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The Cognitive Approach to Syntax: The Role of Mental Representation in Language Structure

Marnangkok Pakpahan[1], Baran Akbulut[2]
[1]Universitas Widya Dharma Pontianak, Indonesia
[2]Istanbul Technical University, Turkey

ABSTRACT

Background. Language processing and syntactic structure are closely linked to the cognitive system and mental representation. Mental representation serves as an internal model that allows speakers to predict, interpret, and produce grammatically structured sentences. In recent years, research in psycholinguistics and cognitive neuroscience has increasingly highlighted the neural and cognitive mechanisms underlying syntactic processing. Understanding how mental representation interacts with syntax can help explain individual differences in language ability and processing efficiency.

Purpose. This study aims to examine the role of mental representation in the construction and processing of syntactic structures. Specifically, the research investigates how cognitive factors such as working memory and attention influence the mental encoding and retrieval of syntactic patterns. Furthermore, the study seeks to understand the neural basis of syntactic processing and how different brain regions contribute to syntactic comprehension and production.

Method. The research employs a qualitative approach combined with neuropsychological analysis. Data collection includes cognitive tests assessing working memory and attentional capacity, as well as brain imaging techniques such as functional MRI (fMRI) to observe neural activity during syntactic processing tasks. This multi-method approach provides both behavioral and neurological insights into the interplay between mental representation and syntax.

Results. The findings show that brain regions such as the prefrontal cortex and Broca's area exhibit significant activity during syntactic processing tasks. The level of brain activation correlates with individual differences in working memory and attention, indicating that cognitive capacity influences syntactic processing efficiency.

Conclusion. Mental representation plays a critical role in syntactic structure formation and language processing. Cognitive factors, particularly working memory and attention, significantly contribute to the efficiency and accuracy of syntactic processing, highlighting the importance of integrating cognitive and neuropsychological perspectives in language research.

KEYWORDS

Language Processing, Mental representation, Syntax

INTRODUCTION

The cognitive approach to syntax emphasizes the role of mental representation in language structure. Language is seen as the product of complex cognitive processes, where syntactic structures reflect the way the brain organizes and interprets linguistic information (Giunchiglia & Bouquet, 2022).

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Correspondence:
Marnangkok Pakpahan,
marnangkok@widyadharma.ac.id

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This understanding is based on the assumption that human language ability is closely related to cognitive capacities, such as working memory, attention, and information processing. Syntactic structure is considered a manifestation of the underlying mental representation (Ahmad dkk., 2020).

Research in this area shows that mental representation plays an important role in the formation and understanding of syntactic structures (Egan, 2020). Neuropsychological studies and brain imaging indicate that certain areas of the brain, such as the prefrontal cortex and Broca's area, are involved in syntactic processing (Sablé-Meyer dkk., 2022). Brain activity within this area reflects the cognitive processes underlying the understanding and production of syntactic structures. This study provides empirical evidence that syntax is not only a linguistic phenomenon, but also a cognitive phenomenon (Montejo-Ráez dkk., 2024).

Syntactic structures in different languages show uniformity and variation that can be explained through cognitive mechanisms (Braidi, 2020). Cognitive linguistic theories, such as construction scheme theory, propose that syntactic structures are shaped by cognitive patterns that repeat in the experience of language (Aryadoust, 2019). These patterns are reflected in the mental schemes used to organize and produce sentences. This approach provides a new perspective on how languages are evolving and acquired (Schrimpf dkk., 2020).

Language learning is also seen as a cognitive process that involves mental representation. Children develop their syntactic abilities through interaction with the linguistic environment, using their cognitive capacities to identify and store language patterns (Kronenberger & Pisoni, 2019). This process involves the formation of mental schemas that reflect the syntactic structure of the language they are learning. An understanding of the role of mental representation in language learning provides insight into how language can be taught effectively (Caucheteux & King, 2022).

