Original Paper

Challenges and Verification: The Reproduction of the "Sapir-Whorf Hypothesis" by Large Language Models

Xiaonan Xie[1*]

[1] International Education & Exchange College, Tianjin Normal University, Tianjin City, China

[*] E-mail: 782452476@qq.com

Author Information:

Xiaonan Xie was born in Benxi , Liaoning Province in 1978, graduated from Nankai University with a Master of Arts in Linguistics, and is currently working at Tianjin Normal University.

Abstract

The Sapir-Whorf Hypothesis posits that language structures significantly influence cognitive processes, yet its application and validation within artificial intelligence, particularly large language models (LLMs), remains largely unexplored. While LLMs like GPT-4 have shown promise in natural language processing tasks, their ability to engage with complex cognitive theories such as the Sapir-Whorf Hypothesis is uncertain. This study aims to investigate the extent to which LLMs can reproduce, challenge, and expand upon the Sapir-Whorf Hypothesis through three case studies: language and cognitive development, the impact of language on social behavior, and the role of language in memory and cognition. A mixed-methods approach, combining qualitative and quantitative analyses, was employed to evaluate the depth and relevance of LLM-generated responses. The results reveal that LLMs are capable of generating relevant responses aligned with theoretical principles but struggle to provide nuanced, context-specific insights, especially in real-world applications such as bilingualism and trauma-related memory. This study contributes to the understanding of LLMs' potential and limitations in theoretical reasoning, offering valuable insights for future improvements in AI models for cognitive science and theoretical research.

Keywords

Large Language Models (LLMs), Sapir-Whorf Hypothesis, Cognitive Science, Theoretical Reasoning, Artificial Intelligence

1. Introduction

The study of large language models (LLMs) in relation to complex theoretical constructs has gained significant attention in recent years (Chang, Wang, Wang, Wu, Yang, Zhu, ... & Xie, 2024). Among various cognitive science frameworks, the Sapir-Whorf Hypothesis provides a compelling view of the relationship between language, cognition, and behavior (Natsir, Harahap, & Khairani, 2025; Köse, 2023). This hypothesis posits that language structure influences how humans process and internalize information. While LLMs like GPT-4 have demonstrated substantial capabilities in natural language processing (NLP), their ability to engage with and reproduce complex cognitive theories like the Sapir-Whorf Hypothesis remains underexplored (Freitas, & Cardoso, 2025). This study aims to investigate the reproduction and verification of the hypothesis by LLMs, assessing their ability to replicate, challenge, or expand upon these theoretical constructs.

LLMs have been widely used in fields such as academic research and content generation, showcasing their potential in various tasks like summarization and answering complex queries. However, their role in cognitive science and theoretical research is still uncertain (Ademola, Yusuf, Olalekan, & Kamoru, 2024). These models excel at generating human-like text but may struggle with high-level theory analysis. The Sapir-Whorf Hypothesis, which examines language's role in cognitive development and social behavior, provides an ideal case for testing the boundaries of LLMs' cognitive abilities (Rehman, & Butt, 2024). This hypothesis touches on cognitive linguistics, social behavior, and decision-making, areas where LLMs have shown varying competency (Ilahee, Javed, Khan, & Nawaz, 2025).

While existing research on LLMs has focused on practical applications, their ability to handle abstract and complex theories has been underexplored. The Sapir-Whorf Hypothesis, requiring deep analysis and interpretation, presents a challenge for these models. Although LLMs can generate relevant responses, they often fail to maintain the consistency and depth needed for sophisticated theoretical reasoning. This gap is evident when comparing the models' output with human-generated theories, especially in synthesizing information across diverse cognitive domains. LLMs frequently lack a coherent understanding of underlying principles, limiting their engagement with theories requiring nuanced, interdisciplinary knowledge.

