Title

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The relations of morphological awareness with vocabulary, word reading, and reading comprehension for Korean-speaking middle school students

Joong won Lee[1] · Young-Suk Kim[2]

Abstract

The aim of this study is to explore the relation of morphological awareness to vocabulary, word reading, and reading comprehension for middle school students in Korea. A total of 121 students (73 boys and 48 girls) in Grade 7 from two middle schools in a metropolitan city in South Korea participated in the study. The students were assessed on the following skills in Korean: morphological awareness in three dimensions (inflectional, derivational, and compound morphological awareness), vocabulary, word reading, and reading comprehension. Using structural equation modeling, we found that students' morphological awareness predicted vocabulary, word reading, and reading comprehension directly. In addition, morphological awareness was also indirectly related to reading comprehension mediated by word reading. Interestingly, once morphological awareness was accounted for, vocabulary did not make an independent contribution to reading comprehension. Our findings illustrate the direct and indirect relations of morphological awareness to vocabulary, word reading, and reading comprehension for Korean adolescents.

Keywords Morphological awareness · Vocabulary · Word reading · Reading comprehension · Adolescence

Introduction

Among a wide array of skills that contribute to reading development, morphological awareness—one's awareness of the smallest meaning units of words (Carlisle, 2000; Goodwin & Ahn, 2013; Kuo & Anderson, 2006; Nagy et al., 2006)—is a critical

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skill associated with diverse language and reading skills such as phonological awareness, orthographic awareness, vocabulary, word reading, text reading fluency, and reading comprehension (Carlisle et al., 2010; Goodwin & Ahn, 2010, 2013; Zhang & Koda, 2014; see Lee et al., 2022 for a meta-analysis). Having advanced knowledge of prefixes, suffixes, and root words can help access the meaning of the words even in the first encounter (Goodwin et al., 2012; Kuo & Anderson, 2006; Nagy et al., 2006). As an example, one's knowledge that the prefix *un-* adds negative meaning to the root word is likely to help infer the meaning of words that contain this prefix (e.g., *un*helpful, *un*stable, *un*known). This, in turn, facilitates reading comprehension because being able to infer meaning of multimorphemic words in texts that would otherwise be incomprehensible would lead to enhanced understanding of the text.

A plethora of findings in this topic are available in English language speakers (e.g., Carlisle, 2000; Deacon et al., 2009; Kieffer & Lesaux, 2008). However, evidence from languages other than English, particularly for adolescents, is limited. In addition, most of these findings explored direct relations only—the relations between two variables involving no mediators—and fewer studies have examined direct and indirect relations—the relations between two variables that are through at least one mediator. In this study, we examined the direct and indirect relations of morphological awareness to reading comprehension through vocabulary and word reading, using data from Korean-speaking middle school students in South Korea.

Theoretical framework

This study is grounded on the Direct and Indirect Effects Model of Reading (DIER, Kim, 2020a, b, 2023; see Fig. 1) as DIER specifies the nature of associations of multiple language, literacy, and cognitive skills including morphological awareness. According to DIER, morphological awareness is related to reading comprehension in two pathways: through listening comprehension and through word reading. As shown in Fig. 1, morphological awareness is important to word reading, which, in turn, is related to text reading fluency and reading comprehension. Morphological awareness is also important to vocabulary, which is related to listening comprehension, which, in turn, is related to text reading fluency and reading comprehension.

Morphological awareness is important to word reading because words' morphological information is represented in their spellings in languages with morphophonological or morphosyllabic writing systems (Adams, 1990; Carlisle, 2000; Goodwin & Ahn, 2010, 2013; Kim, 2020b; Kuo & Anderson, 2006; Nagy et al., 2006) or abjad writing systems (Asadi et al., 2017; Eviatar et al., 2018; Vaknin-Nusbaum, 2018; Vaknin-Nusbaum et al., 2016). In English which is a morphophonological language, for example, one's ability to recognize constituent morphemes of complex words (e.g., "farm" and "-er" in the word "farmer") can aid the reading of multimorphemic words.

Morphological awareness also contributes to reading comprehension via vocabulary (Goodwin & Ahn, 2013; Kieffer & Box, 2013; Kim et al., 2020; Nagy et al., 2006). As morpheme is the smallest meaning unit that builds up a word (Bowers
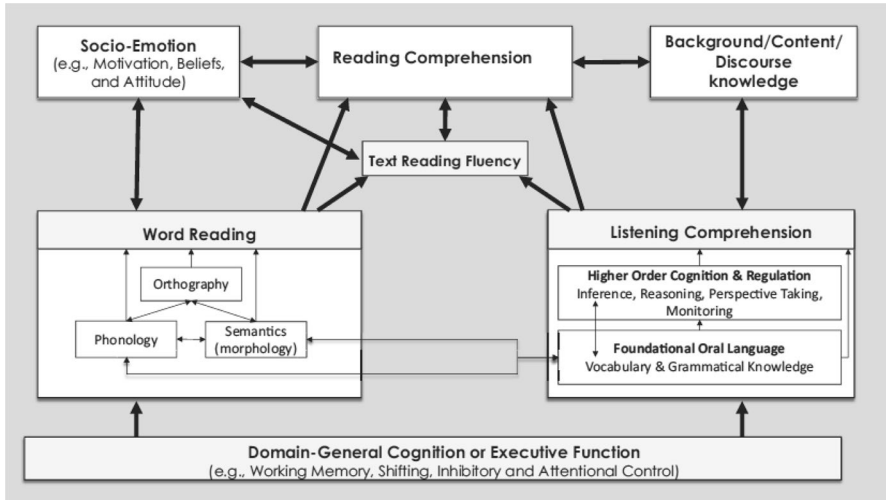
Fig. 1 The direct and indirect effects model of reading (DIER; Kim, 2020a, b)

et al., 2010; Goodwin & Ahn, 2013; Lee et al., 2022; Reed, 2008), it is also considered a subdimension of words (Kieffer & Lesaux, 2012). Words are either morphemes themselves (if they are monomorphemic words) or consist of morphemes that carry certain meanings (if they are multimorphemic words). Therefore, knowledge of morphemes and the ability to identify constituent morphemes of words can facilitate comprehension of the words (Goodwin & Ahn, 2013; Goodwin et al., 2012; Kuo & Anderson, 2006; Nagy et al., 2006). In other words, one's knowledge of morphemes that constitute complex words can help their comprehension of these words whose meanings are otherwise incomprehensible (Goodwin & Ahn, 2010, 2013; Nagy et al., 2006).

