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THE CONNECTION BETWEEN LANGUAGE LEARNING AND COGNITIVE DEVELOPMENT

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Abstract

Our paper attempts an outline of the connection between learning foreign languages and the cognitive development of children and adults. It is an interdisciplinary paper with a view grounded in foreign language acquisition studies (Lenneberg, 1967), but also trying to include studies in psychology, seen as essential background literature for our article.

The goal of the paper is to answer some questions we deem extremely interesting:

- *What is the connection between speaking foreign languages and the cognitive development of children?*
- *Is there a marked difference in the way children and adults learn foreign languages?*
- *Is there such a thing as a 'critical period', after which learning foreign languages become extremely difficult or even impossible?*

The 'pragmatic' outcome of our paper will be, we hope, to prove that the advantages of learning foreign languages extend beyond simple communication benefits and are necessarily linked to the formation of a harmonious and more complex personality.

Keywords: Language learning, Second Language Acquisition (SLA), Critical Period Hypothesis (CPH), Sensitive Period Theory, lateralization, language teaching methods

Introduction: The Critical Period Hypothesis (CPH)

To begin with, we would like to review the literature surrounding the topic of the 'critical period', and briefly discuss the main arguments and counter-arguments connected to the theory.

As Katsumi Nagai notices in his paper[1], originally the phrase 'critical period' was used in studying animal behavior, more exactly, for the ethologists' study of species-specific behavior. It is the period when imprinting[2] is observed in certain species such as young birds and rats. For example, geese isolated from their parents since the hatching react to and follow the moving object they see first. This kind of behavior takes place only for a short period of time after hatching (Lorenz 1961, quoted in Clark & Clark 1977:520). Another example is the so-called 'crystallization' in the case of chaffinch songs. Those songs are highly intricate. If a young bird does not hear an adult singing within a certain period, the bird will never sing a full song. The CPH (Critical Period Hypothesis) posits that there is a short period available for the acquisition of language as well, which is decided by the learners' behavior.

Another influential researcher on the topic of the critical period, Flege (1987)[3] lists four characteristics of imprinting:

1. It tends to appear under well-defined developmental conditions.
2. It cannot be forgotten or revised once it has been established.
3. It involves the recognition of species' characteristics rather than individual characteristics.
4. It may be learned long before it is manifested.

There is an important observation to be made here: Flege assumes that only the first characteristic above is applicable to the human language acquisition. Katsumi Nagai asks, in his paper, an essential question: Is it applicable to second language learners too?

A possible answer to the question above is to be found in a pioneering work by Lenneberg (1967)[4]. His study has greatly contributed to the spread of the critical period theory, although, as we shall try to prove in the following, it has subsequently faced a great deal of criticism (mostly justified).

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[1] Nagai, Katsumi, *A concept of 'critical period' for language acquisition. Its implication for adult language learning*, http://www.ed.kagawa-u.ac.jp/~nagai/papers/kn7/kn7.htm

[2] According to *Encyclopedia Britannica*, **imprinting** is 'in psychobiology, a form of learning in which a very young animal fixes its attention on the first object with which it has visual, auditory, or tactile experience and thereafter follows that object. In nature the object is almost invariably a parent; in experiments, other animals and inanimate objects have been used. Imprinting has been intensively studied only in birds, especially chickens, ducks, and geese, but a comparable form of learning apparently occurs in the young of many mammals and some fishes and insects.', http://www.britannica.com/EBchecked/topic/284209/imprinting

[3] Flege, James Emil (1987), *'A Critical Period for Learning to Pronounce Foreign Language?', Applied Linguistics*, Issue no. 8, pp. 162-177, quoted in Nagai, Katsumi, *A concept of 'critical period' for language acquisition. Its implication for adult language learning*, http://www.ed.kagawa-u.ac.jp/~nagai/papers/kn7/kn7.htm

[4] Lenneberg, E. H. (1967), *Biological Foundations of Language*,Wiley

Lenneberg explores the CPH and says:

> Between the ages of two and three years language emerges by an interaction of maturation and self-programmed learning. Between the ages of three and the early teens the possibility for primary language acquisition constitutes to be good; the individual appears to be most sensitive to stimuli at this time and to preserve some innate flexibility for the organization of brain functions to carry out the complex integration of sub-processes necessary for the smooth elaboration of speech and language. After puberty, the ability for self-organization and adjustment to the physiological demands of verbal behavior quickly declines. The brain behaves as if it had become set in its ways and primary, basic skills not acquired by that time usually remain deficient for life (Lenneberg 1967:158).

