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*Research Article*

# Study on the Application of Infants' Brain Neural Mechanism of Native Language Learning in English Teaching

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## Abstract

Recent studies on neurolinguistics have demonstrated that the process of native language learning of infants involves the perception and interaction of the language learning environment with the brain's innate neurocognitive mechanism. Compared with a foreign or a second language learning in adulthood, native language learning of infants sees advantages and more active expression of brain nerves in terms of perceiving linguistic features, brain learning plasticity, and brain computational characterization. This paper, based on a detailed analysis of the studies on brain neurocognition related mechanisms in the infants' native language learning both at home and abroad, compared in depth the specific differences in the foreign language learning in adulthood between the native language learning in infancy, and proposed learning methods and applied teaching environment in line with the foreign language learning cognitive and perceptual rules and the brain neural mechanism of infants' native language learning, so as to provide scientific and reasonable theoretical support for solutions to the difficulties and challenges in the foreign language teaching, especially English teaching.

## Keywords

Language Learning • Brain Neural Mechanism • English Teaching • Native Language Learning

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The language learning and dissemination is a prerequisite and an important basis for the development of human society. In the process of language learning, all people can learn and master their native language easily in their infancy and childhood. However, in their adolescence or adulthood with a better physical basis and cognitive ability, they always feel extremely hard to learn a foreign or a second language. The reasons for this phenomenon are worth our attention and researches.

From translational learning to direct learning and from listening and speaking learning to communicative learning, theories and methods of English education have emerged in recent years. Although these methods can help English learning and teaching in certain aspects, they cannot comprehensively improve the quality of English education because of limitations of each method, and ultimately face the fate of being eliminated (Yan, 2013). Therefore, only with a relatively clear understanding and study of the essential process and internal mechanism of language learning, especially foreign language learning, can we find the methods and theories that truly solve the problem of language learning.

At present, domestic and foreign studies on language learning mainly focus on the description and interpretation of language learning models and language learning processes, but few progress or a clear understanding and conclusion has been made on the nature of language learning, such as whether the human is born with language learning ability, whether the ability to learn language during infants and young children reflects the innate developmental function of the brain, and the application of the brain cognitive neural mechanism in foreign language education and teaching (Dehaenelambertz, Hertzpannier & Dubois, 2006). Starting from the cognitive mechanism and law of the brain in the language learning, the study on the nature of language learning, especially the infants' cognitive mechanism in the native language learning, should become the main focus of foreign language learning and education, and plays an important role and dominant position in the future English teaching or foreign language teaching. Only in-depth understanding of the brain neurocognitive mechanism in the language learning can truly overcome the difficulties and challenges in the target language learning and education, and then provides scientific and reasonable guidance for language education and teaching.

With the rapid development of computer technology, bioengineering science, and brain imaging technology, as well as corresponding inter-disciplines, many domestic and foreign scholars have conducted in-depth studies on neurolinguistics and brain neurocognitive science, and re-explored and explained the interactive effects and process of brain development, learning cognition, and language learning (Gazzaniga & Bizzi, 2000). Many academic researches on the brain science mechanism in the native language learning have sprung up continuously. They have elaborated in depth the language feature perception ability, brain plasticity, and brain computational neurological characterization involved in infants' native language learning, providing new theoretical guidance and a scientific and effective learning method for English education and teaching dilemma.

### **Brain Neurocognitive Mechanism in Infants' native language Learning**

In recent years, people have made breakthroughs in the understanding of linguistic structure models and language learning process with the study on the cognitive mechanisms in infants' native language learning based

on the neurolinguistics. Infants, with the inborn ability of linguistic feature perception and high-speed computation of language's neuro-expression, can naturally and automatically process the perceived language materials and speech materials, and quickly learn and master the morphemes, language vocabularies, and internal laws of the distribution of words and sentences by exploring the pronunciation and acoustic and perceptual features of the language (Dehaenelambertz, Hertzpannier & Dubois, 2006; Kuhl, 2010). The principle of the brain neurocognitive mechanism in infants' native language learning is shown in Figure 1.