The two pathways by which morphological awareness contributes to reading comprehension according to DIER are in line with the Morphological Pathways Framework (Levesque et al., 2021), which states that morphological awareness facilitates reading comprehension through morphological decoding and morphological analysis. Morphological decoding takes place as morphological information is used in decoding words. This is critical as one goes through morpho-orthographic processing of words in their lexical representation. In morphological analysis, one processes semantic information in each morpheme—the process through which readers are able to comprehend words using the meaning of the morphemes. To illustrate, recognizing the morphemes "base" and "ball" of the word "baseball" in reading is likely to help in identifying and deducing the meaning of the word as one first recognizes and reads each morpheme (morphological decoding) and comprehends their meanings in combination (morphological analysis). In other words, the text that has the word "baseball" will be comprehensible through the process of morphological decoding and morphological analysis. To summarize, morphological decoding in the Morphological Pathways Framework explains the process by which morphological awareness is related to word reading in the context of DIER, and morphological

analysis in the Morphological Pathways Framework explains the process by which morphological awareness is related to vocabulary in the context of DIER.

By now, a large body of evidence has shown that morphological awareness is related to language and literacy skills in line with DIER (Kim, 2020a, b, 2023). For English-speaking students, morphological awareness was related with vocabulary (e.g., Goodwin et al., 2017; Spencer et al., 2015), word reading (e.g., Nagy et al., 2003; Ramirez et al., 2010), and reading comprehension (e.g., Kieffer & Lesaux, 2008; McCutchen et al., 2008). Similar findings were reported in languages other than English. Morphological awareness was found to be associated with vocabulary, word reading, and reading comprehension in Arabic (e.g., Asadi et al., 2017; Eviatar et al., 2018), Chinese (e.g., McBride-Chang et al., 2005; Zhang et al., 2019), Hebrew (e.g., Eviatar et al., 2018; Vaknin-Nusbaum et al., 2016; Vaknin-Nusbaun, 2018), French (e.g., Casalis & Colé, 2009; Deacon et al., 2009) and Spanish (e.g., Ramirez et al., 2010; Simpson et al., 2020). Morphological awareness was also associated with vocabulary (e.g., Kim, 2010; McBride-Chang et al., 2008), word reading (e.g., Cho & McBride-Chang, 2018; Cho et al., 2008), and reading comprehension (e.g., Bae & Joshi, 2017; Kim, 2011) for Korean students, focal participants in the present study.

Although previous studies on morphological awareness and its relation to reading are highly informative, there are at least two important gaps. First, the majority of previous studies were on primary grade students and only a few involved adolescent readers. For example, two studies from Bae and Joshi (2017, 2018) found from Korean-speaking students in their Grades 5 and 6 that morphological awareness contributed to vocabulary and reading comprehension over and above phonological and orthographic awareness in Korean and English. In addition, Ramirez and colleagues (2010) explored the relation of derivational morphological awareness with word reading on Spanish-speaking Grades 4 and 7 students, and found their significant associations both in Spanish and English over and above age, non-verbal skills, working memory, vocabulary, and phonological awareness. Although oral language skills, including morphology, develop rapidly in early childhood, oral language skills and reading skills continue to develop into adolescence (Snow & Biancarosa, 2003).

A second gap is that although theoretical models such as DIER (Kim, 2020a, b, 2023) hypothesizes direct and indirect relations of morphological awareness to reading comprehension, the vast majority of empirical studies examined direct relations (see above). However, a growing number of recent studies examined direct and indirect relations and found support for the two hypothesized pathways: indirect relations of morphological awareness to reading comprehension via vocabulary (e.g., Kieffer & Box, 2013; Kim et al., 2020; Gottardo et al., 2018) and word reading (e.g., Deacon et al., 2014; Kieffer & Box, 2013; Kieffer et al., 2013; Kim et al., 2020; Levesque et al., 2017). For example, Kieffer and Box (2013) found from Spanish-speaking language minority students and native English-speaking students that morphological awareness predicted reading comprehension both directly and indirectly via vocabulary and word reading in English, and the magnitude of the indirect effect was larger for native-speaker students of English than language minority peers. Deacon and colleagues (2014) also found from English-speaking students in Grades 3 and 4 that word reading was a partial mediator of the relation of their morphological

awareness to reading comprehension over and above age, vocabulary, phonological awareness, and non-verbal ability. We addressed these gaps by examining direct and indirect relations of morphological awareness, vocabulary, and word reading to reading comprehension in Korean, using data from Korean adolescents.

