



## NEUROLINGUISTIC APPROACH: A PLAUSIBLE PARADIGM IN SLA

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### ABSTRACT

Second language acquisition (SLA) can contribute to the changes in the brain. The paper having a holistic perspective towards the relation between brain and language asserts that the impact of SLA on the brain change is poorly studied. Moreover, claiming that the brain change is dynamic implicates the assumption that the plasticity of the brain is not merely determined by age-related factors. In this regard, experience, in general, and SLA, in particular, has a tremendous effect on the brain change. Thus, resting on the claim that SLA is respected as software and contributes to the function of brain, the paper directs the attention towards agrammatism which attracts much attention from the researchers in neurolinguistics. The article also tends to cast lights upon our perceptions towards the notion of change in the brain from the neurolinguistic perspective.

### INDEXING TERMS/ KEY WORDS

Adaptation; Agrammatism; Non-adaptationism; Paragrammatism; Plasticity.

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## INTRODUCTION

Our brains are voracious and highly sensitive analyzers of language input and output. In fact, our brain typically reacts to any departures from what it expects and what exists in the input (Ingram, 2007). Neurolinguistics, as the study of the neural mechanisms concerned with language-brain relationship (Caplan, 1987), provides a plausible justification for the voracity and sensitivity of the brain to language input. Regarding the importance of neurolinguistics, Whitaker (1971, cited in Ingram, 2007) holds that progress in language studies depends on some successful synergy between linguistics and neurology. Put differently, as an interdisciplinary theory of SLA, neurolinguistics ponders upon the relation of language and communication to different aspects of brain functions. Though there is a variety of perspectives regarding the relationship between language and the brain including localism, associationism, holism, and evolution-based theories, the paper, more or less, compatible with the holistic perspective, considers many language functions of the brain resulted from widespread areas of the brain working together. Nevertheless, the writers never deny the findings of localists, associationists, and evolution-based theorists. Accordingly, localists have attempted to find locations in the brain for different language functions. Associationists, in contrast, draw a connection between different areas of the brain, and make it possible to associate, for instance, perceptions of different senses with words and/or concepts, and, finally, evolution-based theorists who are in favor of hierarchical development of the brain stress the relationship between how the brain and language evolved over time in different species, how they develop in children, and how adults perform language functions (Ahlsen, 2006). But what makes the paper distinct in its orientation is that the brain will never evolve unless it is exposed to experience. Put differently, the paper attempts to direct its attention towards the truism that the brain, per se, as a hardware system, cannot be conducive to any change. Most of the changes that contribute to the efficiency of brain functioning are because of the employment of an appropriate software. Furthermore, finding out how the brain understands and produces language and communication will pave the way for better understanding of the brain structure.

## SLA AS SOFTWARE

That second language learning is a dynamic phenomenon is undeniable. However, according to several scholars (e.g., Johnson & Newport, 1989; Kuhl, 2004), age-related factors reduce the plasticity of the brain. In this regard, two explanations are presented. The first explanation refers to the existence of critical period that holds SLA is constrained by maturational factors. The second explanation attributes the age-related declines to the influence of increasing exposure with a first language (L1) (Kuhl, 2004). Compatible with the second view, it is plausible to mention that the early experience with certain features of L1 (e.g., phoneme) turns out to degrade the ability to learn aspects of L2 later in life (Osterhout et al., 2008). Both of these views implicate that with an increase in age, the plasticity of the brain decreases. Along the same vein, when the plasticity of the brain decreases, the inflexibility of brain to a variety of changes increases. Still, in spite of the popularity of the view that age-related factors reduce the plasticity of the brain, there is little empirical evidence to support it.

The impact of SLA on human brain organization is poorly studied. That SLA makes the brain larger is compatible with the findings of Mårtensson et al. (2012) who take into account "the cortical thickness and hippocampal volumes of conscript interpreters before and after three months of language studies" (p. 240). In fact, the study carried out by Mårtensson et al. contends that increases in right hippocampus and the left superior temporal gyrus were structurally more malleable in interpreters acquiring higher proficiency in the foreign language. In a sense, that the brain is susceptible to a flux of change is undeniable. Wilson (2013), in this regard, holds that learning a new language can enlarge one's hippocampus, the part of the brain that also helps with long term memory forming. Put differently, SLA can keep the brain in better shape which can, in turn, potentially offset memory-related diseases.

