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Working Memory, Background Knowledge, and L2 Linguistic Knowledge in L2 Literal and Inferential Reading

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This study investigates how working memory (WM) capacity and L2 linguistic knowledge affect L2 literal and inferential reading comprehension, considering the presence or absence of background knowledge. Eighty upper-intermediate to advanced adult English learners participated, completing tasks to assess WM capacity, background knowledge, L2 linguistic knowledge, and reading comprehension (both literal and inferential). Stepwise regression analyses revealed that WM capacity had a stronger influence on both literal and inferential comprehension when background knowledge was absent. For literal comprehension, L2 linguistic knowledge was the sole predictor when background knowledge was present, while WM capacity dominated in its absence. Inferential comprehension was consistently predicted by WM capacity, regardless of background knowledge. These findings indicate that WM capacity and L2 linguistic knowledge influence L2 reading comprehension differently depending on background knowledge and the type of comprehension. Implications include incorporating WM training into L2 reading instruction and employing diverse WM assessment methods to measure WM independently of L2 linguistic proficiency.

Key words: working memory, background knowledge, L2 linguistic knowledge, L2 literal reading, L2 inferential reading

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1. INTRODUCTION

During reading comprehension, readers engage in the assimilation of both linguistic and extralinguistic information. The reading process is regulated and facilitated by working memory (hereafter WM), which is generally defined as a system for temporary storage and simultaneous processing of information (Baddeley, 2003; Baddeley & Hitch, 1974; Just & Carpenter, 1980). WM is widely regarded as one of the most critical components for cognitive and linguistic performance in both L1 and L2 contexts (Alptekin & Erçetin, 2009, 2010, 2011; Joh, 2016; Leeser, 2007; Shin, Dronjic, & Park, 2019). In addition, WM has been regarded as a crucial cognitive device that affects the development of skills and abilities in L2 reading comprehension (Alptekin & Erçetin, 2011; Leeser, 2007; Shin et al., 2019). To comprehend a text, a reader must decipher words and grasp their meaning within the context of the text, while also remembering information that has already been read. The process relies heavily on WM, which enables the reader to temporarily hold and process information simultaneously (Daneman & Carpenter, 1980; Kintsch & van Dijk, 1978).

The involvement of WM in the reading process is further elaborated in the construction-integration (CI) model proposed by Kintsch (1998). The model provides insights into how readers construct mental representations of texts. According to the CI model, during the construction phase, all available knowledge sources, including linguistic knowledge, are activated and held in WM. Subsequently, in the integration phase, accessing conceptual and extralinguistic knowledge, such as background knowledge, requires the involvement of WM, which allocates cognitive resources to process information from long-term memory (Alptekin & Erçetin, 2011; Kintsch, 1998). Thus, the CI model highlights both the cognitively demanding nature of reading and the potential impact of WM on accessing linguistic knowledge and relevant background knowledge during comprehension.

The role of WM capacity in L2 reading comprehension can be dissimilar depending on the type of comprehension—literal or inferential (Alptekin & Erçetin, 2010). For literal reading comprehension, readers must link incoming information from the text with the information currently held in WM, which allows them to integrate the successive propositions presented in the text. Conversely, inferential reading comprehension depends on the WM capacity to retain the textual information that is currently being processed along with relevant information stored in long-term memory in order to facilitate integration (Andreassen & Bråten, 2010). Investigating the relations and effects among WM capacity, background knowledge, and L2 linguistic knowledge in both L2 literal and inferential reading comprehension is essential for gaining a deeper understanding of how the factors collectively influence different types of L2 reading comprehension.

Few studies have explored the combined roles of WM capacity, background knowledge, and L2 linguistic knowledge on L2 literal and inferential reading comprehension within the framework of the CI model despite evidence supporting the individual or partially interacted impacts of the variables on L2 reading (Alptekin, 2006; Leeser, 2007; Shin, 2020b; Wen & Li, 2019; Zhang, 2012). Since the variables interact during the reading process, a comprehensive investigation of their relationships with literal and inferential comprehension is crucial for deeper insights into their roles and effects. The present study aims to clarify the effects of WM capacity and L2 linguistic knowledge on L2 literal and inferential reading comprehension, considering the presence or absence of background knowledge. By distinguishing between the two types of comprehension, the study also seeks to examine similarities and differences in how WM capacity, background knowledge, and L2 linguistic knowledge impact these dimensions of L2 reading. By elucidating their contributions to L2 literal and inferential comprehension, the research can offer valuable insights into the cognitive processes underlying L2 reading and the factors influencing L2 literal and inferential reading. The findings are anticipated to broaden the understanding of L2 reading comprehension and offer practical implications for language teaching and curriculum development. The present study addresses the objectives by investigating the impacts of the variables on L2 reading comprehension, distinguishing between literal and inferential components through the following research questions:

1) What is the effect of WM capacity and L2 linguistic knowledge on L2 literal and inferential reading comprehension, both with and without background knowledge?
2) Does their effect vary across different dimensions of L2 reading comprehension and under different background knowledge conditions?

