PSYCHOLINGUISTICS

HOW LANGUAGE SHAPES COGNITION

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Psycholinguistics, the bridge between language and cognition, has evolved through a rich history of theories and debates, shaping our comprehension of the human mind. But what role does language play in cognition? Language is far beyond just mere communication, as it molds cognition, perception, memory, and problem-solving skills. At its core, the study of language acquisition stands as a foundation for the study of psycholinguistics, spanning diverse theoretical landscapes from behaviorist theories to nativist perspectives. This paper aims to offer insights from a myriad of disciplines, offering a holistic understanding of how language is intertwined with cognitive development. Drawing upon the fields of psychology, linguistics, neuroscience, and anthropology, it unveils the profound impact language has in shaping the trajectory of cognitive development. This interdisciplinary approach illuminates the mechanisms by which language influences cognitive processes, underscoring the symbiotic relationship between language and the development of the human mind. It indicates the importance of interdisciplinary research in understanding the marriage between language and cognition, ultimately revealing the magic behind the human mind.

I. Introduction

Psycholinguistics, a discipline at the intersection of psychology and linguistics, explores the intricate processes underlying language acquisition, comprehension, production, and representation. The establishment of psycholinguistics as a discipline resulted from the amalgamation of linguistics and psychology over centuries of historical development in the study of language and cognition. The term "psycholinguistics" was first seen in 1936 by American psychologist Jacob Kantor, gaining popularity in 1946 through Kantor's student and psychologist Nicholas Pronko. Psycholinguistics emerged as an academic discipline following a seminar at Cornell University in 1951, marking its formal recognition within the scientific community. The relationship between language and cognitive development begins early in life, as infants embark on their language acquisition journey. Infants demonstrate an incredible ability to perceive and learn the sounds, words, and grammatical structures of their native

language(s). As children grow, their linguistic abilities develop alongside cognitive milestones such as memory enhancement, attentional control, and problem-solving abilities. This parallel progression suggests a profound intertwining between language acquisition and cognitive development. Furthermore, language plays a pivotal role in shaping cognitive development by offering a framework for organizing and expressing thoughts. It empowers individuals to conceptualize and communicate complex ideas, thereby fostering skills essential for higher-order cognitive processes. Abstract reasoning, perspective-taking, and symbolic thought are nurtured through language, highlighting its crucial role in shaping cognitive development from early childhood onwards. It investigates how individuals perceive, process, and generate language, shedding light on the dynamic interplay between language and cognition. By delving into various linguistic domains such as phonetics, syntax, semantics, and pragmatics, psycholinguistic research seeks to uncover the underlying mechanisms driving language processing in the human mind.

II. Historical overview

Language has fascinated researchers for its ever-changing nature. Often approached from different angles, the study of language involves dissecting its component parts to understand its underlying structure and functionality. Central to these component parts are two prominent theoretical perspectives: nativist views, championed by Noam Chomsky, and behaviorist theories, notably advocated by B. F. Skinner. These contrasting frameworks offer unique insights into the complexities of language learning and have created extensive debate and investigation within the field. Nativist theories, founded by Chomsky's work, propose that language acquisition is facilitated by innate cognitive structures inherent to the human mind. Chomsky's concept of Universal Grammar talks about a shared linguistic blueprint underlying all human languages, suggesting that children are equipped with a predisposition to acquire language. According to this view, the poverty of the stimulus argument highlights the inadequacy of environmental input alone to account for the richness and complexity of language acquisition, thus emphasizing the critical role of innate mechanisms in guiding linguistic development. Chomsky's ideas sparked intense debate within the field, leading to a paradigm shift towards cognitive approaches to language processing. Cognitive psychologists and linguists began investigating the mental processes underlying language comprehension, production, and acquisition. This cognitive turn in psycholinguistics emphasized the role of internal cognitive mechanisms such as memory, attention, and language processing speed. According to Perlovsky[1], language and cognition share joint acquisition and a dual hierarchy, with emotional prosody potentially serving a fundamental role in connecting sounds and meanings of words. Additionally, Chomsky[2] has suggested that language is separable from cognition, a notion supported by functional imaging experiments in neuroscience[3]. However, cognitive and construction linguistics propose a single mechanism for both language and cognition[4], highlighting the complexity of their relationship. The study of language is considered essential for understanding the structure of the human mind[5], suggesting that language is inherently linked to cognition. In contrast, behaviorist theories, notably advanced by Skinner, emphasize the role of environmental input and reinforcement in shaping language acquisition. Skinner proposed that language learning occurs through operant conditioning, with children acquiring linguistic skills through imitation, repetition, and reinforcement of correct responses. In this view, language development is contingent upon external stimuli and environmental contingencies, with learning outcomes determined by the reinforcement of observable behaviors. The nativist-behaviorist debate has been a central focus of linguistic inquiry, prompting researchers to explore the interplay between innate predispositions and environmental influences in language acquisition. While nativist perspectives highlight the efficiency and universality of language learning across diverse linguistic contexts, behaviorist theories underscore

1 Leonid Perlovsky, "Language and Cognition," *Neural Networks* 22, no. 3 (April 1, 2009): 247–57, https://doi.org/10.1016/j.neunet.2009.03.007.

