (1973) claim that lateralization could be observed earlier than said by Lenneberg, but Penfield and Roberts (1959) consider brain plasticity to end at the age of 9: not as early as Kristen thought, but before puberty. Their studies were based on people trying to recover from different brain damages.

In agreement with those two authors, Johnson and Newport (1989) based their studies on second-language learners. They observed that around the ages of 8 to 10 there is a small yet significant decline in the learning process. Even though it is possible to observe a lack of brain plasticity much earlier than Lenneberg supposed, some authors, such as Johnson and Newport (1989) and Hurford (1991), still support, even if partially, the hypothesis of brain plasticity diminishing around puberty. According to the authors, there is no case of a person incapable of learning a language, first or second, because of age. It would prove the age limit to be an end to a more sensitive period, which does not end the learning process.

Additionally, Johnson and Newport (1989, p. 64) give credit to Lenneberg when it comes to the maturational process. They see it as a special moment for language acquisition in which the brain is “particularly adapt” to it. So do Barbizet and Duizabo (1985) who add to it the importance of interaction and stimulus. Although Lenneberg (1967) is not very sure about how environment affects the learning process, he also recognizes the importance of exposure to language to acquire it successfully.

Lopes and Maia (2000) mention that earlier experiences and motivation are also included in the process. They say that every new learning is the result of interaction between maturation, involvement and experiences. Besides, Lopes and Maia (2000) and Nouri (2015) agree that any of those features can be considered as determinant or exclusively responsible for the process of learning. Even so, Lenneberg (1967) is not very positive about it having a strong impact on learning once the biological structures are ready to develop language the setting has little effect on the process. Santana (2004) partially agrees with Lenneberg when the author says that once the maturation is started, there is no need to worry about input, any external influence can modify the actual state. On the other hand, Friedmann and Rusou (2015) mention that the input is actually crucial, emphasizing its importance during the CP. After this period, agreeing with Santana, they say input is useless.

Owing to the discussion around the importance of external influence and input, some authors observe that these processes depend more on subjective factors than objective ones. Therefore, it is impossible to set a starting and ending point to such process. Santana (2004) upholds the idea of a quantitative point of view. The author disagrees that a process that depends on a variety of biological and external aspects can have a specific start and end. Moreover, following LH, if there is a point where learning is no longer possible, there would not be continuity to the learning process. Singleton (1989) presents the idea of lack of continuity as one aspect of the *strong version*.

Analyzing aspects of Lenneberg’s ideas that are still being discussed, some authors separated the hypothesis into two versions called *strong version* and *weak version*. Redmond (1993, p. 26) presents the *strong version* as the one who deals with biological aspects. Presented by Curtiss (1977)

and Redmond (1993), the *weak version* states that normal language acquisition cannot happen after puberty as naturally as before. Even though a small acquisition is possible, it will never be completely or close to the normal expected.

Despite the changes in neuroscience and linguistics through the years, a strong base can still be found in LH. Lenneberg ideas have been echoing and guiding many authors. It is possible to conclude that the ages of 2 to 3 are not the earliest for the language acquisition, as attempts to communicate can be seen at least one year before. The age limit cannot stop any learning but can make it harder to acquire language. The development of an individual is marked by experiences and, mostly, many maturational processes that cannot be controlled. But these processes shape how, when and which new behavior can be incorporated.

Debates around LH are relevant because they have established the foundation for more recent empirical studies on first-language acquisition and on second-language learning processes. Next section present studies related to research around first language acquisition. Using some case studies and ideas of different authors, important considerations on the process of acquiring a native language are compared to the CPH in order to understand the biological barriers in language.

CRITICAL PERIOD EVIDENCE ON FIRST LANGUAGE ACQUISITION

This section presents a review of the discussion of the CP for first-language acquisition. Important studies of children deprived of communication at different levels are analyzed in order to understand learning processes and discuss the relevance of age on language acquisition. Authors are able to get information about CP observing cases of late acquisition of the American Sign Language (ASL) as well. Although many cases of study have been analyzed recently, authors seem to be unable to conclude whether the CP is the explanation for the success or failure of the maternal language acquisition.