2. LITERATURE REVIEW

2.1. Construction-Integration Model

The Construction-Integration (CI) model, developed by Kintsch (1998) and van Dijk and Kintsch (1983), provides a framework for understanding how readers comprehend text using linguistic knowledge, background knowledge, and WM capacity. Originally, the CI model was proposed to explain L1 reading processes but has since been used to describe general reading processes including both L1 and L2 reading. The present study adopts the CI model because it underlines the interaction of WM capacity, background knowledge, and linguistic knowledge in the reading process, corresponding to the focus of the study. The model emphasizes the interaction of the cognitive resources during the reading process, beginning with the surface structure where readers decode words, parse grammatical structures, and access their meanings. At the propositional text-base level, readers connect propositions to form meaning that is directly derived from the text, and finally, at the situation model level, they integrate the information with prior knowledge to create a coherent understanding of the text.

The model describes two key processes: construction and integration. In the construction process, readers build a text-base from not only linguistic input but also from their prior experiences and knowledge. The integration process then refines the text-base into a coherent whole, allowing readers to generate inferences and apply their prior knowledge to build a mental model of the situation described in the text. This explains why different readers can interpret the same text in various ways based on their unique experiences and knowledge (Kintsch, 1998; Wharton & Kintsch, 1991).

The CI model describes that reading comprehension places significant demands on WM capacity and background knowledge as it involves constantly constructing and updating the mental representation of the text's situation. Just and Carpenter (1992) similarly argue that reading comprehension requires substantial WM storage for processing complex and ongoing information. Throughout the cognitive activity, readers rely on their WM capacity and background knowledge to form integrated inferences and maintain a comprehensive understanding of the text (Kintsch, 1998).

2.2. Literal and Inferential Dimensions of Reading Comprehension

The distinction between literal and inferential reading comprehension, based on cognitive demands, can be largely attributed to Kintsch's research on L1 reading processes (Alptekin & Erçetin, 2011). Kintsch (1998) posits that the reading process involves both linguistic and schema factors. Literal comprehension refers to understanding information through verbal decoding while inferential comprehension integrates information from various parts of the text and the reader's background knowledge to derive a coherent meaning.

Although there is debate about whether comprehension difficulty increases linearly with task complexity, inferential reading is generally considered cognitively more demanding than literal reading (Alptekin, 2006). This is due to its greater reliance on WM capacity (Alptekin & Erçetin, 2010; Kintsch, 1998). Inferential comprehension requires more effortful cognitive control processes compared to the relatively automatic processes involved in literal understanding.

Literal reading comprehension operates at a text-based level, where readers engage in lexical decoding and syntactic parsing to grasp explicit information. As a result, the cognitive load on WM is not as extensive, especially for proficient readers. In contrast, inferential reading requires a deeper interaction with the text, where readers integrate textual information with their background knowledge to form a nuanced understanding (Alptekin & Erçetin, 2009, 2010). Here, WM functions as a mental workspace (Kintsch, 1998).

In summary, the reading comprehension construct in the current study is best represented by two dimensions: literal and inferential comprehension. Although Barrett's taxonomy of reading comprehension, as introduced by Clymer (1968), includes five types such as literal recognition or recall, reorganization, inference, evaluation, and appreciation, the present study focuses on the two dimensions. The approach supports the study's aim of examining how WM capacity, background knowledge, and L2 linguistic knowledge contribute to the two aspects of L2 reading comprehension.