Korean morphology

Even though the Korean writing system is not as opaque compared to English (Kim et al., 2015; Wang et al., 2006, 2009), Korean employs morphophonological principles as does English (Cho & McBride-Chang, 2018; Kim, 2011; Perfetti & Dunlap, 2008; Sohn, 1999). In other words, morphological information is retained over phonological information in Korean. For example, the words "깊다 (deep)" and "깊이 (depth)" share the morpheme "깊" that contains the meaning "deep" whereas the pronunciation of this common morpheme "깊" is different between them where in the former it is pronounced as /gip/ and the latter is pronounced as /gi/. In this example, the spelling of the words retained the morphological information (깊) at the cost of phonological information (/gip/ versus /gi/), rendering Korean language morphologically informative but phonologically inconsistent (Cho & McBride-Chang, 2018; Kim, 2010, 2011; Kim et al., 2015; Sohn, 1999).

Furthermore, Korean has rich inflectional, derivational, and compound morphemes as does English (Cho & McBride-Chang, 2018; Kim, 2010; Sohn, 1999). Please see Table 1 for examples of inflectional, derivational, and compound morphemes in Korean in comparison to English. Korean and English share many inflectional morphemes that function as pluralization (e.g., -들, -s/es), past tense (e.g., -했다, -ed), and possessive (e.g., -의, -'s). A conspicuous difference, however, is that Korean has richer inflectional morphemes than English. One of the characteristics that attribute to the variety of inflectional morphemes in Korean is that there are different levels of politeness or formality in Korean which does not exist in English (Sohn, 1999). Specifically, there are three major levels of formality in Korean: informal (e.g., 먹는다), semi-formal (e.g., 먹어요), and formal level (e.g., 먹습니다). This variety holds regardless of the tense and type of sentence (see Table 1). In addition, inflectional morphemes function as nominal case particles which in English is visible from the verb rather than inflectional morphemes (Sohn, 1999). To illustrate, depending on the subject, there are inflectional morphemes that function as nominal case particles in Korean (e.g., -은/는/이/가) that vary by the pronunciation of the subject's coda. In English, this is indicated by the use of verbs (e.g., am/are/is) and there are no inflectional morphemes that function as such.

Derivational and compound morphemes are similar between Korean and English in terms of their functions and types (Sohn, 1999). For example, there are a wide range of prefixes and suffixes as derivational morphemes in both Korean and English that share their functions such as negation (e.g., 부-/불-/미-; dis-/un-/il-), emphasis (e.g., 최-; super-), and nominalization (e.g., -함/-화; -ness/-tion/-sion). On the other hand, whereas English has derivational morpheme for comparative (-er) and superlative (-est), Korean does not and instead use the adverbs '더 (more)' and '가장 (the most).' For compound morphemes, both Korean and English form

Table 1 Examples of inflectional, derivational, and compound morphemes in english and Korean

Type of morpheme	English	Korean
Inflectional morpheme	-(e)s/-ies: Plural (flowers, puppies) -(e)d/-ied: Past tense (played, studied) -'s: Possessive (Tom's cat) -er: Comparative (smarter) -est: Superlative (tallest)	-들: Pluralization (꽃들, 사람들) -의: Possessive (영수의, 선생님의) -은/는/이/가: Nominal case particle (우리는, 선생님은, 학생이, 축구선수가) -다: Present tense informal (놀다, 예쁘다) -ㅆ다: Past tense informal (놀았다, 예뻤다) -ㄹ 거다: Future tense informal (놀 거다, 예쁠 거다) -ㅏ/ㅓ 요: Present tense semi-formal (놀아요, 예뻐요) -ㅆ 아요: Past tense semi-formal (놀았어요, 웃었어요) -ㄹ 거예요: Future tense semi-formal (놀거예요, 예쁠거예요) -니다: Present tense formal (놉니다, 예쁩니다) -ㅆ 습니다: Past tense formal (놀았습니다, 웃었습니다) -ㄹ 겁니다: Future tense formal (놀겁니다, 예쁠겁니다)

Table 1 (continued)

Type of morpheme	English	Korean
Derivational morpheme	*un-, dis-, il-, ig-, non-, mal-*: Negation (unable, illegal) *-ness, -ment, -t(s)ion*: Nominalization (government, vacation) *-(l)y-ily*: Adjective or adverb (quickly, easily) *-er*: Person or tool (teacher, computer) *-able*: Possible (usable) *-ful*: Be full of (helpful) *-less*: None or scarce (hopeless) *multi-*: Multiple/Many (multitasking) *sub-*: Under (subway, subcategory)	-ㄴ: Adjective (예쁜, 한한, 가벼운) -ㅁ: Nominalization (예쁨, 한함, 가벼움) -이: Nominalization or adverb (길이, 높이) 미, 불, 부, 비, 무-: Negation (미성숙, 불가능, 모면히) -화: Transition (세계화) 신-: New (신세계) 구-: Old (구시대) 다-: Multiple (다목적) 정-: Exact (정사각형) 과-: Excessive (교소비) -가, -자, -수: Person who does something (과학자, 발명가, 가수) -장: Person who is the chief at something (교장, 선장)
Compound morpheme	Noun+Noun=Compound Noun (basket+ball=basketball) Adjective+Adjective=Compound Adjective (light+yellow=light-yellow)	Noun+Noun=Compound Noun (쓰레기+통=쓰레기통) Adjective+Adjective=Compound Adjective (새+파랗다=새파랗다)

compound nouns with nouns as compound morphemes (e.g., basket+ball=basketball; 봄 + 비 = 봄비) and compound adjectives with adjectives as compound morphemes (e.g., dark+brown=dark-brown; 검 + 붉다 = 검붉다).