Lenneberg (1967, p. 125), regarding first language acquisition, observes that no “systematic teaching of language takes place, just as there is no special training for stance or gait.” He believes that there are changes in the environment and behavior toward the child who, at this point, is ready to receive and process it effectively. Lenneberg (1967) calls this state “language readiness”. At the end of this period, around puberty, the abilities to achieve regular language skills decline, which makes it harder or even impossible to learn. Pinker (1994) affirms that the sensitive period can be even shorter than what Lenneberg stated. The author believes that after the age of 6, the ability to acquire language is already in decline until puberty, when a major change happens.

Lenneberg’s idea of starting point to the CP is around 2 to 3 years old, nevertheless, Singleton (1989) notices language attempts much earlier than what Lenneberg proposed in 1967. According to Friedmann and Rusou (2015), children are capable of acquiring language structures, such as syntax

and phonology awareness, since birth. The authors also pay attention to the importance of exposure to the language even though the linguistic awareness is not refined yet: they said that early input support the development of syntax aspects. In agreement, Pallier (2017) states that exposure guarantees a normal development. So does Meisel (2013), who claims that language can always be successfully acquired once the child grows in contact with it since the early months or even before them. Additionally, Newport, Bavelier and Neville (2001) claim that many studies have been made proving early exposure to be an important key for proficiency.

However, it was observed by the previously mentioned authors that not all aspects are directly affected by the age of exposure. Newport, Bavelier and Neville (2001, p. 5) explained that vocabulary and semantics are not a problem for late learners, and that processing meaning is unaffected by the CP. They claim that while some aspects cannot be acquired after the end of this period, others remain susceptible to adaptation and are possible to acquire fully.

The results of late language learning can be seen in cases of deprivation in which problems in phonology and morphosyntax are very clearly detected (AU et al., 2002). Research finds it hard to explain the evolution in these cases and, at the same time, never developing language skills successfully. Hurford (1991) believes that several cases of language deprivation, or delayed learning, can support the CPH. However, he affirms that despite the fact that some aspects of the language are hard, perhaps impossible, to learn after adolescence, he understands that some learning is always possible even with boundaries in many linguistic aspects.

Two cases are mentioned by many authors, such as Singleton (1989), Lima Jr. (2013), and Hurford (1991), which can support the idea of a CP and, at the same time, question the assumption of impossibility to learn after puberty: Victor, a boy found around 1800 in France and a girl called Genie, which is a more recent case, found in 1970 in Los Angeles.

The first study is Victor's case, analyzed and reported by Harlan Lane in 1975. Victor was first seen right after the French Revolution in 1797 and, after several attempts to capture him, he was finally found in 1800 and kept to be taken care of. It was believed he was around 12 or 13 years old, and he showed good appearance, even presenting some small scars on his body. He was healthy, besides some spasms, which might indicate nervous system problems but was never proven to be true. He was not capable of speaking, the only vocalizations expressed by the boy were grunts or cries. He was thought to be impossible to teach after many tries, until a resident medical officer, called Itard, offered to develop an educational program for him (SINGLETON, 1989). Victor's evolution could be seen mainly in written language, as he barely evolved his speaking skills. He eventually learned how to express himself poorly by writing, in which he could recognize and reproduce some nouns and adjectives (LIMA Jr., 2013).

Singleton (1989) claimed that there was a slight possibility that Victor had developed mental problems, such as autism and precocious schizophrenia, after being abandoned. Victor's

small success might be related to his educational program being developed shortly after puberty. However, he could not go much further.

The second relevant case for the authors is Genie. Related by Curtiss in 1977, Genie was a case of isolation: she was kept by her father since the age of 20 months in a small room without windows and any kind of interaction or stimulation. She had very little contact with her family. She was admitted at a hospital in Los Angeles, at the age of 14, with indication of good mental health, yet she was emotionally disturbed. She was very weak and malnourished, and she had no language besides noises. After being tested, Genie could understand some isolated words. Within two years of study, her vocabulary improvement was noticeable. She could communicate, yet she had problems controlling her intonation. Genie was capable of building positive-negative sentences, using “and” and plural and singular forms. Her development was believed to be similar to that of a regular child, but slower.

Genie’s case, alike Victor’s, has a controversial end. It is unknown if her success had to do with any exposure to language, perhaps when she had short moments of contact with her mother or before her isolation. For that reason, she might have been more prompt to improve her language skills. She could learn language after puberty, which would prove the CP to fail. Nevertheless, she never acquired language fully and had problems with pronunciation and intonation, evidence that would confirm the idea of an upper age limit brought by Lenneberg.