2 Ljiljana Progovac, "Why Only Us? Language and Evolution by Robert C. Berwick and Noam Chomsky," *Language* 92, no. 4 (January 1, 2016): 992–96, https://doi.org/10.1353/lan.2016.0085.

3 Kuniyoshi L. Sakai, "Language Acquisition and Brain Development," *Science* 310, no. 5749 (November 4, 2005): 815–19, https://doi.org/10.1126/science.1113530.

4 Perlovsky, "Language and Cognition."

5 Perlovsky, "Language and Cognition."

the importance of social interaction and environmental input in shaping linguistic development. Contemporary approaches often seek to integrate aspects of both perspectives, recognizing the complex and multifaceted nature of language acquisition processes.

III. Language acquisition and processing

Language acquisition is a multifaceted process deeply intertwined with human development and influenced by various social, economic, and historical factors (Manual of Language Acquisition). This intricate phenomenon encompasses the learning and utilization of languages, including individuals' mother tongue and additional languages. Understanding how individuals acquire and use languages involves interdisciplinary research spanning linguistics and psychology. First, it's essential to distinguish between terms such as second language acquisition (SLA) and foreign language learning. SLA research focuses on individuals acquiring a second environmental language. For example, children with a Turkish family background in Germany, where exposure to the language occurs outside of "formal" educational settings. In contrast, foreign language learning takes place within institutional settings, often through the classroom, where individuals acquire languages distinct from their native tongue (Manual of Language Acquisition). Furthermore, language acquisition research delves into the intricate mechanisms underlying the process, exploring theories such as behaviorist and nativist perspectives as discussed earlier. Behaviorist theories, rooted in principles of operant conditioning, emphasize environmental stimuli and reinforcement in shaping language development. In contrast, nativist theories propose the existence of innate linguistic structures or principles that guide language acquisition, as seen in Noam Chomsky's theory of Universal Grammar. The role of innate mechanisms, environmental factors, and social interactions in language development is central to understanding the complexities of language acquisition. Research in this field aims to elucidate the cognitive processes underlying language learning, shedding light on fundamental questions about human cognition and the nature of language itself. Additionally, the question of whether language is unique to humans has intrigued researchers, leading to debates about the cognitive and evolutionary origins of language. Despite claims of human uniqueness in various domains, such as tool use, some researchers have explored the capacity for language in apes, attempting to teach them language-like systems.[6] Regarding the relationship between language and thought, Benjamin Whorf proposed the hypothesis that language shapes our conceptualization of the world, suggesting that speakers of different languages perceive reality differently.[7] However, modern cognitive scientists largely reject this hypothesis, emphasizing that language is not the sole determinant of thought processes. Language acquisition is a complex and dynamic process influenced by a myriad of factors. By exploring various perspectives and theories, researchers aim to deepen our understanding of how individuals acquire and use language, shedding light on fundamental aspects of human cognition and communication.

IV. Language and cognition

Cognition and language are inevitably connected, and both influence and support a person's life. Let's first define cognition. Cognition, as defined by Nelson[8], encompasses the mental processes involved in acquiring, processing, storing, and using information. It encompasses a wide range of mental activities, including perception, attention, memory, reasoning, problem-solving, decision-making, and language comprehension and production. At its core, cognition enables individuals to perceive, understand, and interact with the world around them. It encompasses both conscious and unconscious mental processes that shape how individuals perceive stimuli, make sense of experiences, and adapt their behavior accordingly. Cognition plays a fundamental role in various aspects of human behavior, from basic survival skills to complex social interactions and abstract thinking. The synergy between cognitive and linguistic abilities becomes particularly pronounced in advanced age, where individuals face unique challenges and exhibit diverse outcomes. Understanding this relationship requires a multifaceted approach, considering both the cognitive processes underlying language and the impact of language on social

6 Steven Pinker, *The Language Instinct: How the Mind Creates Language* (William Morrow & Co., 1994).

7 A. M. Halpern, et al., "Language, Thought, and Reality.," *American Sociological Review* 21, no. 5 (October 1, 1956): 643, https://doi.org/10.2307/2089121.