We have given the full quotation as we think this fragment is extremely important for the understanding of the theory put forward by Lenneberg. There are a couple of things we should underline in the fragment: firstly, according to Lenneberg, the ideal period for foreign language acquisition seems to be (roughly) between the ages of three and thirteen ('early teens'). Secondly, Lenneberg gives a reason for this fact, which needs to be further explained in the continuation of our paper, as it might seem somewhat vague at this point: he claims that the decline in the ability to learn languages after puberty is due to the fact that 'the brain behaves as if it had become set in its ways'. While right now this may sound a little unscientific, more information on the concept of the lateralization of the human brain might shed some light on the subject.

The lateralization of the human brain

As we can see in Katsumi Nagai's paper,

> Earlier studies show that the brain seems to have special-purpose computers for limited functions, and there is at present no evidence of any all-purpose computer for any general cognition. If a language is acquired in parallel with the development of the human brain as children grow, it is reasonable to postulate some language function in the brain. Consequently, the critical period for language learning is considered to be the biologically determined period in which the brain keeps its plasticity for acquisition of any language.[5]

The interesting piece of information in the above-quoted fragment is the one referring to a 'language function of the brain', seen as a reasonable assumption by the author of the article. While this is a question better answered by biologists than by linguists, we cannot

[5] Nagai, Katsumi, *A concept of 'critical period' for language acquisition. Its implication for adult language learning*, http://www.ed.kagawa-u.ac.jp/~nagai/papers/kn7/kn7.htm

help but wonder: where, exactly, in the brain could such a language function be activated, and is there scientific evidence of the fact?

Katsumi Nagai partially answers the question:

> At first it was expected that the function of human language acquisition was clarified by exploring a special structure, which all other animal brains lack. The brain of human beings consists of a left hemisphere and a right hemisphere, and different functions are said to develop gradually in different parts of the brain as children grow older. The parts of brain which control a language are placed in the left hemisphere after its lateralization. One of the parts is called the Broca's area and the other part is called the Wernicke's area. The study of aphasia has revealed that the Broca's area controls spoken language. The Wernicke's area is, on the other hand, said to be the center of language understanding.[6]

So, the first part of our question finds an answer in the above: the language function is located in the left hemisphere of the brain. This only happens after the lateralization of the brain. Also, there are different areas in charge of spoken language and language comprehension – Broca's area and Wernicke's area – which is extremely interesting for a language teacher and, as we shall see, might account for differences in the way children and adults acquire language.

But what is lateralization and when does the process occur?

> Lenneberg posits that the development of language is the result of brain maturation. Although both hemispheres of the brain are equal at birth, the function of language gradually settles in the dominant left hemisphere of the brain after biological maturation or the critical period. That is, the critical period for language learning has been considered to agree with the period of the lateralization of brain. Research on people who have suffered brain damage also supplies the evidence for the lateralization of brains. Lenneberg viewed clinical data and claimed that children younger than nine years old had a higher incidence of right hemisphere lesions causing aphasia than adults (Villiers & Villiers 1978:211).

Thus, lateralization is the process by which the brain divides its functions between the right and left hemispheres. Once the process completed, as Lenneberg claims, language acquisition becomes increasingly more difficult.

Another support of lateralization, to be found in Katsumi Nagai's study, is an experimental report of speed and accuracy in language acquisition by Kimura (1973). Kimura examined speech sounds heard in each ear. His result is that speech sound through

[6] Idem 5

the right ear is processed more quickly than through the left ear because the left hemisphere is connected to a right ear.

Clinical studies also seem to confirm the connection between lateralization and language acquisition. A brain is said to lose its plasticity after the lateralization, and some case studies are reported on the impaired brains before and after the critical period.

> Adults who have suffered brain damage in their left hemisphere fail to recover their language if they don't recover in five months, but children show an ability to recover over a longer period, and have sometimes made a full recovery if they were very young at the time of damage (Crystal 1987:263).[7]

Criticism of Lenneberg's theory

As we have said in the previous, Lenneberg's theory has faced justified criticism with the progress of medical science. He claimed that children before their critical period were less severely impaired by brain damage. However, Krashen (1973) reexamined the data used in Lenneberg (1967) and found all the cases of complete recovery from aphasia were under the age of five. Surprisingly, the number of cases of recovery at the age of more than five or over was nearly the same number as the adults'. [8]

Additional problems with Lenneberg's theory were also revealed. For instance, Kinsbourne (1975) pointed out the difficulty in deciding whether only half of the hemisphere was injured or not. Another piece of counter evidence is seen in MacKain et. al. (1983). Their experiment with babies of six months or less shows that lateralization begins much earlier than two years old. This would cause problems and question the validity of the critical period hypothesis, as it raises queries regarding the interval proposed by Lenneberg.