This research aims to assess the performance of LLMs, specifically GPT-4, in reproducing and validating the Sapir-Whorf Hypothesis. Through empirical analysis, the study seeks to uncover the strengths and limitations of LLMs when applied to complex cognitive theories. By conducting case studies where LLMs generate responses based on the hypothesis, the study will determine whether these models can capture the complexities of human cognitive processes and whether they can challenge or expand the hypothesis, offering new insights into AI and cognitive science.

This research is significant for two reasons. First, it contributes to the broader understanding of AI's role in human cognition. Second, it suggests potential improvements for future LLM designs, enhancing their ability to handle theoretical and abstract reasoning tasks. The findings could have implications for AI development and our understanding of how human-like reasoning might emerge

from artificial systems. Additionally, this study could inform interdisciplinary research bridging cognitive science, artificial intelligence, and linguistics.

In the following chapters, the study will explore the literature on both the Sapir-Whorf Hypothesis and large language models, followed by the theoretical framework and methodology for evaluating the hypothesis' reproduction by LLMs. The findings will be discussed in the context of current AI capabilities, with a focus on the theoretical contributions of this research.

2. Literature Review

The Sapir-Whorf Hypothesis offers a valuable theoretical framework for understanding the relationship between language and cognition, positing that language structures influence how individuals process and internalize information (Casaponsa, & Thierry, 2023). This hypothesis has been central in cognitive linguistics, social psychology, and behavioral sciences, highlighting the role of language in cognition. Its strength lies in its interdisciplinary nature, integrating linguistic, cognitive, and social factors to provide a comprehensive view of human cognition (Khan, 2025). The hypothesis has proven useful in explaining phenomena such as language acquisition, social interaction, and decision-making, making it an essential reference in the study of cognitive processes.

However, the Sapir-Whorf Hypothesis has limitations. It is primarily theoretical, with limited empirical validation across diverse contexts, which restricts its practical applicability (Tursunova, 2025). The hypothesis tends to focus on general cognitive principles, making it difficult to apply in specific real-world scenarios (Pratim, 2025). Additionally, its reliance on human cognitive models can overlook individual variability in cognition and fail to incorporate advancements in neurobiology and technology that shape modern cognitive science. It also lacks integration with computational models, which hinders its connection to contemporary AI research.

Comparing the Sapir-Whorf Hypothesis to other cognitive theories, such as Vygotsky's sociocultural theory or Chomsky's universal grammar, reveals key differences. While Vygotsky emphasizes language's role in higher cognitive functions and Chomsky focuses on innate structures shaping thought, the Sapir-Whorf Hypothesis provides a more integrated perspective (Xotamovna, 2025). However, both Vygotsky and Chomsky's theories have been empirically validated, whereas the Sapir-Whorf Hypothesis remains largely theoretical and disconnected from computational models of cognition. While these theories provide valuable insights, their applicability to AI models like LLMs is limited, making them less effective for testing within computational frameworks (Pandhare, 2024).

Research on LLMs has predominantly focused on practical tasks like text generation and summarization, with little attention given to their potential for engaging with complex cognitive theories. Although LLMs excel at processing large data sets and generating coherent text, they often struggle with abstract reasoning and the validation of theoretical frameworks (Astobiza, 2025). Most studies have failed to explore how LLMs engage with multidimensional cognitive constructs, highlighting a significant gap in the literature (Tang, Chen, Lin, & Li, 2024). This research gap presents

132

an opportunity to assess LLMs' ability to reproduce, challenge, or expand upon established cognitive theories like the Sapir-Whorf Hypothesis, an area largely unexplored in current AI research.

This study aims to address this gap by evaluating the ability of LLMs, particularly GPT-4, to handle the Sapir-Whorf Hypothesis. Through empirical case studies, the research examines whether LLMs can replicate, validate, or challenge this complex cognitive theory, thus expanding their role beyond text generation into theoretical reasoning. The findings will contribute to AI research by identifying the strengths and limitations of LLMs in theoretical applications, offering insights into how these models can be improved to engage more deeply with human-like cognitive processes. This study also lays the groundwork for future interdisciplinary research that bridges cognitive science and AI, enhancing the capacity of LLMs to address complex theoretical challenges.