Curtiss (1977) says that evidence from Genie’s case can indeed support Lenneberg’s interpretation of cerebral dominance. Lenneberg (1967) affirms that the phenomenon of laterality is strongly connected to the CP. In situations similar to Genie’s, in which language is acquired after puberty, the left hemisphere is not functioning during language learning anymore. Curtiss (1977, p. 324) concludes that “the fact that Genie has right-hemisphere language may be a direct result of the fact that she did not acquire language during the ‘critical period’” Furthermore, Curtiss (1977) observes that “normal” language has not been defined yet, so it is not possible to say exactly what it is. However, the author agrees that there are features of abnormal language development and Genie presented all of them, such as failing in acquiring specific syntactic forms, presented in normal development.

Another source of evidence that provides important evidence for the existence of a CP for first-language acquisition come from late learning of ASL, American Sign Language, as first language. Pinker (1994) brings these studies as cases of normal first language acquisition: there is not isolation, lack of interaction or psychological or physical issues, problems that could be relevant on the outcomes of Genie’s and Victor’s cases. The case discussed below is Chelsea, who was death since birth and had late contact with the sign language.

Patkowski (2013), Curtiss (1998), Lima Jr. (2013) and Pinker (1994) reported the case of Chelsea, who was the case of the latest language acquisition. She was thought to be “retarded” when she was a child -many children were said to be retarded or emotionally vulnerable due to the lack of diagnosis- and her correct diagnosis came only at the age of 32 (LIMA Jr., 2013). She finally received

proper attention and started learning sign and oral language. The author observed that, different from other cases, she was raised in a loving and warm environment.

Pinker (1994) reported that Chelsea was born in an isolated city in northern California. She lived with her family who supported and took care of her; she was a normal child although she was shy. She had no communication but was very dependable. Only around the age of 31 was she formally diagnosed as deaf by a great neurologist. He provided her with hearing aids, which made it possible for her to hear at a good level. She finally started intensive programs in order to develop her communication skills. Pinker (1994) affirms that she achieved the same level as a ten-year-old child, intelligence wise.

The author observes that she was capable of communicating, reading and writing and she acquired a great range of words. At that point, she was socially independent, had the ability to socialize and had a job in an office. Although she had an impressive evolution in communication and other language skills, Pinker (1994) recognizes that she had many problems with her syntax. She could put words together but in an unusual order, the author defines it as “bizarre”, for instance, “*breakfast eating girl*” and “*combing hair the boy*” (PINKER, 1994, p. 293). Patkowski (2013, p. 16), analyzing and comparing different cases in his work regarding subject order and use in sentences and “WH” use, concluded that she had not developed language normally and probably never would.

Different authors who reported and study the cases mentioned here, similar cases, agree that the age of exposure is the main arguments when they try to explain the difficulties in first language acquisition presented by all cases. Redmond (1993) says that the results are an indication of the late start in the learning process. Furthermore, Johnson and Newport (1989) affirm that a study of late first-language learning in deaf people proves that the ability to acquire a language suffers a linear decline instead of an abrupt end. All cases presented difficulties and poor outcomes, but some language acquisition was yet possible.

Moreover, it was possible to observe that the language aspects that were more difficult to acquire were quite similar in the four cases. Meisel (2013, p. 85) says that the CP “do[es] not, however, affect ‘language’ as a whole but only certain domains of grammar.”. Authors as Curtiss (1977), Friedmann and Rusou (2015), Singleton (1989) among others who reported those cases, pointed out some problems displayed by the subjects. Generally, they had great difficulty in speech production, comprehension and syntax. All cases were able to acquire a satisfactory level of vocabulary, but had problems with intonation and articulation. Meisel (2013) observes that the problems followed a “pattern” and different aspects of the language are correlated, if there is difficulty acquiring one aspect, others will be affected.

Based on Johnson and Newport (1989) mentioned above and on Genie’s case, Hurford (1991) concludes that, even though some language is indeed possible to be acquired after the CP, some aspects seem to be impossible to learn after this period. He mentioned Genie’s difficulties in interrogative

sentences, verbs and pronouns, justifying the existence of many different aspects of the language being affected by the CP differently. Newport, Bavelier and Neville (2001) observed that aspects such as vocabulary and semantic are not a problem for late learners, as can be seen in the cases outlined here.

Furthermore, Meisel (2013) discusses the existence of multiple critical spans for different aspects of language. The author lists phonology, morphology and syntax as examples of language aspects already known to have different timing and independent development. In Meisel’s (2013) opinion, many critical periods would be better than stating only one timespan, considering the different phases of grammar acquisition.