As for dichotic listening[9], experiments in which different stimuli are presented simultaneously to the two ears also show that language functions are lateralized much earlier than the critical period, and no conclusive evidence for right ear advantage based on the lateralization has been reported.[10]

The Sensitive Period Theory

Due to consistent counter evidence brought to the CPH, a revised version of the theory emerged. Researchers like Oyama (1979) or Seliger (1978) proposed the term 'sensitive

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[7] Quoted in Nagai, Katsumi, *A concept of 'critical period' for language acquisition. Its implication for adult language learning*, http://www.ed.kagawa-u.ac.jp/~nagai/papers/kn7/kn7.htm

[8] Idem 7

[9] A brief explanation for dichotic listening: 'Dichotic listening is a behavioural technique for studying brain asymmetry in auditory processing. In a dichotic listening experiment, the subject is presented with different sounds to the right and the left ear simultaneously. This means that the subject receives more auditory stimulus than she is able to analyze consciously. The interesting question, then, is what part of the input will be selected for conscious analysis.', http://folk.uio.no/janneto/300kopi/node22.html

[10] Nagai, Katsumi, *A concept of 'critical period' for language acquisition. Its implication for adult language learning*, http://www.ed.kagawa-u.ac.jp/~nagai/papers/kn7/kn7.htm

period', rather than 'critical period'. As Katsumi Nagai's study suggests, 'the distinction between the CPH and the sensitive period hypothesis is whether acquisition is 'possible only within the definite span of age' or 'easier within the period.' [11]

We think the distinction is essential for foreign language acquisition studies (and practice), especially concerning adults. Most language teachers have probably come across instances (and our experience as teachers confirms this) when adult learners have difficulties where children seem to manage beautifully. The researchers mentioned above bring some explanations for the observations we made.

Oyama (1979:88) says that sensitive periods are preceded and followed by less responsive periods. Seliger's proposal (1978) is that there may be multiple critical or sensitive periods for different aspects of language. The period 'during which a native accent is easily acquirable' appears to end earlier than the period governing the acquisition of a native grammar.[12]

In the conclusions to his study, Katsumi Nagai mentions another extremely interesting model, what he calls a 'neurological mental muscle model' (Long 1990). The proposition here is that 'access to the language-specific endowment which remains intact after puberty is progressively impeded to varying degrees with aging, unless the faculty is used daily and kept plastic.'[13]

We think this theory is supported by numerous examples found in our everyday experience, and that it is hard to deny the fact that the faculty of learning a language, like any other mental ability, needs to be exercised, if we do not want to run the risk of losing it.

Another researcher claims that adults and children appear to behave very much in the same manner, which indicates that activation of certain linguistic development is dependent on the existence of specific environmental factors, rather than on the different cognitive abilities of children and adults (Muhlhauser 1986:266).

In Flege's opinion (1987), the CPH is an a priori assumption about the basis of adult-child differences rather than a testable hypothesis. He goes so far as to say that acceptation of the CPH may impede the development of specific hypotheses that can be tested.

In the end of this part of the paper, we shall quote Katsumi Nagai's conclusions. He says:

> One of the important reasons for the disagreement of results is that a large number of studies involve learners in a classroom environment. In the artificial situation adults can do better because children take a while to adjust themselves to the new environments and unfamiliar teaching methods. Another reason is a confusion of pronunciation and grammar. Since the acquisition of pronunciation and grammar are different in nature, it seems natural for each of them to have independent critical periods. Phonological

[11] Idem 10
[12] Idem 10
[13] Idem 10

acquisition seems to be more sensitive to the critical period than that of grammar. This leads to a theory of the multiple critical periods.[14]

We think that the conclusions above are valuable, as they shed light in two respects: the first one, we should definitely distinguish between learning in an artificial classroom environment and learning 'naturally', in the setting a child has when first acquiring language. Secondly, different aspects of language acquisition need to be treated differently by language teachers; pronunciation and grammar cannot be taught by using the same methods, as most teachers already know.

Second-language acquisition

Let us get back to one of the questions posed earlier. Can we speak of a critical period for second-language acquisition (SLA)[15]? Is it true that adult learners have slimmer chances at native-like fluency than younger learners?

