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Workıng Memory And Ambıguıty Resolutıon In Second Language Comprehensıon: An Experımental Study

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Abstract. *Understanding how learners process ambiguity is a central issue in second language (L2) comprehension research. While previous studies have established a link between working memory and general language performance, its specific role in ambiguity resolution remains insufficiently explored. The present study investigates how differences in working memory capacity influence learners' ability to interpret ambiguous sentences in English. A quantitative experimental design was employed involving 60 intermediate-level EFL learners. Participants completed a working memory assessment using a reading span task, followed by an ambiguity resolution task consisting of structurally and lexically ambiguous sentences. Based on their working memory scores, participants were divided into high and low capacity groups. The data were analyzed using descriptive statistics, independent samples t-tests, and correlation analysis. The results revealed a significant difference between the two groups, with higher working memory capacity associated with greater accuracy in resolving ambiguity. A positive relationship was also observed between working memory and overall performance, suggesting that learners with greater cognitive resources are better able to manage competing interpretations during comprehension. These findings highlight the importance of working memory in handling ambiguity in L2 processing and contribute to a more nuanced understanding of the cognitive mechanisms underlying second language comprehension. The study also offers practical implications for language instruction, particularly in designing materials that account for learners' cognitive limitations. The study provides empirical evidence for the role of working memory as a key cognitive factor in second language ambiguity resolution.*

Keywords: Working memory, Ambiguity Resolution, Second Language Comprehension, Psycholinguistics, Cognitive Processing, EFL Learners

1. Introduction

Second language (L2) comprehension is a complex cognitive process that requires learners to simultaneously decode linguistic input, access lexical knowledge, and integrate contextual information. Among the challenges that learners face, ambiguity represents one of the most persistent and cognitively demanding aspects of language processing. Ambiguous sentences, whether structural or lexical, require the reader or listener to consider multiple possible interpretations before selecting the most appropriate meaning[1].

A key factor that may influence this process is working memory, which is commonly understood as the system responsible for temporarily storing and manipulating information during cognitive tasks. In the context of language comprehension, working memory is believed to support the maintenance of competing interpretations and facilitate the integration of syntactic and semantic information in real time.

Previous research has demonstrated that working memory capacity is associated with various aspects of second language performance, including reading comprehension, listening ability, and syntactic processing. However, much of this research has focused on general comprehension outcomes, with relatively limited attention given to how learners resolve ambiguity specifically. As a result, the precise role of working memory in managing multiple interpretations during L2 processing remains insufficiently explored[2].

In real-world communication, learners frequently encounter sentences that are open to more than one interpretation, and their ability to resolve such ambiguity efficiently can significantly affect overall comprehension.

Despite the growing body of research on working memory in second language processing, little attention has been paid to how learners resolve ambiguity as a dynamic and real-time cognitive process. In particular, the interaction between working memory capacity and different types of ambiguity remains insufficiently examined.

Against this background, the present study aims to investigate the role of working memory in ambiguity resolution during second language comprehension. By examining how learners with different levels of working memory capacity interpret ambiguous sentences, the study seeks to provide a more detailed understanding of the cognitive mechanisms underlying L2 processing.

Unlike previous studies that focus on general comprehension outcomes, this study specifically examines ambiguity resolution as a distinct cognitive process in L2 comprehension. It further contributes by comparing performance across different types of ambiguity and by empirically testing the predictive role of working memory in this context.

2. Literature Review

Research at the intersection of cognitive psychology and second language acquisition has increasingly emphasized the importance of working memory in language processing. According to widely accepted models of working memory, individuals differ in their ability to store and manipulate information, and these differences can have measurable effects on performance in cognitively demanding tasks, including language comprehension[3].

However, not all studies have found a consistent relationship between working memory and second language comprehension. Some researchers argue that task type and proficiency level may mediate this relationship, suggesting that working memory alone may not fully explain variability in L2 processing outcomes. This indicates the need for more focused investigation into specific processes such as ambiguity resolution.

In the field of second language acquisition, several studies have reported a positive relationship between working memory capacity and comprehension outcomes. Learners with higher working memory capacity tend to perform better in reading and listening tasks, as they are better able to retain relevant information while processing incoming input. This advantage becomes particularly evident when dealing with complex syntactic structures or longer discourse segments.

