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REVIEW ARTICLE

A REVIEW ON BRAIN PLASTICITY AND FOREIGN LANGUAGE LEARNING

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ABSTRACT

Neuroscientists in recent years are describing a lot of the complex structure of the brain and also the mechanisms of learning and memory in the brain by using the recently developed technology. Therefore, the researcher attempts to make a leap into an approach for a better foreign language learning by investigating the concept of brain plasticity first and followed by considering the relationship between language acquisition and learning period as well as foreign language proficiency in this paper. Also, the researcher would like to contemplate about how to engrave plasticity on the academic world and how to make best use of it.

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INTRODUCTION

For many years, researchers tended to focus on visible and measurable behavioral evidences resulting from cognitive activities rather than the cognitive activities in human brain itself. Recently, cognitive science researches composing of neurology and cognitive psychology are approaching systematic and deep understanding of structure and function of brain itself. The brain function as a mechanism of learning and memory is indeed an important and interesting subject to educators. Given the potential of cognitive science on education and considering how rapidly such potentials can be realized just like researches on computer science, it is time to change the point of view that 'cognitive science research' is meaningless in educational perspective.

Brain Plasticity

Brain Plasticity of The Concept

Most neurologists would say that the biggest accomplishments in the field of neurology over the last two decades is 'plasticity'. One may find the term 'plasticity' as unfamiliar but it can be understood as 'possibility for change' or flexibility. The traditional brain theory was some sort of 'Law of constant brain'.

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In short, "Brain is composed of collections of specialized processing modules where each module is developed and improved through millions of years of evolution and became genetically wired to perform only certain functions." This is so-called 'localization' theory in neurology. The neuroplasticity took the leading position in the brain science research in 21st century. Norman Doidge introduces numerous pioneer scientists who accomplished the revolution of plasticity. These scientists proved that human brain can possibly change almost limitlessly using diverse animal testing. According to Doidge, animals which received mental training or lived in enriched environment showed 5% increase of weight in cerebral cortex and the brain region directly stimulated by the training shows up to 9% of increase of weight. Moreover, trained or stimulated neurons put out 25% more branches resulting in increase of neuron size, number of connection per neuron, and blood supply. The development of neurons in aged animals is not as fast as in young animals. However, similar changes can be observed in aged animals as well. Likewise, humans can acquire brain changes through practice, stimulation, and training. "Brain Plasticity" refers to the ability of neurons to make new connection themselves, make new path in cerebral cortex, and even carry out new roles. "Neuroplasticity" means "rewiring" of brain in short. If brain can be rewired, then humans can face numerous challenges. In other words, how much effort one makes may possibly change one's life. The brain plasticity is one of the biggest gift of hope provided to mankind by the science.

Neurons that Fire Together, Wire Together

The socialization between neurons can be described by "Neurons that fire together wire together" in neurology. These tendencies of neurons serve as the physiological grounds for neuroplasticity. A Canadian psychologists named Donald Hebb predicted the brain plasticity far before the contemporary neurologists proved it. He found that mouse raised at home as a pet showed higher learning ability compared to mouse raised in the lab. Based on these facts, Hebb proposed a hypothesis that learning takes place when neurons are connected and strengthened in the new manner. Two neurons fire simultaneously through learning and repeated to create chemical change in both neuron strengthening their connection. The occurrence of such event for the first time increases the probability of occurrence in the future. This is where the famous phrase "Neurons that fire together wire together" came from.

On the other hand, the inverse of the "Neurons that fire together wire together" principle holds as well. In short, "Neurons that fire apart wire apart" or "Neurons that don't sync don't link". The inverse principle provides neurological explanation for the learning disability and forgetfulness. The newly learned information is saved in the connection patterns between neurons rather than neurons themselves. What we call knowledge, memory, and learning are all directly connected to connections between neurons. As people study and memorize, these connections strengthen. On the other hand, these connections get removed when learning and memorization stops. Once again, "Use it or lose it" is the harsh reality in the brain. One of the most popular research topics in the neurology today is a kind of protein called brain-derived neurotrophic factor (hereafter BDNF). It helps establishment of basis for cellular circuit as well as growth and upkeep. BDNF is directly connected to "long term potentiation". The experiment showed that BDNF level increased when long term potentiation is triggered due to learning. The possibility for long term potentiation is eliminated when the protein is removed from the brain. This experiment confirmed that chemical substances supporting learning are produced to maintain strong neuron connection when people study certain things intensively.

