A Psycholinguistic Note on the Critical Period Hypothesis in Second Language Acquisition

Una nota psicolingüística sobre la hipótesis del período crítico en la adquisición de una segunda lengua

Carlos Gelormini Lezama, PhD
Universidad de San Andrés
cgelormini@udesa.edu.ar

Abstract

The goal of this note is to offer a brief, critical assessment of the critical period hypothesis for second language acquisition. Four key elements as put forward by Hakuta (2003) are discussed: (1) clearly defined beginning and end points of the period, (2) an abrupt discontinuity at the end (3) the shutting down of the specific language learning mechanism at the end, and (4) the robustness to environmental variation within the period. It is argued that the debate over this issue reflects the fact that the existence of a critical period may be taken as an argument in favor of the modular organization of the mind.
Keywords: psycholinguistics, critical period hypothesis, second language acquisition, modularity, connectionism.

Resumen

El objetivo de esta nota es ofrecer una evaluación crítica y acotada de la hipótesis del período crítico en la adquisición de segundas lenguas. Se discuten las cuatro nociones básicas de Hakuta (2003) para evaluar la existencia de un período crítico: (1) un principio y un final claramente establecidos, (2) una discontinuidad abrupta al final de período, (3) el cierre del mecanismo de adquisición propiamente lingüístico al final, y (4) la robustez frente a la variedad del estímulo durante el período. Se argumenta que el debate alrededor de este tema refleja que la existencia del periodo crítico puede ser tomado como prueba de la organización modular de la mente.
Palabras clave: psicolingüística, período crítico, adquisición de segundas lenguas, modularidad, conexionismo.

1. INTRODUCTION

The purpose of this paper is to discuss the validity, applicability and relevance of the concept of 'critical period' in the process of second language acquisition. First, I discuss the notion of critical period as originally proposed by Lenneberg (1967) for first language acquisition. Second, I summarize some of the evidence for and against the critical period hypothesis (CPH) with reference to the process of second language acquisition. Third, I address the controversial issue of the purportedly modular organization of the mind and its relation to the CPH. In this article, I will follow the classical distinction between the acronyms L2A and SLA: the former refers to the process of second language acquisition whereas the latter refers to the field of linguistics devoted to the study of this topic.

2. TWO HYPOTHESES FOR LATERALIZATION

Cognitive, sensory and linguistic functions in the human brain are said to be lateralized: the two hemispheres of the cortex are in charge of performing different tasks. The left hemisphere is especially involved with analytic, time-based processing whereas the right hemisphere is particularly concerned with more holistic, spatially-based processing (e.g., Amunts et al., 1999, 2004; Broca, 1865; Corballis, 2004; Josse et al., 2004, 2008). While sub-cortical structures such as the basal ganglia and thalami appear to perform the same role on each side of the brain, higher level functions such as language are predominantly located on the left neocortex (Binder et al., 1996, 1997, 2000; Gandour et al., 2002; McManus, 1991). For the majority of human beings, language functions are localized in the left hemisphere.

Two different hypotheses have been proposed to account for the process of lateralization. The invariance hypothesis suggests that lateralization is present at birth and does not increase with experience. Only if the left hemisphere is damaged over a wide area involving both anterior and posterior locations, can the right hemisphere absorb language functions (Corina et al., 1992). The maturation hypothesis, on the other hand, states that both hemispheres are quite similar at birth with respect to language and that the left hemisphere specializes for linguistic functions as the outcome of a process of maturation. The claim of the maturation hypothesis is that the specialization of the left hemisphere for language is acquired slowly through experience. Extreme instances of hemidecortation in adults imply the complete loss of speech abilities. However, children are able to recover, at least partially, which suggests that the brain is not lateralized at birth but that lateralization occurs during a certain critical period (Lennenberg, 1967).

The critical period hypothesis can thus be regarded as a version of this maturation hypothesis. Lenneberg (1967) argued that learning a language was a maturational process, similar to motor development, and that there was a critical period between eighteen months and puberty during which language had to be acquired. Once this period finishes "automatic acquisition from mere exposure to a given language seems to disappear" (Lenneberg, 1967:176). One central element in Lenneberg's theory is the notion that language develops quickly due to maturational processes that

are specific to the domain of language. This limitation on the acquisition of language does not parallel other processes of learning. Lenneberg (1967) claimed that "there are many skills and tasks that are much better learned during the late teens than in early childhood and a great deal of general learning has no age limitation whatever" (Lenneberg, 1967:176).