2.3. The Role of Working Memory Capacity, Background Knowledge and L2 Linguistic Knowledge in L2 Reading Comprehension

2.3.1. Working memory capacity in L2 reading comprehension

The overall findings regarding WM capacity and L2 reading comprehension largely mirror those of L1 studies, indicating a positive association between the two (Wen & Li, 2019). Several L2 studies suggest a connection between WM capacity and reading abilities, supported by theoretical assumptions and empirical evidence (Alptekin & Erçetin, 2009, 2010, 2011; Joh & Plakans, 2017; Leeser, 2007; Shin, 2020a). For instance, Walter (2004) explored the transfer of reading comprehension skills from L1 to L2 among French learners of English, finding that higher WM capacity correlated with better L2 reading performance, thus suggesting WM's key role in reading skill transfer across languages.

Contradictory results have also been found. For example, Chun and Payne (2004) investigated the effects of WM capacity on L2 reading comprehension, vocabulary acquisition, and recall among English speakers learning German. The results showed no significant relationship between WM capacity and L2 comprehension, vocabulary acquisition, or recall. The researchers speculated that experimental conditions, such as unrestricted access to word annotations and a lack of time constraints, may have obscured any potential effects, leading them to recommend cautious interpretation of their results.

Meta-analyses have further validated the relationship between WM capacity and L2 reading comprehension. Shin (2020b) conducted a meta-analysis of 25 studies, revealing a medium-sized correlation between WM capacity and L2 reading comprehension (r = .30), with task-related features such as language and scoring system affecting the results. Similarly, In'nami, Hijikata, and Koizumi (2022) examined 74 studies, reporting a moderate relationship between the two (r = .30) and emphasizing the importance of WM measurement.

While both individual studies and meta-analyses consistently report a positive and moderate relationship between WM capacity and L2 reading comprehension, there is limited research exploring the nature of WM capacity in relation to other aspects such as background knowledge and L2 linguistic knowledge in L2 reading comprehension. Since WM capacity interacts with the aspects during L2 reading, it is evident that a broader scope of research on how WM capacity relates to L2 reading comprehension in conjunction with other factors could lead to a better understanding of WM capacity and its role in L2 reading.

2.3.2. Background knowledge in L2 reading comprehension

Research has steadily demonstrated that a reader's background knowledge plays a fundamental role in L2 reading comprehension (Carrell, 1984, 1987). Content knowledge, topic familiarity, and cultural knowledge significantly enhance understanding of a text, helping readers form a coherent mental model (Alderson, 2000; Grabe, 2009; Kintsch, 1998). Numerous studies highlight the positive influence of background knowledge on L2 reading comprehension (Alptekin, 2006; Grabe & Stoller, 2020; Rumelhart, 1980). Terms like 'subject knowledge,' 'topic familiarity,' and 'cultural familiarity' have been used to describe various aspects of background knowledge (Alptekin & Erçetin, 2011; Brantmeier, 2005), and all refer to content schemata that aid comprehension.

Several studies have examined the effects of background knowledge on L2 reading. For example, Horiba and Fukaya (2015) found that topic familiarity facilitated comprehension for nursing students who read healthcare-related texts. High topic-familiarity readers produced more coherent text representations and elaborate inferences than low topic-familiarity readers, highlighting how prior knowledge enables readers to better integrate and recall information. Alptekin (2006) similarly investigated cultural familiarity, demonstrating that Turkish students scored higher in inferential comprehension when reading culturally familiar, 'nativized' stories compared to American stories though no difference was observed in literal comprehension.

Despite the overall facilitative role of background knowledge, its effects can vary depending on factors like L2 proficiency, text complexity, and reading strategies. For instance, Barry and Lazarte (1995) explored the relationship between background knowledge and text syntactic complexity in L2 inference generation. They found that low-knowledge readers struggled with more complex texts, making fewer and less accurate inferences compared to high-knowledge readers. High-knowledge readers, however, were able to use their background knowledge to compensate for the increased difficulty, demonstrating that text topic and complexity exert a nuanced influence on inference generation, influenced by the readers' background knowledge levels.

The variability in background knowledge's effects is particularly notable when considering the different dimensions of L2 reading comprehension such as literal and inferential comprehension. Alptekin's (2006) study exemplifies the distinction, showing that while background knowledge may enhance inferential comprehension, its impact on literal comprehension is less pronounced. In addition, research suggests that background knowledge has interactive relationships with other factors like WM capacity and L2 proficiency, indicating the need for a more nuanced understanding of the relationships (Joh & Plakans, 2017; Leeser, 2007; Shin et al., 2019).

Future research should explore the precise role of background knowledge in L2 reading comprehension, particularly in relation to both literal and inferential comprehension. Investigating how background knowledge interacts with WM capacity, as proposed by the CI model (Kintsch, 1998), may offer insights into the cognitive mechanisms underlying L2 reading. Understanding how WM moderates the influence of background knowledge could deepen our knowledge of how L2 readers utilize the resources to derive meaning from texts.