8 Charles A. Nelson, Kathleen M. Thomas, and Michelle De Haan, "Neural Bases of Cognitive Development," *Wiley Online Library* (June 1, 2007), https://doi.org/10.1002/9780470147658.chpsy0201.

cognition and vice versa. Cognition has a wide range of mental processes, including memory, reasoning, and attention. As people age, they may experience typical age-related changes in cognitive functioning, such as slower processing speed, alongside non-normative changes like dementia. Cognitive health represents the combination of these abilities, ranging from no impairment to severe impairment, and it is essential to assess and understand these variations accurately. For instance, screening tools like the Mini-Mental State Examination (MMSE) help measure basic cognitive functioning and identify potential impairments, while other assessments like the Clinical Dementia Rating (CDR) offer insights into the degree of cognitive impairment in dementia cases. Moreover, research demonstrates the enduring impact of cognitive and linguistic abilities across a lifespan. Researchers[9] found a positive association between linguistic abilities in emerging adulthood and preserved cognitive functioning in later life, highlighting the potential for resilience even in the presence of underlying brain pathology. Ultimately, the researchers involved show that language plays an immense role in cognition throughout the lifespan, impacting not only communication but also cognitive resilience and preservation in later life.

V. Language processing and memory

Language processing involves two main aspects: comprehension (understanding) and production (generating). Traditionally, these processes were thought to be linked to specific areas of the brain, such as Broca's area and Wernicke's area. Broca's area, located in the left inferior frontal gyrus, is responsible for both language production and comprehension. It helps coordinate speech and processes word retrieval and spelling. On the other hand, Wernicke's area, located in the left superior temporal gyrus, is primarily involved in language comprehension by attaching meaning to auditory information. Moreover, language processing is intertwined with other cognitive domains and involves different brain areas connected by functional circuits. The nature and complexity of a language task determine which brain regions are activated, making it challenging to pinpoint the exact areas involved in language processing. Studies on language processing have used various tasks and modalities, including speech production, reading comprehension, and verbal fluency. Tasks that require naming pictures are commonly used in neuroimaging studies to investigate language processing. Although rapid auditory processing has been linked to language impairments in school-aged children and infants with a family history of language impairment, little is known about the role of processing speed in infants' language acquisition. Furthermore, language processing relies on several connectivity pathways in the brain. These pathways include the ventral semantic stream, dorsal phonological stream, speech perception pathway, articulatory loop, cortico-striatal loop, and speech production pathway. Each pathway facilitates different aspects of language processing, such as semantic interpretation, phonological processing, and articulation. Reasoning and problem-solving abilities contribute to language comprehension by enabling individuals to infer meaning from context, resolve ambiguities, and draw logical conclusions based on linguistic input. Additionally, cognitive flexibility allows individuals to adapt their language comprehension strategies to different contexts and linguistic registers, such as formal versus informal language. Memory is also an important aspect of knowledge acquisition, including language development. Infants who exhibit better memory skills can be seen as more adept at encoding, storing, consolidating, and retrieving representations of objects and events.[10] These memory skills are fundamental to language development, as infants with better recognition and recall memory are likely to produce memory traces that are highly discriminable and persistent, facilitating the linkage to verbal referents. Memory serves as the foundation for language acquisition and retention. When learning a new language, individuals encode linguistic information, such as vocabulary and grammar rules, into their memory systems. This encoding process involves transforming sensory input into meaningful representations that can be stored for later retrieval. For example, when learning new words, individuals associate sounds or visual symbols with their corresponding meanings, forming memory traces that facilitate language comprehension and production. Moreover, memory plays a crucial role in language comprehension by enabling individuals to retrieve previously learned information from long-term memory and integrate it with incoming linguistic input. For instance, when reading a sentence, individuals

9 D. Iacono et al., "The Nun Study," *Neurology* 73, no. 9 (September 1, 2009): 665–73, https://doi.org/10.1212/wnl.0b013e3181b01077.

