Research Article

Korean J Child Stud 2026;47(3):177-191
https://doi.org/10.5723/kjcs.2026.47.3.177
pISSN: 1226-1688 eISSN: 2234-408X

KJCS
Korean Journal of Child Studies

The Building Blocks of Reading Comprehension: Evidence from Decoding and Word List Recall

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읽기 이해의 구성 요소: 해독과 단어목록 회상을 중심으로

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Objective: This study examined whether decoding and word list recall (WLR), an episodic-buffer-related verbal memory task, predict reading comprehension among Korean-speaking first-grade children. In particular, the study investigated whether ordered and random WLR conditions differentially contribute to reading comprehension beyond decoding ability.
Methods: Forty-four Korean-speaking first-grade children participated in this study. Nonverbal intelligence (NVIQ) was assessed using the Korean Kaufman Brief Intelligence Test–II (K-BIT-II). Decoding and reading comprehension were measured using the Korean Language-Based Reading Assessment (KOLRA). Episodic-buffer-related verbal memory was assessed using the WLR task under ordered and random conditions. Partial correlations controlling for NVIQ and multiple linear regression analyses were conducted.
Results: Decoding was strongly associated with reading comprehension. Both ordered and random WLR scores were also significantly associated with reading comprehension after controlling for NVIQ. However, decoding was significantly related to the ordered WLR condition but not to the random WLR condition. In the regression model predicting reading comprehension, decoding significantly predicted reading comprehension, and random WLR explained additional unique variance beyond decoding. In contrast, ordered WLR did not uniquely predict reading comprehension.
Conclusion: These findings suggest that early reading comprehension is supported by distinct but complementary skills. Decoding contributes to reading comprehension through accurate word reading, whereas random WLR appears to capture episodic-buffer-related verbal memory processes independent of decoding. Because random WLR uniquely predicted reading comprehension beyond decoding, verbal memory processes may support comprehension independently of decoding ability.

***Keywords*:** reading comprehension, decoding, word list recall, episodic buffer

Introduction

Reading comprehension is a central goal of early literacy development because it requires children to extract and construct meaning from written language, rather than simply recognize printed words (Snow, 2002). Word recognition provides access to written input, but access alone does not guarantee understanding (Perfetti & Stafura, 2014). To comprehend what they read, children must connect identified words to sentence- and text-level representations and integrate information across clauses, sentences, and short passages (Kintsch, 1988; Perfetti & Stafura, 2014). In this process, children

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build a coherent mental representation of the text by linking individual word meanings with the surrounding linguistic context (Kintsch, 1988; Perfetti & Stafura, 2014). This is particularly important in early reading, when children are still learning to coordinate word-level reading with broader language comprehension and cognitive processes (Cain, Oakhill, & Bryant, 2004; Kendeou, van den Broek, White, & Lynch, 2009). Accordingly, early reading comprehension is not a single skill but a complex outcome supported by multiple component skills, including lower-level reading skills such as decoding and higher-level language-cognitive skills involved in constructing meaning from text (Cain et al., 2004; Duke & Cartwright, 2021; Kendeou et al., 2009).

Among the lower-level skills that support early reading comprehension, decoding is especially important because it allows children to translate printed words into corresponding phonological forms and access word meanings (Ehri, 2005; Gough & Tunmer, 1986). In other words, decoding provides the entry point from print to language: children must first identify written words accurately before they can use the meanings of those words to understand sentences and text. The simple view of reading captures this idea by identifying decoding as one of the two core components of reading comprehension, along with linguistic comprehension (Gough & Tunmer, 1986; Hoover & Gough, 1990). According to this model, decoding supports access to written words, whereas linguistic comprehension supports the interpretation of those words within larger sentence- and text-level contexts (Gough & Tunmer, 1986; Hoover & Gough, 1990). This role may be especially important for early readers, whose word recognition skills are still developing and may require substantial cognitive effort (Ehri, 2005). As decoding becomes more accurate and efficient, children can access word meanings more reliably and devote more resources to constructing meaning beyond the single-word level (Ehri, 2005). Consistent with this view, decoding has been shown to make an independent contribution to reading comprehension in early elementary school children (Kendeou et al., 2009). However, successful reading comprehension requires more than accurate access to individual word meanings. As children move through a sentence or text, they must temporarily maintain the meanings of decoded words and integrate them with previously processed information to construct a coherent representation of the text.

These developmental characteristics make first grade a particularly informative period for examining the contributions of decoding and word list recall (WLR) to reading comprehension. In stage-based accounts of reading development, grades 1 and 2 are characterized as an initial reading stage during which children acquire and consolidate the decoding skills required for accurate word recognition (Chall, 1983). During this period, decoding continues to place a substantial constraint on reading comprehension because word recognition has not yet become fully accurate and automatic. Indeed, the association between decoding and reading comprehension is generally stronger among younger readers and decreases as children's reading skills develop (García & Cain, 2014). Longitudinal evidence also indicates that the relations among word-level reading, reading fluency, and reading comprehension change substantially from grade 1 to grade 2 as children become more proficient readers (Y.-S. Kim, Wagner, & Lopez, 2012). This developmental significance is also reflected in the Korean national curriculum, which emphasizes both the acquisition of Hangeul decoding skills and the development of foundational abilities to understand written sentences and texts in grades 1 and 2 (Ministry of Education, 2015). Thus, first grade should not be viewed as a stage at which the transition from decoding to comprehension has already been completed, but rather as an early transitional period in which children are consolidating decoding while increasingly being required to retain, integrate, and interpret decoded verbal information. Examining children at this stage therefore provides an opportunity to determine whether ordered and random WLR explain individual differences in reading comprehension beyond the contribution of their still-developing decoding skills.

