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Role of Morphological Awareness and Morphological Processing in Korean Secondary School Students' English-Vocabulary Knowledge and Reading Comprehension*

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Despite the recognized importance of morphological knowledge to literacy outcomes such as vocabulary knowledge and reading comprehension, two of its subconstructs—morphological awareness and morphological processing—have received comparatively little attention. In response, the aim of the study reported here was to examine how the relationships between morphological awareness and morphological processing, especially in terms of morphological transparency and morphological frequency, contribute to the vocabulary knowledge and reading comprehension of 62 native Korean-speaking secondary school students—27 eighth-graders and 35 tenth-graders—learning English as a foreign language. The students' performance on the Test of Morphological Structure and the Word Reading Test was assessed to gauge their compounding awareness, inflectional awareness, vocabulary knowledge, and reading comprehension. The results indicated that the students' performance was varied depending on morphological transparency and frequency. In addition, it was not morphological processing, but rather morphological awareness that explained variances in vocabulary knowledge and reading comprehension, when compounding awareness and inflectional awareness were controlled for. This paper discusses what such findings imply for teaching English as a foreign language to Korean learners.

Key words: morphological awareness, morphological processing, vocabulary knowledge, reading comprehension, Korean learners

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1. INTRODUCTION

Reading comprehension is the process of extracting meaning from written contexts as a means to communicate with those contexts (Adams, 1990; Perfetti, 1985; RAND Reading Study Group, 2002; Stanovich, 1986). In making meaning from written contexts, readers use literacy-related metacognitive skills that require applying background knowledge and reading strategies (Hudson, 2007), as well as critical linguistic competencies such as phonological awareness (Goswami & Bryant, 1990), reading fluency (Adlof, Catts, & Little, 2006; Hudson, Pullen, Lane, & Torgesen, 2009), semantic processing (Shankweiler et al., 1995), and structural knowledge (Alderson & Kremmel, 2013). As another of those linguistic skills, morphological knowledge (Carlisle, 1988) has received considerable attention given its relationship to language learners' achievement in not only acquiring vocabulary knowledge (Carlisle & Fleming, 2003; Nagy, Berninger, & Abbott, 2006) and reading words (Carlisle, 1995, 2000; Carlisle & Stone, 2005; Fowler & Liberman, 1995; Leong, 1989; Singson, Mahony, & Mann, 2000; Windsor, 2000) but also in comprehending what they read (Carlisle, 2000; Goodwin, Huggins, Carlo, August, & Calderon, 2013; Windsor, 2000).

Morphological knowledge, however, is not a simple construct. To clarify what morphological knowledge can mean, scholars have divided it into two dimensions: morphological awareness and morphological processing (Goodwin, Petscher, Carlisle, & Mitchell, 2017; Nagy, Carlisle, & Goodwin, 2013). On the one hand, morphological awareness encompasses learned aspects of morphological knowledge that can require significant work for learners as they learn to form words, make meaning, and process syntax. On the other, morphological processing encompasses intuitive aspects of morphological knowledge that do not require much effort for language learners to apply in order to achieve speed and accuracy in reading comprehension. Taken together, the differences between the two constructs also reflect differences in the implicit and explicit domains of second language acquisition—that is, intuitive aspects as implicit and learned ones as explicit (Ellis, 2009)—as detailed in studies on focus on form (Ellis, 1984; Kim, 2016; Kim, Choi, & Kang, 2016; Loewen, 2003; Loewen & Reissner, 2009) and vocabulary acquisition (Hulstijn, 2003).

Another way of understanding morphological knowledge is in terms of morphological transparency and morphological frequency, both of which play pivotal roles in morphological awareness and morphological processing. Morphological transparency describes the clarity and unambiguousness of relationships between root words and derived words (e.g., *move* in *movement*) that do (e.g., *describe* and *description*) or do not (e.g., *excite* and *excitement*) involve any phonological or orthographic changes. By contrast, morphological frequency describes how often morphemes, as the smallest units of meaning, occur in a text; for example, the suffix *-er*, as easily discernible in the words *teacher* and *baker*, exhibits far greater morphological frequency than the suffix *-cian*, as in *beautician* and *mathematician.* Consequently, in conditions of high morphological frequency and transparency, language learners can easily guess the meaning and sound of a given suffix, whereas they need to pay far more attention to discern meanings and sounds in conditions of low morphological frequency and transparency.

In studies on morphological transparency and frequency, researchers have collected data primarily via methods that involve having language learners determine word derivations. As some of the studies which investigated the speakers of English monolingual children have shown, the development of inflection coincides with age; it can emerge in learners as young as 4 years old (Berko, 1958) or as old as 12 (Selby, 1972). Conversely, knowledge of derivational morphology, in which suffixes shift into other syntactic categories, continues to develop into adulthood. Between those periods of development, reading derived words is important because, beginning in middle school, the words that language learners encounter are morphologically complex (Nagy, Anderson, Schommer, Scott, & Stallman, 1989). In fact, usually in the fourth grade, English-speaking students confront a whole new level of unfamiliar words, most of which are relatively uncommon or affixed words, if not both (Anglin, 1993; Carlisle & Stone, 2005). Thus, insufficient knowledge of a language's internal morphemic structure can pose significant problems for middle-school students (Kieffer & Box, 2013), whose academic success depends heavily on their ability to read and comprehend derived words.