2.3.3. L2 linguistic knowledge in L2 reading comprehension

In the reading process, readers engage in activities like decoding words, integrating syntactic information, and constructing coherence as explained in the surface structure and text base model in the CI model. The process requires linguistic knowledge, including vocabulary and grammar, to construct meaning (Grabe, 2009). L2 researchers have emphasized the importance of linguistic competence in understanding L2 reading comprehension as highlighted by Alderson (1984) who argued that L2 reading difficulties stem from both language proficiency and reading skill deficits. His language threshold hypothesis posits that a minimum level of L2 linguistic proficiency is necessary for readers to transfer L1 reading strategies to L2. Similarly, Clarke's (1980) short-circuit hypothesis suggests that inadequate L2 proficiency hinders effective reading strategies, stressing the need to prioritize language acquisition for improving L2 reading comprehension.

Vocabulary and grammatical knowledge are widely acknowledged as crucial for effective reading comprehension (Choi & Zhang, 2021; Grabe, 2009). While some studies highlight vocabulary as more important than grammar (Zhang, 2012), others argue for the greater role of grammar (Shiotsu & Weir, 2007). Despite ongoing debates about their relative importance, both aspects are essential for L2 reading comprehension.

To fully understand L2 reading comprehension, it is necessary to explore the effects of WM capacity, background knowledge, and linguistic knowledge on L2 reading comprehension including L2 literal and inferential reading comprehension within the CI model which emphasizes the iterative process of construction and integration during comprehension (Kintsch, 1998). A deeper understanding of the roles of the variables and their relationships is essential for unraveling the mechanisms underlying L2 literal and inferential reading comprehension. Therefore, the present study aims to address these aspects systematically.

3. METHODOLOGY

3.1. Participants

A total of 80 Korean EFL learners, both undergraduate and graduate students from diverse academic fields such as engineering, medicine, social sciences, law, and arts participated in the study on a voluntary basis. Their English proficiency was confirmed through standardized test scores with TOEIC scores ranging from 745 to 990 ($M = 916$) and TOEFL iBT scores from 92 to 114 ($M = 101$). These scores placed the participants in the upper-intermediate to advanced level of English proficiency as compared to the national average TOEIC score of 678 (YBM Sisa, 2020). The classification agrees with the Common European Framework of Reference (CEFR) benchmarks, where a TOEFL iBT score of 72 corresponds to B2 (upper-intermediate) level and a score of 95 corresponds to the C1 (Advanced) level (Papageorgiou, Tannenbaum, Bridgeman, & Cho, 2015).

3.2. Materials

3.2.1. L2 reading comprehension test

A multiple-choice reading test adapted from the *TOEFL Institutional Testing Program* (Educational Testing Service, 2018) was used to measure L2 reading comprehension. The test included four passages: two on familiar topics and two on unfamiliar topics. Familiar topics were established by requiring participants to comprehensively read an L1 text related to the topic, but not directly connected to the reading passages and the reading test questions, allowing them to access background knowledge on the topics prior to the test. The L1 text used to provide background knowledge was carefully designed to ensure that it did not overlap with the L2 reading passages or the test questions. Each passage was of comparable length and lexical density, ensuring consistent readability and enabling any differences in comprehension to be attributed to factors such as WM capacity, background knowledge, and L2 linguistic knowledge rather than disparities in text difficulty.

The test comprised 28 questions, evenly distributed across the familiar and unfamiliar passages with 14 questions each. They were further divided into seven literal and seven inferential comprehension questions for both conditions. Literal and inferential questions were categorized using Barrett's taxonomy, originally introduced by Clymer (1968). Literal questions focused on recalling explicitly stated information while inferential questions required interpreting and understanding implied information. Figures 1 and 2 illustrate samples of literal and inferential reading questions.

Figure 1

Literal Reading Question Sample

17. According to the passage, Moore wrote about all of the following EXCEPT (1) artists (2) animals (3) fossils (4) workers

Figure 2

Inferential Reading Question Sample

21. It can be inferred from the passage that Moore wrote because she	
(1) wanted to win awards	(2) was dissatisfied with what others wrote
(3) felt a need to express herself	(4) wanted to raise money for the Bronx Zoo

3.2.2. Working memory capacity task

An L2 reading span task was developed as a measure of WM capacity, following the format of Waters and Caplan (1996), Leeser (2007), and Shin et al. (2019). The task was computerized using *Paradigm* by Perception Research Systems Inc. (Tagliaferri, 2005). Figure 3 presents a sample of the WM capacity task.