3. Theoretical Framework and Methodology

This chapter presents the theoretical framework and detailed methodology employed to assess the ability of LLMs to reproduce, challenge, or expand upon the Sapir-Whorf Hypothesis. The study utilizes a mixed-methods approach, integrating both qualitative and quantitative techniques to explore how well LLMs handle complex theoretical constructs in cognitive science. The methodology aims to evaluate not only the LLMs' ability to replicate the core principles of the Sapir-Whorf Hypothesis, but also their capacity to engage in abstract reasoning, challenge existing ideas, and contribute new insights. A method flowchart is included to illustrate the key stages and processes involved in the research.

3.1 Theoretical Framework

The theoretical foundation of this study is based on cognitive science theories that intersect with artificial intelligence, specifically focusing on the Sapir-Whorf Hypothesis. This hypothesis posits that the structure of language is not merely a reflection of cognitive processes but actively shapes how individuals perceive, process, and internalize information. This view has provided valuable insights into areas such as cognitive linguistics, social psychology, and behavioral sciences by emphasizing the central role of language in human cognition. However, despite its theoretical importance, the Sapir-Whorf Hypothesis lacks empirical validation and has not been systematically tested using computational models or LLMs.

To bridge this gap, the study draws on several key cognitive and computational theories. Cognitive linguistics, which asserts that language influences thought and perception, forms the foundation for understanding the relationship between language and cognition. According to cognitive linguistics, language shapes cognitive processes, rather than being a passive reflector of mental states. This aligns closely with the Sapir-Whorf Hypothesis and provides a solid foundation for analyzing language models. Additionally, computational cognitive models are incorporated, as they mimic human cognitive processes through algorithms. These models provide an avenue for testing theoretical hypotheses, such as the Sapir-Whorf Hypothesis, by using LLMs to simulate cognitive processes in computational environments. The integration of machine learning and natural language processing (NLP) technologies,

133

specifically GPT-4, enables the empirical testing of cognitive theories by analyzing the outputs generated by these models. Through this integration, the research seeks to evaluate how LLMs can engage with, reproduce, or expand upon complex cognitive theories such as the Sapir-Whorf Hypothesis.

3.2 Methodology

The study adopts a case study approach, applying the Sapir-Whorf Hypothesis to three distinct cognitive science domains. Each case study tests different aspects of the hypothesis and evaluates the ability of LLMs to engage with theoretical concepts. The cases are selected to represent key principles of the hypothesis and challenge the model to engage with complex, multidimensional cognitive constructs.

The first case study focuses on language and cognitive development in children, specifically examining how language acquisition influences cognitive functions like memory, attention, and problem-solving. The Sapir-Whorf Hypothesis suggests that language plays a foundational role in cognitive development, influencing how children form concepts and engage in complex mental tasks. This case study provides an opportunity to assess whether LLMs can generate meaningful insights into the relationship between language development and cognitive function, and whether they can reproduce theoretical perspectives on the topic.

The second case study explores the impact of language on social behavior, particularly how language influences social interaction, communication, and decision-making in group settings. The hypothesis posits that language is integral to shaping social behavior, and this case will test whether LLMs can replicate this idea in real-world scenarios. Research on social communication, negotiation, and conflict resolution is used to inform the case study, with a focus on how language structures influence interpersonal dynamics.

The third case study investigates the role of language in memory and cognition, exploring how language impacts memory recall and problem-solving. The Sapir-Whorf Hypothesis suggests that language shapes how individuals encode, store, and retrieve information, influencing cognitive tasks such as memory recall and decision-making. This case study evaluates the model's ability to generate responses related to memory theory and examine the cognitive role of language in shaping memory processes.