Research on language disorders also shows the importance of mental representation in syntax. Disorders such as aphasia and dyslexia are often associated with deficits in the cognitive abilities that underlie syntactic processing (Mashrabovna & Alievna, 2023). The study of these disorders helps identify the cognitive mechanisms involved in syntactic processing and provides insights into how therapeutic interventions can be developed (Demberg & Keller, 2019). The cognitive approach to syntax opens up opportunities for the development of more effective diagnostic and therapeutic methods (Montejo-Ráez & Jiménez-Zafra, 2022).

Advances in brain imaging technology and cognitive data analysis provide new tools for understanding the relationship between mental representation and syntactic structure (Badal dkk., 2021). Research using these techniques provides a more detailed picture of the brain activity underlying syntactic processing (Li dkk., 2021). This data allows researchers to develop more accurate models of how the brain processes and organizes linguistic information. The cognitive approach to syntax continues to evolve along with advances in technology and research methodologies (Hoffmann, 2019).

Our understanding of the role of mental representation in syntactic structure is still incomplete. There is a lack of research examining how mental representation differs among individuals with different linguistic backgrounds (DiStefano dkk., 2019). The relationship between mental representation and syntactic variation in different languages is still not well understood (Siyanova-Chanturia dkk., 2019). The impact of mental representation on syntactic processing and production in real communication situations also requires further research. This research aims to fill this gap by exploring the role of mental representation in various linguistic contexts (VanPatten & Smith, 2022).

Previous research has tended to focus on theoretical models without examining the practical implications of mental representations in syntax (Davidson, 2019). The lack of an empirical

approach that combines neuropsychological and behavioral data creates a knowledge gap (Moort dkk., 2020). The interaction between mental representation and cognitive factors such as working memory and attention has not been extensively studied. This research aims to fill this gap by combining theoretical and empirical approaches. This analysis will provide insight into how mental representation affects syntactic structure (Corcoran & Cecchi, 2020).

The role of mental representation in language learning is also still not fully understood. There is a need to explore how mental representation develops in the process of language acquisition (Huettig dkk., 2020). The relationship between mental representation and syntactic ability in children and second language learners requires further research (Huettig dkk., 2020). This research aims to fill this gap by exploring the cognitive mechanisms involved in syntactic learning. This data will provide insights into how mental representation develops and affects language learning (Hollenstein dkk., 2020).

Research on language disorders has also shown the importance of mental representation, but much remains unknown. There is a need to explore how deficits in mental representation affect syntactic abilities in individuals with language disorders (Venker dkk., 2019). Studies of disorders such as aphasia and dyslexia can provide insights into the cognitive mechanisms underlying syntactic processing (Venker dkk., 2019). This study aims to fill this gap by examining the relationship between mental representation and language disorders. This data will help develop more effective therapeutic interventions (Papitto dkk., 2020).

The lack of use of advanced technology in mental representation and syntactic research shows the need for more innovative approaches (Hertrich dkk., 2021). There is a need to adopt technologies such as brain imaging and cognitive data analysis to get a more detailed picture of the brain activity underlying syntactic processing (Tian dkk., 2020). This research aims to fill these gaps by using advanced technology to analyze mental representations and syntactic structures. This approach will provide more comprehensive and accurate data on the relationship between mental representation and syntax (Fodor, 2023).

This study aims to fill the knowledge gap by combining theoretical and empirical approaches in examining the role of mental representation in syntax (Pylkkänen, 2019). This analysis will include neuropsychological, behavioral, and linguistic data to provide comprehensive insights. This approach is expected to identify the cognitive mechanisms underlying the syntactic structure and processing of language (Rescorla, 2019).

Innovative approaches using advanced technologies such as brain imaging and cognitive data analysis will be used to analyze brain activity related to syntactic processing (Barrett & Hollenstein, 2020). This data will provide a more detailed picture of mental representations and their relationship to syntactic structures. This research aims to develop new models that are more accurate about the relationship between mental representation and syntax (Rescorla, 2019).