According to Doidge, humans can maintain the brain change of the young age to the old age if given with compensation that is large enough to continue pay attention. Learning new knowledge keeps plasticity and dopamine controlling system from declining. The brain of Einstein was stored by an American pathology. Diamond et al. acquired small piece of Einstein's brain to analyze the composition and weight, and compared with brains of 11 normal people. The results showed that Einstein's brain showed 73% more glia cells in the inferior parietal lobe in cerebral cortex. The number of neurons in the brain increases from the early pregnancy but stops after two or three month of pregnancy and remain constant for all life. On the other hand, the number of glia cells has to increase continuously even after birth and the degree of increase depends on the environmental effect. The high ratio of glia cells in certain region of Einstein's brain implies that Einstein conducted thinking ability that involves the area of the brain countless times resulting in continuous development of glia cells. The observation that inferior parietal lobe in Einstein's brain is particularly developed received interests. The parietal lobe synthesize all stimulations coming from different sensory organs and perceive the exterior subject by obtaining relevant information from other regions of the brain. Also, this region is known to be related with forming image. According to the results of Diamond et al., Einstein's brain is thought to have extraordinary ability to come up with image when perceiving external stimulations. In fact, Einstein recalled that written and spoken words did not seem to play any role in his mechanism of thoughts. He felt that "combinatory play of certain signs and more or less clear images" seemed to be essential features in productive thoughts.

Brain Plasticity and Foreign Language Learning

Brain Plasticity and Foreign Language Learning Period

Language Acquisition: People seem to go through the following stages of language learning : (1) Echoing voice composed of all possible tone, (2) Babbling composed of phonemes characterizing the mother language, (3) One syllable word, (4) Two syllables word and telegraphic speech, (5) Basic structure of sentence demonstrated in adults (around age of 4). Perceptual changes of decrease in number of distinguishable phoneme and becoming more sensitive to mother language environment.

Children demonstrates overextension error while learning language. This refers to the error that children extend and apply the definition of certain word to a wider scope. Human's language learning cannot be fully explained by apriority nor acquisition. Hypothesis testing mechanism suggests integration of apriority and acquisition. Children learn language in a way that they first establish tentative hypothesis on language by their nature and test the hypothesis in actual environment (through upbringing process). Innate language acquisition device (LAD), which promotes language learning, guide children to establish such hypothesis.

Infant's ability to listen to all possible sounds when listening to people talking serves as the basis for learning any language. That is, new born infants are linguistically 'all round'. Prior to learning first words, the infant's ability to distinguish phone of languages other than mother language decrease rapidly. At age of 12 month, infants fail to distinguish phonetic changes that they easily distinguished at age of 6 months. At the same time, infants get adopted to distinguish sounds in their mother language. For instance, test of English pronunciation /r/ and /l/ on American infant and Japanese infant at age of 6 month and 12 month shows surprising improvement of distinguishing /r/ and /l/ pronunciation in American infant in 8 month and 10 month whereas the ability decreased in Japanese infant. In other words, this is the period sensitive to vocal learning.

A test was conducted on American and Swedish infants who are 6 months old. The test aimed to identify whether the infants can distinguish auditory changes of typical English and Swedish vowels spoken by multiple people. These infants ignored the auditory changes that are close to their mother language. However, such 'categorical recognition' did not appear for language other than mother language. This results explains why an 11 month old Japanese infants can hardly distinguish English vowels /r/ and /l/ after experiencing Japanese. The results of brain image tests and behavioral tests on infants showed that such changes occur between 7 months and 11 months.

