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Universal Grammar in Second Language Acquisition: A Neurolinguistics Investigation of Syntactic Processing in Adult Learners

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ABSTRACT

The role of Universal Grammar (UG) in Second Language Acquisition (SLA) and its connection with neurolinguistics is explored by this study. The theory states that all humans have an innate capacity for language acquisition and are born with the natural ability to acquire language. However, its role in adult second language (L2) learning remains debated. Research indicates that while children rely on UG for language learning, adults depend more on memory and cognitive strategies. Neurolinguistic studies show that native speakers primarily use the left hemisphere for language processing, whereas adult L2 learners activate the right hemisphere, indicating different learning mechanisms. The Critical Period Hypothesis suggests that UG is accessible during early childhood but diminishes with age, making SLA more challenging for adults. Ullman's Declarative-Procedural Model further explains that L1 learning is unconscious, while L2 learning is more explicit. Findings suggest that UG plays a key role in L1 acquisition but is less influential in SLA. Instead, cognitive mechanisms and explicit learning strategies become dominant.

Keywords: *Universal Grammar, Second Language Acquisition, Neurolinguistics, Critical Period Hypothesis, Cognitive Mechanisms, Declarative-Procedural Model, First Language Acquisition.*

INTRODUCTION

Universal Grammar is a theory proposed by Noam Chomsky. The theory states that all humans have innate capacity for language acquisition and are born with natural ability to acquire language. This means that every human has innate capacity to acquire any language that is spoken before him or her due to the built-in ability in the human brain to know, understand grammar, and use the grammar of any language (White, 2023). Moreover, children can learn a second language easily instead of adult learners.

In contrast, it is very difficult for many adult learners to learn the grammar of a second language, especially when the rules of the second language are not similar to the first language. Researchers found that children can learn a second language easily as compared to adult learners, because they still utilize the innate capacity or universal grammar. When it is about adult learners, they learn a second language by practice and memory (Clahsen & Felser, 2022). When we are talking about practice and memory, our brains are

more engaged in the learning process. Our different parts of the brain are more active in second language learning, and neurolinguistics clarifies it more explicitly (Balti, Alamgir, & Hussain, 2024).

Neurolinguistics is the study of the relationship between language and brain. It describes various parts of the brain that are responsible for language processing. It was found by neurologists that the parts of the brain that are engaged in first language acquisition are different from those parts of the brain that are involved in second language learning. For example, when children acquire first language, their left side of the brain is active. On the other hand, when the adult learners learn a second language, then their right side of their brain is active. Similarly, the native speakers of a language make the use of left side of the brain, and the second language learners utilize the right side of the brain.

The current study aims to find out whether adult learners make the use of the same innate capacity or the ways of their learning change when they learn a second language. The study investigates whether universal grammar is still used by adult learners or their brains utilize other neural pathways and methods for second language learning. This study explores how the first language acquisition process is different from second language learning and how neurolinguistics plays a role in distinguishing parts of the brain that are active in first language acquisition and second language learning.

Research Objectives

The study tends to:

1. Find out the role of universal grammar in first language acquisition.
2. Explore the presence or absence of universal grammar in second language learning.
3. To investigate the significance of neurolinguistics in first and second language acquisition.

Research Questions

1. What role does universal play in first language acquisition?
2. Does universal grammar play any role in second language acquisition?
3. How does neurolinguistics describe the distinction between first and second language acquisition?

LITERATURE REVIEW

The role of universal grammar has been described by various hypotheses. The Full Access Hypothesis states that L1 syntactic structures in adults are transferred in the initial stage into L2 when they start second language learning, but they use the rules of the second language. The No Access Hypothesis argues that there is no access of universal grammar to adult learners; only cognitive mechanisms help in second language learning (Sauter, 2002).

Similarly, Rossi et al. (2006) have found in their study that when people make mistakes in their first language before native speakers, their brain react to those who make mistakes; the children who learn a second language react the same, but this process is weakened in adult learners. It means UG is strong in childhood only, but reduced and vanished in maturity.

Connected to this, Weber-Fox and Neville (1996) investigated that if a second language is learned before the age of 11, then universal grammar works as it does in the acquisition of the first language. The decline of universal grammar begins after the the time appointed by critical period hypothesis. Universal grammar remains inactive when the time of critical period hypothesis is completed. Either its role is lessened or totally inactive.