However, it remains unclear how the subconstructs of morphological awareness and morphological processing factor into literacy-related outcomes at the level of words (e.g., vocabulary knowledge) and at the level of texts (e.g., reading comprehension). Particularly unclear is how the underlying features of morphological transparency and morphological frequency, both of which inform morphological awareness and processing, factor into Korean students' vocabulary and their reading comprehension of English as a foreign language (EFL). Furthermore, whether foreign-language learners, including students of English in South Korea, use morphological processing similarly to native-speaking monolingual students young (Carlisle & Fleming, 2003) and old (Goodwin et al., 2017) in environments dominated by the language they work to learn has not received much attention. In response, the study reported here sought to investigate morphological awareness and morphological processing, as well as their shared underlying features of morphological transparency and morphological frequency, in native Korean-speaking learners of English and to elucidate the relationship of both morphological awareness and processing with vocabulary knowledge and reading comprehension.

2. LITERATURE REVIEW

Morphology is "the study of word-formation processes, including inflections, derivations, and compounds" (Nagy et al., 2013, p. 4). By extension, having morphological knowledge means having an understanding of the rules that guide the ways in which words are formed. Of the three components of the word-formation process, *inflections* refer to plural (e.g., in English, *-s* and *-es*) and possessive forms of nouns (e.g., *-'s* and *s'*); third-person singular (e.g., *-s*), progressive (e.g., *-ing*), and past-tense forms of verbs (e.g., *-ed*); and comparative (e.g., *-er*) and superlative forms of adjectives (e.g., *-est*). By contrast, *derivations* refer to the use of suffixes to change the part of speech; for example, when the nominal suffix *-er* is added to the verb *teach*, the word changes from a verb to a noun (i.e., *teacher*). Last, *compounds* refer to words composed of two free morphemes; for example, *basketball* is formed by the combination of the nouns *basket* and *ball.*

Of the three types of morphology based on those three components, derivational morphological knowledge is considered to be especially important. By late elementary school, English-speaking students, for example, begin learning academic words, and beginning in middle school, 60% of the words that they encounter are morphologically complex (Nagy et al., 1989). In English and other languages, academic vocabulary is highly complex because it integrates Latin and Greek roots, and without sufficient knowledge of prefixes, root words, and suffixes, learners cannot readily guess the meanings of words at first glance (Goodwin, 2010). Conversely, with sufficient morphological knowledge, students can infer the meaning of novel words and learn them by deciphering morphologically complex ones during the process of reading (Nagy, 2007). As a result, they can both broaden and deepen their vocabulary knowledge (Kieffer & Lesaux, 2008) as well as improve their reading comprehension (Goodwin et al., 2013).

Morphological awareness refers to "children's conscious awareness of the morphemic structure of words and their ability to reflect on and manipulate that structure" (Carlisle, 1995, p. 194). Similarly, Nagy et al. (2013) explained that morphological awareness bears explicit, intentional, and conscious features that seem to require learners' effort in word formation, meaning-making, and syntactic processing; on the contrary, morphological processing is an implicit and intuitive process that does not require much work when activating the mental lexicon. Using similar terms, *strategic morphological analysis* and *tacit morphological processing*, Goodwin et al. (2017) also explained that strategic morphological analysis requires learners to access and apply discrete knowledge of morphology with consciousness, while tacit morphological processing requires speed and accuracy with no need to draw explicit attention to reach one's lexical representations.

Morphological awareness and morphological processing play key roles in literacy-related outcomes such as vocabulary knowledge and reading comprehension. As for morphological awareness, Choi (2015) examined a case of Korean-speaking high school and university students' derivational morphological awareness using structural equation modeling. As a result, she observed that the students' English derivational awareness directly contributed to English reading comprehension and indirectly contributed to English reading comprehension through the mediation of English vocabulary knowledge. In examining both morphological awareness and morphological processing, Carlisle (2000) reported that a test for morphological awareness—namely, the Test of Morphological Structure (TMS)—and a test for morphological processing—the Word Reading Test (WRT)—indicated different results in a sample of third- and fifth-grade native English speakers. In particular, according to outcomes on the TMS, morphological awareness exerted greater effects on older students' vocabulary knowledge and reading comprehension. However, whether similar trends characterize students at the Korean secondary school level remains unclear.

In morphological awareness and morphological processing, two underlying features—morphological transparency and frequency—play pivotal roles. On the one hand, *morphological transparency* refers to the relationships between root words and derived word forms. For example, *movement* bears a transparent relationship with the root *move*, which is denoted in *movement*, while the nominal suffix *-ment* is added without phonological (i.e., pronunciation) or orthographic (i.e., spelling) changes. However, in morphologically opaque relationships—for instance, *decide* and *decision*—phonological, orthographic, and word class changes are typical. On the other hand, *morphological frequency*, or *surface frequency*, referring to the frequency of morphemes in a text, can be either high or low. Suffixes with high morphological frequency such as *-er* are more easily discernible—for instance, in the words *teacher* and *baker*—because words with the suffix are familiar to learners. By contrast, suffixes with low morphological frequency such as *-cian* as in *beautician* and *mathematician* are less frequent than *-er*, even if they carry the same meaning as suffixes with high frequency. Consequently, upon encountering words with high morphological opacity and low morphological frequency, language learners struggle to discern their meanings as well as sounds.