10 Susan A. Rose, Judith F. Feldman, and Jeffery J. Jankowski, "A Cognitive Approach to the Development of Early Language," *Child Development* 80, no. 1 (January 1, 2009): 134–50, https://doi.org/10.1111/j.1467-8624.2008.01250.x.

rely on their semantic memory to access the meanings of words and their syntactic knowledge to understand the grammatical structure of the sentence. Additionally, working memory, a temporary storage system that holds information in an active state for processing, allows individuals to maintain and manipulate linguistic information in real-time during language comprehension tasks. Conversely, limitations in recognition and recall may result in slower rates of vocabulary growth. Studies on infant memory and language proficiency have primarily focused on visual recognition memory, which has been shown to correlate with language proficiency from toddlerhood to adulthood.[11] Better visual recognition memory is associated with improved comprehension and communication skills in toddlers, preschoolers, and adults. Additionally, impaired visual recognition memory has been observed in infants with a family history of specific language impairment. Conversely, limitations in recognition and recall abilities may hinder vocabulary growth and language development. Research focusing on infant memory and language proficiency underscores the significance of visual recognition memory, which has been consistently linked to language skills from early childhood to adulthood. Enhanced visual recognition memory correlates with better comprehension and communication abilities, while impaired recognition memory may indicate potential language difficulties, as evidenced in infants with a family history of specific language impairment. So, this means that a deeper understanding of memory's role in language processing not only sheds light on fundamental cognitive processes but also informs interventions and strategies aimed at supporting language development across the lifespan. By elucidating the intricate interplay between memory and language, researchers and practitioners can pave the way for tailored interventions that optimize language learning and facilitate effective communication skills.

VI. Sensitive periods in language acquisition

Critical periods in language acquisition refer to specific time windows during which the ability to acquire language is at its peak. These periods are characterized by heightened neuroplasticity, or the brain's capacity to reorganize and adapt in response to experience. The concept of critical periods was popularized by linguist Eric Lenneberg in the 1960s, who proposed that there is an optimal age range for acquiring a first language. According to Lenneberg's hypothesis, the critical period for first language acquisition extends from infancy to early childhood, typically ending around puberty. During the critical period for first language acquisition, children demonstrate remarkable proficiency in acquiring the grammar, vocabulary, and phonology of their native language(s). This rapid language learning is facilitated by a combination of innate cognitive mechanisms and environmental input. Young children are highly sensitive to linguistic input, effortlessly absorbing the sounds, words, and grammatical structures of their surrounding language(s). The brain undergoes significant neural development during this period, with specialized language areas such as Broca's area and Wernicke's area maturing to support language processing. Traditionally, language was perceived as an innate function, inherently present within individuals from birth. However, this view began to shift in the early 19th century with the emergence of cases challenging the notion of language solely as an inborn capacity. Itard's case of the "wild boy of Aveyron," reported in 1801, marked a pivotal moment in this paradigm shift. But who was the "wild boy of Aveyron"? It is a historical case that challenged beliefs about language acquisition and human development. In 1800, a boy, estimated to be 11 or 12 years old, was found in the forests of Aveyron, France, living without human contact. Named Victor, he exhibited primitive behaviors and lacked language skills. Jean Marc Gaspard Itard, a French physician, took on Victor's education. Documented in his 1801 report, "Memoir on the Wild Boy of Aveyron," Itard's work marked an early attempt to rehabilitate a feral child and explore language acquisition and cognitive development beyond infancy. Itard's observations showed Victor's gradual progress in language and social skills, highlighting the role of environmental input. Despite initial difficulties, Victor improved over time, suggesting language acquisition's dependence on both innate abilities and environmental factors like exposure to language and social interaction. Victor's case stirred scholarly interest, leading to further research on language acquisition and early experiences' effects on cognitive development. Itard's work paved the way for studying critical and sensitive periods in language acquisition, emphasizing the significance of early intervention and environmental enrichment in supporting cognitive growth. More cases afterward helped push the idea that language comes

11 Rose, Feldman, and Jankowski, "A Cognitive Approach."

from both genetics and environment, recognizing the importance of flexibility in how language develops.[12] Even though people have known for a while that the environment affects how we learn language, it took some time for scientists to define critical and sensitive periods in language learning. Nonetheless, contemporary understanding of critical/sensitive periods in language development has been informed by psychophysical observations, albeit many of them anecdotal, and a limited number of studies with quantitative data.[13] Despite these challenges, accumulating evidence suggests that there is a time-dependent sequence of functions in language development, driven by adaptive responses of the central nervous system (CNS) to auditory stimuli. Studies have demonstrated that even in utero, the human fetus exhibits auditory abilities, such as sound detection, as evidenced by changes in fetal heart rate and movement in response to external stimuli.[14] Furthermore, neonates have shown preferences for familiar auditory stimuli, indicating early discrimination abilities that likely develop during prenatal exposure to sound.[15] For instance, neonates exposed to specific sounds in utero, such as music or airport noise, exhibit preferences for those sounds after birth, underscoring the adaptability and plasticity of the developing auditory system. In addition to age, other factors such as language aptitude, motivation, and environmental support play crucial roles in determining language learning outcomes during sensitive periods. While younger learners may benefit from greater neural plasticity and exposure to naturalistic language input, older learners can still achieve proficiency through intensive instruction and immersion experiences. The concept of sensitive periods extends beyond second language acquisition to various aspects of language development, including phonological awareness, vocabulary acquisition, and literacy skills. For example, children who receive early intervention for speech and language delays during sensitive periods may demonstrate improved outcomes compared to those who receive intervention later in life. Overall, critical periods and sensitive periods in language acquisition underscore the importance of early and timely language exposure in maximizing language learning potential. By understanding these developmental milestones, educators and policymakers can design effective interventions and educational programs to support language development across the lifespan. Moreover, continued research into the neurobiological mechanisms underlying critical and sensitive periods promises to shed further light on the complex interplay between biology, environment, and experience in shaping human language abilities.