Korean-speaking first graders also constitute a theoretically informative population because of the characteristics of Hangeul. Hangeul has relatively systematic grapheme-phoneme correspondences, which may support the rapid development of basic decoding accuracy compared with less consistent orthographies such as English (Aro & Wimmer, 2003; Seymour, Aro, & Erskine, 2003). However, Korean word reading is not entirely transparent because written forms may be altered in pronunciation through context-sensitive phonological and morphophonemic rules. Beginning Korean readers must therefore learn not only basic print-sound correspondences but also how these rules apply during word recognition, and phonological and morphological awareness have been shown to contribute differently to regular and irregular word reading (Cho, McBride-Chang, & Park, 2008). First grade is thus a particularly appropriate stage for the present study because decoding is sufficiently developed to support access to written words but remains variable as children learn to apply Korean-specific orthographic and phonological rules. At the same time, children are increasingly required to retain and integrate decoded information to understand sentences and text. This combination makes Korean-speaking first graders especially suitable for examining whether verbal memory contributes to reading comprehension beyond children's developing decoding skills.

Although decoding provides essential access to written words, successful reading comprehension requires more than accurate word identification (Perfetti & Stafura, 2014). After words are identified, children must keep recently processed verbal information available while connecting it to upcoming words, sentences, and short stretches of text (Perfetti & Stafura, 2014). This integration process is necessary for constructing a coherent meaning representation, because comprehension depends on linking individual word meanings into larger sentence- and text-level interpretations (Kintsch, 1988; Perfetti & Stafura, 2014). Such processing places demands on working memory, which supports the temporary storage and manipulation of information during complex cognitive activities such as language comprehension (Baddeley, 1992; Daneman & Merikle, 1996). Within this framework, the episodic buffer provides one possible account of how information may be temporarily combined into integrated representations and linked with long-term knowledge (Baddeley, 2000). Thus, even when children can decode written words accurately, reading comprehension may still depend on their ability to temporarily retain and organize verbal information during reading. Verbal recall tasks such as WLR may provide indirect information about some of these verbal memory demands, although they do not isolate the episodic buffer or any single working-memory component (Baddeley, 2000; Chun & Yim, 2017).

Building on this account, WLR provides a useful way to examine children's ability to maintain verbal sequences in working memory. In this task, children recall word lists presented either in a sentence-like order or in a random order (Chun & Yim, 2017; Lee & Yim, 2025). The ordered condition provides linguistic structure, allowing children to use syntactic knowledge and prior language experience to organize individual words into larger, more meaningful chunks (Chun & Yim, 2017; Lee & Yim, 2025). Such linguistic chunking may support recall by reducing the need to retain each word as a separate item and by helping children integrate new verbal input with existing language knowledge (Lee & Yim, 2025). In contrast, the random condition reduces this organizational support because words are presented without sentence-like structure. This condition therefore places greater demands on the temporary retention of individual lexical items and their serial order (Chun & Yim, 2017; Lee & Yim, 2025). Comparing ordered and random WLR conditions may provide information about the extent to which recall benefits from linguistic organization versus the temporary retention of individual words and their serial order. However, differences between the conditions should not be interpreted as directly isolating a specific working-memory component.

Taken together, decoding and verbal memory may support complementary processes in reading comprehension. Decoding provides access to word-level phonological and semantic information, whereas working memory may help keep this information available while it is connected across words, sentences, and text (Daneman & Merikle, 1996; Kendeou et al., 2009; Seigneuric & Ehrlich, 2005). This framework provides the rationale for examining whether WLR contributes to reading comprehension beyond children's decoding skills.

However, prior Korean studies using WLR have primarily demonstrated differences in recall performance across ordered and random conditions rather than examining how each condition contributes to reading comprehension (Chun & Yim, 2017; Lee & Yim, 2025). In particular, it remains unclear whether ordered and random WLR explain unique variance in reading comprehension after children's decoding skills and general nonverbal intelligence (NVIQ) are taken into account. Addressing this gap is theoretically important because it can clarify whether WLR performance provides additional information about verbal memory demands associated with reading comprehension beyond accurate word recognition. It is also practically important because distinguishing the contributions of decoding and verbal memory may help identify whether early reading comprehension difficulties arise primarily from inefficient word reading or from limitations in retaining and integrating verbal information.