Scholars have investigated the roles of morphological transparency and frequency in language learners' ability to read derived words. Mann and Singson (2003), for instance, tested morphologically transparent versus opaque relationships and high versus low morphologically frequency bases among native speakers of English in the third to sixth grades and found that ones in higher grades demonstrated greater accuracy when reading morphologically complex words. In Study 1 of their research, Carlisle and Stone (2005) also observed that higher-grade English-speaking elementary students read morphologically transparent and low-frequency derived words faster and more accurately than their counterparts in lower grades. Both sets of findings imply that students in higher grades, due to their accumulated reading experiences, are more skilled in reading morphologically complex words than those in lower grades. However, different EFL populations might perform differently in those domains, because EFL students would have had limited exposure to literacy experiences both in "quantity and quality of input" (DeKeyser, 2018, p. 3).

Of interest is the struggle of secondary-level native speakers of English to produce morphologically complex words. Carlisle (1988), for instance, divided the relationship of derivations into four conditions—no change, orthographic change, phonological change, and both orthographic and phonological change—and examined the derivational oral production of English-speaking fourth, sixth, and eighth grade students. The results showed that the middle-school students had difficulty when producing both orthographically and phonologically changing words (e.g., *decide* to *decision*) than when producing transparent words (e.g., *enjoy* to *enjoyment*), words with orthographic change only (e.g., *glory* to *glorious*), or words with phonological change only (e.g., *equal* to *equality*) (pp. 263–264). In particular, when the same experimental design is adapted to Korean-speaking secondary-level students in Korea, an entirely different set of results could emerge.

In another study, however, Carlisle, Stone, and Katz (2001) reported that the children with reading disability did not have much difficulty in speed and accuracy, when reading aloud phonologically transparent words (e.g., *culture* and *cultural*) (p. 263) on the naming task compared to their age-matched peers with average reading proficiency and to adults. On the contrary, the poor readers did struggle with the lexical decision task when asked to determine whether given words were "legal" (e.g., *hodropic, deromity*) or "illegal" (e.g., *infsioble, zrenderize*) (p. 257). In sum, phonological transparency, opacity, and word frequency all play together in morphological awareness as well as in morphological processing. Generally, students perform better with high frequency, transparent words, and more experienced readers perform better than their less-experienced counterparts. However, as in Carlisle, Stone, and Katz's (2001) study, poor readers can perform as well as good readers in morphological processing tasks, especially in phonologically transparent words. Thus, when oral reading tasks that include various degrees of transparency and frequency are used, a more accurate picture of morphological processing will possibly be gained.

On the whole, although studies have acknowledged the different contributions of morphological awareness and morphological processing to vocabulary knowledge and reading comprehension, there is ample room for improving the specificity, depth, and breadth of the methods used and findings observed. For one, in measuring aspects of word transparency and frequency in relation to derivational morphology, measuring not at the lexical or sentence level but at the level of passages presented to assess reading comprehension (Carlisle, 2000; Goodwin et al., 2017; Levesque, Kieffer, & Deacon, 2017) seems necessary, chiefly because reading comprehension involves extracting meaning from whole texts, not isolated words or sentences (Adams, 1990; Perfetti, 1985; Stanovich, 1986). Moreover, because the determining the degree of phonological shifting is key to measuring morphological transparency, adding items related to phonological transparency or opacity, if not both, to tests could produce more telling results (Carlisle & Fleming, 2003). Considering all of the above and to contribute to knowledge about morphological awareness and morphological processing, two research questions were developed for the study:

1. Is there a significant relationship between morphological awareness and morphological processing in transparency and frequency aspects for Korean secondary school students of EFL?
2. To what extent do morphological awareness and morphological processing contribute to the English vocabulary knowledge and reading comprehension of Korean secondary school students?

To answer these questions, paired samples *t* tests and stepwise regression analyses were used to measure the relationships among the constructs and with their outcomes of literacy-related achievement at the level of words (i.e., vocabulary knowledge) and at the level of texts (i.e., reading comprehension).

3. METHOD

3.1. Participants

The sample for the study consisted of 27 eighth-grade and 35 tenth-grade native Korean-speaking students, for a total of 62 participants, from two randomly selected public schools in Gyeonggi Province, South Korea. All participants had English classes 3 times per week and started learning English in the third grade. Although their English-language proficiency varied nonetheless, which suited the study's goal of capturing a wide range of English-language proficiency among native-Korean speaking EFL students, the eighth-graders' vocabulary knowledge was matched with that of tenth-graders.[1] By gender, 17

[1] In a previous study, Kim (2018) formed a sample of native Korean-speaking EFL students from three grade levels: sixth, eighth, and tenth. To ascertain the eighth-graders' English-language proficiency, their scores on the Peabody Picture Vocabulary Test, Fourth Edition (PPVT-IV; Dunn & Dunn, 2007) were carefully considered; their mean score was 24.72 (*SD* = 5.39), compared to 15.45 (*SD* = 4.89) for the sixth-graders and 32.72 (*SD* = 5.76) for the tenth-graders. Because the

participants were girls (27%), and 45 were boys (73%); the disproportionate amount of boys was due to the fact that all tenth-graders were from an all-boys' high school.