VII. Bilingualism and multilingualism

In order to understand bilingualism and multilingualism, we must first know how to differentiate the two. Bilingualism and multilingualism are terms often used interchangeably, but they encompass distinct linguistic abilities and experiences. To clarify their differences, it is essential to understand the various perspectives and definitions associated with each term. Bilingualism, traditionally defined, refers to an individual's ability to speak, understand, read, and write proficiently in two languages, akin to being two native speakers in one. This definition emphasizes near-native competence in both languages and implies balanced proficiency across linguistic domains. However, this narrow definition does not fully capture the diversity of bilingual experiences, particularly in multicultural societies where language acquisition occurs in dynamic and varied contexts. In contrast, a broader and more inclusive perspective on bilingualism recognizes it as a common human condition that enables individuals to function, to some degree, in more than one language. This definition emphasizes the key criterion of "more than one" language proficiency, acknowledging a continuum of bilingual abilities. Bilingual individuals may exhibit varying levels of proficiency in comprehension, speaking, reading, and writing in their respective languages, depending on their linguistic experiences and environmental factors. Multilingualism, on the other hand, extends beyond bilingualism to encompass proficiency in three or more languages. Like bilingualism, multilingualism operates along a continuum, with individuals possessing varying degrees of competence in multiple languages. Multilingual individuals may demonstrate proficiency in comprehension and/or production across multiple

12 Eric H. Lenneberg, "The Biological Foundations of Language," *Hospital Practice* 2, no. 12 (December 1, 1967): 59–67, https://doi.org/10.1080/21548331.1967.11707799.

13 Lenneberg, "The Biological Foundations of Language."

14 Barbara S. Kisilevsky et al., "Effects of Experience on Fetal Voice Recognition," *Psychological Science* 14, no. 3 (May 1, 2003): 220–24, https://doi.org/10.1111/1467-9280.02435.

15 Anthony J. DeCasper and William P. Fifer, "Of Human Bonding: Newborns Prefer Their Mothers' Voices," *Science* 208, no. 4448 (June 6, 1980): 1174–76, https://doi.org/10.1126/science.7375928.

languages, albeit to differing extents. Bilingualism and multilingualism have become increasingly prevalent in today's globalized world, with individuals often exposed to multiple languages from an early age. This phenomenon has sparked significant interest among researchers seeking to understand its effects on cognitive development. One of the primary advantages of bilingualism is enhanced cognitive flexibility. Studies have consistently shown that bilingual individuals demonstrate superior abilities in tasks requiring cognitive control and switching between tasks.[16] The constant need to manage two or more languages helps bilinguals develop stronger executive functions, such as inhibition, working memory, and attentional control.[17] This cognitive advantage, often referred to as the bilingual advantage, has been observed across various age groups, from children to older adults.[18] Moreover, bilingualism has been associated with improved metalinguistic awareness—the ability to think about and analyze language itself.[19] Bilingual individuals often possess a deeper understanding of language structures and grammar, as they must navigate between different linguistic systems. This heightened metalinguistic awareness can facilitate language learning and academic achievement in both native and non-native languages.[20] While bilingualism offers numerous cognitive benefits, it also presents challenges, particularly in the context of language maintenance and proficiency. Bilingual individuals may experience language interference or code-switching, where elements of one language intrude into the other during speech.[21] This phenomenon can affect language fluency and communication effectiveness, especially in situations requiring precise language use. Additionally, bilingualism requires ongoing effort and practice to maintain proficiency in both languages. In environments where one language predominates, individuals may face pressure to prioritize one language over the other, leading to language attrition or loss.[22] This can be particularly challenging for heritage speakers—individuals who grow up with exposure to a minority language but predominantly use the majority language in their daily lives. During this research, I came across one noticeable article shedding light on the cognitive advantages of bilingualism in early childhood, which is "Bilingualism in the Early Years: What the Science Says" by Krista Byers-Heinlein and Casey Lew-Williams. This article provides valuable insights into the cognitive benefits of bilingualism, particularly in the context of early childhood development. Early bilingualism offers numerous advantages beyond the obvious linguistic benefits. Popular books and articles often tout the advantages of early bilingualism, emphasizing the importance of knowing multiple languages for travel, employment, maintaining cultural connections, and fostering diverse social interactions.[23] However, researchers have delved deeper into the potential non-linguistic advantages of bilingualism, particularly in social understanding and cognitive development.[24] Studies suggest that bilingual children demonstrate enhanced social understanding compared to their monolingual peers. Bilingual preschoolers, for instance, exhibit better skills in understanding others' perspectives, thoughts, desires, and intentions.[25] The complex social dynamics of navigating multiple languages may contribute to this heightened social awareness among bilinguals. The exact mechanisms underlying these cognitive advantages remain the subject of debate. Some researchers propose that the constant need to switch between languages and inhibit irrelevant responses in