To evaluate the unique contribution of WLR more rigorously, it is also necessary to consider children's general cognitive ability. Performance on decoding, verbal memory, and reading comprehension tasks may reflect not only language- and reading-specific processes but also broader domain-general abilities, including nonverbal reasoning and problem solving. Previous research has shown that intelligence accounts for individual differences in reading comprehension and that part of its contribution to reading may operate through decoding ability (Tiu, Thompson, & Lewis, 2003). Nonverbal fluid intelligence has also been associated with reading comprehension in school-age children (Johann, Könen, & Karbach, 2020). Moreover, although working memory and intelligence are related, they represent distinguishable cognitive abilities and make independent contributions to children's academic attainment (Alloway & Alloway, 2010). These findings highlight the importance of accounting for NVIQ when examining whether verbal memory contributes specifically to reading comprehension.

To address these gaps, the present study examined the relations among decoding, ordered and random WLR, and reading comprehension in Korean-speaking first-grade children. The study was guided by the theoretical assumption that decoding and verbal memory support complementary stages of reading comprehension: decoding provides access to the phonological and semantic representations of printed words, whereas verbal memory supports the temporary maintenance and integration of this information across sentences and text. Accordingly, we expected decoding and both WLR conditions to be positively associated with reading comprehension. We further expected decoding to explain unique variance in reading comprehension because accurate word recognition remains a central constraint on comprehension during the early stages of reading development. Because random WLR provides less sentence-like structural support than ordered WLR, it was expected to place greater demands on the temporary retention of individual words and their serial order. We therefore examined whether random WLR would contribute to reading comprehension after decoding and NVIQ were taken into account, without assuming that it directly measured a specific working-memory component. Ordered and random WLR were examined separately to determine whether their differing linguistic and memory demands were associated with distinct patterns of contribution to reading comprehension.

The study was guided by two research questions:

1. Are decoding and WLR associated with reading comprehension in Korean-speaking first-grade children?
2. Do ordered and random WLR conditions uniquely predict reading comprehension beyond decoding and NVIQ?

Methods

Participants

Participants were 44 Korean-speaking children enrolled in the first grade at a private elementary school in Seoul, South Korea. The sample included 29 boys and 15 girls. The children had a mean age of 87.27 months (*SD* = 3.67). All participants used Korean as their primary language and had no parent-reported hearing or vision problems or history of a diagnosed developmental disorder or neurological condition.

The participating school was a private elementary school that enrolled children from multiple residential areas rather than serving only children from a single local neighborhood. Thus, although all participants attended the same school, they did not necessarily share the same residential or regional background. Family-level socioeconomic information, including parental education, household income, and participation in private education, was not collected. Therefore, the socioeconomic composition of the sample could not be directly characterized.

Measures

NVIQ was assessed using the Korean Kaufman Brief Intelligence Test-II (K-BIT-II; Moon, 2020). This measure was administered to assess children's nonverbal cognitive ability and was included as a control variable in the main analyses. Receptive and expressive vocabulary were assessed using the Receptive and Expressive Vocabulary Test (REVT; Y. Kim, Hong, Kim, Jang, & Lee, 2009) to characterize children's language abilities. Decoding and reading comprehension were measured using the Korean Language-Based Reading Assessment (KOLRA; Bae, Kim, Yoon, & Jang, 2015). For the decoding task, children read aloud 40 real words and 40 nonwords, and decoding accuracy was calculated based on the total number of correctly read items. For the reading comprehension task, children completed 24 cloze-type items that required them to read sentences or short passages and provide the missing word that best completed the meaning of the text.

WLR was used to assess children's ability to temporarily maintain verbal sequences. The task included two order conditions: ordered and random, in which children recalled word lists presented either in a sentence-like sequence or in a random order (Chun & Yim, 2017; Lee & Yim, 2025). In the ordered condition, words were presented in a sentence-like sequence, providing syntactic and linguistic support that allowed children to organize individual words into larger, meaningful chunks (Chun & Yim, 2017; Lee & Yim, 2025). In the random condition, words were presented without sentence-like organization, reducing linguistic support and placing greater demands on the temporary retention of individual lexical items and their serial order (Chun & Yim, 2017; Lee & Yim, 2025). Children listened to each list and orally recalled the words in the presented order. Accuracy scores were calculated for each condition and used in the statistical analyses. The two conditions were analyzed separately to examine whether linguistically supported recall and recall under reduced organizational support were differentially associated with reading comprehension.

Procedure

Recruitment information was distributed through the school to the families of children enrolled in all first-grade classrooms. Parents indicated their interest in participating by completing an online application form and subsequently provided informed consent for their child's participation.

Eligibility was determined based on parental reports provided through the online application form. To be eligible, children were required to be enrolled in the first grade, use Korean as their primary language, have no reported hearing or vision problems, and have no history of a diagnosed developmental disorder or neurological condition. All 44 children whose parents submitted an application met the eligibility criteria and proceeded to the assessment sessions. Thus, the participants constituted a volunteer convenience sample recruited from a single private elementary school.

Data collection was conducted between September and October 2025. Each child completed two individual assessment sessions on separate days in a quiet room at the school. Each session was administered by a trained researcher and lasted approximately 40-50 min, resulting in a total assessment time of approximately 80-100 min per child.

The assessments of nonverbal intelligence, receptive and expressive vocabulary, decoding, reading comprehension, and WLR were distributed across the two sessions to reduce fatigue and maintain attention. Standardized instructions were provided for each task. During the WLR task, children listened to prerecorded word lists and orally recalled the words in the order in which they had been presented. Short breaks were provided between tasks as needed or upon the child's request.