Considering the authors mentioned here, in comparison with the first ideas about a CP, it is possible to observe a change in concepts. There is an agreement on the existence of a sensitive period for first language acquisition; however, it might affect language aspects differently. Aging and exposure is also being discussed, once it was proved that some learning is always possible after puberty. Despite of the lack of more concrete information, the PCH is still strong on the first language acquisition due to the evidence that late learners have never acquired language fully. To sum up, the follow table gathers considerations on the controversial topics discussed by the authors throughout work about the CPH.

Table 1 - Summary of the considerations about the critical period for first language acquisition through the years.

Author (Year)	Term used	Period/ Age	Ending	Single or Multiple
Johnson and Newport (1989)	Critical Period	Not specified	Gradual	Not specified
Hurford (1991)	Critical or Sensitive Period	Not specified	Gradual	Multiple
Pinker (1994)	Critical Period	Until the age of 6	Gradual	Single
Grimshaw et al. (1998)	Critical Period	Ends at puberty	Gradual	Not specified
Newport, Bavalier and Neville (2001)	Critical or Sensitive Period	Since birth	Gradual	Single
Goswami (2004)	Sensitive Period	Between the age of 3 or 4 and puberty.	Gradual	Multiple
Lima Jr. (2013)	Critical Period	Author says it is not possible to determine.	Gradual	Single
Meisel (2013)	Critical Period or Sensitive Phases	Starts at prenatal	Gradual	Multiple
Friedman and Rusou (2015)	Critical Period	Since birth	Abrupt	Multiple
Pallier (2017)	Critical Period	First years of life	Gradual	Single

Source: Developed by the authors.

It seems to be impossible to find evidence that would clearly support or refute the existence of a CP for first-language acquisition. Some authors claim that the hypothesis of a CP might be more suitable to second language acquisition and, an idea explored in the next section. It holds a deep discussion on how second language learning relates to first-language acquisition and how it is affected by age. The discussion continuous with methods and considerations on teaching and learning, regarding environment and how different ages learn.

THE IMPLICATIONS OF THE CRITICAL PERIOD ON SECOND LANGUAGE LEARNING

Many authors quoted here agree that aging works differently regarding second language learning. This section explores the differences in learning for adults and children, discussing different points of view and exploring biological aspects such as memory and brain plasticity. At this part, the age of exposure is mentioned by the authors as relevant to the level of proficiency and accuracy achieved in a foreign language. Finally, methods of formal language education are analyzed as well.

Through the discussion around the CP for first-language acquisition, established previously, the evidence is not clear enough to prove the hypothesis to be, in fact, the reason why many cases of late learners were not able to acquire language fully. For this reason, some authors believe that the observation of second-language learning might provide a better understanding on the age effects, once the available data is easier to access and it is possible to be observed in a regular and healthy environment.

The hypothesis is clear: young learners should acquire and learn language more easily than adults. Redmond (1993) consents, saying that, in case of the existence of the CP, young learners should be able to acquire many aspects of a second language more easily than old learners after puberty. However, Cruz (2017) recalls the subjectivity of this matter saying that “young” and “older” cannot be measured and are relative terms; the author recalls that there is no specific timing for learning a second language. Furthermore, Zhao and Morgan (2004) agree that age is a dominant factor, but also mention that motivation, anxiety and natural learning skills are also strong components, added to time and learning environment.

Trying to explain the existence of a CP and the relationship between the age of acquisition and the proficiency attained, Bialystok and Hakuta (1999) selected and analyzed participants who lived in the United States for ten years or more, who spoke either Chinese or Spanish. The authors point out that the research would prove the existence of a CP if it showed a sudden break in learning process around the age of 13. However, it was possible to observe through graphics a constant and linear decline in proficiency as age increased, for both Chinese and Spanish speakers.

As previously mentioned, the CPH claims the puberty to be the end of the ability to learn a language, but Pinker (1994) affirms that it could be even shorter. The author believes that at the age of 6 it is possible to observe a decline. On the other hand, Birdsong (2006) proposes three patterns in order to explain potential results of the process of learning considering the relation between the age effects and the end of the maturation. The first and more relevant pattern is described by the author as a “stretched L”. It shows a slope on the left as the decline in learning because of the age effects and a flat part, when it reaches the end of the maturational process, around puberty. However, Birdsong (2006) observed that in adults the most common representation would be a linear decline, similar to the results presented by Bialystok and Hakuta.