Figure 3

Working Memory Capacity Task Sample

SET 2 (2 Sentences)		
Trial 1	1	It is important for a manager to have strong leadership skills.
	2	*The director wants to shoot his new movie the in adventure woods.*

Note:Italicized sentences represent incorrect sentences.

The task aimed to assess WM's storage and processing functions, involving components such as recalling final words, judging sentence acceptability, and recording reaction times to measure storage, processing accuracy, and processing speed. The sentences were adapted from previous studies (Harrington & Sawyer, 1992; Lee, 2014), comprising 42 simple sentences, half of which were semantically and syntactically plausible. Each sentence contained 11 to 13 words, ending with a one-syllable noun with vocabulary selected from the 1,000 to 3,000 frequency bands in the British National Corpus (BNC) words list (Nation & Beglar, 2007) to control task difficulty. All sentences in the task were declarative and affirmative, written in the active voice. They were prescreened with 43 college students who did not participate in the study to ensure an appropriate difficulty level.

In the reading span task, participants silently read a sentence displayed on a computer screen and made immediate judgments on the semantic and syntactical acceptability of the sentence by clicking the *correct* or *incorrect* buttons while their reaction times were recorded. Sentences were grouped into sets of two to five with three trials per set. After each set, participants recalled and wrote down the final words of all sentences. Participants were given two practice trials and detailed instructions before starting the task along with opportunities to ask questions to ensure full understanding.

3.2.3. Background knowledge tasks

As stated in the L2 reading comprehension test, the current study purposefully created two conditions for L2 reading comprehension: with and without background knowledge. Participants read L1 texts related to two L2 reading passages before the L2 reading test to introduce topics and provide background knowledge without significant overlap with the L2 content and reading test questions. The L1 texts focused on Native Americans' lifestyle and agricultural techniques, sourced from Wikipedia, while the L2 passages covered Marianne Moore's life and bird nesting behaviors, presented without prior background knowledge.

To evaluate participants' background knowledge, a topical knowledge test was developed based on the methodologies of Shin et al. (2019) and Joh and Plakans (2017). Figure 4 shows an example of the test questions. The test aimed to confirm participants had knowledge of the Native American topics but lacked familiarity with the others. It was expected that scores for the Native American topics would be higher. If the analyses detected the opposite case, the corresponding data were to be excluded from the analyses.

Figure 4

Background Knowledge (Topical Knowledge) Test Sample

2. 매우 뜨겁고 건조한 토지에 나무가 거의 없는 남서부 지역에 사는 아메리카 원주민들은 진흙벽돌로 집을 지었으며 부락을 이루어 생활했다. **(T/ F/모름)**

The topical knowledge test consisted of 12 questions—six for familiar passages and six for unfamiliar ones—where participants selected answers from *True*, *False*, or *"I don't know."* The test was written in L1 to avoid exposure to L2 vocabulary, aiming to prevent L2 linguistic knowledge from confounding results in the subsequent reading comprehension assessment.

3.2.4. L2 linguistic knowledge tests

L2 linguistic knowledge was measured through assessments of vocabulary and grammar (Figure 5). The vocabulary test was constructed following Nation's Vocabulary Size Test

(VST) (2010), with questions randomly selected from Shin, Chon, and Kim (2011) and Choi (2017). The questions—50 in total—consisted of five questions in each band from the first 1,000 (1K) to tenth 10,000 (10K) word families in the British National Corpus (BNC) words list (Nation & Beglar, 2007). Participants were required to select the correct meaning of a word written in L1. The test demonstrated a Cronbach's α of .787.

Figure 5

Vocabulary and Grammar Test Sample

46. deject: I feel dejected. ① 상쾌한 ② 졸린 ③ 낙담된 ④ 추운 ⑤ 잘 모르겠음 1. It is the most costly musical of the year. (   )

In addition, the grammar test was constructed as a grammatical judgement test. It contained 40 questions, half of which were grammatically correct while the other half were grammatically incorrect. It was designed for participants to make a grammatical judgement after reading each sentence by answering *T* or *F*. The test questions were adopted and revised from Lee (2014) based on pilot test results. The Cronbach's α of the test was .686.