3.2. Measures

3.2.1. Vocabulary knowledge

A receptive measure, the Peabody Picture Vocabulary Test Fourth Edition (PPVT-IV; Dunn & Dunn, 2007), was administered by presenting four pictures and asking each participant to indicate which best depicted items presented orally by the researcher or English teacher. To save time, and because the differences between scores obtained from the full and modified versions of the PPVT-IV have been few (Deacon, Benere, & Pasquarella, 2013), participants completed a shortened version of the test (Deacon, Kieffer, & Laroche, 2014; Pasquarella, Chen, Lam, Luo, & Ramírez, 2011), which contained every fourth item of the original PPVT-IV. As recommended by the PPVT-IV manual, the age of participants was taken into account in determining how many items they would answer; the eighth-graders responded to 36 items as EFL learners aged 14–16 years, whereas the tenth-graders responded to 39 items as EFL learners aged 17–18. Following the scoring scheme for the shortened version of the PPVT-IV (Deacon et al., 2014), scoring stopped if a participant provided six incorrect answers consecutively. Each test took roughly 30 minutes to complete; 1 point was awarded for each correct answer, whereas 0 points were awarded for each incorrect answer. The PPVT-IV's test–retest reliability reported by the test's developers is .93.

3.2.2. Reading comprehension

Three brief narrative reading passages were adapted from the oral reading fluency test sets of the Dynamic Indicators of Basic Early Literacy Skills[2] Sixth Edition (DIBELS-VI; Good & Kaminski, 2002), and 18 reading comprehension questions about the passages were developed by the author. The questions about reading comprehension addressed the main idea, mood, and details of the respective passage or else required participants to make

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mean scores of students in each grade were approximately 9 points apart and because students in each grade were exactly 2 years younger or older than their fellow participants in other grades, eighth-graders were considered to be appropriate participants in the study reported here.

[2] The DIBELS provides research-based benchmark assessments such as phonological awareness and reading comprehension to teachers, parents, or educators so that they can make use of the test results for screening their students' or children's grade-level literacy skills. The reading passages for the current study were adapted from the sixth edition of the DIEBELS oral reading fluency test sets and used without modification (https://dibels.uoregon.edu/assessment/dibels#resources).

inferences about the passage's content. The reading comprehension test for each grade level took about 30 minutes to complete. Each correct answer received 1 point, and the reliability of the questions calculated by the researcher was .72. To assess the reading level of the passages, Flesch–Kincaid Grade Level scores and the Reading Ease scores were obtained by referring to previous analyses of English-subject textbooks used in South Korea (Im, Cho, & Jong, 2015; Jeon, 2014). The Flesch–Kincaid Grade Level scores for the eighth-graders and tenth-graders were 3.63 and 5.86, respectively, whereas the Flesch–Kincaid Reading Ease scores were 89.23 and 78.86, also respectively.[3]

3.2.3. Compounding awareness

Thirteen test items were created by the author with reference to studies by McBride–Chang et al. (2005, 2008) and Jong and Jung (2015). The 26 lexical items were taken from the list of essential vocabulary, containing 3,000 words, provided by South Korea's Ministry of Educational Science and Technology (MEST, 2011) in light of participants' familiarity with the words. During testing, the researcher or teacher read the following in Korean, for example: "When news is printed on paper, we call it *newspaper*. If a story is printed on paper, what do we call it?" The correct answer for that item was *storypaper*. Following McBride–Chang et al. (2008), participants were permitted to write answers either in Korean or English on the answer sheet provided, because testing compounding awareness aims to measure learners' metalinguistic knowledge in terms of whether they can create novel words by combining semantically laden ones. The test took about 20 minutes to complete, and each correct answer received 1 point. The reliability of the items calculated by the researcher was .54.[4]

3.2.4. Inflectional awareness[5]

[3] For example, a Flesch–Kincaid Grade Level score of 1.80 means that the text represents the average reading level of native English-speaking students at the eighth month of first grade in the United States. The Flesch–Kincaid Reading Ease score also gauges the grade level and reading ease of texts; higher scores mean greater readability.

[4] In a previous study, Kim (2018) reported the internal reliability of the same test (i.e., compounding awareness) was .78. The current study discussed here is the Study 2 of her original study. Although the same compounding awareness test was used in both studies, its reliability in Study 2 was .54 compared to .78 in Study 1, perhaps due to the smaller sample ($N = 62$) in Study 2 than in Study 1 ($N = 210$). According to Button et al. (2013), the reliability is sensitive to small sample size.

[5] Similar to morphological knowledge (Nagy et al., 2013), inflectional knowledge is also divided into inflectional awareness and inflectional processing (Rogers, Révész, & Rebuschat, 2016). However, because the chief purpose of the study reported here was to determine the effect of morphological awareness and morphological processing on Korean EFL students' vocabulary knowledge and reading comprehension, as well as whether the effect of derivational knowledge on those literacy-related outcomes is greater than that of inflections and compounds, inflectional

The task for inflectional awareness was adapted from Berko's (1958) study. However, to measure participants' pure knowledge of inflection (i.e., the plural form and two possessive forms of nouns, comparative and superlative forms of adjectives, and the third-person singular, progressive tense, and past tense of verbs), only 15 items of inflectional awareness were adapted into questions. As in Berko's (1958) study, the author or teacher presented the items orally; for example, "This is a *wug*. Now there is another one. There are two of them. There are two ______." (p. 155). Participants were asked to write the correct answer (i.e., "wugs"). As in Berko's (1958) study, unlicensed images were used to support participants' application of inflectional knowledge in creating new words.[6] The test took about 20 minutes to complete; each correct answer received 1 point, and misspelled answers did not receive any points. The maximum possible score was 15 points, and the reliability of the task calculated by the researcher was .65.