Regarding early and late learners, Bialystok and Hakuta (1999), in agreement with Johnson and Newport (1989), say that empirical studies present evidence that there are many differences in proficiency for children and adults, supporting the idea children would have advantages learning a second language. According to Nouri (2015), there is evidence that a child is able to process linguistic inputs since birth, or even before. This is one of the facts used by researchers to explain why children learn languages more easily than adults do.

A study was conducted by Au et al. (2002) with two distinct groups, one which had been exposed to a second language since childhood and another which had not been exposed to the same language until around age 14. The author chooses to test the aspects usually mentioned as easier to children and harder for adults to acquire. For the research, the participants had to read sentences aloud from a computer, as naturally as possible. Analyzing the results, Au et al. (2002) reported that the participants who overhear the target language since they were children were able to produce sounds more nativelike than the late learners; they were considered similar to a native speaker.

Another case was reported by Johnson and Newport (1989) in second-language acquisition and the results were quite similar to the ones attained by Au et al. (2002). The authors observed and tested 46 native Chinese or Korean speakers, who had arrived in the United States from the ages of 3 to 39. The subjects had, at least, five years of exposure to English and lived in the country for at least three years. They were divided into early-arrivals group that had lived in the country since before the age of 15 and a late-arrivals group that had lived in the country since after the age of 17. Observing the individuals' results, Johnson and Newport (1989) claim that the relation between age of arrival and performance was substantial. The authors reported that a small decline in performance could be observed between the ages of 8 to 10, and at puberty, a more significant change happened. Additionally, Johnson and Newport (1989) note that only subjects who started learning English at the age of 3 to 4 had achieved native performance.

Some authors believe that that main (and perhaps the only) reason young learners have an advantage in second-language learning is because phonology is the feature taken into account. According to Viola, Jia and Shiyang (2014), adults have better developed cognitive skills, such as memorization, problem-solving and attention span, which are useful during the learning process. Osterhout et al. (2008) claim that the adult brain is dynamic, and Redmond (1993) agrees. For instance, Sanders, Neville and Woldorff (2002), through their studies, point out that prosody could be found in the speech of late learners.

Redmond (1993) calls attention to the variety of aspects that compose a language, which are as important as phonology. Additionally, the author claims that success in acquiring a second language is not a result of early exposure alone. Nouri (2015) claims that vocabulary is one language aspect that is easier for adults to acquire, considering the refined understanding of the language lexis. Nevertheless, it is understood that aging affects senses and cognitive functions. According to Osterhout

et al. (2008), an individual starts learning a language by memorizing. Birdsong (2006) observes memory performance in different tasks and there is indeed a decline as age increases. Bialystok and Hakuta (1999) also observe that adults need more time in activities with memorization and vocabulary than young learners do.

An aspect mentioned firstly by Lenneberg in 1967, and is recalled by some authors in order to explain the difficulty in achieving second language proficiency after a certain age, is brain plasticity. Lenneberg (1967) claims that, after puberty, the brain loses its ability to adapt to new behaviors. Cruz (2017) agrees, saying that a child might be able to learn a skill fully as long as the brain has not reached the end of the adaptable period. On the contrary, according to Osterhout et al. (2008), this popular idea about the decrease of brain plasticity does not have enough evidence to be proved true.

Brain maturation, brought up by Lenneberg in 1967, is also explored by Johnson and Newport (1989) in order to explain the nature of the CP and whether it is applicable to second language acquisition. As already reported, Johnson and Newport (1989) conducted an experiment with Korean and Chinese speakers, living in the United States. By the results achieved from the tasks, the authors assumed that maturation is an important influence in the learning process. Johnson and Newport (1989) find evidence that support the biological timing mentioned by Lenneberg in 1967, in which the maturational process ends around puberty. According to Johnson and Newport (1989), considering that each individual have different timing for biological processes, there seems to be a decline of language-learning ability once maturity is reached. Moreover, the authors documented that the ability of learning a language is equal from birth until, at least, the age of 10, and what determines the success of achieving a language is how early the individual is exposed to it, in accordance with many authors.