16 Ellen Bialystok, "The Bilingual Adaptation: How Minds Accommodate Experience," *Psychological Bulletin* 143, no. 3 (March 1, 2017): 233–62, https://doi.org/10.1037/bul0000099.

17 Ellen Bialystok, "Bilingualism: The Good, the Bad, and the Indifferent," *Bilingualism* 12, no. 1 (January 1, 2009): 3–11, https://doi.org/10.1017/s1366728908003477.

18 Judith F. Kroll and Ellen Bialystok, "Understanding the Consequences of Bilingualism for Language Processing and Cognition," *Journal of Cognitive Psychology* 25, no. 5 (May 22, 2013): 497–514, https://doi.org/10.1080/20445911.2013.799170.

19 Ellen Bialystok, *Bilingualism in Development* (Cambridge University Press, 2001): 1–20, 219–48, https://doi.org/10.1017/cbo9780511605963.

20 Bialystok, *Bilingualism in Development,* 1–20, 219–48.

21 Kathryn Kohnert, "Bilingual Children with Primary Language Impairment: Issues, Evidence and Implications for Clinical Actions," *Journal of Communication Disorders* 43, no. 6 (November 1, 2010): 456–73, https://doi.org/10.1016/j.jcomdis.2010.02.002.

22 Silvina Montrul, *Incomplete Acquisition in Bilingualism: Re-examining the Age Factor* (John Benjamins Publishing, 2008).

23 Krista Byers-Heinlein and Casey Lew-Williams, "Bilingualism in the Early Years: What the Science Says," PubMed Central (PMC), (January 1, 2013), https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6168212/.

24 Nameera Akhtar and Jennifer A. Menjivar, "Cognitive and Linguistic Correlates of Early Exposure to More Than One Language," in *Advances in Child Development and Behavior* (2012): 41–78, https://doi.org/10.1016/b978-0-12-394388-0.00002-2.

25 Byers-Heinlein and Lew-Williams, "Bilingualism in the Early Years," 95–112.

bilingual individuals may lead to cognitive benefits.[26] Similarly, infants exposed to bilingual environments may develop enhanced cognitive abilities through the need to discriminate between their two languages.[27] However, it is important to note that cognitive advantages associated with bilingualism are not unique; similar benefits have been observed in individuals with early musical training, suggesting that multiple enriched experiences can promote cognitive development.[28] While the cognitive advantages of bilingualism are compelling, it is essential to approach this topic with nuance. Despite the popular portrayal of the "bilingual advantage," research findings are based on highly sensitive laboratory methods, and the extent to which these advantages translate to everyday life remains unclear.[29] Moreover, bilingualism is not the only factor influencing cognitive development, and individual differences play a significant role in shaping cognitive abilities. While the mechanisms underlying these advantages are not fully understood, the complex interplay between language experience and cognitive development underscores the importance of bilingualism in early childhood. Multilingualism, the ability to speak three or more languages, offers further cognitive benefits beyond those observed in bilingualism. Research suggests that multilingual individuals exhibit even greater cognitive flexibility and task-switching abilities compared to bilinguals.[30] The constant juggling of multiple languages enhances neural plasticity and strengthens cognitive control mechanisms, resulting in superior executive functioning skills.[31] Moreover, multilingualism has been linked to a delayed onset of cognitive decline in older adults. Studies have shown that multilingual individuals experience symptoms of dementia and Alzheimer's disease, on average, 4 to 5 years later than monolinguals.[32] The cognitive reserve hypothesis proposes that the cognitive benefits accrued from multilingualism act as a protective factor against neurodegenerative diseases, delaying the onset of cognitive impairment.[33] While bilingualism and multilingualism show evidence of cognitive advantages, it is important to note that they are not the only determinants of cognitive development. Ultimately, cognitive development is a multifaceted concept, influenced by different factors beyond language acquisition.