Language development seems to exhibit at least three of the properties of biologically given behaviors (Chomsky, 1976, Lenneberg, 1967). First, there is an orderly progression of stages, which operates at different levels: phonology, morphology, syntax, etc. Second, development is to a certain degree independent of external stimuli. Third, there exists a critical period beyond which the ability to acquire the behavior is significantly impaired.

Some evidence for the CPH - in the case of first language acquisition - comes from feral children who were not exposed to language during the critical period. None of these children are able to fully acquire language and their performance never reaches the level of a normal adult native speaker (Pinker, 2007). There is also some evidence from deaf children who coo and babble but abruptly cease after six months. Another piece of strong evidence offered by Lenneberg (1967) to support the CPH comes from the studies of recovery after traumatic aphasia. Patients between four and ten years of age suffer from similar symptomatology to that of adult aphasics but the chances of recovery from an acquired aphasia are significantly higher in children than in adult patients. However, Snow y Hoefnagel-Hohle (1978) offered some evidence from second language learning against the critical period hypothesis, the topic to which we now turn.

3. THE CRITICAL PERIOD IN SECOND LANGUAGE ACQUISITION

Hakuta (2003) proposed that for the critical period hypothesis to apply in L2A, four conditions must be satisfied. First, there should be a clearly specified beginning and end points for the period. Second, this period should end up with an abrupt decline in L2A. Third, there ought to be evidence of qualitative differences in the process of learning inside and outside the critical period. Fourth, there should be robustness to environmental variation inside the critical period.

There appears to be nothing nearly similar to a clearly defined beginning and/or end point. Lenneberg (1967) suggested that the critical period began at eighteen months coinciding with the development of syntactic complexity and that it ended at puberty. Johnson and Newport (1989) considered age 15 to be the end of the critical period while Pinker (1994) established that it began at age 6 and ended at puberty. One of the reasons that specifically obscures the issue of the onset of the critical period is that for some authors the beginning of this period is signaled by the beginning of the process of language acquisition in general while for other authors the critical period really starts when there is "a characteristic acceleration in linguistic development" (Hyltenstam and Abrahamssom, 2003: 558).

Singleton (1989) offers a discussion of different onsets – in the plural – in the areas of phonology, grammar, lexicon, and discourse. His claim is that different aspects of language have different onsets, which reflects the notion put forward by Seliger (1978) that there are different critical

periods, again in the plural. Seliger (1978) coined the notion of multiple critical periods to account for the fact that each of the sub components of language, such as phonology, morphology or syntax, has its own differentiated critical onset. Similarly, Yang (2019) argues that the CPH could have different effects on each of these specific domains.

The second element of a critical period requires that the pattern of decline in second language acquisition ought to produce an abrupt discontinuity. A general decline in the ability to learn is not enough to claim that there is a critical period. The CPH predicts a rapid decline at the end of the critical period which should be significantly different from the general monotonic and continuous decline that comes with age and that continues throughout the life span. The discrepancy among researchers with respect to the end point of the critical period suggests that establishing such a point is not a straight forward matter, possibly, one could argue, because there is no abrupt decline in the process but just a steady and predictable decline. With respect to the end point, it should also be noted that Krashen (1973) claimed that the process of lateralization is complete much earlier than puberty.

The third element requires the shutting down of the specific language learning mechanism. As a consequence, if learning occurs outside the critical period, then this must be the outcome of alternative mechanisms. Thus, there ought to be obvious differences in the patterns of acquisition between children and adult L2 learners. The existence of aspects of the language system that adults could not possibly learn would provide us with strong evidence for this third element of the critical period.

In regard to the fourth element, the robustness to environmental variation inside the critical period, the CPH predicts a threshold level of exposure with similar outcomes, even with considerable environmental variation. The CPH predicts that environmental variation should play a larger role outside the critical period where outcomes would become more variable depending on the quantity and quality of the stimuli.