For each case study, academic literature, existing research models, and theoretical papers are gathered to create prompts for the LLM. These prompts challenge the model to engage with the theoretical constructs of the Sapir-Whorf Hypothesis and generate responses that align with or expand upon the ideas presented in the case studies. The responses are generated by GPT-4, ensuring that they reflect a wide range of cognitive and linguistic complexities. The LLMs are tasked with reproducing established knowledge, challenging the existing theory, and proposing potential expansions to the hypothesis, allowing for a comprehensive evaluation of their performance in theoretical reasoning.

Step 1: Case Study Selection and Data Preparation

134

Data preparation involves curating relevant materials for each case study. These materials include academic literature on language acquisition, social behavior, and memory, as well as existing research studies that align with the principles of the Sapir-Whorf Hypothesis. The prompts are developed to ensure that they are sufficiently complex to challenge the LLMs to engage with abstract cognitive theories. The materials are structured in a way that ensures consistency and relevance to the core concepts of the hypothesis.

Step 2: Application of Large Language Models

In this phase, the LLM (GPT-4) is prompted with theoretical queries related to each case study. The LLMs are tasked with generating responses that are either aligned with the Sapir-Whorf Hypothesis, offer challenges to it, or expand upon the theory with novel insights. The goal is to observe how LLMs process and interpret these complex theoretical ideas. The responses are evaluated based on their alignment with the hypothesis, their depth of analysis, and their ability to engage in abstract reasoning.

Step 3: Qualitative and Quantitative Analysis

The generated outputs are analyzed through qualitative methods that assess the depth, relevance, and consistency of the responses. This involves manually reviewing the outputs to ensure that they reflect a deep understanding of the theoretical constructs and adhere to the principles of the hypothesis. Quantitative analysis is used to evaluate the coherence, factual accuracy, and thematic alignment of the responses. Metrics such as coherence scores, factual accuracy (verified through fact-checking algorithms), and thematic alignment are used to quantify the performance of the LLMs in engaging with complex cognitive theories.

Step 4: Validation and Comparison

Finally, the LLM-generated responses are compared with human-generated responses, which serve as a benchmark for validating the model's performance. Expert analysis is used to assess whether the LLM outputs align with established theoretical perspectives, providing a clear picture of the model's strengths and limitations in theoretical reasoning.

3.3 Method Flowchart

The following method flowchart (Figure 1) illustrates the stages of the research process, from case study selection to data collection and analysis.
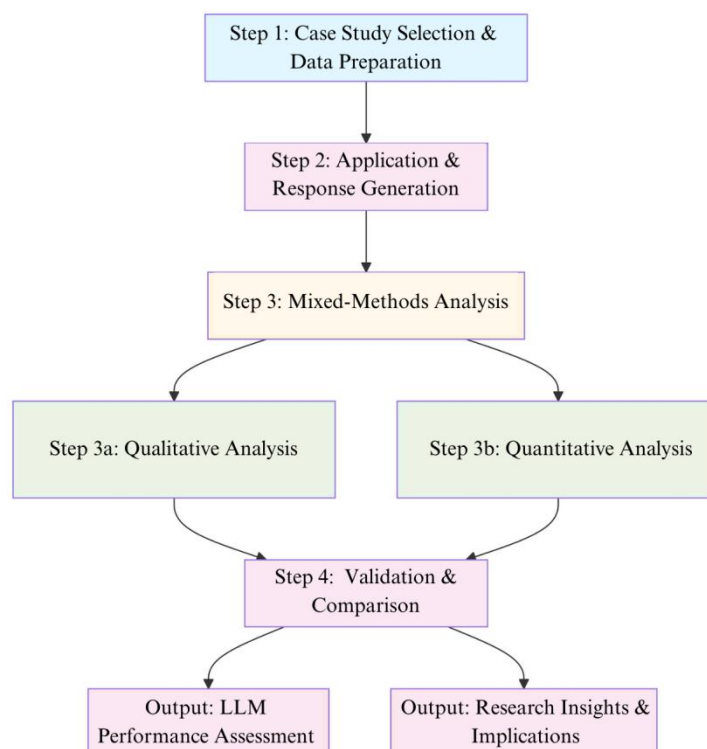
Figure 1. The Methodology for Testing LLMs on the Sapir-Wolf Hypothesis