Reading development of Korean students

Since Korean is an alphabetic language that uses an alphabet (called Hangul), and is orthographically shallow compared to English (Kim, 2011; Sohn, 1999), phonological awareness along with letter-sound knowledge and orthographic awareness is critical in young Korean students' early reading development (Kim, 2011). In addition, as stated in the previous section, Korean is a morphophonological language where morphological information is encoded in the spelling (Kim, 2010; Lee et al., 2022; Sohn, 1999). Perhaps not surprisingly, Korean-speakers' morphological awareness was related to vocabulary (e.g., Bae & Joshi, 2017; Kim, 2010), word reading (e.g., Kim, 2011; Wang et al., 2009), and reading comprehension (e.g., Bae & Joshi, 2017; Kim, 2011; Wang et al., 2009). For example, Bae and Joshi (2017) found from Grades 5 and 6 Korean bilingual students of Korean and English that their morphological awareness contributed to vocabulary (0.62) and reading comprehension (0.54) over and above phonological and orthographic awareness in Korean. Similarly, Wang and colleagues (2009) found from Korean-English bilingual students in Grades 2 to 4 that morphological awareness supported word reading (0.43) and reading comprehension (0.39) over and above age, home language practice, vocabulary, and phonological awareness.

Present study

The present study builds on and extends previous work in several unique ways. First, whereas previous studies showed the relation of morphological awareness to diverse language and reading skills such as vocabulary, word reading, and reading comprehension in Korean (e.g., Cho & McBride-Chang, 2018; Kim, 2010, 2011, 2015; Wang et al., 2006, 2009), the nature of direct and indirect relations have seldom been explored. For example, Bae and Joshi (2017) explored direct and indirect relations of morphological awareness, vocabulary, and reading comprehension over and above phonological and orthographic awareness in Korean. In the current study, we extended this finding by including word reading. Second, we measured morphological awareness more comprehensively by including all three types of morphological awareness—inflectional, derivational, and compound morphological awareness—whereas previous studies tended to include one or two types of morphological awareness. This is an important unique aspect of the study as measuring all three types more accurately reflects the morphological characteristics of the Korean language. Lastly, the majority of previous studies have been conducted with children in elementary grades (Cho et al., 2008; Kim, 2010, 2011); and evidence from adolescents, especially in languages other than English, is sparse. The present study makes a meaningful contribution to the field by filling these gaps. We had

following research question: How is Korean Grade 7 students' morphological awareness directly or indirectly related with vocabulary, word reading, and reading comprehension? We hypothesized, based on DIER (Kim, 2020a, b, 2023) and the literature (e.g., Goodwin & Ahn, 2010, 2013; Kuo & Anderson, 2006; Lee et al., 2022), that there would be positive relations of their morphological awareness to vocabulary, word reading, and reading comprehension for Korean adolescents. In addition, according to DIER, we expected both vocabulary and word reading to be mediators of the relation of morphological awareness to reading comprehension.

Method

Participants

Grade 7 students ($N = 121$, 73 boys and 48 girls, $M_{age} = 13.17$, SD = 0.27) who did not have identified severe behavioral challenges and diagnosed sensory or intellectual disabilities from the two middle schools in a metropolitan city in South Korea were invited to participate in this study. One school serves only male students whereas the other school serves only female students. An oral assent from the students and written parent permission were obtained. All students spoke Korean as their first language, and one participant was from a multicultural background.

Measures

All the measures below were piloted and revised using data from Grade 7 students ($N = 22$). All the assessments were administered in a group setting whereas word reading was individually administered. Unless otherwise noted, items were dichotomously scored (1 = correct; 0 = incorrect).

Morphological awareness

The student's morphological awareness was assessed with the adapted morphological awareness tests that have been used widely in English (Kirby et al., 2012). There were 15 items respectively for the inflectional, derivational, and compound morphological awareness. These tasks were presented in a written form where the test administrator read out the practice items and had the students read the test items by themselves. This measure was administered in a group setting.

Inflectional morphological awareness

The Word Analogy Test (Kirby et al., 2012) was adapted. In this test, the participants were asked to fill in the blank following the pattern of the given example. The participants were asked to figure out the pattern in the words A:B, and apply this pattern to C:D (e.g., push: pushed = jump: jumped; 밀다: 밀었다 = 뛰다: 뛰었다). There were two practice items. The test items included the past tense (e.g., -했다),

future tense (e.g., -것이다), negation (e.g., -않다), and passive voice (e.g., -졌다). Plural and possessive forms were not included, because in Korean, these rules are often not strictly abided by. Cronbach's alpha was 0.67.

Derivational morphological awareness

Derivational morphological awareness was measured drawing on two tests: adapted versions of the Word Analogy Test (Kirby et al., 2012) and Comes From Task (Muse, 2005). The format and procedure of the Word Analogy Test was same as mentioned in the previous section in inflectional morphological awareness, but the items asked the students' awareness of derivational morphemes (e.g., walker: walk = teacher: <u>teach</u>; 결정: 결정하다 = 게임: <u>게임하다</u>). There were three practice items and eight test items. Some examples of derivational morphemes for this section were personification suffixes (e.g., -사 which works as "-er" in English that indicates a person who does something), nominalization suffixes (e.g., -기 which works as "-tion" in English), and prefixes (e.g., 미-, 최- which means "un-" and "super-" respectively in English). These derivational morphemes function similarly to those in English.

The Comes From Task provided students with a pair of words and asked whether the second word is the derived form of the first word. There were two practice items, one of which the answer is yes (e.g., teach and teacher; 빠르다 and 빨리) and the other of which the answer is no (doll and dollar; 딸 and 딸기). There were seven test items. However, two items were removed because of low item-total correlations, and therefore, five items were used in the analysis. Across the two tasks, there was a total of 13 items (8 items from the Word Analogy task and 5 items form the Comes From task). Cronbach's alpha was 0.58.