3.3. Data Collection Procedures

The experiment comprised two sessions. In the first session, participants completed three paper-and-pencil tests in sequence: (a) a topical knowledge test following two background passages in L1 (three minutes); (b) an L2 reading comprehension test (35 minutes); and (c) L2 linguistic knowledge tests covering vocabulary and grammar (15 minutes). Conducted online via platforms like *Zoom* or *Webex*, participants chose comfortable locations to enhance concentration. They were required to keep their cameras on during the tests and were prohibited from using supplementary materials such as dictionaries or search engines. The first session lasted approximately 53 minutes. The second session occurred one to two days later, where the researcher and individual participant met at a designated location to assess WM capacity. Each participant had 15 minutes to learn the reading span task, practice with a set, and then complete the task independently.

3.4. Data Analysis

3.4.1. Scoring procedures

The L2 reading comprehension test consisted of 28 questions: a set of 14 questions for two reading passages provided with or without background knowledge, respectively. For scoring, one point was given for each correct answer, totaling 14 points for each set of questions with or without background knowledge and 28 points for full marks. Each set of 14 questions consisted of seven points for literal comprehension questions and seven for inferential comprehension questions. Hence, the test comprised seven points each for inferential questions with and without background knowledge as well as for literal questions with and without background knowledge.

The background knowledge assessment, conducted through a topical knowledge test, featured 12 questions. Six questions were related to familiar reading passages and the other six pertained to unfamiliar passages. Each correct response earned one point, allowing for a maximum score of six points in the familiar or unfamiliar passage categories, respectively. To assess L2 linguistic knowledge, L2 vocabulary and grammar tests were utilized: The former had 50 questions and the latter had 40 questions. One point was given for each correct answer, totaling 90 points.

For measuring WM capacity, three components—(a) the number of sentence-final words correctly recalled (storage), (b) the number of sentences correctly judged (processing accuracy), and (c) the mean reaction times in milliseconds for the sentences correctly judged (processing speed)—were assessed, following the methodology proposed by Waters and Caplan (1996). For scoring the number of last words correctly recalled, minor spelling errors were ignored and one point was given for each correct answer. For scoring the number of correctly judged sentences, one point was also given for each correct answer. In addition, for the mean reaction times for the correctly judged sentences, the computer program *Paradigm* was utilized to measure the length of the time during which the participants read the provided sentences and made a correct judgement in milliseconds. The reaction times were multiplied by -1 since shorter reaction times mean better processing performance (Lee, 2014; Leeser, 2007; Shin et al., 2019). Therefore, 42 points were the maximum score for the first and second components of the WM capacity measure, respectively.

To mitigate the undue impact of extreme observations in each subcomponent of WM capacity, a winsorization procedure was implemented. Winsorization is a robust statistical technique that assigns extreme outliers to a specified percentile of the data, thereby reducing their influence while retaining the qualitative pattern of results (Price, Siegle, & Mohlman, 2012). In the present study, a highly conservative 90% winsorization was applied to values of storage, processing accuracy, and processing speed of WM capacity.

Finally, the scores from the three components were transformed into a *z*-score since they have a different unit: milliseconds and numbers (Lee, 2014). A *z*-score, which is an example of a standardized score, measures how many standard deviations a score is from the mean in a distribution (Brown, 1988). Each *z*-score indicates the score of (a) storage, (b) processing accuracy, and (c) processing speed of WM capacity. To assess WM capacity comprehensively, the three *z*-scores were averaged to derive an overall reading span score for each participant (Leeser, 2007).

3.4.2. Statistical analyses

The data were analyzed using SPSS (version 26.0). First, a paired samples *t*-test was conducted to verify whether the participants possessed background knowledge in the two designated topics as intended and lacked background knowledge in the other two topics. Second, separate stepwise regressions were conducted to address the research questions concerning the predictive power of WM capacity and L2 linguistic knowledge on L2 literal and inferential reading comprehension when background knowledge was either present or absent. They also explored the similarities and differences in predictive power across different dimensions of L2 reading and under varying background knowledge conditions.

4. RESULTS AND DISCUSSION

The descriptive statistics for the variables including (a) L2 reading comprehension (accounting for both the presence and absence of background knowledge as well as literal and inferential reading comprehension), (b) WM capacity, and (c) L2 linguistic knowledge are presented in Table 1. The L2 reading comprehension test scores varied depending on the background knowledge conditions and the different dimensions of reading comprehension.