According to David Singleton[16], in learning a second language, "younger = better in the long run." However, he points out that there are many exceptions to the above-mentioned rule. Some figures: 'five percent of adult bilinguals master a second language even though they begin learning it when they are well into adulthood — long after any critical period has presumably come to a close'.[17]

This would prove the fact that, while the window for learning a second language never completely closes, some aspects of language are more affected than others.

As we have mentioned before, accent (pronunciation) is one of them:

> For example, adult second-language learners nearly always retain an immediately identifiable foreign accent, including some who display perfect grammar (Oyama 1976).

Some writers have suggested a younger critical age for learning phonology than for syntax. Singleton (1995) reports that there is no critical period for learning vocabulary in a second language. Robertson (2002) observed that factors other than age may be even more

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[14] Nagai, Katsumi, *A concept of 'critical period' for language acquisition. Its implication for adult language learning*, http://www.ed.kagawa-u.ac.jp/~nagai/papers/kn7/kn7.htm

[15] The term "language acquisition" became commonly used after Stephen Krashen contrasted it with formal and non-constructive "learning." Today, most scholars use "language learning" and "language acquisition" interchangeably, unless they are directly addressing Krashen's work. However, "second-language acquisition" or "SLA" has become established as the preferred term for this academic discipline, http://en.wikipedia.org/wiki/Critical_period_hypothesis

[16] Singleton, David, and Lengyel, Zsolt. (1995). *The Age Factor in Second Language Acquisition.* Clevedon: Multilingual Matters. *See also* http://web.archive.org/web/20060319062202/http://www-rcf.usc.edu/~ionin/SLAgroup/Ling527papers/Singleton+Critical+Periods+iral.2005.43.4.269.pdf

[17] http://en.wikipedia.org/wiki/Critical_period_hypothesis

significant in successful second-language learning, such as personal motivation, anxiety, input and output skills, settings and time commitment.[18]

Shortcomings of SLA theories

One of the most important shortcomings of SLA theories is the fact that most of the data derive from literate learners.

Tarone, Bigelow and Hansen (2009) find significantly different results when replicating standard SLA studies with low literate L2 learners. [19]

> Specifically, learners with lower alphabetic literacy levels are significantly less likely to notice corrective feedback on form or to perform elicited imitation tasks accurately. These findings are consistent with research in cognitive psychology showing significant differences in phonological awareness between literate and illiterate adults (Reis and Castro-Caldas 1997; Castro-Caldas et al. 1998). An important direction for SLA research must therefore involve the exploration of the impact of alphabetic literacy on cognitive processing in second-language acquisition.[20]

Consequences for the SL teaching methodology

In what follows, we shall make a brief review of the main language teaching methods, and try to see how the SLA theories could help us select some of the most appropriate methods for a certain age group.

The Grammar-Translation Method

> In the grammar translation method, rules are first taught to the learners and the vocabulary is learned from bilingual word lists. Exercises are designed to learn and practice grammar rules and vocabulary in isolation. Rules are explained in students' first language. Even when the sentences given for drills are comprehensible, students focus on form and not on the meaning of the sentences.[21]

While according to SLA theories, such a method would be rather suitable for adult learners, given their ease in learning grammar, we think that such methods are rather outdated and more communicative teaching methods should be used instead, for adult learners as well as for children and young adults.

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[18] http://en.wikipedia.org/wiki/Critical_period_hypothesis
[19] Idem 18
[20] Idem 18
[21] Joseph Ponniah. (2010). *Insights into second language acquisition theory and different approaches to language teaching*, I-manager's Journal on Educational Psychology, Vol. 3, No. 4, February - April 2010, https://www.academia.edu/390883/Insights_into_second_language_acquisition_theory_and_different_approaches_to_language_teaching, p.15

The Audio Lingual Method

In the audio lingual method, the emphasis is given to mimicking a dialogue and eventually the learners memorize the dialogue, and through pattern drills they try to automatize the memorized chunks. In addition, they engage in basic drills such as repetition drill, chain drill (to make the learned dialogue automatic through such practice), transformation (e.g. changing a positive sentence into a negative) and translation. Learners' errors are corrected while speaking because the emphasis is more on the accuracy in production and, therefore, conscious rules of the language are taught, assuming that learners will correct errors.[22]

While this method seems to be quite restrictive, we think a moderate use of the method presents benefits, especially for adult learners (if we assume that SLA theories are correct in saying that pronunciation is more difficult for this type of learners). We should, however, take into account the shortcomings of the method:

As the entire class hour is devoted to practice a dialogue through drills and doing grammar exercises, the method fails to provide more comprehensible input. The method presumes that conscious control of the language is necessary for acquisition.[23]