3.2.5. Derivational awareness

Two parts of Carlisle's (2000) TMS—Production and Decomposition—were used to measure participants' derivational awareness. For the TMS Production test, participants were asked to complete sentences by changing a root word to a derived word. For example, given the word *farm*, they were asked to complete the sentence "My uncle is a _______," for which the correct answer was "farmer." Conversely, for the TMS Decomposition test, they were asked to extract the root word from a given word in order to complete a sentence. For example, if the derived word was *driver*, then the answer to the sentence "Children are too young to _______" was "drive." Carlisle's (2000) TMS Production test was adapted given the correspondence of its words to the essential list of 3,000 vocabulary words provided by MEST (2011); more precisely, 26 of the 28 words on the test appear on that list. According to Carlisle (2000), word frequency, word length, and suffix frequency were equally matched on both the TMS Production and Decomposition tests. Each test took about 35 minutes to complete, and each correct answer received 1 point, for a maximum possible score of 28 points on each test. The reliability of the tests calculated by the researcher was .92 for the TMS Production test and .86 for the TMS Decomposition test.

3.2.6. Derivational processing

Carlisle's (2000) WRT was used without any alterations to measure the students'

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awareness and inflectional processing were not evaluated in the study.

[6] The images were downloaded from https://pixabay.com, https://www.dreamstime.com, and http://www.clipartpanda.com.

derivational processing. The WRT includes three types of word tests; Set A contains transparent words with high frequency (e.g., *powerful*, *suddenly*, and *harmful*), Set B contains shift words with high frequency (e.g., *explanation*, *easily*, and *solution*), and Set C contains transparent words with low frequency (e.g., *dramatize*, *secretive*, and *beastly*). The sets were composed of 9, 16, and 20 words, respectively. A voice recorder was given to each participant, who was asked to read the words on the WRT as accurately and as quickly as possible. Following Carlisle's (2000) scoring criteria for both accuracy and speed, 2 points were awarded for correct pronunciation given within 2 seconds and 1 point for correct but delayed, self-corrected, or repeated pronunciation within 2 seconds. However, since the core of derivational knowledge is knowledge about phonological shift, any mispronounced answer received 0 points, even if participants displayed automaticity within 2 seconds, although each answer with self-corrected pronunciation given within 2 seconds received 1 point. Voice data scoring was performed by a native English speaker with graduate-level education in English education and who had taught English to native Korean-speaking students. The test took about 10 minutes to complete but most of the students finished the recording within 2 minutes. For scoring, both American and British pronunciations were accepted. The maximum possible score on the WRT was 90 points.

3.3. Procedure

All data were collected in a quiet classroom at the participant's respective school. It took roughly 5 hours for the eighth-graders and 4 hours for the tenth-graders to complete all testing. For the test order, the vocabulary test was administered first, followed by the compounding and inflectional awareness tests. Two tests about derivations—derivational awareness and derivational processing—were next. The very last step was a reading comprehension test. Due to the various durations of the tests, each test was administered one by one in a single day, except for derivational awareness and derivational processing tests because recording of the WRT did not require much time to complete. For each grade level, about a whole week was required collect all the data sets. The author primarily administered all tests in the presence of an English teacher from the participant's respective grade level. All tests were explained, and practice items were completed. To gauge the difference between morphological transparency and frequency, *t* tests were run. Subsequently, to gauge the power of the TMS and WRT in relation to the dependent variables (i.e., vocabulary knowledge and reading comprehension), a series of hierarchical regression analyses were conducted that controlled for compounding awareness and inflectional awareness. For all analyses, the Statistical Package for the Social Sciences version 21 was used.

4. RESULTS

The descriptive statistics in Table 1 present the secondary school students' mean scores and standard deviations on the TMS Production test, TMS Decomposition test, and WRT, as well as scores for compounding awareness, inflectional awareness, vocabulary knowledge, and reading comprehension. On the TMS, participants performed better on the Decomposition test and with transparent words, whereas on the WRT they performed better when reading transparently derived words (i.e., Set A). On the TMS Production test, they earned a mean score of 9.42 (*SD* = 3.83) out of 15 with transparent words; however, with shift words, they scored far less than half the possible score, with a mean of 5.31 (*SD* = 3.60) out of 13 points. Their performance on the WRT also differed by test set; participants performed best while reading Set C's low-frequency transparent words, for a mean score of 20.63 points (*SD* = 6.27), followed by Set B's high-frequency shift words, for a mean score of 18.81 points (*SD* = 4.53), and Set A's high-frequency transparent words, for a mean score of 9.26 points (*SD* = 4.04). For compounding awareness, participants nearly reached the maximum possible score by earning a mean score of 12.65 (*SD* = .83) out of 13 points. For inflectional awareness, vocabulary knowledge, and reading comprehension, the students scored a mean of 11.61 points (*SD* = 2.34), 30.34 points (*SD* = 6.88), and 14.56 points (*SD* = 2.83), respectively.