Data Analysis

All statistical analyses were conducted in R (version 4.5.2; R

Core Team, 2025). Descriptive statistics were calculated for all main study variables, including decoding, reading comprehension, ordered WLR, random WLR, and NVIQ. Partial correlations controlling for NVIQ were conducted to examine associations among decoding, WLR, and reading comprehension after accounting for broader cognitive ability.

Multiple linear regression analysis was used to examine whether ordered and random WLR explained unique variance in reading comprehension beyond decoding and NVIQ. Reading comprehension was entered as the outcome variable, and decoding, ordered WLR, random WLR, and NVIQ were entered as predictors in the same model. Including ordered and random WLR in the same model allowed us to determine whether each WLR condition made a unique contribution to reading comprehension after decoding and NVIQ were included in the model. Additional regression models examined whether decoding predicted ordered and random WLR after controlling for NVIQ.

Given that the available sample size was fixed at 44 participants, a sensitivity power analysis was conducted using G*Power 3.1 (Faul, Erdfelder, Buchner, & Lang, 2009). For a fixed-model multiple regression testing the increase in R^2 associated with one focal predictor, with four predictors in the full model, α = .05, and statistical power of .80, the present sample was sufficient to detect an incremental effect of f^2 = .19 or larger. Thus, the study was adequately powered to detect medium or larger unique effects, although smaller effects may not have been detected.

Results

Descriptive Statistics

Descriptive statistics for the main study variables are presented in Table 1. Complete data were available for all 44 children included in the analyses. The mean NVIQ standard score was 116.39 (*SD* = 16.63), with scores ranging from 79 to 149. The mean decoding score was 61.18 (*SD* = 7.94) out of a maximum possible score of 80, corresponding to approximately 76.5% of the total score. The mean reading comprehension score was 9.16 (*SD* = 4.77) out of a maximum possible score of 24, indicating that the children answered, on average, approximately 38.2% of the items correctly. Thus, performance on the reading comprehension task was farther from the maximum possible score than performance on the decoding task. The decoding, reading comprehension, and WLR scores represent raw task performance and should not be interpreted as norm-referenced classifications of reading or verbal recall ability, whereas the NVIQ values represent age-standardized scores. For WLR, children showed higher performance in the ordered condition (*M* = 54.82, *SD* = 5.66) than in the random condition (*M* = 42.89, *SD* = 7.31), indicating that recall performance was higher when words were presented with sentence-like organizational support.

Correlations Among Decoding, WLR, and Reading Comprehension

Partial correlations controlling for NVIQ are presented in Table 2. The partial associations between reading compre-

Table 1

Descriptive Statistics for Main Study Variables

Variable	*M* (*SD*)	IQR (Q1-Q3)	Range
Ordered WLR	54.82 (5.66)	52.00～59.00	35-62
Random WLR	42.89 (7.31)	37.75～47.25	22-59
Decoding	61.18 (7.94)	58.00～67.00	30-72
NVIQ	116.39 (16.63)	108.00～128.25	79-149
Reading comprehension	9.16 (4.77)	6.75～12.25	0-18

Note. *N* = 44. WLR = word list recall; IQR = interquartile range; Q1 = first quartile; Q3 = third quartile. NVIQ values represent age-standardized scores from the K-BIT-II.

Table 2

Partial Correlations Among Decoding, WLR, and Reading Comprehension Controlling for NVIQ

Variable	Decoding	Reading comprehension	Ordered WLR	Random WLR
Decoding	—			
Reading comprehension	.62***	—		
Ordered WLR	.31*	.46**	—	
Random WLR	.24	.55***	.68***	—

Note. Values are partial correlation coefficients controlling for NVIQ. WLR = word list recall.
*p < .05. **p < .01. ***p < .001.