In addition to general comprehension, working memory has also been linked to syntactic parsing and sentence processing. During real-time comprehension, learners must continuously update their interpretation of a sentence as new information becomes available. This process often involves maintaining multiple possible interpretations, especially in cases of ambiguity. Studies in psycholinguistics suggest that individuals with greater working memory capacity are more efficient at managing such competing interpretations[4]

Despite these insights, relatively few studies have directly examined ambiguity resolution in second language contexts. Existing research on ambiguity has largely focused on native speakers, with an emphasis on parsing strategies and processing speed. In contrast, L2 learners may rely more heavily on cognitive resources due to less automatized language knowledge, making working memory an even more critical factor.

Furthermore, ambiguity can arise at multiple levels, including lexical ambiguity (words with multiple meanings) and structural ambiguity (sentences with multiple syntactic interpretations). Successfully resolving such ambiguity requires not only linguistic knowledge but also the ability to hold and evaluate alternative interpretations. This reinforces the idea that working memory plays a central role in this process.

Moreover, previous studies have rarely distinguished between different types of ambiguity when examining working memory effects. This lack of differentiation limits our understanding of how cognitive resources operate across varying linguistic conditions.

This gap is particularly important in light of increasing interest in cognitive approaches to second language processing, where fine-grained distinctions between processing types are essential for theoretical development.

The present study builds on this body of research by focusing specifically on the relationship between working memory capacity and ambiguity resolution in L2 comprehension. By doing so, it addresses a gap in the literature and contributes to a more nuanced understanding of how cognitive factors influence language processing in non-native speakers[5].

3. Methodology

3.1 Research Design

This study employed a quantitative experimental design to investigate the role of working memory in resolving ambiguity during second language (L2) comprehension. The primary aim was to determine whether differences in working memory capacity influence learners' ability to interpret ambiguous linguistic structures[6].

A comparative approach was adopted in which participants were divided into two groups-high and low working memory-based on their performance on a standardized memory task. This design made it possible to examine both group differences and the predictive role of working memory in ambiguity resolution.

To ensure clarity in the research process, the overall procedure of the study is presented in Figure 1.