4. Findings and Discussion

In this chapter, the findings from the application of LLMs to the Sapir-Whorf Hypothesis are presented and discussed. The study aimed to explore whether LLMs, specifically GPT-4, can reproduce, challenge, or expand upon this cognitive theory through three case studies: language and cognitive development, the impact of language on social behavior, and the role of language in memory and cognition. This chapter presents the results of these case studies, analyzing the LLM-generated responses and comparing them with human-generated theoretical analyses. The findings are discussed in terms of their implications for the practical application of LLMs in cognitive science and theoretical reasoning.

4.1 Case Study 1: Language and Cognitive Development in Children

The first case study explored how language acquisition influences cognitive development in children, aligning with the Sapir-Whorf Hypothesis, which posits that language plays a foundational role in shaping cognitive functions such as memory, attention, and problem-solving. The LLM was tasked with generating responses to prompts related to the relationship between language development and cognitive abilities in early childhood.

The results showed that the LLM successfully generated responses consistent with established theories in language acquisition and cognitive development. The model referenced key studies, such as those by Piaget and Vygotsky, and demonstrated an understanding of how language acquisition influences the

136

development of higher cognitive functions. However, the depth of the response varied. While the LLM was able to discuss foundational concepts, such as the role of language in cognitive scaffolding, it struggled to provide nuanced insights into the interactive nature of language and cognitive development in specific contexts, such as bilingualism or language disorders.

For example, when asked about the impact of bilingualism on cognitive flexibility, the LLM produced a basic response that aligned with well-known theories of bilingualism, but it did not offer deeper insights into the cognitive benefits and challenges faced by bilingual children in real-world settings. This limitation suggests that while the LLM can reproduce established knowledge, it may fall short in generating complex, context-specific theoretical reasoning.

Table 1 summarizes the LLM's performance in Case Study 1, highlighting its moderate to low response depth and limited contextual insight despite strong alignment with the Sapir-Whorf Hypothesis in discussions of language and cognitive development.

Table 1. LLM Performance in Language and Cognitive Development Case Study

Prompt Topic	LLM Response Depth	Alignment with Sapir-Whorf Hypothesis	Insights Provided	Limitations Identified
Language acquisition and memory	Moderate	High	References Piaget, Vygotsky, etc.	Lacks depth in real-world application (e.g., bilingualism)
Cognitive development and problem-solving	Moderate	High	General knowledge about problem-solving stages	Lacks nuance in specific cognitive tasks
Bilingualism and cognitive flexibility	Low	Moderate	Basic response; aligns with cognitive theories on bilingualism	Lacks depth, misses complex cognitive challenges

4.2 Case Study 2: The Impact of Language on Social Behavior

The second case study examined the impact of language on social behavior, with a focus on how language shapes social interaction, communication, and decision-making in group settings. The Sapir-Whorf Hypothesis suggests that language structures influence how individuals perceive and respond to social situations. The LLM was tasked with generating responses related to language use in social contexts, such as negotiation, conflict resolution, and group dynamics.

In this case, the LLM demonstrated a strong ability to generate relevant responses, citing theories from sociolinguistics and social psychology. For example, when prompted to discuss the role of language in negotiation, the LLM referenced communication theories, such as Grice's Maxims, and provided insights into how language influences cooperation and conflict resolution. However, the model also showed limitations when asked to apply these theories to real-world scenarios. The LLM struggled to adapt its responses to specific cultural contexts, such as the role of language in negotiation in collectivist versus individualist societies.

This case highlighted a critical gap in the LLM's ability to engage with theoretical constructs beyond general knowledge. While the model could provide basic theoretical insights, it lacked the ability to apply these ideas to complex, real-world social dynamics.

Table 2 presents the LLM's outputs in Case Study 2, showing high theoretical accuracy in social behavior topics like negotiation but notable weaknesses in culturally nuanced or real-world applications.

