

## Sensitive periods in second language learning: Implications for pre-elementary Japanese learners of English?

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### Abstract

In Japan, the number of infants and pre-school children entering second language schools is increasing with many parents becoming aware of the advantages of exposing their young children to a second language. If we are to suppose that there is a sensitive period for first language acquisition and that this *window* begins to close from around six years of age then it is obvious that exposure to a second language from as early as possible, *optimally before the age of four*, will benefit the child. By exposing and teaching a second language to very young children we are able to apply the principles of first language acquisition to their second language learning experience. With sufficient exposure that is encouraging, fun and realistic we are able to create an environment conducive to a bilingual upbringing within a monolingual family and society. This paper discusses recent research into the sensitive periods of first language acquisition, in particular that area of the brain designated to syntactic processing, and the effects of age on second language learning. The paper supports the position that it is beneficial for very young second language learners to take advantage of the sensitive period of the brain's language development and that more resources should be made available promoting both early and continuous second language development in Japan.

Keywords: second language acquisition, language development, brain development, sensitive period, bilingualism, experience-expectant development,

### 1. Introduction

This paper discusses the critical-period hypothesis in relation to the brain's language development and the maturational effects on second language acquisition. It is focused on the second or bilingual language acquisition of very young children. The development of the brain's language centre, particularly that of Broca's area, is a highly sensitive period for first language acquisition. By allowing children from birth to have sufficient *native like* quality exposure to a second language the *experience-expectant* development of the brain will allow bilingual like development to occur. This level of exposure should occur over a period of six years and language

maintenance and development must continue after this period as with a first language.

The paper is divided into four parts with the introduction including an overview on current research concerning the sensitive and advantageous periods of language development and the arguments for and against such hypothesis. Much of the debate centers on the adult learner's ability to achieve native-like competence whereas this paper is focused on the very young learner.

Part two looks at the importance of experience in language development which in turn supports the critical period hypothesis of first language acquisition and its importance in the second language acquisition of very young children. Part three looks at the development of the brain's language centers and how necessary experience is during the critical periods of the brain's 'wiring'.

The conclusion, part four, summarizes key research findings that support the concept of age related effects on learning a second language.

The grammatical, lexical and phonetic disparities between English and Japanese are large and the speakers of these languages often find each other's languages difficult to learn (Thompson 2001). Despite compulsory English classes through out their secondary school education many adult Japanese students are often looking for ways to overcome such disparities between the languages as they grapple with the sentence structure of English. There is no luxury of regular exposure to English and little opportunity to practice or experiment with the language learned outside the classroom.

If adult English language learners had received a significant amount of English language exposure from the time they entered kindergarten would this have removed or reduced the disparities they now face?

My observations of very young children learning English as a second language reveal notable differences between those children whose parents are ensuring continued exposure to English away from school and / or are attending more than one class a week and those only taking a one hour class once a week. For most parents having their child attend a number of classes a week or making use of home teaching materials is cost prohibitive yet, for children aged from birth to six, this is the opportune time to become immersed in a second language.

The importance of English as a second language in Japan can be seen through the compulsory classes at secondary school level. Such importance is also highlighted by Japan's Ministry of Education, Culture, Sports, Science and Technology (MEXT) 2004 forum "The Action Plan to Cultivate 'Japanese with English abilities". I believe it is quite likely that if the State places the emphasis on language development at kindergarten and early elementary school age instead of

from grade five, the motivation to continue studying English throughout the secondary school years will be much higher. This is simply due to the fact many of the barriers now facing secondary school students would have been reduced or removed and their success will be their motivator to continue study.

Successful Bilingual language programs for kindergarten aged children and younger have been set up around the world to ensure the survival of indigenous languages such as New Zealand Maori's *Te Kōhanga Reo* and the Hawaiian program *Punana Leo* (Stiles, 1997). There are a number of factors why these programs are successful including community and parent involvement as well as government support but the one factor that I want to emphasize is that of age. The *Te Kōhanga Reo*, (*language nest*), program commences from birth until six when the children enter primary school. It is within this age that our language development is at its most sensitive, which, through normal upbringing, ensures the acquisition of our first language (s).