TABLE 1

Descriptive Statistics of the Variables

		Total	*M*	*SD*
L2 reading comprehension	With background knowledge	14	13.19	1.07
	Literal comprehension	7	6.56	.76
	Inferential comprehension	7	6.63	.58
	Without background knowledge	14	12.36	1.62
	Literal comprehension	7	6.31	.84
	Inferential comprehension	7	6.05	1.01
	Total	28	25.55	2.40
WM capacity	Storage	--	.00	1.00
	Processing accuracy	--	.00	1.00
	Processing speed	--	.00	1.00
	Total	--	.00	.55
L2 linguistic knowledge	Vocabulary	50	37.51	6.64
	Grammar	40	28.66	4.25
	Total	90	66.18	9.24

The little difference between scores for literal and inferential comprehension on the L2 reading comprehension test suggests that inferential comprehension questions, typically seen as more challenging, did not pose greater difficulty for the participants. The result likely reflects the high English proficiency of the participants.

Prior to conducting *t*-test and regression analyses, the data's normality was assessed using skewness and kurtosis values: skewness ranged from -1.921 to -.869 and kurtosis ranged from .047 to 3.294. These values indicate a normal distribution as skewness between -3 and 3 and kurtosis between -10 and 10 are considered acceptable (Kline, 2005). Thus, the data were suitable for further analysis.

A paired samples *t*-test was performed to confirm that participants were being evaluated under two conditions: with and without background knowledge in the L2 reading comprehension test. The results, shown in Table 2, indicate that topical knowledge test scores were significantly higher for familiar topics with background knowledge than for unfamiliar topics without it ($t = 24.022$, $p = .000$). With the confirmation, the main analyses for the study were ready to proceed.

TABLE 2

***t*-test Results of Familiar and Unfamiliar Topic Conditions in the Topical Knowledge Test**

	N	*M*	*SD*	*t*	*p*
Familiar	80	5.15	1.092	24.022*	.000
Unfamiliar	80	1.01	.934		

Note: * $p < .05$

Separate stepwise regression analyses were conducted to explore the effect of WM capacity and L2 linguistic knowledge for L2 literal reading comprehension under with- and without-background knowledge conditions. Stepwise regression is particularly useful for identifying a regression model that includes only those variables with substantial explanatory power as it systematically eliminates variables that do not significantly impact the dependent variable. Tables 3 and 4 display that when background knowledge was available, L2 linguistic knowledge was the only significant predictor of L2 literal reading comprehension, explaining 8.6% of the variance (Table 3). Without background knowledge, WM capacity became the dominant predictor, accounting for 11.6% of the variance (Table 4).

TABLE 3

Results of Stepwise Regression Analysis for L2 Literal Reading Comprehension With-Background Knowledge

Model	B	Std. Error	Beta	*t*	Sig.	R^2	Adjusted R^2
1 (Constant)	4.864	.592		8.223	.000	.097	.086
L2 LK	.026	.009	.312	2.899	.005		

TABLE 4
Results of Stepwise Regression Analysis for L2 Literal Reading Comprehension Without-Background Knowledge

Model	B	Std. Error	Beta	*t*	Sig.	R^2	Adjusted R^2
1 (Constant)	6.312	.088		71.852	.000	.127	.116
WM	.539	.160	.357	3.375	.001		

Next, to investigate the effect of the variables for L2 inferential reading comprehension, depending on the presence or absence of background knowledge, separate stepwise regression analyses were also conducted. The results revealed that WM capacity was the sole significant predictor in both conditions. For the with-background knowledge condition, WM capacity accounted for 4.6% of the variance in L2 inferential reading comprehension (Table 5). In the without-background knowledge condition, WM capacity explained a larger portion, accounting for 20.3% of the variance in L2 inferential reading comprehension (Table 6).

The results revealed that the R^2 values from the regression analyses were relatively low. While the predictor variables showed statistical significance, they explained only a small portion of the variance, indicating that other factors not examined in the study may also play a role.