TABLE 1

Means and Standard Deviations of the Tested Variables (*N* = 62)

	TMS				WRT			COMP	INF	VOCA	RC
	Production		Decomposition		Set A	Set B	Set C				
	Trans.	Shift	Trans.	Shift	Trans.	Shift	Trans.				
M	9.42	5.31	10.19	11.08	9.26	18.81	20.63	12.65	11.61	30.34	14.56
SD	3.83	3.60	2.18	3.06	4.04	4.53	6.37	.83	2.34	6.88	2.83
Max	15	13	13	15	18	32	40	13	15	36.39	18

Note. TMS = Test of Morphological Structure; WRT = Word Reading Test; COMP = compounding awareness; INF = inflectional awareness; VOCA = vocabulary knowledge; RC = reading comprehension; trans. = transparent words; shift = shift words

Table 2 presents the correlations among all the variables. Their mean scores for compounding awareness and inflectional awareness, as well as on the TMS, showed moderate correlations, whereas their WRT scores did not reveal any correlations with any of the other variables. Vocabulary knowledge and reading comprehension had the strongest relationship with TMS scores (*r* = .697 and *r* = .493, respectively), whereas the correlation between WRT scores and reading comprehension was *r* = -.055.

TABLE 2
Correlations Among Tested Variables (*N* = 62)

		1	2	3	4	5
1	Compounding awareness					
2	Inflectional awareness	.534**				
3	TMS	.259*	.460**			
4	WRT	.078	.157	.176		
5	Vocabulary knowledge	.325**	.333**	.697**	.073	
6	Reading comprehension	.331**	.254*	.493**	-.055	.432**

Note. TMS = Test of Morphological Structure; WRT = Word Reading Test; *$p < .05$, **$p < .01$

Table 3 displays the correlations among the aspects of TMS and WRT. Generally, the transparent and shift words on the TMS Decomposition test had relationships with high-frequency shift words in Set B on the WRT. TMS Production test scores did not significantly correlate with any words on the WRT, and high-frequency transparent words in Set A on the WRT and low-frequency transparent words in Set C on the WRT did not relate with scores on the TMS Production and Decomposition tests.

TABLE 3
Correlations of the Test of Morphological Structure (TMS) and Word Reading Test (WRT)

TMS	WRT		
	Set A Trans. High freq.	Set B Shift High freq.	Set C Trans. Low freq.
Production, trans.	.090	.206	.143
Production, shift	-.105	.125	-.035
Decomposition, trans.	.093	.384**	.185
Decomposition, shift	.091	.335**	.165

Note. trans. = transparent words; shift = shift words; freq. = frequency; **$p < .01$

Tables 4 and 5 present the results of the two paired samples *t* tests for the first research question addressing the relationship between morphological awareness and morphological processing in terms of transparency and frequency. First, Table 4 presents the results for transparent and shift words on the TMS Production and Decomposition tests. The aspects of transparent and shift words differed more on the TMS Production test ($t(61) = 16.892$, $p = .000$), although corresponding differences also emerged on the TMS Decomposition test ($t(61) = -3.491$, $p = .001$).

Table 5 presents the paired samples *t* test results of different aspects of the WRT. Between Sets A and B, aspects of transparent and shift words exhibited differences ($t(61) = -17.520$, $p = .000$), as did aspects of high- and low-frequency words between Sets A and C ($t(61) = -15.534$, $p = .000$).

TABLE 4
Paired Samples *t* test Results for the Test of Morphological Structure (TMS)

	M (*SD*)	*t*	*p*
TMS Production, trans.	9.42 (3.83)	16.892***	.000
TMS Production, shift	5.31 (3.60)		
TMS Decomposition, trans.	10.19 (2.18)	-3.491**	.001
TMS Decomposition, shift	11.08 (3.06)		

Note. trans. = transparent words; shift = shift words; ***p* < .01, ****p* < .001

TABLE 5
Paired Samples *t* test Results for the Word Reading Test (WRT)

	M (*SD*)	*t*	*p*
Set A: High-freq. trans. Set B: High-freq. shift	9.26 (4.04) – 18.81 (4.53)	-17.520***	.000
Set A: High-freq. trans. Set C: Low-freq. trans.	9.26 (4.04) – 20.63 (6.37)	-15.534***	.000

Note. freq. = frequency; trans. = transparent words; shift = shift words; ****p* < .001

Next, to answer the second research question and gauge the relative power between morphological awareness (i.e., TMS) and morphological processing (i.e., WRT) on dependent variables (i.e., vocabulary knowledge and reading comprehension), the order of each construct was switched by entering one in the second and third steps.

Table 6 presents the four variables that explained 51.5% of the total variance of the participants' vocabulary knowledge. Results indicated that the control variables, a combination of compounding awareness and inflectional awareness, explained 14.1% ($p < .05$) of the total variance. The control variable entered in the first step, a combination of compounding awareness ($\beta = .206$, $p = .154$) and inflectional awareness ($\beta = .223$, $p = .124$), although not significant separately, was significant ($p < .05$) with a positive standardized coefficient. In addition, TMS score explained 37.2% ($\beta = .687$, $p < .000$) and 37.4% ($\beta = .694$, $p < .000$) when entered in the second and third steps, respectively. However, WRT score did not explain any variance in performance related to vocabulary knowledge. Thus, scores on the TMS was considered to be a unique predictor of the secondary school students' vocabulary knowledge when other variables were controlled for.