If we are to consider how best to facilitate second language learning in *very young* children then I believe that the *critical* or *sensitive period* of language development is as important to second language learning as it is to first language acquisition. If administered correctly such programs are providing the opportunity to develop children with near native like proficiency in their second language.

The notion of a critical-period in language development was first proposed in 1959 by Penfield and Roberts (Hakuta et. al. 2003). This theory was subsequently pursued by Lenneberg who in 1967 suggested that the ability to learn a native language occurs within a fixed period specifically from birth through to puberty with a decline in learning abilities from puberty (Fromkin & Rodman, 1998). In their research into the characteristics of birdsong and human speech and the importance of the young being exposed to the communicative sounds of adults, Doupe & Kuhl (1999:609-610) define the critical or, more appropriately, the "sensitive or impressionable period" as "a specific phase of the life cycle of an organism in which there is enhanced sensitivity to experience, or the absence of a particular experience". Bortfeld and Whitehurst (2001:175) point out that the sensitive period "refers to an effect of *environmental* stimulation that can be produced more readily during a certain period than earlier or later". Newport (2002:737) defines a critical period as "a maturational time period during which some crucial experience will have its peak effect on development or learning".

Research appears to be divided as to whether there is an actual critical period with second language learners with arguments in favor of such a hypothesis, (e. g. Oyama, 1976 & 1978; Johnson and Newport, 1989; Newport, 1990; DeKeyser, 2000), and arguments that are less supportive, (e. g. Bialystok, 2002; Hakuta, Bialystok and Wiley, 2003;). The disagreement on

whether there is a critical period for second language learners is often based on how research is interpreted. For example Birdsong & Molis (2001:247) note that the results of their replication of Johnson & Newport's 1989 study (discussed in part 3) with Spanish immigrants "are broadly in line with those of Johnson and Newport". However their results show evidence not only of age effects on second language learning but that it is possible for adult learners to achieve native like performance. Accordingly their findings can be used to argue against the critical period hypothesis. Hakuta et al. (2003:31) suggests "an alternative to the critical-period hypothesis is that second-language learning becomes compromised with age".

The actual term *critical period* was originally introduced by Konrad Lorenz in the 1930's in his work on the *imprinting* of the first large moving object in certain species of newly hatched birds (Bruer, 2001). Such imprinting occurred within the first days of hatching and ended abruptly.

## 2. Our language centers.

For over 95% of people the left hemisphere of our brain is the dominant location of language (Eliot, 1999) although Hoff (2001) observes that the estimate falls between 80% and 98% depending on the source of the estimate. Within the left hemisphere there are two specific areas that divide language by semantics (word meaning) and syntax (word order and grammar). (Fig. 1). The left posterior areas including Wernicke's area, as well as a large area above and behind it, are activated during tasks involving the meaning of words. People with damage to this area (Wernicke's aphasics) retain the rules to form sentences but do not have enough words to say or understand anything of substance (Eliot, 1999). Goodglass, (1993:2) writes, "'aphasia' is an umbrella concept combining a multiplicity of deficits involving one or more aspects of language use". The following example of speech produced by a patient with Wernicke's aphasia on his hospital experience (Goodman 1993:1) highlights the language loss involved.

I had one of those...they did on my...my...ort...my art...I can't say it...there are two of them". (Examiner: The aortic valve?) That's right. Then I was in the...where they put three or four people...

Wernicke's area is also located near the junction of three important senses: hearing, vision and touch which no doubt assists in the formation of meaning.

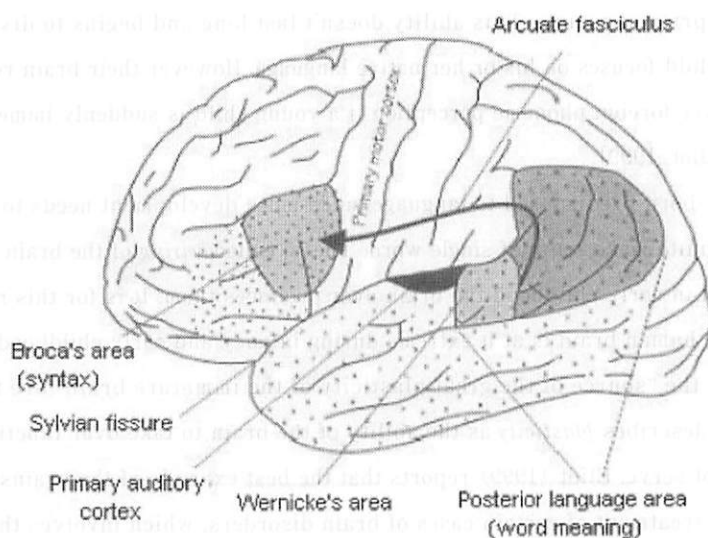


Fig. 1. In Elliot (1999:355) after A. R. Damasio and H. Damasio, "Brain and Language", *Scientific American*, September 1992