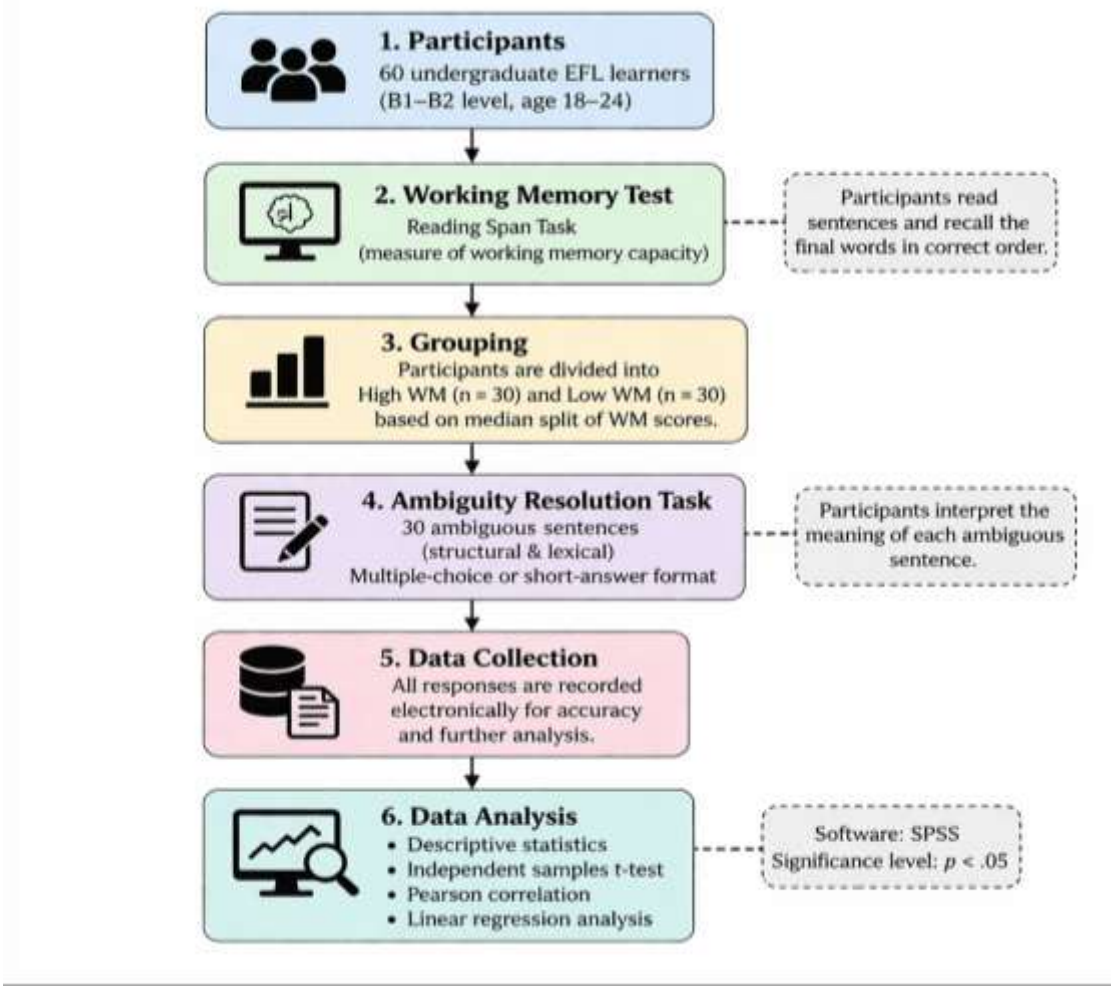

Figure 1. Research Procedure

This figure illustrates the overall design of the study, including participant selection, assessment of working memory through a reading span task, grouping based on working memory capacity, administration of the ambiguity resolution task, and subsequent data collection and statistical analysis.

3.2 Participants

The study involved 60 undergraduate students enrolled in English language programs at a university. All participants were non-native speakers of English and were classified as intermediate-level learners (B1–B2) according to institutional placement criteria.

Participants ranged in age from 18 to 24 years and had received formal instruction in English for a minimum of five years. None reported any known cognitive or language-related impairments. Participation was voluntary, and all individuals provided informed consent prior to the study.

A summary of participant characteristics is provided in Table 1.

Table 1. Participant Characteristics

Group	N	Age Range	Mean Age	Proficiency Level	Years of English Study
High WM	30	18–24	20.8	B1–B2	5–7 years
Low WM	30	18–24	21.1	B1–B2	5–7 years
Total	60	18–24	20.9	B1–B2	5–7 years

This table summarizes the demographic and academic background of the participants, including group distribution based on working memory capacity, age range, mean age, proficiency level, and years of English language study. The sample size was considered adequate for statistical analysis based on comparable studies in second language research.

3.3 Instruments

Two main instruments were used to collect the data.

First, working memory capacity was measured using a computerized Reading Span Task, which is widely recognized in psycholinguistic research. In this task, participants read a series of sentences and were required to recall the final word of each sentence in the correct sequence. The total number of correctly recalled items constituted the working memory score[7].

Second, an ambiguity resolution task was developed to assess participants' ability to interpret ambiguous sentences in English. The task consisted of 30 items, including both structural ambiguities (e.g., sentences with multiple syntactic interpretations) and lexical ambiguities (e.g., words with multiple meanings).

Each item was followed by either multiple-choice options or a short-response prompt requiring participants to identify or explain the intended meaning. The materials were reviewed and piloted in advance to ensure appropriate difficulty and clarity.

The reliability of the ambiguity resolution task was evaluated using Cronbach's alpha, which yielded an acceptable value ($\alpha = 0.81$), indicating good internal consistency.

3.4 Procedure

Data collection was carried out in a controlled classroom environment over a single session. The procedure consisted of two main stages.

In the first stage, participants completed the working memory task individually using computers. Clear instructions were provided, and several practice items were included to ensure familiarity with the task format.

In the second stage, participants completed the ambiguity resolution task. They were instructed to read each sentence carefully and select or provide the most appropriate interpretation. Although no strict time limit was imposed, most participants completed the task within approximately 25–30 minutes.

All responses were recorded electronically to ensure accuracy and facilitate subsequent analysis.

3.5 Data Analysis

The data were analyzed using statistical software. Descriptive statistics were first calculated to summarize overall performance on both the working memory and ambiguity resolution tasks.

Participants were then divided into high and low working memory groups based on a median split of their scores. An independent samples t-test was conducted to determine whether there were significant differences in ambiguity resolution performance between the two groups.

In addition, Pearson correlation analysis was used to examine the relationship between working memory capacity and ambiguity resolution. Finally, a linear regression analysis was performed to assess the extent to which working memory predicts performance in ambiguity resolution tasks.