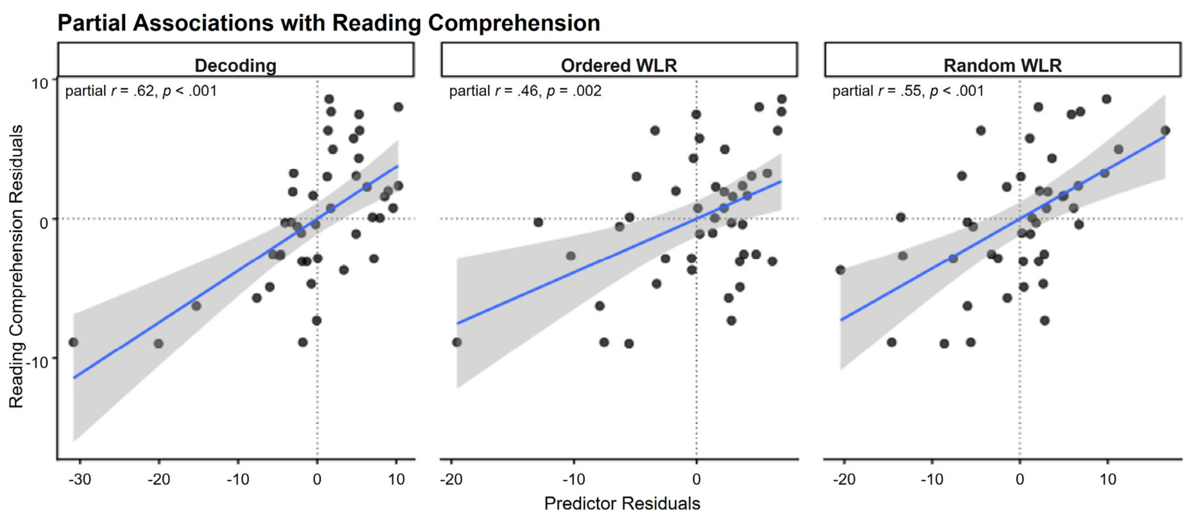

Figure 1. Partial associations with reading comprehension controlling for NVIQ. Scatterplots show residualized associations after removing the effect of NVIQ from both reading comprehension and each predictor. Lines represent fitted linear regression lines with 95% confidence bands. WLR = word list recall.

hension and each predictor are also visualized in Figure 1. Decoding was significantly associated with reading comprehension, partial r = .62, p < .001. Reading comprehension was also significantly associated with ordered WLR, partial r = .46, p < .01, and random WLR, partial r = .55, p < .001. Decoding was significantly associated with ordered WLR, partial r = .31, p < .05, but not with random WLR, partial r = .24, p > .05. Ordered and random WLR were strongly associated with each other, partial r = .68, p < .001.

Regression Predicting Reading Comprehension

A multiple linear regression analysis was conducted to examine whether ordered and random WLR uniquely predicted reading comprehension beyond decoding and NVIQ; the results are presented in Table 3 and Figure 2. The overall regression model was significant, $F(4, 39) = 13.51$, p < .001, and explained 58.1% of the variance in reading comprehension, R^2 = .58, adjusted R^2 = .54. Decoding was a significant unique predictor, B = .31, 95% CI [.18, .44], β = .51, p < .001, accounting for approximately 23.4% of the unique variance in reading comprehension. Random WLR also made a significant unique contribution, B = .27, 95% CI [.08, .46], β = .42, p = .006, accounting for approximately 9.0% of the unique variance beyond decoding, ordered WLR, and NVIQ. In contrast, ordered WLR, B = .01, 95% CI [-.24, .26], β = .01, p = .938, and NVIQ, B = .02, 95% CI [-.04, .08], β = .08, p = .458, did not explain significant unique variance.

Table 3

Linear Regression Predicting Reading Comprehension

Predictor	*B*	*SE*	95% CI for *B*	β	*t*	*p*	*sr²*
Intercept	-24.56	6.00	[-36.69, -12.43]	—	-4.10	< .001	—
Decoding	.31	.07	[.18, .44]	.51	4.67	< .001	.23
Ordered WLR	.01	.12	[-.24, .26]	.01	.08	.938	< .001
Random WLR	.27	.09	[.08, .46]	.42	2.90	.006	.09
NVIQ	.02	.03	[-.04, .08]	.08	.75	.458	.01

Note. WLR = word list recall; NVIQ = nonverbal intelligence quotient. NVIQ values represent age-standardized scores from the K-BIT-II. R^2 = .58; adjusted R^2 = .54, $F(4, 39)$ = 13.51, p < .001. β = standardized regression coefficient; sr^2 = squared semipartial correlation.

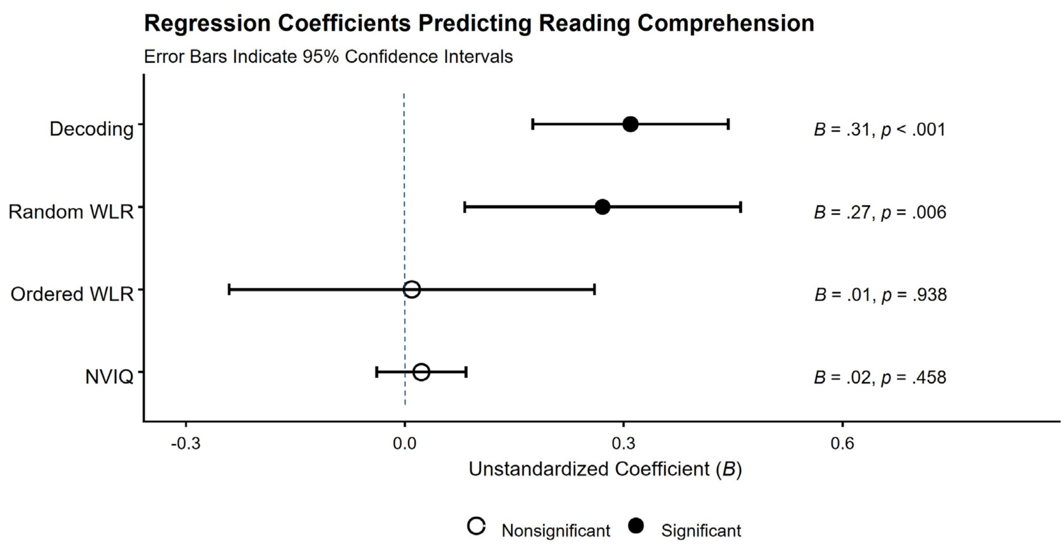

Figure 2. Regression coefficients for predicting reading comprehension. Error bars indicate 95% confidence intervals. Filled and open circles indicate significant and nonsignificant predictors, respectively. WLR = word list recall; NVIQ = nonverbal intelligence.