Fig. 1 The language centers of the brain. Dots in Broca's area and X's in Wernicke's area and the posterior language area show the areas activated during verb and noun use, respectively.

The left frontal cortex, which includes Broca's area, is more specifically activated during tasks involving grammatical processing. People with damage to Broca's area are impaired in the use of grammar with a notable lack of verbs however are still able to understand language. Hoff (2001) cites an example from Goodman (1979:256) of speech produced by a patient with Broca's aphasia.

Yes...ah...Monday...er...Dad and Peter H... (his own name), and

Dad...er...hospital...and ah...Wednesday...Wednesday, nine o'clock...and

oh...Thursday...ten o'clock, ah doctors ...two...an' doctors...and er...teeth...yah.

The actual development of our language centers begins well before birth with the left hemisphere specialized for language by the end of the 2<sup>nd</sup> trimester (Elliot, 1999) which supports the notion of speaking to your child before birth. This early specialization also explains various linguistic abilities of the newborn child such as being responsive to human speech, their preference to their mother's voice, and their ability to discriminate between native and foreign languages. In fact babies can actually detect far more speech sounds than adults can. For example (Kuhl) 1993 writes that Japanese babies can detect the difference between the /l/ and /r/ sounds which proves most difficult for their parents. Kuhl (1993) considers that infants are 'citizens of the world' due to the fact they can distinguish sounds from languages around the

world without prior exposure. This ability doesn't last long and begins to disappear after 6 months as the child focuses on his or her native language. However their brain remains flexible enough to recover foreign phoneme perception if a young child is suddenly immersed in a foreign language (Eliot, 1999).

While we are born predisposed to language much more development needs to take place before we can begin to make sense of single word. The so called *wiring* of the brain takes the form of synapses and in early childhood the brain over produces them. It is for this reason that the plasticity of the human brain is at it extreme during infancy and early childhood. According to Hoff (2001:60) the "source of the great plasticity of the immature brain" are the redundant synapses. Hoff describes *plasticity* as the ability of the brain to take over functions they ordinarily would not serve. Eliot (1999) reports that the best example of the brains plasticity can be found in the treatment of certain cases of brain disorders, which involves the complete removal of the left hemisphere. According to Eliot if this procedure is carried out on a child no more than 4 or 5 years of age the child will almost completely recover their language as their brain rebuilds the language circuits in the right hemisphere. By puberty however such an operation results in complete language loss.

The initial wiring of a particular region of the brain marks the onset of a particular ability such as vision in the first few months and language in the second year. The brain produces twice as many synapses as will eventually be needed and only synapses that are highly active (those that receive more electrical impulses and release greater amounts of neurotransmitter) are deemed useful, stabilized and cemented into their appropriate place. (see fig. 2). Less active synapses do not stabilize, are eventually made redundant and are lost or "pruned" as Eliot describes the process. This is basically survival of the fittest and most importantly adapts our neural circuits to the requirements of our environment. It is experience that basically decides which connections will be preserved and therefore how the brain will be permanently wired for certain ways of thinking, perceiving and acting. The critical period of development is when there is an excess of synapses and the brain plasticity remains at a maximum. Once the pruning commences and the excess synapses are gone the critical period is over.