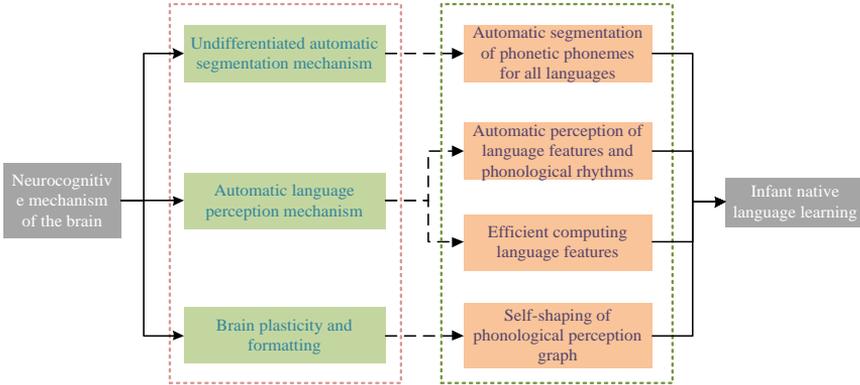


Figure 1. The Brain Neurocognitive Mechanism in Infants' Native Language Learning.

**Infants' brain neural mechanisms can inherently distinguish the human language and voice indiscriminately.**

According to Kuhl's researches (Kuhl, 1998), during the first 6 months after an infant is born, the brain, without a systematic language preference mechanism, can openly and indiscriminately receive all human languages and automatically distinguish voices and morphemes of all languages. This ability is inherent and has nothing to do with the environmental stimuli. However, as infants grow, they will gradually lose the ability to distinguish other languages in the native language environment, but show a tendency to be increasingly sensitive to the native language instead. This is the magnetism effect of the native language, and will become more prominent when the infant grows up to 1 year old. Kuhl has proposed and verified that the brain neuro system of infants will gradually show a native language tendency in the speech recognition after 6 months old. In this mechanism, infants will undergo constant changes in the indiscriminate language phonemes distinguishing ability under the stimulus from the language environment, and gradually develop a phonological perception map with the native language preference in the brain.

A further study has found that the phonological perception developed in early infancy can have a decisive influence on the subsequent learning and mastery of other languages. Kuhl and Conboy *et al.*, (Kuhl, 2005), conducted an experimental test on the level of phonological perception of infants aged less than 6 months, and achieved a reasonable prediction of the infants' ability to understand language, master syntactic vocabulary, and comprehensively use the language within 3 years. Ramírez-Esparza and Kuhl *et al.*, (Ramírez-Esparza,

García-Sierra & Kuhl, 2016). conducted follow-up experiments on the infants and found that, statistically speaking, the learning processes of language vocabulary, grammar, and syntactic complexity of 3-year-old infants are clearly correlated to their language and speech distinguishing and cognitive ability when they were aged 6 months old.

### **Automatic perception and cognitive strategies in infants' native language learning**

In the native language learning process, infants have a cognitive neural mechanism for automatic language perception. In the womb of the mother, an infant has begun to perceive the language and speech in the surrounding environment and implant this perception into the brain's cognition (DeCasper & Spence, 1986). It is difficult to imagine that infants can correctly distinguish the smallest phonetic units of speech without knowing anything about speech, vocabulary and syntax, and successfully distinguish and understand more abstract vocabulary and syntax. A series of speech-cognitive experiments have showed that when repeated speech occurs in language materials, newborns can successfully perceive the change of vowels and make corresponding physiological and neurobehavioral responses (Kuhl, 2000). They not only have the ability to automatically perceive language features in terms of speech, but also have sufficient sensitivity to the perception of language rhythm. Compared with the rhythms of native language and strangers, infants prefer their native language and mother's voice.

Infants also have efficient language feature computing capabilities and analysis mechanisms, and can quickly calculate combined and statistical characteristics of native language element categories from external language stimuli. Newborns can abstract and combine the phoneme units and basic components of the language based on signals from external language environments, summarize the objective laws and internal relations of the native language from these specific combinations and collocations, and then abstract the higher-level lexical units and syntax from the basic morphemes, vocabulary and grammar, so as to master the native language quickly. As shown in the experiments in Reference (Kuhl *et al.*, 1997), 6-month-old Dutch infants are able to distinguish sensitively the syllable combinations "zw" and "vl" frequently found in Dutch, while American newborns of the same age are insensitive to them that rarely appear in English.