Babcock et al. (2017) conducted their study on the Italian people. Besides their own language, they spoke English, in English speaking environment. The study found that due to their prolonged speaking in English

speaking environment, their brain worked differently. It was concluded that our brains are flexible and they can change with the new environment. This also suggests that universal grammar remains active in first language acquisition and limited to second language learning when it is learned after childhood.

Hawkins (2011), relates the significance of universal grammar in both L1 and L2. He argues that there is no doubt about the access of universal grammar in first language acquisition, which enables first language acquisition more rapid and easiest; however, universal grammar does not have full access to second language learning, though, there are certain universal principles that still influence interlanguage development. Similarly, Cook and Newson (1996) discovered that as compared to first language acquisition, the role of universal grammar is confined in second language acquisition; they suggest that the dependency of second language learners is mostly on explicit learning and cognitive strategies.

Ullman (2016) introduced the Decarative Model and Procedural Model. His model suggests that L1 and L2 have different memory systems. For example, first language speakers dominantly depend on the procedural memory model, while adult learners in second language learning depend on the declarative memory model. This shows that L1 has different stages than L2 learning, and their syntactic information is processed differently from L2.

This study aims to determine whether adult learners rely on the same innate capacity for language acquisition or if their learning methods change when acquiring a second language. The study investigates whether universal grammar is still used by adult learners or their brains utilize other neural pathways and methods for second language learning. This study explores how the first language acquisition process is different from second language learning and how neurolinguistics plays a role in distinguishing parts of the brain that are active in first language acquisition and second language learning.

Rationale of the Study

The role of universal grammar is clear in first language acquisition. The theory relates that all humans are born with an innate capacity that helps in first language acquisition. However, the role of universal grammar in second language acquisition is not clear (White, 2003; Bley-Vroman, 1990). There is no solid research to manifest the presence or absence of universal grammar in second language acquisition. This study brings novelty to distinguish the parts of the brain that are active in first and second language acquisition. The connection of neurolinguistics helps to explore the presence or absence of universal grammar in second language acquisition.

Research Gap

The role of universal grammar and its presence has been explained in many research articles, however, there is no clear information about the role of universal grammar in second language acquisition. Some hypotheses accept and some reject the presence of universal grammar in second language acquisition. This study not only avoids confusion but also fills the gap regarding the presence and absence of universal grammar both theoretically and neurolinguistically. The existing articles and neurolinguistics help to ensure the presence or absence of the role of universal grammar in second language acquisition.

Limitations of the Study

There are so many limitations of the study: first, the study only relies on the available articles related to the topic; the study does not collect any data from the participants in this regard. Secondly, the study collects all the information from secondary data and draws a conclusion based on the collected data. Finally, the study connects neurolinguistics and monolingual learners' brain functions in the second language acquisition; the functions of the brain can vary when a person is polyglot.

Delimitations of the Study

This study is delimited in so many ways: first, it only clarifies the presence or absence of universal grammar through neurolinguistics, critical period hypothesis, other theories and concepts can bring change in the study. Secondly, this study is delimited to the acquisition of second language by adult learners; it does not delimit to the children who acquire second language easily in their childhood due to the presence of universal grammar. Finally, talking about second langue acquisition, the study does not talk about any specific language.

Research Design and Methodology

This study is qualitative in nature, and the data is analyzed based on thematic analysis. All published articles have been included in the data to conclude the collected data. The information from the introduction and literature review has been placed in the data analysis. Analyzing the existing articles, several themes have been deduced.

DATA ANALYIS

The following themes have been deduced based on the existing data.

Universal Grammar and Its Role in First Language Acquisition

Universal grammar plays an important role in first language acquisition. The theory of universal grammar was presented by Noam Chomsky. The theory discusses the presence of innate capacity in the brain of human. The theory argues that all humans are born with innate capacity that helps humans to understand the grammar of their first language (White 2013). Critical period hypothesis supports the theory and specifies a stage of first language acquisition. Critical period hypothesis states that there is a stage of first language acquisition in which every child can acquire any language; however, when that stage of childhood is over, then first language acquisition is impossible. The hypothesis also supports the learning of a second language in childhood; second language learning becomes easy for children due to critical period. Many researchers are also agree that universal grammar is present in early childhood but its role is over after maturity (Hawkins, 2011).