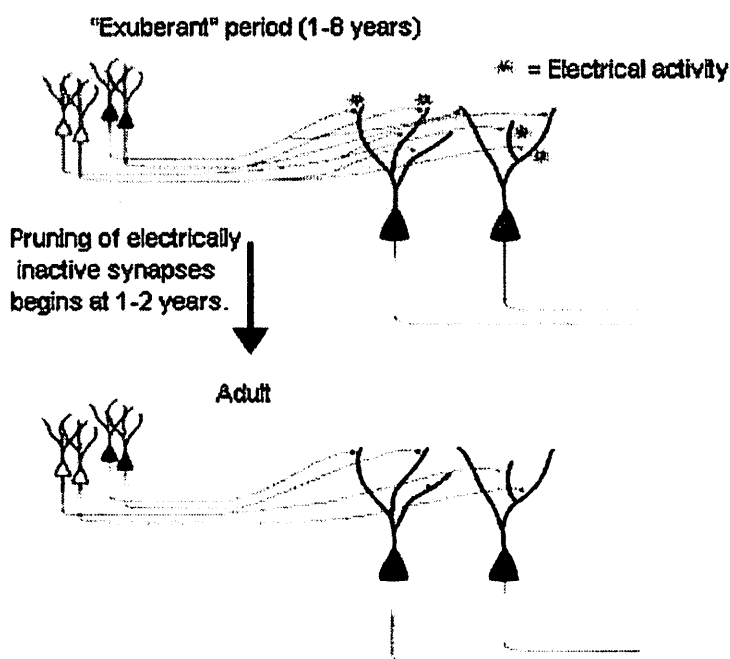


Fig. 2. In Eliot. (1999:31)

Fig. 2. Eliot (1999) During the "exuberant" period of brain development, children produce about twice as many synapses as they will eventually need. These are shown as small circles and squares in the above diagram. Electrical activity created by 'experience' determines which synapses will be preserved and which will be pruned.

Researchers have found that the number of synapses within Wernicke's area and the rest of the posterior language center peaks between 8 and 20 months with final development at around 2 years. This is earlier than that of Broca's area which see synapses in the left frontal areas peaking between 15 months and 24 months with final overall development occurring between 4 years and 6 years (Eliot, 1999).

### 3. Critical and Advantageous periods of Language Learning.

The fact that infants and children from around the world can differentiate between foreign and native speech sounds, acquire their language rapidly with little effort (Fromkin & Rodman, 1998; Woods, 1998), and all "go through the same stages of phonological, morphological, and syntactic rule acquisition" (Fromkin & Rodman, 1998), forms the basis of Chomsky's theory of Universal Grammar. First put forward in 1957 Chomsky's theory suggests in-built blueprints

for grammatical rules (Pinker, 1994). This supports the nature debate that language is innate.

However Kuhl's (2000:11856) Native Language Magnet Theory suggests that "what is innate about language is not a universal grammar and phonetics but innate biases and strategies that place constraints on perception and learning". According to Kuhl this means that the infant discovers the rules from the language input of his or her community and therefore 'language is innately discoverable'.

A crucial aspect of brain development is that the brain's wiring occurs within certain time periods for various functions and that these periods are critical in that once the wiring is complete there is no going back. Moreover the skills on which the wiring depends is heavily influenced by experience (the nurture debate). The brain's language network can only successfully and permanently be wired up when it is exposed to a coherent combination of sound, meaning and grammar from any single language (or combination in the case of bilingual or multilingual children).

In 1987 distinction was made between two ways in which experience causes change to the brain; one of which is called *experience-expectant* development and the other is called *experience-dependent* development (Bruer & Greenough 2001). This distinction is important. *Experience-expectant* development relates to the sensitive periods which involve sensory and motor systems including first language acquisition. The experiences required to ensure that these systems develop normally are "reliably present in any typical human environment" (Bruer & Greenough 2001:211). *Experience-dependent* development is, as described by Bruer & Greenough (2001:212) driven by "experiences that are unique to the individual and to the physical, social and cultural environment individuals inhabit". They continue noting that this is relatively age independent allowing us "to learn and benefit from experience throughout our lives". Based on this I conclude that a language learnt after the sensitive period to first language learning has ended falls under the category *experience-dependent* learning in which age does not play a factor.