VIII. Discussion

The results of this research shed light on the need to consider multiple perspectives and findings when exploring the relationship between language and cognition. We see that language is not simply a tool for human communication but a fundamental part of the cognitive processes, including memory, problem-solving, and reasoning. This emphasizes the need of different disciplines to fully understand how deeply language affects cognition. Historically, two main theories were used to understand how language is acquired: behaviorism and nativism. While behaviorist theories highlight the role of the environment, nativist theories propose the idea that language is innate. This research shows that there is no conclusive evidence of whether language acquisition is attributed to behaviorist or nativist theories, but that both could play important roles in language learning. Furthermore, the concept of sensitive periods in language acquisition suggests that later acquisition of language negatively affects children cognitively, which highlights the importance of early intervention. Furthermore, the results I have presented show that language serves as both to retrieve and conceal memories, pointing to other evidence that cognition and language work together. The findings I have presented also suggest that there are cognitive advantages associated with bilingualism and multilingualism, highlighting an interesting relationship between

26 David W. Green, "Mental Control of the Bilingual Lexico-semantic System," *Bilingualism* 1, no. 2 (August 1, 1998): 67–81, https://doi.org/10.1017/s1366728998000133.

27 Núria Sebastián-Gallés et al., "A Bilingual Advantage in Visual Language Discrimination in Infancy," *Psychological Science* 23, no. 9 (July 18, 2012): 994–99, https://doi.org/10.1177/0956797612436817.

28 E. Glenn Schellenberg, "Music and Cognitive Abilities," *Current Directions in Psychological Science* 14, no. 6 (December 1, 2005): 317–20, https://doi.org/10.1111/j.0963-7214.2005.00389.x.

29 Byers-Heinlein and Lew-Williams, "Bilingualism in the Early Years," 95–112.

30 David W. Green and Jubin Abutalebi, "Language Control in Bilinguals: The Adaptive Control Hypothesis," *Journal of Cognitive Psychology* 25, no. 5 (May 24, 2013): 515–30, https://doi.org/10.1080/20445911.2013.796377.

31 Green and Abutalebi, "Language Control in Bilinguals.

32 Ellen Bialystok, Fergus Craik, and Gigi Luk, "Cognitive Control and Lexical Access in Younger and Older Bilinguals," *Journal of Experimental Psychology. Learning, Memory, and Cognition* 34, no. 4 (January 1, 2008): 859–73, https://doi.org/10.1037/0278-7393.34.4.859.

33 Bialystok, Craik, and Luk, "Cognitive Control and Lexical Access."

the amount of languages learned and the enhancement of cognition. Overall, these findings provided further the knowledge of understanding how multiple factors simultaneously affect language and cognition, revealing a dynamic and reciprocal relationship.

IX. Bibliography

Akhtar, Nameera, and Jennifer A. Menjivar. "Cognitive and Linguistic Correlates of Early Exposure to More Than One Language." *Advances in Child Development and Behavior* (2012): 41–78. https://doi.org/10.1016/b978-0-12-394388-0.00002-2.

Bialystok, Ellen. *Bilingualism in Development*. Cambridge University Press, 2001. https://doi.org/10.1017/cbo9780511605963.

Bialystok, Ellen. "Bilingualism: The Good, the Bad, and the Indifferent." *Bilingualism* 12, no. 1 (2009): 3–11. https://doi.org/10.1017/s1366728908003477.

Bialystok, Ellen. "The Bilingual Adaptation: How Minds Accommodate Experience." *Psychological Bulletin* 143, no. 3 (2017): 233–262. https://doi.org/10.1037/bul0000099.

Bialystok, Ellen, Fergus Craik, and Gigi Luk. "Cognitive Control and Lexical Access in Younger and Older Bilinguals." *Journal of Experimental Psychology: Learning, Memory, and Cognition* 34, no. 4 (2008): 859–73. https://doi.org/10.1037/0278-7393.34.4.859.

Byers-Heinlein, Krista, and Casey Lew-Williams. "Bilingualism in the Early Years: What the Science Says." PubMed Central (PMC) (2013). https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6168212/.

DeCasper, A. J., and W. P. Fifer. "Of Human Bonding: Newborns Prefer Their Mothers' Voices." *Science* 208, no. 4448 (June 6, 1980): 1174–76, https://doi.org/10.1126/science.7375928.

Green, David W. "Mental Control of the Bilingual Lexico-semantic System." *Bilingualism* 1, no. 2 (1998): 67–81. https://doi.org/10.1017/s1366728998000133.