Compound morphological awareness

To assess the students' compound morphological awareness, the Korean adapted Bee Grass Test (Muse, 2005) and the morphological awareness subtest of the Korean Test of Literacy Diagnosis (K-TOLD; Cho et al., 2017), a norm-referenced Korean language and literacy skills assessment, were used. In the Bee Grass Test, students were asked to mark from two answer choices the one that better answers the riddle (e.g., Which is a better name for a bee that lives in the grass? A grass bee or a bee grass?; '버섯 모양의 사탕'에 대한 이름으로 어느 것이 적당할까요? 버섯사탕일까요 아니면 사탕버섯일까요?). There were seven items on this task followed by two practice items. In addition, morphological awareness subtest of K-TOLD (Cho et al., 2017) asked the students to produce a compound word with compounding two words in Korean (e.g., Early in the morning, we can see the sun coming up. This is called a sunrise. At night, we might also see the moon coming up. What could we call this? <u>Moonrise</u>; 냉장고 안에 김치를 보관하면 김치 냉장고라고 불러요. 그러면 냉장고 안에 꽃을 보관하면 무엇이라고 부를까요? <u>꽃냉장고</u>). There were two practice items followed by eight items on this test. Cronbach's alpha was 0.61.

Vocabulary

The Receptive and Expressive Vocabulary Test was used (REVT; Kim et al., 2009). REVT is a norm-referenced picture vocabulary test, and we used the receptive portion of this test. For each item there were four pictures, and the students were asked to choose the right picture of the word that had been called out to them. Whereas this test is to be administered individually, due to the time constraint, REVT was administered as a whole class. To this end, we selected 30 items that were appropriate for our participating students' grade level based the test manual (items relevant for age 13 or older). Each target word was read out twice by the assessor, and the students were asked to mark the appropriate picture for each word. There were 30 test items. However, four items were removed due to low item-total correlations, leaving the total of 26 items. Cronbach's alpha was 0.74.

Word reading

The students' word reading proficiency in Korean was assessed with word reading subtest of K-TOLD (Cho et al., 2017). This assessment took place individually with each student. Each student was given a word list composed of 192 Korean words—the combination of the items in the forms A and B—listed in an ascending order of difficulty. Each student was asked to read the words as accurately and quickly as possible in 45 s. The students' score of this test was the number of words they read correctly in 45 s. The test–retest reliability of this measure based on the pilot test was 0.94.

Reading comprehension

The Korean language section of the National Student Diagnostic Test appropriate was used. This norm-referenced test is published by the Korean Institute for Curriculum and Evaluation. In the present study, we used a version from the year 2012 because that was the last year that the test was implemented to Grade 6, the grade level that was the closest to our target students' grade level. The test was administered in a whole group, and the students were allowed 40 min to complete the test. The test was composed of 23 multiple choice items, 3 open-ended short answer items, and 2 brief (2–5 sentences) essay items. Multiple-choice items were scored dichotomously (1=correct; 0=incorrect). Open-ended short answer items were scored 0 to 2 depending on the precision. Brief essay items were scored 0 to 3 depending on the degree of following the provided three guidelines (e.g., The response should 2–3 sentences long, use two examples from the table, use the phrase "it is not over until it is over"). The inter-rater reliability for the scoring of open-ended and essay questions between the first author and a research assistant was 96%. The total possible score on this test was 35. Cronbach's alpha was 0.87.

Procedure

All the assessments took place in the school sites during regular English classes.

Analytic strategy

We used structural equation modeling (SEM) shown in Fig. 2 using MPlus version 8 (Muthén & Muthén, 1998–2012) to answer our research question. A latent variable was created for morphological awareness based on the three indicators—inflectional, derivational, and compound morphological awareness—whereas vocabulary, word reading, and reading comprehension were observed variables as they were measured by single measures. Before addressing the research questions including morphological awareness, we fitted a preliminary model that examined the relations among vocabulary, word reading, and reading comprehension to establish their relations (i.e., vocabulary and word reading predict reading comprehension; Model 1 in Fig. 2). Next, the two alternative models were fitted for the direct and indirect relations among morphological awareness, vocabulary, word reading, and reading comprehension (Models 2 and 3 in Fig. 2). Model 2 hypothesized both direct relation of morphological awareness to reading comprehension and their indirect relations through vocabulary and word reading, whereas Model 3 hypothesized only indirect relations between morphological awareness and reading comprehension via vocabulary and word reading and no direct relation. In Models 2 and 3, the indirect relations are those of morphological awareness to reading comprehension through vocabulary and word reading as mediators, and the rest are direct relations.

We used Full Information Maximum Likelihood as the estimator; and used chi-square, Root Mean Square Error of Approximation (RMSEA), Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), and Standardized Root Mean Square Residuals (SRMR) as model fit indices. Typically, RMSEA values below 0.08, CFI and TLI values above 0.90, and SRMR values below 0.10 indicate an acceptable model fit (Kline, 2005).