Inborn or acquired: An eminent linguist, Noam Chomsky (1965, 1972), asserted that humans have inborn language acquisition device (LAD) which promotes language acquisition. That is, we, humans, are biologically ready to learn language. The linguistic stimulations experienced by children (spoken language or finger language) are relatively limited in terms of quantity and diversity. However, the internalized language structure produced by the children are highly delicate and complicated which makes this ability very phenomenal. Children understand the numerous rules of the language structure implicitly, and appear to know the trick to apply the rule into new vocabularies and contexts. However, adults may learn new language if they are put into intensive foreign language learning programs. Adult's language acquisition can be successful. However, it is still possible that an accent reflecting the phonemes of the mother language. For instance, a Spanish speaker learning English will demonstrate Spanish accent while speaking English. Likewise, an American speaking Spanish shall demonstrate American English accent while speaking Spanish.

Research Objective

- Does the brain region working for understanding spoken language in adults appear to be same for 2 months old infants?
- fMRI results:
- Observation on temporal lobe of left brain of 2 months old infants.

Conclusion

The ability to use language seems to be inborn ability.

Meta-cognition, which refers to the ability of understanding and controlling cognitive functions of oneself, provides the most outstanding assistant tool for language learning. The advantage of learning language for adults is that they are more familiar with language structures. However, how much meta cognition contribute to learning new language depends on how closely related the newly language is with acquired language. For instance, most of English speakers learn Spanish easier than Russian because the structure of Spanish is similar to English compared to Russian. In general, Chinese are difficult to learn because the difference between Chinese structure and English structure is even bigger than that of Russian. Recently accumulating results suggest that brain can change its functional structure by itself when it is subject to effects due to modified environment. In other words, the environment and experience after birth affects the weight, size, and biochemical characteristics. These cognitive scientists explains that the brain damage in the early life shows certain degree of recovery. In early 1970s, Peter Eimas showed that infants have exceptional ability to catching the auditory changes and distinguishing phonetic units of all languages in the world. He showed that infants can easily catch the small changes when the kind of phone change. The infants well distinguished phonetic units of languages that they never experienced. This phenomenon is called categorical perception. Adults possess categorical perception ability for phonetic units of languages that they can speak fluently. For instance, Japanese find it very difficult to differentiate /r/ and /l/ sounds in American English. As we know, the both sounds are recognized as /r/ in Japanese and Japanese speakers often get confused with uses of the two sounds. In 1957, behavioral psychologists B. F. Skinner suggested that language is acquired through learning. In his book titled 「Verbal Behavior」, he claims that language is a behavior learned in the childhood under external reinforcing and parental care just like other animal behaviors. Noam Chomsky who wrote criticism on 「Verbal Behavior」, take opposite view on this. Chomsky claimed that traditional reinforcement learning theory is irrelevant to the human language learning. Instead, all people are inborn with 'language ability' including universal grammar and phonetics, and the 'selection' process begins when humans are exposed to certain languages. Other recent studies on language acquisition of infants and children provides evidence to the idea that language acquisition of infants are different from the ones through external reinforcement and monitoring suggested by Skinner. However, the idea claimed by Chomsky and other nativist that one process is selected from all inborn characteristics when infants experience certain language cannot provide full explanation for the characteristics of infant language acquisition.

Does language acquisition have critical period?

Eric Lenneburg claimed that maturation factor causes changes in the neuro-mechanism that controls language acquisition during the adolescence. The researcher could find evidence supporting the claim from the Chinese and Korean immigrants in US who emigrated between age of 3 and 39. The immigrants were given tasks to find grammatical errors in the sentences which are easily done by the native English speakers. The results indicated that those who emigrated to US later showed lower scores. Similar tendencies can be found from people who learned American Sign Language since birth and those who learned the sign language between age of 5 and 12. Then what factor restricts people from learning new language after adolescence? Development studies suggest previously acquired language as the factor. As a result of learning mother language, a neural commitment to understand the auditory pattern of the language occurs which degrade the ability to learn other languages in later part of life. The deterrent effect is negligible until the neural network is completely established which is why people can easily learn two or more languages when they are young. The maturity enabling learning and the neural commitment rising from learning both restrict the new language acquired at latter part of life. Humans have not completely lost the ability to learn new language in the later part of life. No matter when, the second language learning is improved by the education that imitate the critical factors of the early language learning: long term auditory training under social environment (preoccupation), using both visual and auditory information, exposure to words similar to simplified and exaggerated motherese. Hubel and Weisel (1962, 1965, 1970, and 1977) are the scholars representing studies on critical period of brain developments. They studied the effect of early environment deficiencies on development of cerebral cortex which process the visual information of young cats. The researchers chose 21 young cats in different ages and close one or both of their eyes with blindfold and let them live accordingly.