Regarding performance in a second language, Johnson and Newport (1989) observed that late exposure to the target language would make it nearly impossible to acquire native levels of proficiency. Many authors rise this concern and the assumption that the more a person sounds like a native speaker, the better his or her proficiency level is. Bialystok and Hakuta (1999) call the attention to the idealization of the perfect second language speaker, whose objective learning a language is to sound exactly like a native and this hypothesis supports the success of early learners.

Many authors, such as Redmond (1993), have proved that it is only possible to attain native levels if the exposure to the language starts during the first years of life. Furthermore, experiences have shown that after puberty, some aspects of the language are never acquired naturally or properly as during early ages. Abrahamsson and Hyltenstam (2009) list aspects such as morphosyntax and problems related to speech that are challenging to late learners, after the age of 13. Although Abrahamsson and Hyltenstam (2009) consider nativelylike levels of proficiency to be hard for adults, they are aware that some aspects are not affected by aging.

The existence of a hypothesis in which the different aspects of a language are acquired individually would explain why some features remain learnable after puberty. Osterhout et al. (2008)

consider this idea saying, that language is built by independent yet connected elements. Sanders, Neville and Woldorff (2002) notice that it is possible that some of them cause more problems for some learners than others. Additionally, the authors observe different levels of proficiency for different aspects, proving that learning is not a linear process.

A concern outlined by many authors for first-language acquisition, besides the biological factors, is the environment: a healthy and rich space where a child would be able to interact and use language naturally in order to achieve proficiency. The setting is also important for L2. Ipek (2009) claims that the context in which the acquisition of a second-language happens can affect directly the level of proficiency of the learners. The author observes that the context for first-language acquisition is more restrictive while the second language learning takes place in many different contexts. However, Viola, Jia and Shiyang (2014) report that the natural context for second language is very unusual and, in most cases, it takes place in a formal environment.

Goswami (2008) supports the importance of a rich setting for learning and agrees that most of language-learning happens in schools. The author mentions that the atmosphere should be happy and the learners should feel safe and not stressed. On the other hand, Zhao and Morgan (2004) point out that learning in a classroom has time limitations and poor interaction, while in a natural setting, the communication is authentic and there is maximal exposure.

Goswami (2008) states that learning is better consolidated if it follows a sequence. The continuity of the learning process is mentioned by Meulman et al. (2015). Considering learning as a process, Goswami (2008) points out the relevance of the relationship between topics, in order to provide recycling of preview knowledge and a more effective growth of brain connections. Additionally, Ipek (2009) states that to promote meaningful associations the contents should follow a sequence. Besides, the social nature of learning should be recognized, with valuable moments of interaction used in the classroom to improve language.

Concerning the learning process, Bialystok and Hakuta (1999) affirm that literate children can count on a different perspective for learning. The authors believe that literacy provides a better development of phonological structures and learners are able to evolve language awareness more quickly, consequently, it changes the children's idea of language. Viola, Jia and Shiyang (2014) say that children learn through sensorial experiences, and there is a need to work with concrete subjects while adults can deal with more subjectivity.

Some authors rely on the mother tongue to explain the processes of learning a second language. Cruz (2017) explains that once learners have developed phonological aspects in the maternal language, he or she have the potential to apply these aspects to the second language, regardless of age. Sanders, Neville e Woldorff (2002) and Osterhout et al. (2008) agree that the two processes are related, sharing word and meaning process. Meanwhile, Viola, Jia and Shiyang (2014) recall that

adult learners present a lack of flexibility in articulation of speech organs, since the body is adapted to the mother tongue and it influences in the achievement of the L2 nativelike proficiency.

According to Osterhout et al. (2008) and Meulman et al. (2015), the aspects of a second language that are similar to the learner's first language are more easily acquired. Goswami (2008) exemplifies the difficulty of acquiring elements that are different from the maternal language with the "r" sound, such in cases when Japanese speakers have attempt to learn English. The author states that the Japanese speakers have consolidate "l" and "r" into the same sound, which makes learning a different sound to one of those phonemes hard, yet not impossible.

Despite the fact that many authors compare the language-learning process between first and second languages, Bialystok and Hakuta (1999) say that might be a mistake. They suggest that language is acquired and processed by an innate biological principal, so the acquisition of different languages can be similar yet no related. However, learning a L2 after the CP would actually begin with linguistic aspects already processed in the maternal language by the learner, proving the existence of a CP for L2. According to Bialystok and Hakuta (1999), even though the outcomes and learning development are slightly different between L1 and L2, it is not clear if they are part of completely different process or not.