Results

Descriptive statistics and preliminary analysis

Descriptive statistics of the students' means, standard deviations, minimum and maximum scores, skewness, and kurtosis for each assessment are shown in Table 2. All skewness values within ± 3 and those of kurtosis within ± 7 indicate that distributional properties of all variables are appropriate for our analyses (West et al., 1995). Bivariate correlations among the variables are in Table 3. All variables were significantly related with rs ranging from 0.19 to 0.56.
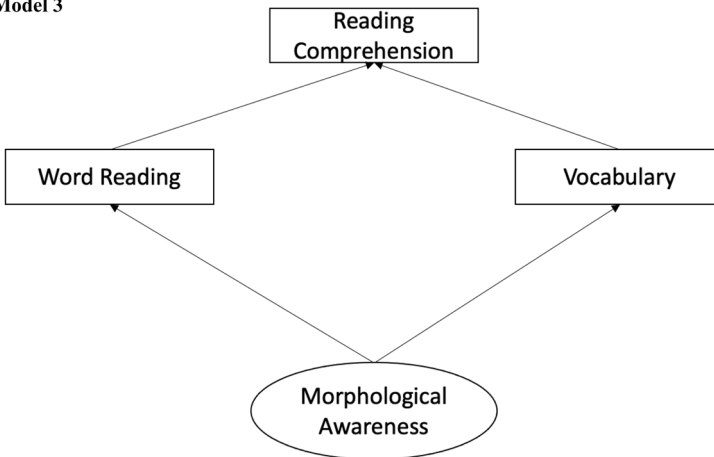
a **Model 1**
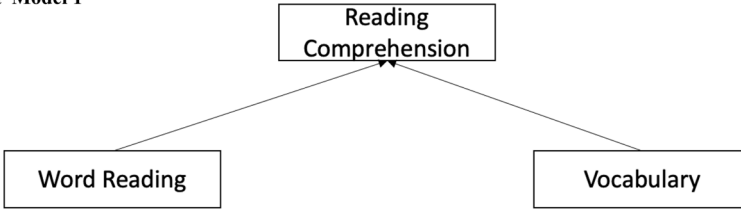
b **Model 2**
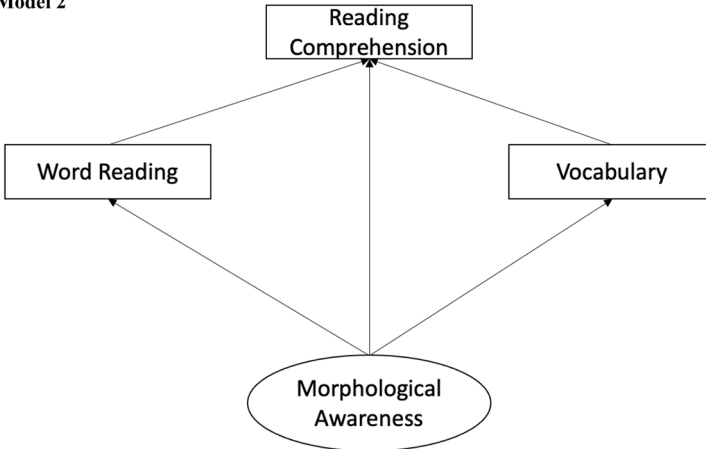
c **Model 3**

Fig. 2 Alternative models for the relations among morphological awareness, vocabulary, word reading, and reading comprehension **a** Model 1. **b** Model 2. **c** Model 3

Table 2 Descriptive statistics

Variable	Reliability	N	M	SD	Minimum	Maximum	Skewness	Kurtosis
Inflectional morphological awareness	.67	116	9.45	2.62	0	15	− 0.75	3.77
Derivational morphological awareness	.58	116	9.22	2.19	0	13	− 0.68	3.38
Compound morphological awareness	.61	116	12.90	1.97	0	15	− 1.14	4.07
Vocabulary	.74	119	15.55	4.28	0	26	0.02	2.26
Word reading	.94	121	82.77	12.56	0	192	− 0.19	3.04
Reading comprehension	.87	116	25.70	7.29	0	35	− 1.03	3.62

All reliability measures except word reading were Cronbach's α. Reliability measure for word reading was test–retest reliability

Table 3 Bivariate correlations among variables

Variable	1	2	3	4	5	6
1. Inflectional morphological awareness	–					
2. Derivational morphological awareness	.56***	–				
3. Compound morphological awareness	.51***	.45***	–			
4. Vocabulary	.42***	.39***	.35***	–		
5. Word reading	.27**	.23*	.19*	.23*	–	
6. Reading comprehension	.55***	.49***	.50***	.46***	.40***	–

$N = 121$

$^*p < .05.$ $^{**}p < .01.$ $^{***}p < .001$

The relation of morphological awareness to vocabulary, word reading, and reading comprehension

We first examined the relations among vocabulary, word reading, and reading comprehension without morphological awareness (see Model 1 of Fig. 2). This is a just-identified model and therefore, model fit information is not available. According to this model, vocabulary (0.39, $p < 0.001$) and word reading (0.32, $p < 0.001$) predicted reading comprehension. Then we tested Models 2 and 3 and their model fits were as follows: Model 2: $\chi2$ (df) = 1.02 (7), $p = 1.00$, RMSEA = 0.00 [0.00, 0.00], CFI = 1.00, TLI = 1.00, SRMR = 0.01; Model 3: $\chi2$ (df) = 32.56 (8), $p < 0.001$, RMSEA = 0.16 [0.11, 0.22], CFI = 0.87, TLI = 0.75, SRMR = 0.10. According to the chi-square difference test, Model 2 had a superior model fit than Model 3 ($\Delta\chi2 = 31.54$, $\Delta df = 1$, $p < 0.001$). In other words, vocabulary and word reading did not fully mediate the relation of morphological awareness to reading comprehension. Instead, there was a direct relation from morphological awareness to reading comprehension over and above vocabulary and word reading.