Green, David W., and Jubin Abutalebi. "Language Control in Bilinguals: The Adaptive Control Hypothesis." *Journal of Cognitive Psychology* 25, no. 5 (2013): 515–30. https://doi.org/10.1080/20445911.2013.796377.

Halpern, A. M., Benjamin Lee Whorf, John B. Carroll, and Stuart Chase. "Language, Thought, and Reality." *American Sociological Review* 21, no. 5 (1956): 643. https://doi.org/10.2307/2089121.

Iacono, D., W. R. Markesbery, M. Gross, O. Pletnikova, G. Rudow, P. Zandi, and J. C. Troncoso. "The Nun Study: Clinically Silent AD, Neuronal Hypertrophy, and Linguistic Skills in Early Life." *Neurology* 73, no. 9 (2009): 665–73. https://doi.org/10.1212/WNL.0b013e3181b01077.

Itard, J.-M. G. *The Wild Boy of Aveyron (L'enfant sauvage): A Report Made to His Excellency the Minister of the Interior*. Translated by George Humphrey and Muriel Humphrey. Prentice-Hall Inc., 1962.

Kisilevsky, B. S., S. M. J. Hains, K. Lee et al. "Effects of Experience on Fetal Voice Recognition." *Psychological Science* 14, no. 3 (2003): 220–24. https://doi.org/10.1111/1467-9280.02435.

Kohnert, Kathryn. "Bilingual Children With Primary Language Impairment: Issues, Evidence and Implications for Clinical Actions." *Journal of Communication Disorders* 43, no. 6 (2010): 456–73. https://doi.org/10.1016/j.jcomdis.2010.02.002.

Kroll, Judith F., and Ellen Bialystok. "Understanding the Consequences of Bilingualism for Language Processing and Cognition." *Journal of Cognitive Psychology* 25, no. 5 (2013): 497–514. https://doi.org/10.1080/20445911.2013.799170.

Lenneberg, Eric H. “The Biological Foundations of Language.” *Hospital Practice* 2, no. 12 (1967): 59–67. https://doi.org/10.1080/21548331.1967.11707799.

Montrul, Silvina. *Incomplete Acquisition in Bilingualism: Re-examining the Age Factor*. John Benjamins Publishing, 2008.

Nelson, Charles A., Kathleen M. Thomas, and Michelle de Haan. “Neural Bases of Cognitive Development.” *Handbook of Child Psychology*. John Wiley & Sons, 2007. https://doi.org/10.1002/9780470147658.chpsy0201.

Perlovsky, Leonid. “Language and Cognition.” *Neural Networks* 22, no. 3 (2009): 247–257. https://doi.org/10.1016/j.neunet.2009.03.007.

Pinker, Steven. *The Language Instinct*. New York: William Morrow & Co., 1994.

Progovac, Ljiljana. “Why Only Us? Language and Evolution by Robert C. Berwick and Noam Chomsky,” *Language* 92, no. 4 (January 1, 2016): 992–96, https://doi.org/10.1353/lan.2016.0085.

Rose, S. A., J. F. Feldman, and J. J. Jankowski. “A Cognitive Approach to the Development of Early Language.” *Child Development* 80, no. 1 (2009): 134–50. https://doi.org/10.1111/j.1467-8624.2008.01250.x.

Sakai, Kuniyoshi L. “Language Acquisition and Brain Development.” *Science* 310, no. 5749 (2005): 815–19. https://doi.org/10.1126/science.1113530.

Schellenberg, E. Glenn. “Music and Cognitive Abilities.” *Current Directions in Psychological Science* 14, no. 6 (2005): 317–20. https://doi.org/10.1111/j.0963-7214.2005.00389.x.

Sebastián-Gallés, Núria, Bàrbara Albareda-Castellot, Whitney M. Weikum, and Janet F. Werker. “A Bilingual Advantage in Visual Language Discrimination in Infancy.” *Psychological Science* 23, no. 9 (2012): 994–99. https://doi.org/10.1177/0956797612436817.

Traxler, Matthew J., and Morton Ann Gernsbacher, eds. *Handbook of Psycholinguistics*. 2nd ed. Elsevier, 2006.

Vanhove, Jan. “The Critical Period Hypothesis in Second Language Acquisition: A Statistical Critique and a Reanalysis.” *PLoS One* 8, no. 7 (2013) https://doi.org/10.1371/journal.pone.0069172.

Whorf, Benjamin Lee. *Language, Thought, and Reality: Selected Writings of Benjamin Lee Whorf*. Edited by John B. Carroll. MIT Press, 1956.