### **Infants have strong brain plasticity and language "formatting" mechanism**

Babies have a powerful brain plasticity and language "formatting" mechanism that can gradually develop and train the native language in the process of native language learning, and continue to promote the learning and strengthening of the native language. Infants' cognition of language is not the mechanical conditional learning in Mr. Skinner's doctrine, but refers to the constant language development and strengthening in the brain with the stimulation of speeches. In the process of language learning and establishment, the brain does not simply activate the innate native language perception mechanism, but begins a process of constantly developing and "formatting" native language itself (Zhang & Wang, 2007). During the infancy, the brain is able to continuously perform the nerve cell links and the proliferation and metabolism of neural memory, and the metabolic rate at this stage is exponentially increasing. Newborns already have a unified material and

physiological basis for learning human languages, which is the innate linguistic neural mechanism of the brain. However, in the acquired learning, the continuous stimulation of the native language environment enables the infant to continuously strengthen and consolidate the native language area in the brain, while the recognition and learning ability of the foreign language is continuously weakened and degraded due to the long-term gap and lack of the language environment. The continuous strengthening and shaping of the brain by the social and the native language environment have intensified the establishment and evolution of the infant's native language phonological perception map (Kuhl, 2010).

## **Differences between Infants' Native Language Learning and Adults' Foreign Language Learning**

An infant's brain is highly malleable and enjoys advantages over adults in terms of language learning process and environment.

### **Differences in brain neural mechanism**

In the brain, links and neural circuits between infant brain neurons are constantly being metabolized and adjusted. If the brain is compared to a computer, the process from birth to mastering the native language is equivalent to formatting the brain and reloading the native language system. In the adult brain, the neural cell link is relatively stable, and the native-language-formatted brain loses much flexibility in expansion and correction when learning and processing new languages, especially for two language materials incompatibles in the speech, vocabulary, and grammar (Zhang & Wang, 2007). It is difficult for people to use the second language naturally without thinking, because this unconscious use of language behavior can only happen if a stable and reliable neural link is established in the brain. That is to say, only after the internal neural circuit of the brain is trained, shaped and solidified by the language environment, can we freely understand and use the free combination and fixed expression of speech phonemes, various lexical and syntactic structures in the language. The laws of native language that the infant learns in the early stage have been solidified into the brain's neurons and neural links, and a firm linguistic functional area and a native language phonological perception map have then been established in the brain and will be continuously strengthened when the infant grows up. Therefore, it is difficult to break this inherent mechanism in the adulthood to build new grammar rules and language system. Based on this, we can easily explain why even professionals who have obtained advanced certificates and are proficient in English are not able to use English instinctively without thinking.

### **Differences in language learning process and learning environment**

The process of language learning essentially involves the perception and interaction between the language learning environment and the brain's innate neurocognitive mechanism. An in-depth comparison of the differences in the infants' native language learning and the adults' foreign language learning can help us learn

more objectively and rationally the foreign language learning and education. Usually we always think that infants can learn and master their native language easily without spending too much effort. However, although infants seem naturally relaxed in their native language learning, this process is far from being as simple as we thought. Stadler et al (Stadler & Frensch, 1998). found that infants need to continuously receive two to three years of continuous stimulation of the native language environment after birth in order to be able to basically build and form a relatively fixed native language speech recognition perception map and speech vocal nerve link in the brain. It's not a quick and easy process for infants to learn the pronunciation of the native language, but a gradual process. In this process, the infant's brain cognitive neural network has received a lot of unconscious deep-level learning and training.

The infant's language learning is a process of self-discovery and self-exploration of language rules. As there is no specific syllabus to follow in the process of native language learning, infants are required to continuously explore, discover, and explore abstract semantic collocation and language combination features under the stimulation of realistic language environment. For adults in the foreign language learning, they seem to follow a scientific and rigorous syllabus system and norms, but such systems and norms are not necessarily objectively consistent with human brain learning mechanisms and natural laws because of the lack of language learning self-discovery and exploration in this process. This passive intensive training cannot make the language an inherently flexible communication tool. By comparison, it can be seen that there is a great difference between the learning of the native language by infants and learning of foreign languages by adults in terms of learning motivation and feedback mechanisms. It is a life-essential living requirement for infants to learn the native language, while the foreign language learning by adults is a subjective learning process guided by systematic norms. They have huge differences in several aspects, such as learning willingness, education and teaching norms, the quality of language materials, and the practical mastery of language.