The Process of Second Language is Different from First Language

When adult learn second language, they memorize words, grammar and rules of second language which are mostly different from first language. The second language learners, practice and repeat the words in speaking to master the language. Those who learn second language due to the differences of their first language with the second language, they face difficulties in second language learning; they overcome the difficulties by practice and repetition of the words and rules of second language (Clahsen & Felser, 2022). This shift in reliance suggests that adult brains engage more cognitive resources during second language learning, compared to children who still heavily draw on their natural linguistic ability.

Several studies challenge whether UG still plays a significant role in adult second language acquisition or not. While children benefit from UG in both L1 and L2 acquisition, adult learners, especially as they get older, seem to rely more on explicit learning and cognitive strategies rather than on an inborn capacity for grammar (Cook & Newson, 1996). Neurolinguistics provides further insight into these differences, helping us understand how distinct parts of the brain are engaged when learning a first language compared to a second.

Neurolinguistics and Brain Activity in Language Learning

Neurolinguistics, as the science that explores the relationship between brain activity and language, has presented good evidence about the role of various parts of the brain in language acquisition. The brain was found to activate different neural routes in the learning of first and second languages. For instance, during

the process of acquiring a first language, the left brain is mostly stimulated. Adult second language learners, on the other hand, prefer to use the right side of the brain (Perani et al., 2021). This change in brain activity implies that adults can utilize other cognitive strategies in understanding and learning the grammar of a second language differently from children who learn their first language.

Research has established that the native speakers of a language primarily utilize the left hemisphere of their brain to process the language. Adults, however, who are learning a second language typically engage the right hemisphere, potentially indicating the utilization of various neural approaches to comprehend grammar (Perani et al., 2021). This is important as it shows how adult learners are likely to be employing other methods for language acquisition, utilizing fewer innate UG structures.

In addition, Ullman's (2016) language learning model further supports the fact that L1 and L2 are processed separately in the brain. His Declarative Model and Procedural Model indicate that first language acquisition is mediated by procedural memory—an unconscious, automatic system of learning—whereas second language acquisition is based mainly on declarative memory, which is more conscious and rule-governed. This is significant in realizing how adults struggle to learn a second language: they are not applying the same pathways that they learned with their native language.

The Critical Period Hypothesis and Its Role in Language Learning

One of the most dominant themes in the literature is the Critical Period Hypothesis (CPH), which posits that there is a certain time frame in early childhood when the brain is especially sensitive to learning language. As Weber-Fox and Neville (1996) state, universal grammar is available for second-language learners under the age of 11 years, and the brain treats the second language essentially the same as a first language during this time. But beyond this critical phase, the capacity for UG use reduces and second language acquisition is increasingly reliant on other cognitive operations, including memory and practice (Hawkins, 2011).

The reduction of UG access as an individual ages concurs with evidence by Sauter (2002) and Babcock et al. (2017). These findings imply that, although the brain is still malleable, the innate capacity for learning language via UG decays with age. In adults, however, the process of acquisition is more driven by cognitive processes and conscious learning strategies, especially when acquiring a second language. This process is also affected by the Critical Period, where UG is only operative in early childhood and loses its role in adulthood.

Cognitive Mechanisms of Second Language Acquisition

Another theme of importance is the cognitive mechanisms used by adult learners in learning a second language. Children use their built-in UG to learn a second language, whereas adults rely mostly on explicit learning and memory mechanisms. The role of UG in second language acquisition is less salient in adults, as argued by Cook and Newson (1996). Instead, adult learners increasingly depend on cognitive strategies to grasp the grammar of a second language. This increased reliance on declarative memory in second language acquisition is reflected in Ullman's (2016) Declarative Model, which focuses on how the brain's dependency on explicit learning and conscious processes of memory becomes essential for adult learners.

This observation implies that while UG could still play some part in second language acquisition, especially at an early stage, its impact fades as adults continue their learning. Adults, rather, move toward employing memory-based learning strategies with greater emphasis on the conscious manipulation of grammatical rules.