For all analyses, the level of statistical significance was set at $p < .05$.

Prior to analysis, the data were screened for normality and outliers to ensure the assumptions of parametric tests were met.

4. Results

4.1 Descriptive Overview

The analysis began with a general overview of participants' performance on both the working memory and ambiguity resolution tasks. Overall, the results indicated noticeable variability across individuals, particularly in relation to their working memory capacity.

Participants with higher working memory scores tended to demonstrate greater accuracy in interpreting ambiguous sentences, while those with lower scores showed more frequent misinterpretations. This pattern was consistent across both structural and lexical ambiguity items, suggesting a stable relationship between cognitive capacity and comprehension performance[8].

4.2 Group Differences in Ambiguity Resolution

To further examine this pattern, participants were divided into two groups based on their working memory performance: high and low capacity groups. A substantial difference in ambiguity resolution accuracy was observed between the two groups.

The high working memory group consistently outperformed the low working memory group, achieving higher accuracy rates across the task. This difference is visually presented in Figure 2.

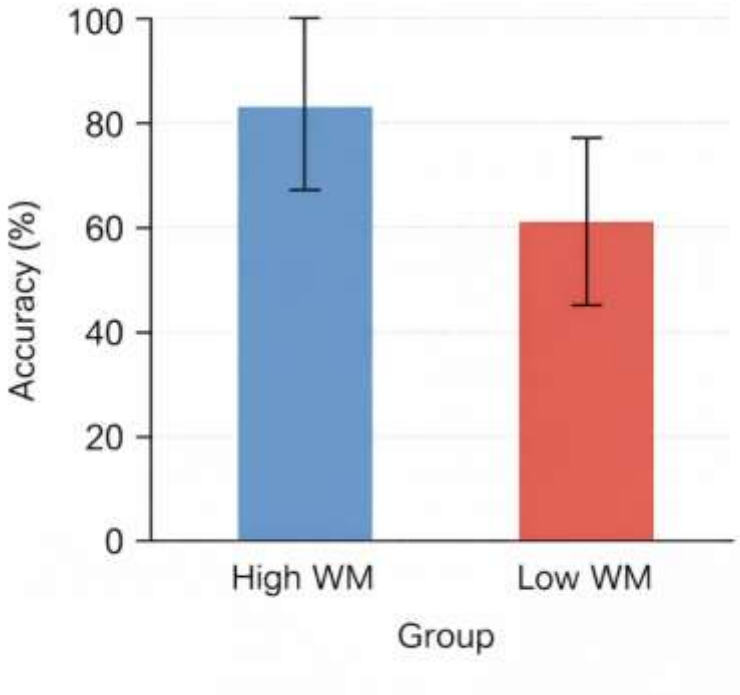

Figure 2. Ambiguity Resolution Performance by Group

This bar chart illustrates the differences in ambiguity resolution accuracy between the high and low working memory groups. As shown, participants with higher working memory capacity achieved significantly higher accuracy scores compared to those with lower working memory capacity. The results highlight the role of cognitive resources in successfully interpreting ambiguous sentences in second language comprehension.

The observed gap between the two groups suggests that learners with greater cognitive resources are better equipped to manage competing interpretations and select the most contextually appropriate meaning.

4.3 Inferential Statistical Analysis

To determine whether the observed differences were statistically significant, an independent samples t-test was conducted. The results confirmed that the difference in performance between the two groups was significant, indicating that working memory capacity plays a measurable role in ambiguity resolution.

A detailed summary of the statistical comparison is provided in **Table 2**.

Table 2. Independent Samples t-test Results

Group	N	Mean (%)	SD	t	df	p-value
High WM	30	80.2	8.7	6.45	58	< .001
Low WM	30	64.8	9.5	-	-	-

This table presents the comparison between high and low working memory groups in terms of ambiguity resolution performance. The results indicate a statistically significant difference between the two groups, with the high working memory group achieving higher mean scores.

The findings demonstrate that the high working memory group not only achieved higher mean scores but also showed more consistent performance, as reflected in lower variability compared to the low working memory group.

The effect size was calculated using Cohen's d, which indicated a large effect ($d = 1.20$), suggesting that the difference between groups was not only statistically significant but also practically meaningful.

4.4 Relationship Between Variables

In addition to group comparisons, the relationship between working memory capacity and ambiguity resolution was examined more broadly. The analysis revealed a positive association between the two variables, indicating that increases in working memory capacity are generally accompanied by improvements in ambiguity resolution performance[9].