As seen in Fig. 3, there were significant relations of morphological awareness to reading comprehension (0.62, $p < 0.001$), vocabulary (0.56, $p < 0.001$),
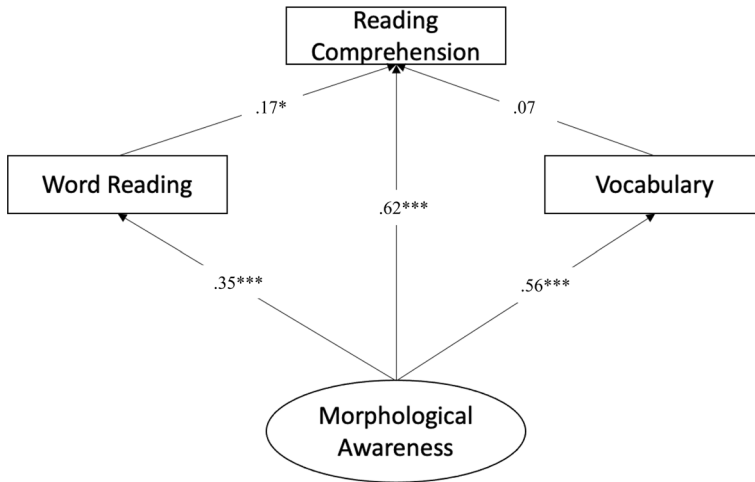
Fig. 3 Standardized path coefficients for the relations among morphological awareness, vocabulary, word reading, and reading comprehension for Korean Grade 7 Students. *Note. *p < .05. **p < .01. ***p < .001*

and word reading (0.35, $p < 0.001$). In terms of indirect relations, word reading was a significant mediator of the relation of morphological awareness to reading comprehension (0.06, $p = 0.03$; the product of the coefficients of morphological awareness with word reading and of word reading and reading comprehension) whereas vocabulary was not (0.04, $p = 0.42$).

Discussion

The goal of our study was to examine the direct and indirect relations of morphological awareness to vocabulary, word reading, and reading comprehension for Korean-speaking Grade 7 students. According to DIER (Kim, 2020a, b, 2023), morphological awareness is a predictor for all the above mentioned skills where vocabulary and word reading mediate the relation of morphological awareness to reading comprehension.

Without morphological awareness, vocabulary and word reading predicted reading comprehension. This finding is in line with the role of orthographic and semantic processing of words (word reading and vocabulary respectively) in reading comprehension (Kim, 2020a, b, 2023; Levesque et al., 2021; Nation, 2001; Perfetti & Stafura, 2014). This is consistent with the findings from English-speaking adolescent students that vocabulary (e.g., Goodwin et al., 2017; Kieffer et al., 2013; Zhang & Koda, 2013) and word reading (e.g., Goodwin et al., 2017; Kieffer et al., 2013) are related to reading comprehension. When morphological awareness was added, morphological awareness was directly and indirectly related to reading comprehension. This is in line with the previous findings (e.g., Kim, 2011; Kuo & Anderson, 2006; Lee et al., 2022; Nagy et al., 2006), including those with adolescent students (e.g., Goodwin et al., 2017; Kieffer et al., 2013), and suggest that one's awareness

of morphemes facilitates lexical processing through orthographic and semantic cues. Our findings add to the growing literature of the relation of morphological awareness to vocabulary and word reading by providing findings from Korean middle school students, supporting DIER (Kim, 2020a, b, 2023) and the Morphological Pathways Framework (Levesque et al., 2021).

As stated above, we hypothesized based on DIER (Kim, 2020a, b, 2023) that vocabulary and word reading would mediate the relation of morphological awareness to reading comprehension. Interestingly, however, morphological awareness had a direct relation to reading comprehension over and above vocabulary and word reading; and while word reading remained weakly related to reading comprehension over and above morphological awareness and vocabulary, vocabulary was no longer related to reading comprehension after controlling for morphological awareness and word reading. In other words, word reading did partially mediate the relation of morphological awareness to reading comprehension whereas vocabulary did not. The direct relation of morphological awareness to reading comprehension is similar to previous studies with English-speaking students. For example, Kieffer and colleagues (2013) found that morphological awareness was directly related to reading comprehension over and above vocabulary, word reading, text reading fluency, and listening comprehension for Spanish-speaking English bilinguals in Grades 6, 7, and 8. Levesque and colleagues (2017) also found that morphological awareness was directly related to reading comprehension and indirectly via morphological decoding, word reading, and morphological analysis for English-speaking students in Grade 3. The nonsignificant relation of vocabulary to reading comprehension once morphological awareness was included was also reported in Levesque et al. (2017).

There might be several explanations for the direct relation of morphological awareness over and above vocabulary to reading comprehension and the lack of relation of vocabulary to reading comprehension over and above morphological awareness and word reading. One explanation is the dynamic relations hypothesis of DIER, according to which the direct and indirect relations of component skills to reading comprehension vary as a function of several factors, including measurement of constructs. In the present study, morphological awareness was measured comprehensively including inflectional, derivational, and compound morphology, and using a latent variable approach which minimizes measurement error. In contrast, vocabulary, word reading, and reading comprehension were measured with single tasks and using observed variables, and therefore, these constructs were not measured as precisely as morphological awareness. Therefore, it is possible that results might differ if vocabulary, word reading, and reading comprehension were also measured with multiple tasks and using latent variables. Future studies are warranted to investigate this speculation.

A second potential related explanation is that morphological awareness construct included inflectional morphology which plays grammatical roles, in addition to derivational and compound morphemes. The extent of the relation between morphological awareness and vocabulary would be primarily determined by derivational and compound morphology, not inflectional morphology. Therefore, the grammatical aspect captured in the morphological awareness latent variable may have led to its independent relation to reading comprehension over and

above vocabulary. To explore this speculation, we conducted a post hoc analysis by fitting Model 2, where the morphological awareness latent variable only included derivational and compound morphological awareness without inflectional morphological awareness. The model fit of this alternative model was as follows: $\chi2$ $(df) = 0.51$ (3), $p = 0.92$, RMSEA $= 0.00$ [0.00, 0.06], CFI $= 1.00$, TLI $= 1.00$, SRMR $= 0.01$. Importantly, the results were largely the same with and without inflectional morphological awareness in terms of significant relations and magnitudes (see Appendix). The only small difference was that in the original model, word reading was a significant predictor of reading comprehension (0.17, $p = 0.02$) whereas in the alternative model in which morphological awareness was only the latent variable of derivational and compound morphological awareness, the p-value was just shy of 0.05 (0.16, $p = 0.053$). These results suggest that the direct relation of morphological awareness to reading comprehension over and above vocabulary may not be explained by the morphosyntactic aspect of morphological awareness (at least as measured by inflectional morphological awareness in this study).