4. JOHNSON AND NEWPORT AND THE MATURATIONAL VERSION OF THE CPH

Johnson and Newport (1989) described two different versions of the CPH. The exercise version claims that if the capacity for acquiring language is not exercised during the critical period, it will disappear with maturation. The maturational state version which is the most extended version of the CPH, claims that the capacity for acquiring any language is affected by maturation. "If native like levels are to be achieved, the acquisition of a first or second (or third, etc.) language must begin early in life, since the human capacity for learning languages declines with maturation, whether exercised in early life or not. Thus, this version of the CPH predicts non-native proficiency levels for anyone first exposed to the L2 after a critical period" (Hyltenstam and Abrahamsson, 2003: 557).

Johnson and Newport (1989) conducted a seminal study which gave support to the hypothesis of a critical period in L2A. They studied native speakers of Korean and Chinese who had immigrated to the United States between 3 and 39 years old. The production of these subjects was analyzed

within a grammaticality judgment task. The results showed that prior to 15 there was a negative correlation with age, but after 15 there was no correlation at all. These findings are quite consistent with the first two conditions outlined above: there appears to be a clearly defined end point, after which there is an abrupt decline. In addition, adult learners showed greater variability in learning outcomes than children, which may be taken as evidence for robustness to environmental variation.

These authors concluded that their data supported the maturational state version of the CPH. This means that the capacity to acquire language – any language – declines regardless of whether we receive input during the critical period or not.

SOME PROBLEMS FOR THE CRITICAL PERIOD HYPOTHESIS IN L2A

The notion that there is an age-related decline in the success with which individuals master a second language is not, in itself, controversial. What raises controversy is whether this pattern of decline meets the conditions required by the notion of a critical period. Therefore, showing that old people are worse learners than children is, in itself, quite irrelevant to the question of whether there is a critical period for language acquisition.

Interestingly, Snow (1983) argued that children were not better than adults at acquiring a second language. His argument relied on the fact that children spend much more time being exposed to language than adults, which makes the comparison difficult to evaluate. Snow and Hoefnagel-Hohle (1978) compared the performance of English young children between three and four years old and adults in their first year of living in the Netherlands learning Dutch. The young children scored lowest of all. Adults had an initial advantage in learning a second language, but this difference was not correlated with regards to ultimate attainment.

Feral children seem to serve both as evidence and counterevidence for the CPH. On the one hand, they can never acquire language to reach the competence of a normal child. When they do acquire some fragmentary language, their verbal abilities are extremely rudimentary. This would seem to support the CPH. However, feral children can constitute a strong example against the CPH. Genie, one of the best studied feral children, did manage to acquire, at least, some language, despite all the physical and mental abuse of which she was a victim (Curtiss, 1977). Genie's case could also be taken as supportive of a weaker version of the CPH suggesting that there may be some distinctive features and restrictions in the process of language acquisition when it takes place outside this period. But once we have accepted the possibility of a weak version of the CPH, we are, strictly speaking, outside the domain of a biological critical period.

Hakuta et al. (2003) tested the CPH for second language acquisition based on data from the 1990 U.S. Census using responses from 2.3 million immigrants with Spanish or Chinese language backgrounds. The analyses tested the prediction that the line regressing second-language attainment on age of immigration would be markedly different on either side of the end of the critical period. The data from this study suggest that the ability to acquire a second language shows a continuous decline with age and not a sharp drop-off break at puberty. The general conclusion of this study was that "the pattern of decline in second – language acquisition failed to produce the

discontinuity that is an essential hallmark of a critical period" (Hakuta et al., 2003:31). The data from this study count as strong evidence against the first two elements of the critical period hypothesis for L2A.

Klein (1986) acknowledges that L2A is more difficult after puberty but he argues that "the biological explanation can be replaced or supplemented by arguments of social nature" (Klein, 1986: 10). Again, what is at stake when discussing the CPH is not just any decline in the ability to acquire a second language. As discussed above, this hypothesis goes beyond the obvious notion that old people are generally worse learners than children. Very often empirical studies which are presented as evidence for the CPH can also be explained in terms of social, psychological, or educational factors. For example, it has been argued that it may well be the case that adult learners are less willing to give up their linguistic identity (Klein, 1996).