This relationship supports the view that working memory contributes to the efficient processing of linguistically complex input, particularly in situations where multiple interpretations must be evaluated.

A Pearson correlation analysis revealed a strong positive relationship between working memory capacity and ambiguity resolution performance ($r = .62$, $p < .001$).

4.5 Summary of Findings

Taken together, the results provide clear evidence that working memory is closely linked to second language ambiguity resolution. Participants with higher working memory capacity demonstrated both greater accuracy and more stable performance patterns.

These findings highlight the importance of cognitive resources in managing ambiguity and suggest that working memory plays a central role in supporting successful second language comprehension.

5. Discussion

The present study set out to explore the role of working memory in ambiguity resolution during second language (L2) comprehension. The results reveal a clear and consistent pattern: learners with higher working memory capacity demonstrate a stronger ability to interpret ambiguous sentences accurately and consistently.

This finding can be interpreted within established models of working memory, which suggest that limited cognitive capacity constrains the ability to maintain and manipulate multiple competing representations during language processing.

One way to understand this finding is by considering the cognitive demands imposed by ambiguity. When encountering an ambiguous sentence, learners are required to maintain multiple potential interpretations while simultaneously integrating contextual and linguistic cues. This process is inherently resource-intensive. Individuals with greater working memory capacity appear to manage these competing demands more effectively, allowing them to delay premature interpretation and arrive at more accurate conclusions[10].

This result is consistent with previous findings in second language processing research, where working memory has been shown to facilitate the management of syntactic complexity and competing interpretations.

Importantly, the advantage observed in the high working memory group was not limited to a specific type of ambiguity. Their performance remained relatively stable across both structural and lexical ambiguity tasks. This suggests that working memory supports a more general mechanism of interpretation, rather than being tied to a single linguistic level. In other words, it contributes to overall processing flexibility and control.

These findings align with broader perspectives in psycholinguistics that emphasize the role of cognitive resources in language processing. However, the current study extends previous work by focusing specifically on ambiguity resolution, an area that has received comparatively less attention in L2 research. By doing so, it highlights the importance of examining not only whether learners understand language, but how they manage uncertainty during comprehension.

Another noteworthy aspect of the results is the difference in performance consistency between groups. Learners with lower working memory capacity not only performed less accurately but also showed greater variability in their responses. This may indicate difficulties in maintaining stable interpretations or in effectively revising initial hypotheses when faced with conflicting information.

From a cognitive load perspective, learners with lower working memory capacity may experience overload when processing ambiguous input, leading to less accurate interpretations. These findings reinforce the view that second language comprehension is not solely a linguistic process but also a cognitively constrained activity shaped by individual differences in processing capacity.

From a pedagogical standpoint, these findings suggest that ambiguity in instructional materials should be carefully managed, particularly for learners with limited cognitive resources. Providing clearer contextual support, reducing unnecessary complexity, and gradually increasing task difficulty may help learners develop more effective processing strategies.

At the same time, it is important to acknowledge that working memory is only one component of a larger cognitive system. Factors such as language proficiency, attention, and prior exposure to similar structures are also likely to influence how ambiguity is resolved. Therefore, the results of this study should be interpreted within a broader cognitive and linguistic framework.

6. Conclusion

The present study provides empirical evidence that working memory plays a critical role in ambiguity resolution during second language comprehension. Participants with higher working memory capacity achieved greater accuracy and showed more consistent performance across tasks, indicating a clear cognitive advantage in managing competing interpretations.

By focusing specifically on ambiguity resolution, the study contributes to a more detailed understanding of second language processing. It moves beyond general measures of comprehension and highlights the importance of examining how learners deal with uncertainty and complexity in real time.

The results also have practical implications for language teaching. Instructional approaches that take into account learners' cognitive limitations may lead to more effective learning outcomes. For example, simplifying input, providing explicit contextual cues, and structuring tasks in a way that gradually increases cognitive demand may support learners with lower working memory capacity.

Despite these contributions, the study is not without limitations. The sample was relatively homogeneous in terms of proficiency level and educational background, which may limit the generalizability of the findings. Future research could expand on this work by including more diverse learner populations and by exploring additional cognitive variables that interact with working memory.

These findings highlight the importance of integrating cognitive perspectives into second language teaching and assessment.

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