The results of examination on number of cells in the same region of visual cortex are as follow:

The number of cells in visual cortex decreased for cats which lived blindfolded. Especially, the 4 weeks old to 5 weeks old cats were affected the most. Simply living blindfolded for short

period of time, 3 to 4 days, resulted in significant decrease of cells in the visual cortex. The visual cortex of cats whose one eye was blindfolded for 3 months demonstrated very limited recovery during the years of growing process. The recovery refers to phenomenon that surrounding cell takes charge of the damaged function or connection with other cells increase. The results of this study proved that damage in visual function in the early part of life showed far less recovery compared to damages received afterwards. An implication from the study of Hubel and Weisel is that brain plasticity can take place not only when brain experiences enriched environment but also when brain experiences deficient environment. It implies that the degree of recovery from recovering experience is insignificant compared to the degree of damage, once the brain tissue and its function are degenerated. Although brain plasticity is a lifelong characteristics, it is hard to neglect the claims of numerous cognitive scientists that environmental factors at youth plays especially important role in brain development. Therefore, educators must provide children, especially the lower graders, with careful consideration, temporal and physical investments to avoid deficiencies in necessary environmental experience.

Most of the researches on deficient environments so far were postmortem studies on people who experienced deficient environment without any choice. However, these studies have limitations such that it is hard to determine the critical period influenced by the deficiencies for detailed thinking abilities based on studied cases. Secondly, even if critical period for human brain can be found, it is hard for school to provide any support if the critical period is found to be prior to the school age. Therefore, it is important to have parents notified of the effect of environment during the critical period rather than educators in school. An important implication for educators is that plasticity characteristics demonstrated in human's brain development continues after the critical period with significantly reduced effect. In this perspective, the school environment is considered to have continuous effect on home environment which is why it should be considered as subject of interest and improvement continuously. Despite being hypothetical, it is very likely that early school environment may ply important role in the formation and development of children's thinking function. If this is true, then richness or deficiency of early school education environment may play important role in the children's learning or realization of thinking function later.

Conclusions

The ability to manage language is similar for bilinguals who learned foreign language at early age and late language but there exists slight difference. As aforementioned, the difference in brain appears to be determined by "difference in proficiency in foreign language" rather than "difference in acquisition period". Therefore, adults can learn foreign language well as well. Diverse teaching methods must be utilized depending on the linguistic section, contents, and purpose. Also, the researcher believes that the connections between brain science, cognitive science, and psychology play important role in foreign language learning and combination of theoretical aspects and experimental aspects will create significant synergy effect. Considering the neurological perspective, educational perspective (educational environment or teaching methods), and other conditions like individual efforts, the idea that foreign language learning is a result of linguistic knowledge but the researcher believes that it is more of integrated perspective. Often, electrocorticography and fMRI are used to explain the changes in brain structure. In order for this researches to be continued, role of collaborators are very important as well since use of fMRI involves collaboration with hospitals and high costs. The researcher expects further studies to be conducted in these regards.

REFERENCES

Kang, S. & Nam, K. and Lee, J. 2008. Donga Science, 274, 62-77

Kim, S. 2004. How does brain remember. Paju: Haenamu, Mind determined by Brain, Brain determined by Mind

Lee, K. 2000. Cognitive Linguistics, Hankookmunhwasa

Nam, K. 2009. Foreign Language Learning and Change of Brain, Cognitive Neuroscience Research Laboratory, Korea University

Seok, Y. 2011. Novelist who stole brain, Wisdom House

Son, S. & Ahn, K. 1997. A Study on Brain Functino Improvement for Creativity Improvement, Journal of Seoul Women's University, 5, 301-315

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