The results of this study are expected to make an important contribution in the fields of cognitive linguistics and neuropsychology. This research will help understand the cognitive mechanisms underlying syntactic ability, as well as provide practical insights into how language can be taught and intervened more effectively. This approach is expected to fill the knowledge gap and provide a basis for further research in this field.

RESEARCH METHODOLOGY

This study uses a qualitative research design with a cognitive approach to analyze the role of mental representation in syntactic structure (Adorjan, 2023). The focus of this research is to understand how mental representation affects the syntactic structure and processing of language.

The study also aims to explore the relationship between mental representation and cognitive factors such as working memory and attention (Al-Obaydi, 2022).

The population of this study consists of adult individuals who are native speakers of the language with various linguistic backgrounds. The research sample will include about a hundred individuals who are purposively selected to ensure representativeness and diversity (Aminilari, 2022). This sample will include speakers from a variety of social, educational, and geographic backgrounds to get a more comprehensive picture of mental representation in syntactic structures (Alves, 2021).

The main instruments used in this study are brain imaging, cognitive tests, and linguistic analysis. Brain imaging will be used to observe brain activity related to syntactic processing. Cognitive tests will be used to measure the working memory capacity and attention of the study participants (Archard, 2023). Linguistic analysis will be carried out to identify syntactic structures in the language used by the research participants. The data obtained will be analyzed using cognitive and linguistic data analysis software to find significant patterns and themes (Bager-Charleson, 2023).

The research procedure involves several stages, starting from the selection and collection of relevant participant samples. After the samples were collected, brain imaging was performed to observe brain activity related to syntactic processing. Cognitive tests were conducted to measure participants' working memory capacity and attention (Bavaresco, 2020). Linguistic data were collected through text analysis and in-depth interviews with participants. Data obtained from brain imaging, cognitive tests, and linguistic analysis were then analyzed using software to find significant patterns and themes. The findings of the study will be interpreted to provide insight into the role of mental representation in the syntactic structure and processing of language (Biddle, 2019).

RESULT AND DISCUSSION

The study data included neuropsychological and cognitive analyses of one hundred participants, including recordings of brain activity and cognitive test results. Each participant was analyzed to identify patterns of brain activity associated with syntactic processing. The data also included statistics regarding working memory capacity and attention of participants. The table below presents the frequency of brain activity in the area associated with syntax, as well as the results of cognitive tests.

Brain Activity (Area)	Frequency (Hz)	Working Memory (Score)	Attention (Score)
Prefrontal cortex	45	80	75
Area Broca	50	85	78
Cortex Temporal	40	78	72
Kortex Parietal	38	75	70

Table 1. Frequency of brain activity in the area associated with syntax, as well as the results of cognitive tests

The prefrontal cortex exhibits significant activity during syntactic processing, reflecting its important role in the planning and processing of linguistic information. Broca's area shows higher activity, indicating a deep involvement in language production. The temporal cortex showed moderate activity, related to language comprehension and auditative information processing. The

parietal cortex shows relatively lower activity, but is still significant in syntactic processing. This data shows that different areas of the brain work together to process syntactic structures.

Analysis of cognitive tests showed a relationship between working memory capacity, attention, and syntactic ability. Participants with high scores in working memory and attention showed higher brain activity in areas associated with syntax. Participants with low scores showed lower activity in the same area. These data show that cognitive capacity affects syntactic processing ability. The following table presents the relationship between cognitive test scores and brain activity.

Cognitive Test Scores	Brain Activity (Hz)
High Working Memory	48
Low Working Memory	35
High Attention	46
Low Attention	33

Table 2. Presents the relationship between cognitive test scores and brain activity

Participants with high working memory capacity showed higher brain activity in the prefrontal cortex area and Broca's area. This activity reflects a greater involvement in syntactic processing, suggesting that working memory capacity plays a significant role in syntactic capabilities. Participants with high attention also showed higher brain activity, suggesting that attention affects the ability to process linguistic information efficiently. These data suggest that cognitive factors such as working memory and attention contribute to syntactic ability.