Controlled studies in determining the sensitive periods of first language acquisition are ethically wrong and inhumane. Bortfeld and Whitehurst add that if such studies were permitted there would be difficulties interpreting the results due to the likelihood that opportunities for normal social and cognitive development would also be deprived. They note evidence supporting critical periods largely comes from four areas of study. The first source of evidence can unfortunately be found in cases involving children growing up without normal linguistic and social interaction either through abuse or being left out in the wild to die. Having been exposed to language later in life many were able to acquire a useful vocabulary but were unable to understand



some of the simplest grammatical rules. Isolation from language also affected their ability to isolate and produce individual sounds of speech. Not only were these children deprived of language but also many other forms of experience. A noted and tragic case is that of "Genie" who from 20 months until age 13 spent her time alone strapped to a potty chair or to her bed in a small bedroom and was beaten by her father whenever she made a noise (Hoff, 2001). Her nearly blind mother, who was also held prisoner by her mentally ill husband, escaped with her daughter and the horrific tale unfolded. Amongst the many inconceivable mental and physical disabilities facing Genie was that of having no language. She could not talk at all when discovered however four years later she had a vocabulary of a five year old and was able to combine words into complex utterance and express meanings (Hoff, 2001) however her syntactic skills were extremely deficient. Her language ability is telegraphic and somewhat like utterances of Broca's aphasia patients (Fromkin & Rodman, 1998). This also follows the development period of Wernicke's area, which ends around two years and Broca's area with its overall development occurring between 4 and 6 years. Curtiss (cited in Pines, 1997) devoted seven years researching Genie and discovered that Genie used her right hemisphere for both language and non-language functions. In fact Genie's vocabulary revealed an incredible attention to her visual surroundings and she was particularly good at tasks involving the right hemisphere. Curtiss's explanation of Genie's dependence on her right hemisphere are based on critical periods for the development of the left hemisphere (Pines, 1977). Curtiss suggests that if development fails, later learning may be limited to the right hemisphere.

The second source of evidence is from the natural variation of age in which deaf children are exposed to sign language. Newport (1990) demonstrated observable support for a critical period of language acquisition when she compared the grammatical skills of three groups of deaf subjects who had been using American Sign Language for at least 30 years and had attended the same school. A few subjects, who were native signers having been exposed from birth, made full use of the grammatical capabilities of their language whereas the group who began learning ASL from around 4 to 6 years of age performed well but not as competent as the native signers. The group that entered the school after the age of 12 were late ASL learners and this group consistently signed in certain ungrammatical ways. This also supports Bakers "rough guide" for 2<sup>nd</sup> language learners where he suggests that there seems little problem for children up to the age of seven to quickly adapt to a new language environment at school. From 7 years to around 11 or 12 years of age "children need support within and outside the classroom to be able to acquire sufficient competence to be able to cope in the classroom". In secondary education, after the ages of 12 and 13, it becomes difficult for a child to face a completely new and different language pat-

tern" (Baker, 2000:112).

A third source of evidence looks at the effects of age on second language learning. In Johnson and Newport's 1989 study, 46 Chinese and Korean natives living in America and who had learned English for at least five years as a second language on arrival, were presented with a number of grammatical tasks. The results showed that those who were between three and seven years of age on arrival did equally as well as the control group of native English speakers. Those between eight and fifteen did less well however the younger they were when they arrived the closer they came to approximating native speakers. Those who were seventeen or older on arrival performed least well and there was no difference between a 17 year old and a thirty year old. Hoff (2001) reports that Oyama's 1976 study on the age-of-arrival effects on 60 Italian immigrants and their degree of foreign accent revealed that young arrivals had a lesser accent than older ones. Oyama also noted that young arrivals were more inept at being able to repeat English sentences played to them under noisy conditions. Kim, Relkin, Lee, & Hirsch's 1997 study on "how multiple languages are represented in the human brain" revealed that, within Broca's area, second languages acquired outside childhood "are spatially separated from native languages" (p. 171) as opposed to languages acquired during early childhood significantly overlap each other. (see fig. 3) Moreover their study revealed that within Wernicke's area there is little or no separation regardless of the age of second language acquisition. Kim et. al. (p. 173) suggest that on the basis of their findings, "the distinction between native and second languages may be less for younger ages of exposure to a second language".