The third element of a critical period in L2A predicts that there should be qualitative differences between child and adult learners. However, a number of studies have shown that this is not really the case. Hakuta (2001) argues that the crucial question to determine the viability of this third condition is whether adult learners show more evidence of negative transfer than children because, according to the CPH, children supposedly have direct access to the L2 whereas adults must go through their L1. However, children learning an L2 seem to be subject to positive and negative transfer as much as adults do (Bialystok and Hakuta, 1994).

In another study Bailey et al., (1974) compared the performance of adult and child learners of English as an L2 on a test of morphosyntax. The results showed a noticeable similarity in the performance between children and adults. "Overall, this study provides support for the fact that child and adult learners progress along similar paths of development" (Hakuta, 2001: 200).

White and Geneese (1996) used sentences containing 'wanna' contractions and asked adults who had learned English at different ages to judge the grammaticality of those sentences. Some sentences contained structures such as "*Who do you wanna feed the dog?", where the trace between *want* and *to* turns the use of the contraction ungrammatical. Although overall more adults fail to recognize the ungrammaticality of these sentences compared to child learners, a third of the adults performed as high as children and as high as English native speakers. This means that "adults are capable of learning abstract rules that theory would say are accessible only with specialized language acquisition mechanisms" (Hakuta, 2001: 202).

With regards to environmental variation the CPH assumes that this should have minimal effects: if the learner receives sufficient stimuli, the process of learning will be complete independent of the amount of stimuli. Hakuta (2001) argues that the 1900 Census data showed that socioeconomic factors played a major role in L2A, suggesting that there is sensitivity, as opposed to robustness, to environmental variation.

Hakuta (2001) draws a categorical conclusion by claiming that "the evidence for a critical period for L2 acquisition is scanty, especially when analyzed in terms of its key assumptions. There is no

empirically definable end point, there are no qualitative differences between child and adult learners, and there are large environmental effects on the outcomes" (Hakuta, 2001: 203).

6. DISCUSSION: THE CPH AND THE MODULARITY DEBATE

The CPH debate is not only a dispute over the existence of the critical period. On a deeper level, what is being discussed is the validity of the modularity hypothesis (Chomsky, 1995; Fodor, 1983). Mistakenly or not, the CPH has been used as a powerful tool in the heated debate over the purportedly modular organization of language in the mind.

The concept of modularity is central to the field of psycholinguistics (Allot and Smith, 2021; Fodor, 1983; Smith and Allot, 2016). The notion of module can be understood in different ways. It can be regarded as a self-contained set of processes by which some input is turned into an output without any outside help. A module is thus independent of processing occurring outside and displays a purely bottom-up type of processing. There is no reverse information flow between modules and processing at any given level is assumed to be essentially free of influence from processing decisions about the input on any other level.

In sharp contrast, the connectionist position involves interactive processes in which feedback plays a crucial role (Plaut, 2003; Rumelhart and McLeland,1986; Zerilli, J. 2019). According to this view, earlier stages of processing, such as parsing, can be influenced by later stages such as pragmatic knowledge. Connectionism regards processes of language as interacting with one another. Processing at any level takes into account any and all information from other levels. Comprehension would be the outcome of a process that integrates information deriving from bottom-up analysis of the data, together with top-down information deriving from the higher levels. For this model, the role of context and feedback are fundamental in the study of language. Interestingly, Swain (1985, 1995) claimed that comprehensible input, as put forward by Krashen (1973) is an essential component in language acquisition, but she further argued that the output is necessary because it allows the learner to test the relevant hypotheses and to accommodate or change the underlying rules of language production.

An important issue, very frequently neglected in the literature, is the difference between neurological modularity and psychological modularity (Bates, 1994; Bates and Dick, 2002;). Neurological modularity refers to the idea that certain processes are localized in specific parts of the brain. This goes back to the old idea of the localization of the functions from 19th century phrenology. Psychological modularity is related to the modular organization of psychological processes. It is crucial to make this difference because a set of processes can be distributed across different areas of the brain (against neurological modularity) but the functioning of the process can display a modular fashion. Nevertheless, it is theoretically more elegant to believe that if the biological substrate displays a certain organization –either modular or interconnected– then the psychological phenomena will reproduce the same structure. However, of course, this might not be the case.