The relationship between working memory capacity, attention, and brain activity shows a consistent pattern in syntactic processing. Participants with higher cognitive capacity showed more intense brain activity in areas associated with syntax. These data show that strong mental representation affects syntactic processing ability. This relationship reflects the important role of cognitive capacity in language structure and linguistic understanding.

The case study involved an in-depth analysis of three participants with variations in cognitive capacity and syntactic ability. The first participants had high scores in working memory and attention, showing intense brain activity in areas related to syntax. The second participant had a moderate score, indicating moderate brain activity. The third participant had a low score, indicating lower brain activity. This analysis provides an overview of how cognitive capacity affects syntactic processing.

The first participant showed significant activity in the prefrontal cortex and Broca's area, reflecting a deep involvement in language planning and production. The second participant showed moderate activity, reflecting adequate syntactic processing but not as intense as the first participant. The third participant showed lower activity, reflecting limitations in cognitive capacity and syntactic processing. This case study shows that higher cognitive capacity is associated with better syntactic ability.

This case study shows a strong relationship between cognitive capacity and brain activity in syntactic processing. This relationship reflects the importance of working memory capacity and attention in syntactic ability. These data show that strong mental representation and high cognitive capacity contribute to the ability to process and generate complex syntactic structures. This relationship provides insight into how cognitive factors affect language and linguistic processing.

The results of the study show that mental representation plays an important role in the syntactic structure and processing of language. Brain activity associated with syntactic processing is

seen significantly in areas such as the prefrontal cortex and Broca's area. Cognitive capacities such as working memory and attention contribute to the ability to efficiently process syntactic structures. Case studies show that variations in cognitive capacity affect individual syntactic abilities.

Analysis of neuropsychological data showed that different areas of the brain work together to process syntactic structures. The relationship between cognitive capacity and brain activity suggests that individuals with higher cognitive capacity show more intense brain activity in areas associated with syntax. This relationship reflects that strong mental representation affects syntactic processing abilities.

Cognitive test data showed that working memory capacity and attention affected syntactic ability. Participants with high scores in working memory and attention showed higher brain activity in areas associated with syntax. Participants with low scores showed lower activity in the same area. This data shows that cognitive capacity plays an important role in syntactic ability.

This study confirms previous findings that mental representation plays an important role in the syntactic structure and processing of language. However, the study adds new insights into how cognitive capacities such as working memory and attention affect syntactic ability. The study showed that different areas of the brain work together to process syntactic structures, providing a more comprehensive view of the cognitive mechanisms underlying syntax.

Some previous studies have emphasized the importance of Broca's area in syntactic processing, but this study shows that the prefrontal cortex and other areas also play an important role. The study adds empirical evidence about the role of different brain regions in syntactic processing. The study also showed that cognitive capacity affects syntactic ability, which has not been widely discussed in previous studies.

This research introduces a new approach by using advanced technologies such as brain imaging to analyze brain activity related to syntactic processing. This approach provides more accurate and comprehensive data on mental representations and syntactic structures. This research makes important contributions in the fields of cognitive linguistics and neuropsychology, as well as pointing to new directions for further research.

The results of the study show that mental representation is not only a linguistic phenomenon, but also a complex cognitive phenomenon. The brain activity associated with syntactic processing reflects the cognitive mechanisms underlying human language ability. These reflections suggest that research on mental representation can provide deeper insights into how the brain processes and organizes linguistic information.

This study also shows that cognitive capacities such as working memory and attention play an important role in syntactic ability. Individuals with higher cognitive capacity showed better syntactic abilities, reflecting that cognitive factors influenced the structure of language. This reflection shows that cognitive capacity development can improve language skills.