TABLE 5
Results of Stepwise Regression Analysis for L2 Inferential Reading Comprehension With-Background Knowledge

Model	B	Std. Error	Beta	*t*	Sig.	R^2	Adjusted R^2
1 (Constant)	6.625	.064		104.268	.000	.058	.046
WM	.254	.116	.241	2.198	.031		

TABLE 6
Results of Stepwise Regression Analysis for L2 Inferential Reading Comprehension Without-Background Knowledge

Model	B	Std. Error	Beta	*t*	Sig.	R^2	Adjusted R^2
1 (Constant)	6.049	.100		60.316	.000	.213	.203
WM	.839	.182	.462	4.601	.000		

Overall, the current results illustrate different impacts of WM capacity and L2 linguistic knowledge on L2 reading comprehension based on background knowledge conditions. They suggest that WM capacity was a stronger predictor of L2 reading comprehension, including both literal and inferential aspects, in the absence of background knowledge. For instance, WM capacity accounted for 20.3% of the variance in L2 inferential comprehension without background knowledge but only 4.6% when background knowledge was provided. The result corroborates the “compensation model” by Hambrick and Engle (2002) and the “Stanovich model” by Stanovich (1980, 2000), which proposes that deficiencies in one area of knowledge or skill, such as background knowledge, can be compensated for by strengths in another area, like WM capacity.

The results also reveal discrepant roles of WM capacity and L2 linguistic knowledge in L2 literal and inferential reading comprehension, which can be attributed to the distinct characteristics inherent in each type of reading. The present findings illuminate that L2 linguistic knowledge was a predictor of L2 literal reading comprehension in the with-background knowledge condition while WM was a predictor of L2 literal reading comprehension in the without-background knowledge condition and L2 inferential reading comprehension in both with- and without-background knowledge conditions. Literal reading comprehension primarily involves understanding facts and information explicitly stated in the text, which demands less cognitive load on WM capacity due to the relatively automatic processes, especially for advanced-level L2 readers (Alptekin & Erçetin, 2009). In this regard, the result that L2 linguistic knowledge was found to be a single and significant predictor of L2 literal reading comprehension in the with-background knowledge condition is reasonable and aligns with expectations.

On the other hand, inferential reading comprehension is regarded cognitively more demanding, requiring readers to engage in reasoning beyond the text to form new interpretations (Alptekin & Erçetin, 2009, 2011). The process imposes greater demands on WM capacity as readers must manipulate information from the text, retrieve prior knowledge, and integrate it to generate insights (Molokopeeva & Simard, 2024). In line with the features of inferential comprehension, the study found that WM capacity significantly predicted inferential comprehension in both with- and without-background knowledge conditions. The result is corroborated by the finding from Alptekin and Erçetin (2011) which indicated a significant role of WM capacity in L2 inferential comprehension rather than L2 literal comprehension.

5. CONCLUSION

The study investigated the effects of WM capacity and L2 linguistic knowledge on L2 reading comprehension, considering the influence of background knowledge and differences in L2 literal and inferential comprehension. The results revealed that the impacts of WM capacity and L2 linguistic knowledge on L2 reading comprehension vary depending on both background knowledge conditions and dimensions of L2 reading comprehension.

The present study seeks to extend the scope of existing findings by further exploring the role of WM capacity with other variables such as background knowledge and L2 linguistic knowledge in L2 literal and inferential reading comprehension. A clearer understanding of the contributions and effects of the variables across specific dimensions of L2 reading comprehension is essential for developing theoretical reading models and instructional frameworks that can assist L2 learners in becoming more proficient readers (Oh, 2011).

The results underscore the role of WM capacity in L2 reading comprehension and highlight the importance of helping L2 readers effectively use their WM capacity during reading tasks. Notably, WM capacity is not fixed and can be improved through targeted training or strategy practices (Morrison & Chein, 2011). Integrating WM training with L2 reading materials and activities can enhance reading comprehension. For example, incorporating complex span tasks, such as L2 reading span tasks, into instructional programs can effectively train WM capacity. Richmond et al. (2011) demonstrated that targeted WM training, including complex verbal span tasks, can significantly improve WM capacity. The L2 reading span task, which involves reading sentences in L2 while recalling unrelated words, allows learners to practice dual-task management, enhancing their ability to retain and manipulate information in WM while engaging with L2 texts. This, in turn, can lead to improved L2 reading comprehension.

The present study utilized the L2 reading span task to measure participants' WM capacity. However, it is important to recognize that advanced English learners may benefit from their higher L2 linguistic skills, potentially affecting their task performance (Yuill, Oakhill, & Parkin, 1989). To address the limitation, future studies should consider including additional WM span measures such as the L1 reading span task or the operation span task (Turner & Engle, 1989). Using multiple tasks would allow researchers to assess WM capacity independently of L2 linguistic ability.

Applicable levels: Tertiary

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