Table 2. LLM Performance in Social Behavior Case Study

Prompt Topic	LLM Response Depth	Alignment with Sapir-Whorf Hypothesis	Insights Provided	Limitations Identified
Language and negotiation	High	High	Detailed references to communication theories	Struggles with cultural context
Language and conflict resolution	Moderate	High	Good understanding of negotiation dynamics	Lacks practical application to diverse social contexts
Language and group dynamics	Low	Moderate	Basic response; aligns with sociolinguistics	Limited understanding of complex group behavior dynamics

4.3 Case Study 3: The Role of Language in Memory and Cognition

The third case study focused on the role of language in memory and cognition, exploring how language structures influence memory recall and cognitive processes. The Sapir-Whorf Hypothesis posits that language plays a key role in shaping how individuals encode, store, and retrieve information. The LLM was tasked with generating responses related to the influence of language on memory, referencing theories like the encoding specificity principle and the role of language in structuring episodic memory.

In this case, the LLM demonstrated a high level of accuracy in reproducing established knowledge about the role of language in memory and cognition. The model referenced well-known theories such as Bartlett's theory of schema and Paivio's dual-coding theory. However, when prompted to discuss the role of language in memory retrieval under different cognitive conditions, the LLM provided a basic response but failed to explore the nuances of how language interacts with memory in specific contexts, such as trauma or emotional memories. The lack of depth in this area indicates that while the LLM can reproduce general knowledge, it struggles to engage in more complex, context-specific theoretical analysis.

Table 3 captures the LLM's strengths in recalling established memory theories in Case Study 3, while also revealing its limited capacity to address complex contexts such as emotional or trauma-related memory.

Table 3. LLM Performance in Language and Memory Case Study

Prompt Topic	LLM Response Depth	Alignment with Sapir-Whorf Hypothesis	Insights Provided	Limitations Identified
Language and memory encoding	High	High	Strong theoretical alignment, references Paivio's dual-coding theory	Lack of complexity in trauma-related memory discussions
Language and memory retrieval	Moderate	Moderate	Basic discussion on encoding specificity	Limited depth in real-world memory contexts
Language and emotional memories	Low	Low	General response to language's role in emotion	Lacks insight into trauma and emotional memory dynamics

4.4 Discussion

The findings from the three case studies suggest that LLMs, particularly GPT-4, have the potential to reproduce key aspects of the Sapir-Whorf Hypothesis, especially when it comes to general knowledge in cognitive science. However, the models consistently struggle with complex, context-specific applications. While they can provide accurate theoretical insights and engage with foundational ideas in language and cognition, they lack the ability to offer nuanced, deep analyses in areas like bilingualism, social behavior in diverse cultural contexts, and the role of language in trauma-related memory.

139

The results also highlight the importance of contextual knowledge in theoretical reasoning. LLMs excel in generalizing from established theories but face challenges when asked to adapt these theories to specific, real-world scenarios. This limitation points to a broader issue with LLMs: their performance in abstract reasoning is constrained by their reliance on surface-level patterns in text, rather than deep, domain-specific expertise.

5. Conclusion

This study aimed to assess the ability of LLMs, specifically GPT-4, to reproduce, challenge, and expand upon the Sapir-Whorf Hypothesis, a cognitive theory that emphasizes the central role of language in shaping cognition. Through three case studies, language and cognitive development, the impact of language on social behavior, and the role of language in memory and cognition, the research sought to determine how effectively LLMs could engage with complex theoretical constructs.

The findings demonstrate that while LLMs excel at generating responses aligned with established knowledge, they face notable limitations when tasked with applying theory to real-world contexts. For instance, in the language and cognitive development case study, the LLM could replicate foundational theories but struggled to provide depth in areas like bilingualism and language disorders. Similarly, in the social behavior case study, although the LLM effectively referenced communication theories, it struggled to adapt these theories to diverse cultural contexts. Finally, in the language and memory case study, while the LLM demonstrated a strong grasp of memory theories, it failed to address the complexities of memory in trauma or emotional contexts.