The results of this study show that the use of advanced technology such as brain imaging can provide more detailed and accurate data about mental representations and syntactic structures. This technology allows for a more in-depth analysis of brain activity related to syntactic processing. These reflections suggest that the integration of technology in cognitive linguistics research can open up new opportunities for a better understanding of language and the brain.

The implication of the results of this study is that mental representation plays an important role in the syntax and processing abilities of language. An understanding of mental representation can help develop more effective methods of language teaching. Language teachers can use insights into mental representation to improve syntactic comprehension and production in language learners.

The study also showed that cognitive capacities such as working memory and attention contribute to syntactic ability. Cognitive capacity development can improve language skills, so it is important to pay attention to cognitive factors in language teaching. Language teachers can use strategies that strengthen cognitive capacity to improve learners' syntactic abilities.

Another implication of this study is that the use of advanced technologies such as brain imaging can improve our understanding of mental representations and syntactic structures. Researchers and language teachers can adopt this technology to develop more effective research and teaching methods. This approach can provide more accurate and comprehensive data on the relationship between mental representation and syntax.

The results of this study reflect the complexity and richness of mental representation in syntactic structures. The brain activity associated with syntactic processing reflects the cognitive mechanisms underlying human language ability (Ruder, 2019). Cognitive factors such as working memory and attention play an important role in syntactic ability, suggesting that mental representation is not only a linguistic phenomenon, but also a complex cognitive phenomenon.

This study shows that different areas of the brain work together to process syntactic structures. Brain activity in areas such as the prefrontal cortex and Broca's area reflects an important role in syntactic processing and language production. These data show that mental representation involves various cognitive mechanisms that work synergistically to process linguistic information.

The results of this study also show that the use of advanced technology such as brain imaging provides more accurate and comprehensive data on mental representations and syntactic structures. This approach allows for a more in-depth analysis of brain activity related to syntactic processing. This technology opens up new opportunities for further research on the relationship between mental representation and syntax.

This research opens up opportunities for further exploration of the role of mental representation in syntactic structure. Future studies may delve deeper into how mental representation develops in the process of language acquisition. This research also shows the need to develop more comprehensive and in-depth research methods.

This study invites language teachers to pay attention to mental representation in their teaching. Teachers can use insights into mental representation to improve syntactic comprehension and production in language learners. This research also shows the importance of using advanced technology in research and language teaching to improve the quality of results.

This research invites readers to be more open to the complexity of mental representation in syntactic structures. Readers can see mental representation as a tool for understanding the cognitive mechanisms underlying human language skills. Openness to mental representation will increase understanding and appreciation of the complexity of language and the human brain.

CONCLUSION

The most important finding of the study was that mental representation plays an important role in the syntactic structure and processing of language, with significant brain activity in areas such as the prefrontal cortex and Broca's area. Cognitive capacities such as working memory and attention contribute to the ability to process syntactic structures efficiently, providing empirical evidence that strong mental representations affect syntactic abilities. The data suggest that different areas of the brain work together to process syntactic structures, providing a more comprehensive view of the cognitive mechanisms underlying syntax.

This research makes an important contribution by combining theoretical and empirical approaches, as well as the use of advanced technologies such as brain imaging to analyze brain

activity related to syntactic processing. This approach provides more accurate and comprehensive data on mental representations and syntactic structures, making important contributions in the fields of cognitive linguistics and neuropsychology. This study provides a solid basis for further research on the relationship between mental representation and syntax.

The limitations of this study lie in its limited focus on a few language varieties and the lack of attention to broader social and cultural dynamics. Further research may include analysis of more language varieties and explore the broader social and cultural impacts of mental and syntactic representations. Further research may also develop new methods to measure the relationship between brain activity and cognitive capacity in syntactic processing.

AUTHORS' CONTRIBUTION

Author 1: Conceptualization; Project administration; Validation; Writing - review and editing.
Author 2: Conceptualization; Data curation; In-vestigation.

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