The CPH appears to fit nicely into a theory that regards language processes as displaying a modular fashion. Within a modular view, it is almost natural to claim that an isolated module in charge of the acquisition of language has a biologically determined shelf life. It is easy to postulate a time during an organism's life span when it is more sensitive to environmental influences or stimulation than at other times. Jackendoff (1994) expresses this point in a very clear manner: "If there is one [a critical period], it provides strong support for a specialized capacity for learning language, separate from the general-purpose learning capabilities that remain active throughout the life span" (Jackendoff, 1994: 118)**.** On the other hand, claiming that language processes are essentially very similar to any other cognitive process makes it difficult to explain why the capability to acquire language would fall drastically at puberty with no decline in other cognitive skills. Connectionism does not isolate language so any process that affects language ought to, in principle, show up in other cognitive areas.

There is a strong bias in the literature that has obscured the investigations of the critical period for L2A. Studies that are intended to provide evidence for the CPH are, for the most part, based on the modularity hypothesis. If the study offers evidence against the CPH, the theoretical framework is usually connectionism. One of the reasons why the CPH cannot be disentangled from views on the general organization of the mind is the confusion of three different concepts: innateness, localization and domain specificity (Bates, 1994). Innateness entails that our ability to acquire a language is determined by our genes, and mediated by a form of neural organization that is specific and unique to our species. Localization implies that our ability to process language is localized in specific regions of the brain. Proponents of domain specificity go beyond these two claims and suggest that our localized language abilities are discontinuous from the rest of the mind. Within this same biolinguistic perspective, the faculty of language is defined as a mental organ or as a computational cognitive mechanism (Bolhuis et al., 2014).

Fodor's (1983) version of modularity unifies innateness, localization and domain specificity. In this view, language is innate, localized and domain-specific. However, all logical combinations of innateness, domain specificity and localization are, in principle, possible and should therefore be subject to empirical inquiry. Localization can perfectly be the result of experience. The process of learning may serve to set up neural networks that are localized as well as domain-specific, but not necessarily innate. Tomography studies of brain activity have shown a region of visual cortex that is specialized for words that follow the spelling rules of English (Petersen, Fiez and Corbetta, 1992). It would be unacceptable to claim, based on these findings, that English spelling is innate. However, this organ seems to be localized in a domain specific module. The system might be innate and domain specific but not localized. There may be a strong innate predisposition to set up domain-specific functions in a form that is broadly distributed across many different cortical regions. The confusion of these three elements in the field of SLA implies that very often studies that provide evidence for just, for example, locality, are mistakenly offered as proof of innateness or domain specificity.

7. CONCLUSION

The critical period hypothesis in L2A is an old hypothesis that has been able to weather more than one storm. The general consensus appears to be that the critical period is a much stronger hypothesis in the realm of L1 acquisition than in L2A. The CPH, whether it proves true or false, has been food for thought for many linguists interested in L2A. Arguing for the CPH is a tool to be used against the hypothesis that language processes can be best accounted for by means of a connectionist model. Arguing for the CPH, as suggested by Jackendoff, is a strong argument for the biolinguistic and modular perspective put forward by Chomsky (Bolhuis et al, 2014, 2015).

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Autor
Carlos Gelormini Lezama, PhD
Universidad de San Andrés
cgelormini@udesa.edu.ar

Datos curriculares
Carlos Gelormini Lezama es doctor en Lingüística por la Universidad de Carolina del Sur y licenciado en psicología por la Universidad de Buenos Aires. Profesor asociado y director de la licenciatura en comunicación en la Universidad de San Andrés. Recibió la beca doctoral Fulbright (Estados Unidos) la beca postdoctoral de Conicet (Argentina) y la beca postdoctoral de la Fundación Carolina (España), entre otras. Ha publicado en las revistas científicas internacionales indexadas de mayor impacto dentro de la psicolingüística: Journal of Memory and Language, Journal of Psycholinguistic Research, Cognition, PloS ONE, Behavioral and Brain Functions, Language, Cognition and Neuroscience y Frontiers in Human Neuroscience, entre otras.