Research shows that most of the studies in the realm of neurolinguistics are limited to the localist study of brain damage. Particularly, among the central localist question that has a special place in neurolinguistics is what happens to language and communication after brain damage of different types? Aphasia or language loss due to brain damage is an acquired language disorder. As Ahlsen (2006) claims, language loss might result in infarction, hemorrhage, and even a head trauma. In fact, the study of aphasia, i.e., aphasiology, is the dominant branch of neurolinguistics.

Nevertheless, the change in brain function is not only because of the brain loss. Unlike brain loss, experience, both from pre-natal and post-natal periods, has an inevitable role on the function of the brain. In other words, experience, as software, contributes to changes in the brain.

Debate over the neuroscience ranges across a slew of issues, but there is an overwhelming consensus among scholars that "the organization of brain circuitry is constantly changing as a function of experience" (Kolb, Gibb, & Robinson, 2003, p. 1). In this regard, brain is a hard-wired system. It lacks any software. Put differently, what makes brain change and function efficiently is the existence of a variety of software. Accordingly, considering SLA as software will undeniably contribute to the function and change of the brain. Undeniably, SLA contributes to changes in brain functioning; these changes are referred to as brain plasticity. In other words, brain plasticity, or neuroplasticity, refers to the brain ability to change as a result of experience. In the same vein, Kolb et al. assert "if neural networks are changed by experience, there must be some corresponding change in the functions mediated by those networks" (p.1). Henceforth, understanding how experience influences brain function is vital not only for the better appreciation of normal and abnormal behavior, but also for prescribing treatments for the probable disorders. There is not much space in the paper to delve into such a broad issue, but what is certain is that due to relatively delayed rate of brain development, human beings are highly susceptible to the longer influence of postnatal experiences (Jenson, 1998), rather than prenatal experiences.

The susceptibility to a flow of change results from the neuroplasticity of brain. In this regard, to better appreciate the notion of experience, Cherry (n. d.) takes into account the key facts about neuroplasticity that can cast light upon our perceptions



towards neurolinguistic issues. Cherry further asserts that there are four basic issues regarding neuroplasticity that the role of experience directly or indirectly implied in them: (a) neuroplasticity can vary by age; (b) it involves a variety of ongoing processes; (c) it results from two different reasons, either as a result of experience and memory formation, or as a result of damage to the brain; and (d) environment plays a vital role in the process, but genetics can also have an influence.

## **NEUROLINGUISTICS AND UG: LANGUAGE AND BRAIN**

It is widely assumed that human language learning and the structure of human languages are intimately related. This relationship is suggested to be rooted in a language-specific biological endowment, which encodes universals, but arbitrary principles of language structure. Christiansen and Chater (2008) argue that UG could not have arisen either by biological adaptations or non-adaptationist genetic processes. To them, UG is the result of the language-as-an organism perspectives. Elsewhere, Chater and Christiansen (2009) put forth that there is no plausible argument in support of "how such an innate domain-specific system for language could have evolved" (p. 4). Thus, it can be claimed that since language is a mirror of mind (Chomsky, 1957), through the study of language faculty, one can better appreciate the brain change. Accordingly, three views are suggested regarding the origin of UG, in particular, and the change of language faculty, in general.

### **Adaptationism**

Chater and Christiansen (2009) assert that according to adaptationists (e.g., Pinker & Bloom, 1990) "UG is characterized by a set of universal grammatical principles that hold across all languages" (p. 4). Adaptationists place emphasis upon the gradual evolution of the human language faculty through natural selection. In a sense, based on the natural selection point of view, Christiansen and Chater (2008) maintain "language, like other cultural adaptations, changes far too rapidly to provide a stable target over which natural selection can operate" (p. 8). In disfavor with developmental constraints including anatomical constraints and genetic constraints that inhibit the effectiveness of natural selection, Pinker and Bloom (1990) further argue "natural selection is the only scientific explanation of adaptive complexity" (p. 709). As Pinker and Bloom go on to hold, adaptive complexity is based on the notion that any system is composed of many interacting parts where the details of the parts are conducive to the function of the whole system.

### **Non-adaptationism**

Non-adoptionists remark that "some process of chance variation leads to the creation of UG" (Chater & Christiansen, 2009, p. 4). Incompatible with the natural selection approach, several scholars (e.g., Chomsky, 1988) assign a minimum role to natural selection in the emergence of language in humans, focusing instead on a variety of alternative possible mechanisms. To them, UG appears to be unique in terms of structure and properties that it may seem unlikely to be a product of a process of natural selection amongst random mutations. The implication, as to Christiansen and Chater (2008), appears that there seems to be little or no language-specific genetic endowment that language has adapted to the brain.