CPH is able to explain the biological aspects that affect either first- or second-language, acquisition. The studies started with the maternal language and due to the globalization process, second language gained importance. The differences between first and second language can be seen in the table below. It shows the age effects in learning according to the hypothesis and how the CP affects fundamental language elements. Additionally, it summarizes the considerations on formal instruction.

It goes without saying that preparing an authentic class with a variety of activities is an important concern of an educator, but so are the characteristics of the students as individuals in a foreign language classroom. Firstly, the CPH calls attention to the background of every learner that interferes in how language is seen. The perception of a language is different if a child is exposed to it during early ages. Another difference is the support that literacy provides to children, giving a different perspective of the language structure. Literate learners are able to work with the language in context through written texts, which should be authentic enough to provide a natural view of the target language. Moreover, Ipek (2009) mentions sociocultural aspects, setting and differences in input as important parts of an effective learning, and these are not taking into account by the CPH. According to the authors, acquisition cannot be analyzed without considering the outside interferences.

Despite many other aspects that are part of the process, the CPH's main concern is how age affects learning and how difficulties in acquiring some language aspects increase during life. Therefore, this hypothesis can provide information on possible limitations that learners might face according to their age and so educators can provide support for a successful development.

Table 2 - Summary on first and second language learning.

Aspects	First Language	Second Language
Critical Period	It is possible that multiple critical period exists for different aspects of the language. (HURFORD, 1991); Some authors (e.g.: PINKER, 1994) believe in one single period for one maturational process.	There are windows of opportunities, moments when acquiring language is easier (NOURI, 2015); it is not finite, but is possible to observe a decline with age in learning (BIALYSTOK; HAKUTA, 1999); proficiency can still be acquired after puberty (CRUZ, 2017).
Age	According to some authors (e.g.: FRIEDMAN; RUSOU, 2015) learning a language starts at birth. Others (e.g.: GOSWAMI, 2004) claim that it begins around the ages of 2 and 3.	Early exposure provides better levels of proficiency (REDMOND, 1993).
Aging effects	After puberty, around the age of 13, the ability of acquiring language declines and make it hard or even impossible to learn linguistic skills (LENNEBERG, 1967).	Lack of memory (BIALYSTOK; HAKUTA, 1999); difficulty acquiring phonological skills (REDMOND, 1992); children are better at learning languages than adults (BIALYSTOK; HAKUTA, 1999).
Syntactic and Semantic	All cases of late learners of first language showed problems in comprehension and syntax, such as put the words in the right order (CURTISS, 1977).	For adult learners, acquiring vocabulary is easier; (NOURI, 2015); adults need more time in activities with memorization (BIALYSTOK; HAKUTA, 1999); late learners have problems acquiring speech production, perception and in language formulation (ABRAHAMSSON; HYLSTENSTAM, 2009).
Phonology	All cases of late learners of first language had problems with pronunciation and intonation. Some were never able to communicate spontaneously (MEISEL, 2013).	Learners who start acquiring a second language after the age of 13 could not show nativelikeness in their speaking. (ABRAHAMSSON; HYLSTENSTAM, 2009); phonology might be the only aspect affected by the critical period (REDMOND, 1992). “[...] areas of lexical retrieval, structural ambiguity resolution, and detection of acoustic distinctions in the areas of syllable stress, consonant voicing, and vowel length” are the most problematic ones for late learners (BIRDSONG, 2006).
Formal instruction	The studies presented in this thesis do not report any consideration on this matter. However, Redmond (1993) calls the attention for language development: linguistic problems should be diagnosed and treated as early as possible to avoid permanent consequences.	Use of memorization (OSTERHOUT et al., 2008); literate students can have a different perception of the language (BIALYSTOK; HAKUTA, 1999); continuity and connection between topics facilitates learning (GOSWAMI, 2008).

Source: Developed by the authors.

Considering adult learners, after the age of 24 (ABRAHAMSSON; HYLSTENSTAM, 2009), the CPH explains that brain plasticity is decreasing so processing new information and acquiring new behaviors need more time and effort. However, Zhao and Morgan (2004) believe that not only biology affects learning for adults, but also their personalities and social roles, which make them less flexible. Therefore, the acquisition of new information requires patience, understanding and repetition, especially with new vocabulary.