Regression Predicting Ordered and Random WLR

Linear regression analyses were conducted to examine whether decoding predicted ordered and random WLR after controlling for NVIQ standard scores; the results are presented in Table 4. Decoding significantly predicted ordered WLR, B = .22, SE = .11, t = 2.08, p = .044. In contrast, decoding did not significantly predict random WLR, B = .22, SE = .14, t = 1.57, p = .124. NVIQ did not significantly predict either ordered WLR, B = .04, SE = .05, t = .73, p = .469, or random WLR, B = .04, SE = .07, t = .58, p = .564.

Discussion

The present study examined two questions: whether decoding and WLR are associated with reading comprehension in Korean-speaking first-grade children, and whether ordered and random WLR uniquely predict reading comprehension beyond decoding and NVIQ. The results provided clear answers to both questions. First, decoding, ordered WLR, and random WLR were all significantly associated with reading comprehension after NVIQ was controlled, supporting the view that early reading comprehension depends on both word-level reading skills and broader language-cognitive processes (Duke

Table 4

Linear Regression Models Predicting Ordered and Random WLR

Outcome	Predictor	*B*	*SE*	*t*	*p*
Ordered WLR	Intercept	37.07	8.16	4.54	< .001
Ordered WLR	Decoding	.22	.11	2.08	.044
Ordered WLR	NVIQ	.04	.05	.73	.469
Random WLR	Intercept	24.90	10.81	2.30	.026
Random WLR	Decoding	.22	.14	1.57	.124
Random WLR	NVIQ	.04	.07	.58	.564

Note. WLR = word list recall; NVIQ = nonverbal intelligence.

& Cartwright, 2021; Kendeou et al., 2009). Second, when the predictors were entered into the same model, only decoding and random WLR uniquely predicted reading comprehension. Ordered WLR was associated with comprehension but did not explain additional variance after decoding, random WLR, and NVIQ were included. This pattern suggests that the contribution of WLR to reading comprehension depends on the type of verbal recall demand involved. In particular, random WLR performance was associated with reading comprehension beyond decoding, suggesting that verbal recall under limited linguistic structural support may be relevant to comprehension. However, the present findings do not identify the specific working-memory mechanism underlying this association (Baddeley, 2000; Perfetti & Stafura, 2014).

The associations among decoding, WLR, and reading comprehension are consistent with the view that successful comprehension requires both access to written words and the integration of verbal information across larger units of meaning (Duke & Cartwright, 2021; Perfetti & Stafura, 2014). Decoding was associated with reading comprehension because accurate word identification allows children to access the linguistic input needed to construct meaning from print, a central assumption of the simple view of reading (Gough & Tunmer, 1986; Hoover & Gough, 1990). This relation also aligns with theories of word reading development, which emphasize that efficient reading depends on children's ability to connect printed forms with phonological and lexical representations (Ehri, 2005). At the same time, the significant associations between WLR and reading comprehension indicate that comprehension is not supported by word access alone. After words are identified, children must hold verbal information in mind and integrate it across words, sentences, and short stretches of text to build a coherent representation of meaning (Perfetti & Stafura, 2014). This process places demands on working memory, which supports the temporary availability and organization of linguistic information during comprehension (Baddeley, 2000; Daneman & Merikle, 1996; Seigneuric & Ehrlich, 2005). Thus, the correlational findings suggest that early reading comprehension reflects the coordination of decoding-related word access and verbal memory processes that support the maintenance and integration of linguistic information (Duke & Cartwright, 2021; Kendeou et al., 2009).

The unique contribution of random WLR provides important evidence that decoding alone did not fully account for reading comprehension. Unlike ordered WLR, random WLR offered little sentence-like structure, thereby reducing the syntactic and linguistic cues that could support recall (Chun & Yim, 2017; Lee & Yim, 2025). As children could not rely as strongly on sentence-like organization, successful performance in the random condition likely placed greater demands on maintaining individual lexical items and their serial order. However, random WLR should not be interpreted as a direct measure of a specific working-memory component. Performance may reflect multiple processes, including phonological short-term storage, serial-order retention, attention, lexical retrieval, and the organization of verbal information. Therefore, its unique association with reading comprehension is best interpreted as evidence that verbal recall under limited linguistic structural support provides information beyond decoding, rather than as direct evidence for an episodic-buffer mechanism.