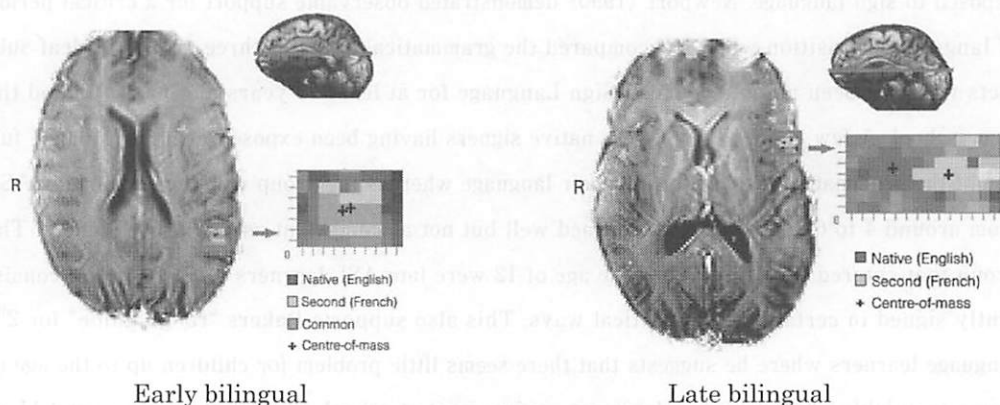


Fig. 3. From Kim, Relkin, Lee, & Hirsch, (1997) Distinct cortical areas associated with native and second languages. *Nature*, 388: 171-174.

The early bilingual subject acquired Turkish and English simultaneously during early childhood. The image, "obtained through functional magnetic resonance imaging (fMRI) to determine the spatial relationship between native and second languages in the human cortex" reveals that regardless of what language is used elevated activity occurs within the same part of Broca's area. The late bilingual subject revealed "distinct but adjacent centers of activation" during the use of their native English language or French second language.

Given that language is innate or at least innately discoverable any language continuously exposed to from birth is acquired naturally. If the sensitive period of language acquisition is within the first 4 to 6 years then it should hold that adequate exposure to a second language during this time will be more beneficial simply due to the brain's own development phase and plasticity. This is particularly important in terms of achieving native competence in grammar and word order. For monolingual parents living within their own monolingual society it is possible to raise a child bilingually however, much will depend on the availability of resources and support and their own commitment.

#### **4. Conclusion**

Research supports the notion that a sensitive period for second language acquisition does exist and correlates with the development of the brain's language centers. This is most evident in the development of Broca's area which affects syntax. Grammatical structures and word order do appear difficult for adult learners of a second language as shown by research into the effect of age and language exposure on immigrants. This is supported by studies into American Sign Language acquisition, studies of children such as Genie and work with those suffering from Broca's aphasia. Such studies highlight the importance of experience during the sensitive period of language development and the critical periods of the brain's development. Brain imaging techniques show that languages learned outside of childhood are treated differently from that of our first language or languages.

The critical-period hypothesis does not suggest a specific cut off point to second language acquisition but does reveal that age related factors may impair our ability in acquiring a second language. A young child's continuous exposure to a second language during the development of Broca's area will result in bilingual or native-like competence which, while still possible, is unlikely for a great many adult second language learners. Vocabulary itself does not pose a problem for most adult language learners and this is likely due to the positioning of Wernicke's area near three important senses: hearing, vision and touch.

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第2言語の獲得における敏感期  
— 英語を学ぶ日本人の幼稚園児に対する影響について —

シンクル ピーター M.

要 旨

日本では、多くの親が、幼いうちに子供を第二言語に触れさせることのメリットに気付くようになり、第二言語の学校に通う乳幼児が増加している。母語の習得には敏感期があり、この期間が6歳くらいで終わると仮定すると、できるだけ早い時期に、最適なのは4歳前から第二言語に触れることが子供の利益になることは明らかである。幼い子供を第二言語に触れさせて第二言語を教えることにより、母語の習得原理を第二言語の学習経験に応用できる。第二言語への十分な接触が楽しく現実的で励みになるようにすると、単一言語を用いる家庭および社会の中でバイリンガル教育を促進する環境を作り出すことができる。本論文では、母語習得の敏感期に関する最近の研究について、特に統語処理に指定されている脳の領域と、第二言語学習における年齢の影響について検討する。脳の言語発達の敏感期を利用することは若い第二言語学習者にとって有益であり、日本で早期の継続的な第二言語発達を奨励して、より多くの資源を利用できるようにする必要があるという見解を支持している。

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