TABLE 6
Hierarchical Regression Analyses Predicting Vocabulary Knowledge

Steps	Variables	*R*	R^2	$\triangle R^2$	$\triangle F$
1	Compounding awareness Inflectional awareness	.376	.141	.141	4.852*
2	TMS score	.716	.513	.372	44.253***
3	WRT score	.718	.515	.003	0.302
2	WRT score	.376	.142	.000	0.033
3	TMS score	.718	.515	.374	43.964***

**p* < .05, ****p* < .001

Table 7 presents the five variables that explained 31.9% of the total variance of the participants' reading comprehension. To determine those values, vocabulary knowledge, compounding awareness, and inflectional awareness were all entered in the first step as control variables, followed by TMS score and WRT score, to gauge the role of each variable by switching the order. Results indicated that the control variable—that is, the combination of vocabulary knowledge (β = .358, p < .01), compounding awareness (β = .199, p = .157), and inflectional awareness (β = .028, p = .839)—explained 22.8% (p < .01) of the total variance. TMS score explained 7.2% (β = .401, p < .05) and 8.10% (β = .430, p < .05) of the variance when entered in the second and third steps, respectively. By contrast, WRT score was not a significant variable for reading comprehension. Accordingly, TMS score was a unique predictor of the students' reading comprehension when vocabulary knowledge, compounding awareness, inflectional awareness, and WRT score were controlled for.

TABLE 7
Hierarchical Regression Analyses Predicting Reading Comprehension

Steps	Variables	R	R^2	$\triangle R^2$	$\triangle F$
1	Vocabulary knowledge Inflectional awareness Compounding awareness	.477	.228	.228	5.699**
2	TMS score	.547	.300	.072	5.852*
3	WRT score	.565	.319	.020	1.616
2	WRT score	.488	.238	.010	0.779
3	TMS score	.565	.319	.081	6.674*

*p < .05, **p < .01

In all, WRT score did not predict either outcome variable (i.e., vocabulary knowledge and reading comprehension). However, TMS score explained 37.4% (β = .694, p < .000) of vocabulary knowledge when compounding awareness, inflectional awareness, and WRT score were ruled out, as well as explained 8.1% (β = .430, p < .05) of the reading comprehension when vocabulary knowledge, compounding awareness, inflectional awareness, and WRT score were all controlled for. Those results indicate that morphological awareness, not morphological processing, had more power in predicting the native Korean-speaking secondary school students' English-language vocabulary knowledge and their reading comprehension.

5. DISCUSSION & CONCLUSION

The study aimed at examining the relationships of morphological awareness and morphological processing in terms of morphological transparency, morphological frequency, vocabulary knowledge, and reading comprehension among native Korean-speaking secondary school students learning EFL. To that end, two tests addressing awareness of morphology—the TMS Production and TMS Decomposition tests—and another addressing morphological processing—the WRT—were borrowed from Carlisle's (2000) study. Paired samples *t* tests revealed differences in the students' performance in the conditions of phonological transparency and opacity, while hierarchical regression analyses revealed the contribution of TMS score, not WRT score, to both their vocabulary knowledge and reading comprehension.

The first research question addressed the relationship between morphological awareness and morphological processing as well as two aspects of derivational morphology in relation to transparency and frequency. In terms of phonological transparency, on the TMS tests the students earned higher scores in the phonologically transparent condition and when they were asked to decompose derived words, and both findings uphold the results of previous studies (Carlisle, 2000; Leong, 1989; Windsor, 2000). In terms of morphological frequency on the WRT, students on average read 51% of high-frequency words in Set A and 52% of low-frequency words in Set C, meaning that the difference in their ability to read high- and low-frequency words was slight. That result, however, did not uphold the findings of previous studies.

Better scores in reading phonologically shift words and lower scores in reading transparent words as well as low-frequency words can be interpreted from various angles. First, contradictory results on the WRT can be explained by Nagy et al.'s (2013) morphological processing indexes. Since reading derived words is an oral production task involving procedural knowledge, the learners in that study were asked to read the morphologically complex words as fast and as accurately as they could, meaning that they might not have had sufficient time to apply morphological processing to reach top speed and accuracy. Presumably, the students might have also had underdeveloped procedural knowledge about oral morphology, possibly due to their limited opportunities to read morphologically complex words and low-frequency words (e.g., the suffix *-dom* as in *queendom* and *stardom*) aloud in their daily lives. On the contrary, on the TMS tests, students had plenty of time to apply their metalinguistic awareness. Although most previous studies have involved investigating native English-speaking students' morphological awareness and morphological processing in completing oral tasks (Carlisle, 1988, 2000; Leong, 1989; Windsor, 2000), the population examined in the study presented here consisted of EFL students, who might need more time to perform tasks on the WRT.

Second, pronunciation could be another reason for better scores in reading phonologically shift words and lower scores in reading transparent words as well as low-frequency words, since scoring the accuracy of pronunciation strictly followed Carlisle's

(2000) scoring scheme. Consequently, any incorrect pronunciation received 0 points, even if the student read the words within 2 seconds. Regarding pronunciation errors, Korean-speaking EFL students' most common errors are pronouncing /p/ versus /b/, /b/ versus /v/, /θ/ versus /ð/, and /r/ versus /l/, followed by arbitrary vowel insertion or elision (Lee, 2010). In addition, when reading phonological shift words, students in present study did not apply rules of change. For instance, most students incorrectly read the word *explanation* in Set B of high-frequency shift words. When the verb *explain* changes to a noun, it undergoes phonological and orthographic changes that render the first syllable's pronunciation as /eks/. However, most students read *ex-* as /ɪks/ as in the first syllable of the verb form. Set C of transparent low-frequency words also impeded the students' accuracy, particularly for three words: *equalize*, *odorous*, and *queendom*. In reading *equalize*, students mispronounced /w/ in the second syllable (i.e., *-qual*), and in reading *odorous* and *queendom*, some said "orderous" /ɔːrdərəs/ for *odorous* and "kingdom" /kɪŋdəm/ for *queendom*. As the results revealed, the participants could not read unfamiliar low-frequency words aloud as accurately and as quickly as native English speakers in previous studies (Carlisle, 1988, 2000). However, more experience with the language could have aided their recognition of low-frequency derived words.