Direct-Method

In this method, the instruction is given in the target language and the students do the exercises in the L2 and the use of first language is not allowed in the classroom. The method insists on the learners to think in the target language. It focuses on the inductive method of teaching grammar, which encourages the learners to guess grammar rules used in an utterance in order to avoid errors during the production of the language. As in grammar translation, this approach aims at accuracy in production and therefore errors of the students are corrected. Students spend a great deal of time in learning grammar. [24]

This method is quite modern and has very few shortcomings, for children as well as for adults. Given the insistence on grammar and correct use of grammar rules, it would apply better to older children and young adults, as well as to adults, since young children (and the SLA theories presented confirm this) tend to learn a language intuitively, so there is no need (nor possibility, due to their limited knowledge of grammar rules even in the L1) to focus too much on grammar. This is one of the drawbacks of the method:

The insistence on the use of grammar through error correction at the early stage is a constraint for learning the language and it will cause high anxiety. However, the

[22] Idem 21, p. 16
[23] Idem 22
[24] Idem 22

teacher's explanation of the rules in the target language is a good source of comprehensible input.[25]

Total Physical Response

Students respond physically to the commands given by the teacher. They are asked to obey the command, which involves the physical response of students…. In this method, listening is given more importance than writing and speaking. Students are not forced to speak; in fact, they are allowed to speak only when they feel that they are ready to talk.[26]

Needless to say, from the description, this method is ideal for children. Aside from the fact that it uses exactly the kind of skills which come easiest to this age group (listening, rather than writing, which could cause problems to very young children), this method has an extremely important advantage, which should never be neglected in a classroom: it is fun. It allows for interaction, and, very importantly, engages children physically, which corresponds to their (commonly) high energy levels (a fact rarely achieved by the other teaching methods).

Drawing from SLA theories, we shall notice the fact that this type of method corrects one of the problems that the other ones have – an artificial classroom environment, not suitable for children's natural way of acquiring language. This method is less artificial, in the sense that it is closer to a game, which is children's natural way of making sense of the world around them.

The major constraints of this method are the continuous use of imperative sentences, grammar based lessons and the inductive learning of grammar. But when compared to the grammar translation, the audio-lingual and the direct method, this method provides more comprehensible input and the students' physical response to the teacher talk confirms this. As the students are not forced to produce output, they feel more comfortable in the class, which, of course, will help them acquire language in a low anxiety situation. The method gives more importance to 'comprehension' which certainly will lower the affective filter of learners when they experience the language.[27]

The Natural Approach

Class time is devoted for providing comprehensible input. The teacher explanation of a topic is only in the target language and the students can use the second language or the L1. Students' errors are not corrected unless the communication is seriously impaired. Grammar exercises are not given in classroom because there are several constraints in

[25] Idem 22
[26] Idem 22
[27] Idem 22

using consciously learned grammatical knowledge in real situations and on a wide variety of tests (Krashen, 2003; Ponniah, 2009)...The approach claims that grammar is acquired in predictable order while experiencing input in the language. [28]

We have left (what we think is) the best method last. There is an important advantage of the method: the fact that it does not use immediate correction, and focuses on communication – so it concentrates on the goal of language use, and not on the means.

We think that this is the source of many of the mistakes concerning SL teaching – teachers become too caught up in methodology and they forget the most important thing: the goal is *communication* in a foreign language, and not perfect knowledge of grammar rules.

Conclusions

The current paper has reviewed theories regarding Second Language Acquisition (SLA) and the existence of a critical period (The Critical Period Hypothesis) as far as the learning of a language is concerned.

We have found, by gathering information from multiple sources, that the Critical Period Hypothesis has serious shortcomings, and we tend to agree with the newer theories put forward (by researchers like Oyama or Singleton), which suggest the replacement of the Critical Period theory with a Sensitive Period theory, or, more specifically, with a theory of the existence of multiple sensitive periods.

Also, we think that the distinction between several aspects of language learning (such as the learning of pronunciation, or that of grammar) is essential for the language teacher (as well as for the learner), who should be aware of the need of applying different methods when teaching aspects of language which are more or less age-sensitive.

We have also made a brief review of the main language teaching methods, in an attempt to see how SLA theories could help us select some of the most appropriate methods for a certain age group.

As directions for further research, we think that a study comparing the effect of various learning environments on the speed and accuracy of the learning process would be extremely valuable, as we have come to the conclusion, by perusing literature for the current study, that an artificial learning environment is often not sufficient for fast and effective progress, especially in the case of adult learners.

[28] Idem 22

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