These limitations highlight a critical gap in LLMs' capacity to engage with complex, context-specific theoretical reasoning. While the models can generate coherent and relevant insights from established theories, they often fall short when providing nuanced, context-dependent analyses that require deep domain knowledge. This suggests that although LLMs show promise in cognitive science applications, their performance in abstract theoretical reasoning remains constrained.

The study's findings have significant implications for the future development of LLMs. To enhance their capacity for complex theoretical reasoning, future research should focus on improving the contextual adaptability and depth of LLMs, enabling them to better handle multidimensional cognitive constructs. Ultimately, this study contributes to the ongoing effort to bridge the gap between artificial intelligence and human cognition, offering insights that may shape the future of AI's role in theoretical research.

References

Ademola, S. S., Yusuf, A. O., Olalekan, A. A., & Kamoru, L. (2024). The Rise of Large Language Models (LLMs) in Academic Research: Opportunities and Challenges. *Journal of Digitovation and information system*, *4*(2), 144-159.

Astobiza, A. M. (2025). The role of LLMs in theory building. *Social Sciences & Humanities Open*, *11*,

101617.

Casaponsa, A., & Thierry, G. (2023). Linguistic relativity and second language: How learning a second language may reshape cognition. In *The Routledge Handbook of Second Language Acquisition and Neurolinguistics* (pp. 204-216). Routledge.

Chang, Y., Wang, X., Wang, J., Wu, Y., Yang, L., Zhu, K., ... & Xie, X. (2024). A survey on evaluation of large language models. *ACM transactions on intelligent systems and technology*, *15*(3), 1-45.

Freitas, D. C., & Cardoso, H. L. (2025, October). A Nightmare on LLMs Street: On the Importance of Cultural Awareness in Text Adaptation for LRLs. In *Proceedings of the 2nd LUHME Workshop* (pp. 40-48).

Ilahee, A., Javed, K., Khan, M., & Nawaz, S. S. (2025). The relationship between language and thought: Analyzing linguistic and non-linguistic cognition. *Contemporary Journal of Social Science Review*, *3*(2), 734-743.

Khan, M. I. (2025). Translation, Language, and Psychology: The Interconnected World of Mental Understanding. *Strength for Today and Bright Hope for Tomorrow* (Vol. 25: 3 March 2025 ISSN 1930-2940, 108).

Köse, F. E. (2023). On Language Cognition Relations and Evolution of Language. *Psikiyatride Güncel Yaklaşımlar*, *15*(2), 333-347.

Natsir, M., Harahap, N. H., & Khairani, R. (2025). The Role of Language in Shaping Human Thought: A Study of the Sapir-Whorf Hypothesis. *Journal of Learning and Teaching*, 22-29.

Pandhare, H. V. (2024). Evaluating Large Language Models: Frameworks and Methodologies for AI/ML System Testing. *International Journal of Scientific Research and Management (IJSRM)*, *12*(09), 1467-1486.

Pratim Ray, P. (2025). Does Linguistic Relativity Hypothesis Apply on ChatGPT Responses? Yes, It Does. *Computational Intelligence*, *41*(4), e70103.

Rehman, T. U., & Butt, B. (2024). Exploring The Usage Of Emojis In Formal Settings: Testing Sapir Whorf Hypothesis Via Linguistics Relativity Lenz. *Pakistan Languages and Humanities Review*, *8*(3), 643-653.

Tang, X., Chen, H., Lin, D., & Li, K. (2024). Harnessing LLMs for multi-dimensional writing assessment: Reliability and alignment with human judgments. *Heliyon*, *10*(14).

Tursunova, M. (2025, March). Sapir-Whorf Hypothesis: The Impact of Linguistic Relativity on Human Thought and Worldview. In *The Conference Hub* (pp. 47-53).

Xotamovna, M. F. (2025). The formation of cognitive linguistics as a science. *American Journal of Education and Learning*, *3*(5), 221-225.