This is the conclusion of the Data Analysis section that highlights major themes and findings concerning the contribution of Universal Grammar to second language acquisition, the brain's role in language

acquisition, and the cognitive processes that underlie second language acquisition. Some of the inconsistencies in the literature need to be addressed through additional research, as well as whether UG contributes to multilingual or bilingual speakers.

FINDINGS

This chapter describes the study findings on the function of Universal Grammar (UG) in second language acquisition (SLA) and its interaction with brain activity and the cognitive processes underlying second language learning. The analysis of the data brought out a number of important themes that explained the language acquisition process, particularly in adult learners. Presented for the first time by Chomsky, the Universal Grammar (UG) explains that human beings are genetically endowed with a built-in ability to learn language. The evidence is in favor of the UG hypothesis for L1 acquisition, where children learn their native language without effort because of the built-in cognitive systems. But the function of UG in adult second language (L2) learning is less definitive. Though children can apply UG to both L1 and L2 acquisition, adults have greater recourse to overt learning methods and memory. That transition indicates that adults apply more cognitive capacity than children when learning a second language, which means L2 acquisition is a harder task for them. Neurolinguistics studies have shown that the brain treats first and second languages differently. The left hemisphere of the brain is most activated when children learn their first language. Adults, on the other hand, learning a second language, activate the right hemisphere. This implies that adult learners employ distinct cognitive strategies from children, drawing less on inborn linguistic structures and more on deliberate, effortful learning strategies. Also, research focused on the fact that first language acquisition is mostly done through procedural memory, which is unconscious and automatic, whereas second language acquisition relies to a greater extent on declarative memory, which is conscious and rule-based. The Critical Period Hypothesis (CPH) suggests that there exists a certain period in early childhood when the brain is most accepting of learning a language. The results validate this hypothesis, revealing that children learn both their first and second languages more readily before the age of 11. Once this critical period is past, access to UG becomes less available, and second language learning becomes increasingly dependent on practice and memory. Research verifies that the brain's ability to deal with UG diminishes with age, and second language learners, particularly adults, have to use explicit learning strategies as they get older. Adult learners of the second language almost entirely employ deliberate strategies like explicit learning and memory-based strategies. They are more conscious and willful in nature as opposed to automatic processes deployed by children. The results confirm that although UG can still influence the onset stages of the acquisition of second languages, the prominence of the component diminishes with advancing proficiency levels. Rather, adults move on to declarative memory, with greater emphasis on rules and conscious processing.

CONCLUSION

This research investigated the contribution of Universal Grammar (UG) to second language acquisition (SLA), the neurolinguistics mechanisms underlying language acquisition, and the cognitive processes that adult learners use. The results verify that though UG has an important function in first language (L1) acquisition, its contribution to second language (L2) acquisition is reduced with increasing age. Children are aided by their natural language skills, which help them learn both their first and second languages effortlessly. Adult learners, on the other hand, use more overt learning strategies, memory, and thinking processes instead of an innate grammatical structure. Neurolinguistics studies identify vast differences in brain functioning between L1 and L2 acquisition. Acquisition of a first language mainly engages the left hemisphere, which is linked with automatic and intuitive use of language. In contrast, adult second language learners show increased activation in the right hemisphere, indicating a greater reliance on conscious learning strategies. Additionally, the findings support Ullman’s model, which suggests that L1 is largely processed through procedural memory, while L2 acquisition depends more on declarative memory, making

it a more effortful process for adults. The Critical Period Hypothesis (CPH) also confirms that the brain is most sensitive to learning language under 11 years. It is only in this critical period that UG is still open, and second languages are learned similar to one's first language. But once this window of time is closed, UG accessibility reduces, and learning a second language becomes reliant on cognitive processes like explicit practice and instruction. Although the research offers insightful information on second language acquisition, there are contradictions in the literature. Some theories propose that UG is still accessible to adult learners, whereas others propose that its impact vanishes completely after childhood. Most research has also concentrated on monolingual learners, with gaps in knowledge regarding how UG and neurolinguistics processes operate in multilingual speakers. More research must be conducted to examine these domains, especially how multilingualism may affect brain processes and the availability of UG in second language acquisition.

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