## **Inspiration and Application of Infants' Native Language Learning Mechanism to and in English Teaching**

Compared with English learning, infants have unparalleled advantages in learning their native language concerning the neurocognitive mechanism of the brain and the external language environment. Through in-depth analysis of the brain's neural mechanism in infants' native language learning, this paper proposed the applied teaching environments and learning methods that meet the cognitive and perceptual rules of foreign language learning.

### **Early correct guidance of English education**

Through the analysis of the infant's native language learning mechanism, it can be seen that the voice perception formed in the infant's early stage can have a decisive influence on the subsequent learning and mastering of other languages. Therefore, in the actual foreign language education, children's English learning should be correctly guided as early as possible. The key-period theory holds that people cannot truly learn and

master a foreign language after they have missed the golden age of learning. This argument is obviously one-sided and unscientific. However, for young children or adolescents, the brain has not yet fully matured. At this time, if we can adhere to scientific learning and continue to accept external language stimuli, it will still shape and change the brain's phonetic perception map and the construction of language functional areas so as to establish and modify new language learning neural links to learn new languages other than the native language more quickly and efficiently. However, it needs to be emphasized that wrong and blind English teaching in an early stage will lead to inverse effects. For example, a teacher without solid basic skills or accurate phonetic pronunciation may misguide children in English learning.

### **Scientific analysis and guidance of English learning**

Based on the above research and analysis of the cognitive mechanism in the infants' language learning, the research results of the brain neural mechanism in native language learning can be made full use to solve the difficulties in English teaching by creating a learning process and environment similar to that of native language learning. The research results have scientifically explained the reasons for the effect of language-level differences such as phonetics and grammar on the critical period of language learning, profoundly revealed that the critical period of language learning cannot determine the success or failure of language learning, and reasonably answered the oral English teaching by a foreign teacher with native pronunciation cannot effectively improve most students' English listening and speaking. In the actual teaching stage, these research results can be scientifically applied to develop the speech recognition and speech synthesis technology for students at all ages with different accents, and to design English teaching software that meets the neurocognitive mechanism of the brain to support the spoken language teaching. Scientific use of the neurocognitive mechanisms can help us to analyze the difficulties and challenges of English education in depth, and help students effectively construct an effective foreign language learning speech system in native-speaking speech perception maps.

### **Create a phonetic learning environment that meets the cognitive laws of the brain**

Creating a phonetic learning environment that meets the cognitive laws of the brain can give learners the motivation and vitality of self-discovery in the passive learning environment. The superiority of infants in learning the native language lies in their ability to receive continuous and authentic native language environmental stimuli, in which they continue to develop, shape, and strengthen the brain's native language perception map and functional areas. Chinese students who learn English can master the basic vocabulary and grammar for English daily communication at the secondary school. Therefore, the focus of English teaching in the university stage should shifted to the application of language, with the philosophy of applying English to practice followed. The teaching of college English cannot be limited to English classroom in this case, but a better environment for English practice and use should be created. From the beginning of enrollment, colleges and universities should use basic English teaching materials, teach in English for general courses and basic courses as much as possible, and encourage students to complete class notes, after-school assignments, laboratory analysis reports in English and read English literature. The English community, dining service, and

campus shopping community should hire international students to create a fully English communication environment in study and life scenarios. Also, universities and colleges should utilize rich online resources to enable campus services, campus BBS forums, and in-campus communication tools with full-English exchanges and dialogues to increase the opportunities for oral English exchanges and occasions.

## Conclusion

At present, many scholars are still tirelessly exploring the neurolinguistic principles in foreign language learning. The research the brain neurocognitive mechanism in the language learning process from the perspective of natural sciences can provide theoretical support for the reasonable assessment of language learning obstacles and difficulties and scientific guidance for foreign language learning. Also, the discussion and exploration of English teaching methods in this paper can be extended to other foreign language education. The study on the brain neurocognitive mechanism during the infant's native language learning and even the deep analysis of the neural mechanism of language learning can help to propose learning methods and applied teaching environment that meet the cognitive and perceptual rules of language learning, so as to bring about revolutionary breakthroughs or innovations in language teaching, especially English teaching.

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