A third possibility is that students' morphological processing of words through morphological decoding and morphological analysis may have been a more prominent skill that mediated the association of morphological awareness to reading comprehension instead of their knowledge of vocabulary (Levesque et al., 2017, 2021). This is because one's morphological processing is a substantial mechanism through which students process words of which they are not familiar with the meaning. According to Levesque and colleagues (2017) and Nagy and colleagues (2006), English-speaking elementary grade students' oral language skills are not yet fully developed, and until these young students' vocabulary knowledge matures, morphological processing is likely to substitute the contribution of vocabulary in reading comprehension. We are not clear whether this would hold for our adolescents in Grade 7, and future studies are needed to test the hypothesis about the students' vocabulary level and the relative role of morphological processing in reading comprehension.

Our last potential reason may be due to the nature of the items in our vocabulary measure. The items that constitute REVT (Kim et al., 2009) are mostly monomorphemic words, and this might explain the present findings. In other words, measurement of vocabulary may be an important factor in accurately capturing the mediating role of vocabulary in the relation of morphological awareness to reading comprehension. Although not the primary focus of the present study, it is worth noting that according to DIER, oral language skills such as vocabulary and listening comprehension are expected to make a relatively stronger contribution to reading comprehension than does word reading once readers reach a certain level of word reading skill (see Kim, 2020a for theory and evidence; also see Adlof et al., 2006 for evidence). This was expected for adolescent readers in the present study. However, the findings of the present study did not align with this expectation. Again, measurement of construct is an important consideration in the nature of relations (Kim, 2020a, 2023), and therefore, future studies are warranted to investigate the impact of measurement of vocabulary as well as other constructs on the nature of relations.

Limitations and future directions

There are a few limitations to our study. First, morphological awareness measures had overall lower-than-ideal internal consistency estimates. Even though we used a latent variable approach, which would alleviate the concern, the low internal consistency of these assessments is certainly a limitation. Moreover, morphological awareness is the only latent variable with three subtests—inflectional, derivational, and compound morphological awareness—whereas the rest variables were measured by single tasks. Future studies need to replicate the present study using multiple measures and latent variables for vocabulary, word reading, and reading comprehension for greater precision in findings. In addition, morphological awareness was administered in written context because adolescents in our study were expected to have developed proficient word reading and therefore, administration in written context was not hypothesized to present challenges to students. However, we acknowledge that this might have influenced on the relation of morphological awareness to word reading and reading comprehension. Last but not least, our study explored the relation of morphological awareness to vocabulary, word reading, and reading comprehension, but we did not examine the mechanisms through which these hierarchical relations hold. In our future study, we can explore additional variables that explain the mechanism of morphological processing (e.g., morphological decoding, morphological analysis; see Levesque et al., 2017, 2021; text reading fluency, listening comprehension; Kim, 2020a, b, 2023) to better explain the associations of morphological awareness to language and reading skills.

Our findings illustrate the importance of morphological awareness in explaining development of Korean middle school students' language and literacy skills such as vocabulary, word reading, and reading comprehension, the skills which are all critical for the students' academic success (Nation, 2001). Even though we are cautious to make a causal claim since correlation does not indicate causation, the positive relations we found suggest that systematic and explicit instruction on morphological awareness is likely to be helpful for Korean-speaking middle school students' vocabulary, word reading, and reading comprehension. Future instructional studies are needed to explore this speculation.

Overall, our study makes a unique contribution to the field of language and reading in that we have found the positive direct and indirect associations of morphological awareness to other language and reading skills for Korean adolescents as well as what is predominantly found in English-speaking students in comparable developmental phases of reading (e.g., Carlisle, 2000; Kieffer & Box, 2013; Nagy et al., 2003). Both Korean and English being morphologically informative languages (Kuo & Anderson, 2006; Sohn, 1999), our findings have further underscored the importance of students' morphological awareness in the development of other language and reading skills such as vocabulary, word reading, and reading comprehension in languages with the morphophonological writing system.

Appendix

Standardized Path Coefficients for the Relations among Morphological Awareness (Derivational and Compound Morphological Awareness), Vocabulary, Word Reading, and Reading Comprehension for Korean Grade 7 Students.
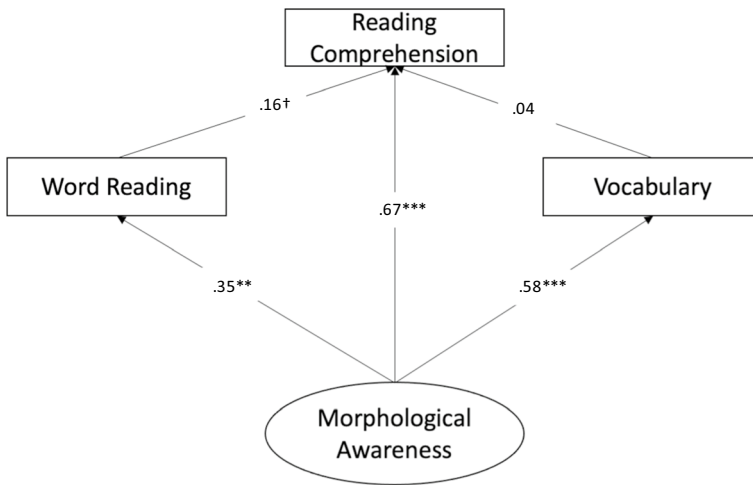
$*p < 0.05. **p < 0.01. ***p < 0.001.$

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