Ordered WLR showed a different pattern from random

WLR. Although ordered WLR was significantly associated with reading comprehension, it did not uniquely predict comprehension when decoding, random WLR, and NVIQ were included in the same regression model. One possible explanation is that the ordered condition provided sentence-like structure, allowing children to use syntactic knowledge and prior language experience to organize words into larger, meaningful units and thereby reducing demands on temporary verbal maintenance (Chun & Yim, 2017; Lee & Yim, 2025). This may explain why ordered WLR shared variance with reading comprehension at the correlational level but did not explain additional variance once decoding and random WLR were included in the model. In contrast, random WLR may have placed greater demands on maintaining and organizing verbal information when sentence-like structure was unavailable. Thus, the unique contribution of WLR to reading comprehension may be most evident under conditions in which children must rely less on linguistic structure and more on temporary verbal maintenance and integration processes that support the construction of meaning during reading (Baddeley, 2000; Perfetti & Stafura, 2014).

The present findings should also be interpreted in relation to the characteristics of the Korean writing system. Hangeul is an alphabetic writing system with relatively systematic grapheme-phoneme correspondences, although letters are arranged within syllable blocks and the pronunciation of written words may be modified by phonological and morphophonemic rules. Cross-linguistic studies have shown that children learning to read in relatively consistent orthographies generally acquire accurate word and pseudoword decoding more rapidly than children learning less consistent orthographies, particularly English (Aro & Wimmer, 2003; Seymour et al., 2003). Research in Finnish, a relatively transparent orthography, has also demonstrated that the relations among word-level reading, language comprehension, and reading comprehension change across the early elementary grades as decoding develops (Torppa et al., 2016). These cross-linguistic findings suggest that the relative transparency of an orthography does not eliminate the role of decoding, but may allow language and cognitive abilities beyond decoding to become more prominent as basic word-reading skills stabilize.

Thus, the unique contribution of random WLR beyond decoding is not inconsistent with the relative transparency of Hangeul. Rather, systematic grapheme-phoneme correspondences may facilitate the development of basic word reading, thereby allowing individual differences in verbal memory and other language-cognitive abilities to become apparent relatively early. At the same time, orthographic transparency does not mean that decoding is uniformly easy or fully automatized for all beginning readers. The participants in the present study were first graders who were still consolidating decoding, and Hangeul is not completely transparent at the word level because children must also apply context-sensitive phonological and morphophonemic rules. Indeed, phonological and morphological awareness have been shown to make different contributions to regular and irregular word recognition among beginning Korean readers (Cho et al., 2008). Therefore, the significant contribution of decoding may reflect first graders' continuing development of both basic print-sound correspondence knowledge and the ability to apply Korean-specific phonological rules. At the same time, the unique contribution of random WLR suggests that successful reading comprehension depends not only on accessing individual written words but also on temporarily maintaining and integrating the linguistic information made available through decoding. Thus, the present findings extend cross-linguistic accounts of early reading development by showing that decoding and verbal memory make distinguishable contributions to reading comprehension in a relatively transparent but morphophonemically complex writing system.

Other reading- and language-related skills not included in the present regression model may also contribute to reading comprehension. Reading fluency, particularly prosody, may serve as a bridge between word-level decoding and text-level comprehension by supporting appropriate phrasing, syntactic parsing, and the organization of meaning during oral reading. Longitudinal evidence indicates that text reading fluency predicts subsequent reading comprehension, and prosodic features have been associated with comprehension beyond decoding and other language skills (Y.-S. Kim et al., 2012; Y.-S. G. Kim, Quinn, & Petscher, 2021; Veenendaal, Groen, & Verhoeven, 2014). Vocabulary knowledge may also support comprehension by enabling children to access precise word meanings and integrate them into sentence- and text-level representations. Previous longitudinal research has demonstrated closely related developmental trajectories between vocabulary knowledge and reading comprehension (Quinn et al., 2020). These factors may also overlap with WLR performance: vocabulary knowledge may facilitate the encoding and retrieval of individual words, whereas prosodic and phrasing skills may support the organization of verbal information. Therefore, the unique contribution of random WLR should be interpreted within the set of predictors examined in the present study rather than as a complete account of the language and reading processes underlying comprehension.

The present findings have clinical and educational implications for the assessment of early reading comprehension. Because decoding and random WLR each made a unique contribution to reading comprehension, assessments may benefit from examining both children's word-level decoding skills and their ability to temporarily maintain and integrate verbal information. For example, a child who shows poor reading comprehension together with weak decoding may require further assessment of print-sound correspondence knowledge, phonological decoding, and the application of Korean phonological rules. In contrast, a child who demonstrates relatively adequate decoding but poor reading comprehension may benefit from additional assessment of verbal memory and sentence- or text-level integration. Random WLR should not be used as an independent diagnostic measure; however, it may serve as a supplementary task for identifying children who have difficulty retaining verbal information when sentence-like structural support is limited. Comparing performance across ordered and random WLR may also provide useful descriptive information. A child who performs substantially better in ordered than in random WLR may benefit considerably from linguistic structure, whereas consistently weak performance across both conditions may indicate broader difficulties in retaining verbal information. Such performance patterns should be interpreted together with standardized measures of decoding, language comprehension, and reading comprehension rather than in isolation.