### **Language-as-an organism**

As to Christiansen and Chater (2008), from the language-as-an-organism perspective, language is not supposed to be shaped by the brain; language reflects preexisting, and hence non-language specific human learning and processing mechanisms. In fact, according to Christiansen and Chater, language-as-an-organism perspective considers language as organism; such an organism is a complex system of interconnected constraints evolved through a symbiotic relationship with human beings.

Nevertheless, scientists used to think that the structure of the human brain does not change much after infancy. In contradiction with this view, several studies show that how malleable and adaptable the human brain is. Recent findings, as mentioned earlier, indicate that the functions of different regions of the brain can be shaped by experience and learning. Comparing the brain with a computer, one can claim that the brain of the young is like a computer with incredibly sophisticated hardwiring, but no software (Genesee, 2000). In a sense, the brain, like a computer, without any software does not run. Furthermore, the development of the software is individually done. Genesee goes on to hold that all individuals have to acquire or develop their own software in order to harness the processing power of the brain with which they are born. In a nutshell, the susceptibility to changes, as Jenson (1998) puts, can be described in a couple of ways: malleability and neuroplasticity. The former refers to the brain's capacity to change as a result of general long term experiences, such as stress, repeated trauma, nutrition, and even SLA. Neuroplasticity, on the other hand, refers to use-dependent cortical reorganization. This process occurs when the brain changes as a response to a specific experience, such as tying shoes and riding a bike. Metaphorically, Jenson's (1998) terminology, brain is like suburban sprawl-land once used for farming, and now it is used for housing. This view claims that the brain changes not just from experience, but that it buys, sells, and homesteads neural real estate based on what one actually does on a daily basis.

## **NEUROLINGUISTICS AND SLA**

Although to several scholars (e.g., Scovel, 1982), the direct application of neurolinguistic research to SLA is highly critical, now it is viable to assert that neurolinguistics is undeniably respected as a paradigm in SLA (Netten & Germain, 2012). Considering SLA as an experience that can change the function of the brain is not a newly heated debate. In contrast, knowing how these changes occur and what neural mechanisms are responsible for such changes is worth investigating.



Sakai (2005), on finding out an answer to whether the function of grammar center in the brain can be modified during the acquisition of new languages, holds that the cortical activation changes in the brain are due to two maturational factors: the age of acquisition and the proficiency level. The place of age in language acquisition is highly related to the hypothesis known as sensitive period. The hypothesis extended to L2 acquisition maintains that English proficiency declines after the age of 7. Though the sensitive period hypothesis has recently been challenged, the stance of age in SLA should not be ignored. In this regard, Sakai trying to clarify the contribution of age of acquisition and proficiency level came to hold that the functional changes in the left inferior frontal gyrus were susceptible to shared genetic and environmental factors. Sakai, having examined whether learning of English past-tense verbs as L2 knowledge changes the brain activation of 13-year-old participants, claims that the more improvement in the participants' knowledge of the past tense, the more activation in the left inferior frontal gyrus will be observed. Henceforth, Sakai comparing participants aged 19 with those who are 13 concluded that the activation in the left dorsal inferior frontal gyrus was lower corresponding to a higher proficiency level, suggesting that proficiency level plays a significant role in the activation of this region.

In this regard, Osterhout et al. (2008), in a study on the brain's electrophysiological response to L2 stimuli, suggest that there are separate syntactic and semantic processes in L2 learning. L2 learners segregate linguistic input into those aspects of the language that relate to sentence form and those that relate to sentence meaning. Accordingly, they claim, learners grammaticalize some aspects of L2, but not others. By grammaticalization, Osterhout et al. refer to "the instantiation of grammatical knowledge into the learner's on-line, real-time language processing system" (p. 510).

Nevertheless, no one denies that grammaticalization is accompanied with changes in the brain functioning. However, grammaticalization is not a mechanism itself, but certain tendencies that show language production is because of change in the brain. To investigate grammaticalization during SLA, Osterhout et al., focusing on the acquisition of grammatical features and their associated morphosyntactic rules, go on to investigate the factors that inhibit or facilitate grammaticalization of the grammatical features and their morphosyntactic rules. These scholars, also referring to the research carried out by Hawkins and Franceschina (2004) regarding the factors that influence grammaticalization, assert that only grammatical features that are present in the L1 can be acquired during L2 acquisition. To them, the covariation of morphology and phonology probably plays a role in L2 grammatical morpheme learning.