In response to the second research question regarding the contribution of morphological awareness and morphological processing to lexical- and text-level comprehension, only morphological awareness played a significant role in both literacy-related outcomes. In the vocabulary knowledge model, all of the variables together accounted for 51.5% of the total variance, and TMS score alone explained 37.4% of the variance after controlling for compounding awareness, inflectional awareness, and WRT scores. Considering that the sum of all of the variables accounted for more than half of the total variance in that model, the proportion of morphological awareness was non-negligible. In the reading model, in the total variance of 31.9% TMS score alone contributed to 8.1% of the variance after controlling for vocabulary knowledge, inflectional awareness, compounding awareness, and WRT scores. Such results suggest that morphological awareness played a unique, more pronounced role than all of the other variables in the model. However, in both the vocabulary knowledge and reading models, reading morphologically complex words on the WRT did not constitute a significant variable.

Although the experimental tools were borrowed from Carlisle's (2000) study, the contribution of TMS score to vocabulary knowledge and reading comprehension differed from that in her results. In that study, TMS did not make any contribution to third-graders' vocabulary knowledge or reading comprehension; however, for fifth- graders, TMS score explained 6.8% of the variance in vocabulary knowledge, and its contribution doubled for reading comprehension (i.e., 13.7%). In the study reported here, the contribution of the TMS score to vocabulary knowledge was 37.4% and to reading comprehension was 8.1%, respectively. That difference likely stemmed from the study's use of hierarchical regression analysis, which involved entering the most influential variable—vocabulary knowledge—in the first step. Carlisle (2000), by contrast, used simple regression analysis by entering all of the variables at the same time. Consequently, a more accurate interpretation may be that TMS score contributed 8.1% to Korean secondary-level students' reading comprehension when all of the other variables were ruled out.

At the same time, the contribution of morphological awareness to both literacy outcomes resembled that in Goodwin et al.'s (2017) sample of seventh- and eighth-grade English-monolingual students. For older students, morphological word reading and spelling contributed negatively to vocabulary knowledge and the reading comprehension of a passage, whereas morphological awareness contributed positively to both literacy-related outcomes. For older learners, spelling and pronunciation appear to be redundant information to process; even without using phonological and orthographic information, the students could successfully achieve comprehension. Goodwin et al. (2013) noted that, "by fifth grade, awareness of units of meaning may play a more important role in reading than the processing of words letter by letter and sound by sound" (p. 1407). Assuming that the native Korean-speaking secondary school EFL students in the study reported here have morphological awareness similar to native Spanish-speaking EFL students in upper elementary school (e.g., fourth- or fifth-graders), the former might have directly achieved comprehension without attempting to decode morphologically complex words. However, given the missing link between speed and accuracy for the Korean-speaking EFL students, there is room to complement measures by adding various tasks for morphological spelling or morphological meaning (Goodwin et al., 2017).

In all, the study reported here sought to demonstrate the extent to which morphological awareness, measured by the TMS, and morphological processing, measured by the WRT, contribute to native Korean-speaking EFL students' vocabulary knowledge and reading comprehension. The results revealed that only morphological awareness significantly related to those outcomes. Such results have some implications for teaching EFL. For one, morphological instruction should also include phonological and orthographic information (Kirby & Bowers, 2017). However, for Korean-speaking EFL students, phonological changes seem to have more weight than orthographic changes, because the participants in the study did not fully reflect knowledge of phonological changes while completing the WRT, whereas their knowledge of orthographic changes was reflected well on the TMS. In addition, morphological frequency also impeded Korean-speaking EFL students' in pronouncing unfamiliar derivations accurately and quickly. Thus, English teachers in South Korea may need to provide more opportunities for their students to decode morphologically complex words during lessons.

The study involved some limitations. For one, the sample of tenth-graders contained participants of only one gender (i.e., boys). Having a larger sample and including more test sets that embrace both easy and difficult phonological and morphological information could overcome those setbacks. In response to those limitations, researchers should seek to identify other dimensions of morphological awareness as well. For example, in experimental research, scholars could design and test morphological awareness embedded in curricula in content areas such as history and science. Furthermore, in a cross-sectional study, researchers could determine how the three aspects of morphological awareness (i.e., inflections, derivations, and compounds) interact in first-language and second-language learners. Nevertheless, the current study is valuable because an in-depth investigation into the phonological transparency and frequency of derivations revealed their relationships with morphological awareness and morphological processing. This study also highlighted the students' insufficient knowledge of phonological changes of derivations and their limited opportunities to encounter and use English derivations. Accordingly, the significance of Korean secondary school students' morphological awareness in their vocabulary knowledge and reading comprehension was stressed, as was the weakness of their morphological processing, which can inform future research on the morphological knowledge of native Korean-speaking EFL learners.

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