The findings may also inform the selection of instructional and intervention supports. For children whose comprehension difficulties are primarily associated with weak decoding, instruction may emphasize accurate and efficient word recognition, grapheme-phoneme correspondences, and the application of phonological and morphophonemic rules in Korean. For children who decode words accurately but have difficulty maintaining and integrating verbal information, intervention may provide greater external support for meaning construction. Relevant strategies may include presenting text in shorter units, pausing to review previously read information, asking children to restate or summarize each segment, explicitly connecting new information with earlier sentences, and using visual organizers to reduce memory demands. Linguistic structure may initially be provided through meaningful sentence frames or semantic grouping and then gradually reduced so that children practice retaining and integrating information with less external support. These applications remain preliminary because the present study did not directly evaluate assessment classification or intervention effectiveness. Nevertheless, the findings suggest that early reading support should be matched to children's underlying performance profiles rather than based solely on their overall reading comprehension scores.

Although the present study provides evidence for the distinct role of random WLR in reading comprehension, several limitations remain. First, the relatively small sample size should be considered when interpreting the findings. The sensitivity analysis indicated that the present sample provided 80% power to detect an incremental effect of approximately f^2 = .19 or larger. The observed unique effect of random WLR corresponded to f^2 = .22, suggesting that the sample was sufficient to detect the medium-sized effect identified in the primary analysis. However, the study may not have been sensitive to smaller unique effects. Therefore, the nonsignificant contribution of ordered WLR should not be interpreted as evidence that it has no relation to reading comprehension. Rather, its unique effect may have been smaller than the effect that could be reliably detected with the present sample. Replication with a larger sample is needed to obtain more precise effect-size estimates and determine the stability of the distinction between ordered and random WLR.

Second, the geographic, school, and sampling characteristics of the participants should be considered when interpreting the findings. The participants were volunteers recruited from a single private elementary school in Seoul, although the school enrolled children from multiple residential areas. Therefore, the sample may not represent the broader population of Korean first-grade children. Previous research has shown that students attending private elementary schools in Korea tend to come from families with higher income, parental education, educational expectations, and academic support than students attending public schools (Byun, Chung, & Ahn, 2021). However, socioeconomic indicators such as parental education, household income, and home literacy resources were not collected in the present study. This omission is important because socioeconomic status has been associated with children's working memory and reading development (Li, Peng, Ma, Ding, & Zhao, 2023; Mooney, Prady, Barker, Pickett, & Waterman, 2021). Thus, unmeasured socioeconomic differences may have influenced performance on WLR and reading measures and, consequently, the observed associations among the study variables. Accordingly, caution is warranted when generalizing the findings to children attending public schools or those from different geographic, educational, and socioeconomic backgrounds. Future studies should recruit participants from multiple public and private schools and directly assess relevant socioeconomic characteristics.

Third, the cross-sectional design does not allow conclusions about developmental or causal relations among decoding, WLR, and reading comprehension. Longitudinal studies are needed to examine whether ordered and random WLR predict later growth in reading comprehension. Fourth, because the study focused only on Korean-speaking first-grade children, future research should examine whether similar patterns are found in older children, children with reading or language difficulties, and children learning to read in writing systems with different levels of orthographic transparency. Also, WLR was interpreted as an index of episodic-buffer — related verbal memory, but it remains an indirect measure of these processes. Future work should include additional working memory, language comprehension, and sentence-level integration tasks to clarify the mechanisms linking verbal memory to reading comprehension (Baddeley, 2000).

Lastly, reading fluency and vocabulary knowledge were not included in the primary regression model. In particular, oral reading prosody was not assessed, although appropriate phrasing and intonation may support the organization and interpretation of written language. Although receptive and expressive vocabulary measures were administered as part of the broader assessment battery, vocabulary was not included as a predictor in the present analyses. Therefore, the study could not determine whether decoding and random WLR would continue to explain unique variance after reading fluency, prosody, and vocabulary knowledge were considered. Vocabulary may also have influenced WLR performance by supporting the encoding and retrieval of lexical items. Future research should include measures of reading accuracy and rate, oral reading prosody, and vocabulary breadth and depth to clarify the relative and overlapping contributions of these skills to reading comprehension.

Despite these limitations, the present study provides evidence that early reading comprehension in Korean-speaking first-grade children is supported by both decoding and verbal memory processes. Decoding was strongly related to reading comprehension, consistent with the view that accurate word reading provides essential access to written language (Ehri, 2005; Gough & Tunmer, 1986; Hoover & Gough, 1990). However, decoding alone did not fully explain comprehension performance. Random WLR uniquely predicted reading comprehension beyond decoding and NVIQ, suggesting that children's ability to temporarily maintain and integrate verbal information contributes to meaning construction during reading (Baddeley, 2000; Perfetti & Stafura, 2014). In contrast, ordered WLR was associated with reading comprehension but did not explain unique variance, likely because its sentence-like structure provided linguistic support that overlapped with other language- and decoding-related processes (Chun & Yim, 2017; Lee & Yim, 2025). Together, these findings suggest that early reading comprehension should be understood not only as a word-reading outcome but also as a language-cognitive process that depends on the organization and integration of verbal information during reading.

Acknowledgements

This work was supported by the Ministry of Education of the Republic of Korea and the National Research Foundation of Korea (No. NRF-2021S1A3A2A01096102).

Conflict of Interest

No potential conflict of interest relevant to this article was reported.

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Received June 15, 2026
Revision received July 18, 2026
Accepted August 6, 2026