Providing a strong debate over the impact of SLA on the brain change, scholars show more tendency towards agrammatism that is more or less related to Broca's aphasics, rather than Wernicke's aphasics. Although the present writers are not much concerned with localist perspective that holds each part of the brain is responsible for a specific function, the distinction between agrammatism and paragrammatism that are investigated from localist perspectives appears to be worthwhile. The distinction made between agrammatism and pragmatism was earlier drawn by Kleist (1916, cited in Heeschen & Kolk, 1988). On defining these two terms, Kleist refers to "agrammatism as speech with a predominance of omissions of grammatical elements [, while paragrammatism] as speech with a predominance of substitutions" (p. 299). In brief, as Heeschen and Kolk (1988) maintain "the 'omission-patients' belonged more or less to what we nowadays call Broca's aphasics; the 'substitution-patients' would be the Wernicke's aphasics" (p. 299). Accordingly, Ahlsen (2006) puts forth that Wernicke's aphasia results from posterior lesions and is characterized by fluent speech. She goes on to mention that the grammar of these patients, paragrammatism, does not really attract much attention from researchers. The speech of these patients, according to her, is together with self interruptions, restarts, and circumlocutions. The second main syndrome, Broca's aphasia, which results from frontal lesions, is characterized by any nonfluent speech. The grammar of those patients suffering from Broca's aphasics is often characterized as agrammatic. That is, such patients tend to speak in very short, simple sentences, or even shorter structures mainly containing nouns, main verbs, and adjectives, but omitting most grammatical morphemes (such as noun and verb inflections) and so-called function words (conjunctions, articles, etc).

According to Ahlsen, three frameworks for describing agrammatism can be traced: (a) the mapping hypothesis, (b) the adaptation hypothesis, and (c) the trace deletion hypothesis. Researchers, in favor of the mapping hypothesis, hold that individuals suffering from agrammatic aphasia have difficulty in comprehending sentences in which the order of noun phrases is not aligned with the structure of the corresponding event (O'Grady & Lee, 2005). The adaptation hypothesis, in contrast, presented by Kolk (1987) focuses on agrammatism as a processing disorder rather than a central representational disorder. Kolk (2006), referring to two types of adaptation, corrective and preventive, maintains that in case of corrective adaptation, the incomplete sentence representation is repaired by a covert restart. Restart involves faster activation by profiting and restarting from the activation of the first attempt (Ahlsen, 2006). In preventive adaptation, on the contrary, there is a bias towards simplification, i.e., reduced variety, and isolated phrases (Kolk, 2006). In effect, the underlying disorder is seen as a disorder affecting the timing of activation of sentence information, either by delay or by too rapid decay of activation (Ahlsen, 2006).

Nevertheless, research shows that the patients suffering from agrammatism also benefit from their linguistic experience and background knowledge of the subject taught (Tłokiński, 2007). Regarding the importance of experience, Tłokiński asserts that in order to assess aphasia, especially grammar, patients' linguistic experience and background knowledge should be taken into account. In fact, stimulating experiences activate certain synapses in neural system, and triggers growth processes that consolidate those connections. However, the nature of the experience is different. Thompson (2001) holds that there are two forms of brain development that occur throughout life. The first is called experience-expectant that describes early experiences as a catalyst which has to be provided for the brain development. Put differently, if the catalyst is not made ready, the growth of brain goes awry. The second form of brain development is experience-dependent that denotes how individual experiences foster new brain growth and refine existing brain structures. Such experiences are individual since different people have exercised different parts of the brain throughout life. The brain of a musician is different from the brain of a poet, for instance. Henceforth, people are the essence of their



experience. And the experience can contribute to the loss of plasticity. Like employing inappropriate software in a computer that might debilitate the process of hardwired system, if one does not know how to use the related software, i.e., SLA, the brain function goes awry.

## CONCLUSION

It seems beyond doubt that the ontogenesis of the human brain and language lasts as long as the brain remains healthy. Moreover, that the age-related factors have indispensable role on the ontogenesis of the brain and language is critical. In fact, despite the popularity of the view that a reduction in neural plasticity decreases the ability to learn and retain new linguistic information, there is little distinct evidence to support it (Osterhout et al, 2008). In sum, that language experience tunes the plasticity of the brain, in general, and cortex, in particular, is undeniable. Nevertheless, incorporating the ideality into a curriculum is not an easy task, and we do not yet have any precise ideas on how to do it, but to explain its value is already a step in the right direction. In a sense, neurolinguistics, as the study of neural mechanisms, can pave the way for finding out the route of language acquisition among males and females. In other words, there is a need felt in the realm of neurolinguistics to better understand what neural mechanisms males and/or females employ in order to learn a language.

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