Late learners have already a good understanding of language in general and have more information to refer to and compare; authors mentioned that it is a facilitator when it comes to acquiring lexis. Another obstacle that instructors need to be aware of is that memory also become less effective according to the CP. Zhao and Morgan (2004) report that advanced late learners should not focus

on memorization of structures or sentences but on meaningful communication and problem-solving. For beginners, activities should provide practice and repetition to facilitate the memorization of new structures and vocabulary. Matching activities using pictures can be helpful for presenting new vocabulary, besides, the learners need to use and recycle the words through the lesson. Moreover, activities such as guessing and describing words encourage group work and the usage of social skills, a very important tool for learning and practicing language.

Zhao and Morgan (2004) describe the process of learning a second language for children and highlight its spontaneity. The authors talk about children's will to participate socially and report that this natural behavior facilitates the process of learning. Additionally, lessons for children are usually focused on joy and entertainment, a different setting from the adults. The authors recall the necessity of using concrete objects and concepts. Classifying, ordering, location and repetition are examples of activities given by the authors.

These ideas can help professionals to acknowledge the needs of the students selecting activities. For instance, instructors can focus on listening practice, in order to exercise sound recognition. Using the phonological system can provide a support for sound training and it is important to consider the difficulty of achieving the nativelike proficiency. Late students should not be focusing on accuracy at first, speaking activity that exercise fluency can make learners more comfortable using the new language. Ipek (2009) remembers that practice in the classroom can result in acquisition. With reference to evaluation, the author also mentions that teacher should be realistic and provide the input necessary for focusing on learning, with the acquisition as the ideal result.

The CPH has many aspects that still cause discussion and cannot be proved due to limitations in acquiring authentic evidence on the topic. It is possible to conclude that professionals should acknowledge the effects of natural biological processes combined with social experiences, considering the situations of every student, in order to have a complete idea of the individuals. Using activities that engage all senses, capable of supporting students' needs and the social aspect of language, will help learners establish relevant cognitive connections making learning more effective, causing the brain to adapt significantly and permanently.

FINAL CONSIDERATIONS

During the process of studying and understanding the CPH, the importance of the biological aspects in language learning and acquisition was noticeable. The idea first reported by Lenneberg in the 1960s has caught the attention of many authors. The main interest of this paper is to explain how aging, which causes biological changes in brain function, interferes with the process of learning

a language. Furthermore, regarding learning a second language, it aimed to explain how instructors could use this information to provide the right support for a significant and pleasurable learning.

Considering the importance of the CP and the relevance of the concepts, there is no doubt that the biological aspects interfere in the language learning development. The discussions around learning and teaching seem not to take into consideration the features that shape and explain the source of many problems faced by the students during the process of acquiring a second language. The study around the CPH here reported was able to explain how those aspects influence the learning process and provide evidence of the natural process in language acquisition.

Analyzing the results of this paper, it was possible to build arguments and explain through the concepts of the CP how learning is indeed structured by biological features. Although indications were found on the existence of the CP, the concept now is very different from what was first thought by Lenneberg. The most significant change in his ideas presents the possibility of multiple periods in which language aspects are affected differently, proving that the cognitive development has many maturational stages during life.

Despite the discussions and the subjectivity of the aspects analyzed by the hypothesis, research and recent data the ideas about the CP has been improved and updated to provide a wider understanding of the learning process. The results brought by this study are able to help instructors to identify the limitations and necessities of each student based on their experiences with the language and age specifications.

Furthermore, there are aspects that become more challenging to be acquired after certain age, which support the idea of the CP for specific language features. In spite of the accent, many aspects of the language can be acquired fairly well after puberty, according to some authors. Consequently, instructors should be aware of this limitation in order to motivate and evaluate late learners according to their limitations. Due to the fact that late learners are more prompt to develop fluency in speaking but maybe never acquire native accuracy, the evaluation needs to focus on the process and the evolution of the phonological abilities, keeping the learner motivated. This improvement can be guided by activities that simulate real conversation and about relevant matters that call the attention of the speaker, bring them closer to the real language.

Considering all the analysis and studies, the relevance of Lenneberg's CP hypothesis is very clear considering the significant influence of the biological aspects in the learning process. It provides an important form of guidance for instructors to understand the origin of the limitations and the reason why adaptation is needed for each learner. Through the awareness of the factors reported by the CP, teaching can be more effective, making the process of learning easier to the students, who can also understand their limitations, avoiding frustration and avoid the pressure of achieving nativelylike proficiency.

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