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Direct and Indirect Roles of Morphological Awareness in the English Reading Comprehension of Native English, Spanish, Filipino, and Vietnamese Speakers

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This study tested three hypotheses about the direct and indirect contributions of derivational morphological awareness to English reading comprehension in sixth-grade students from differing language backgrounds ($n = 952$). Students included Spanish-speaking, Filipino-speaking, and Vietnamese-speaking language minority learners as well as native English speakers. Multiple-group structural equation modeling indicated that morphological awareness made a significant direct contribution to reading comprehension, controlling for reading vocabulary and word reading fluency. Morphological awareness also made a significant indirect contribution to reading comprehension via reading vocabulary, but not via word reading fluency. Effects were similar across the four language groups. Findings suggest that morphological awareness may play multiple important roles in English reading comprehension for students from a variety of home language backgrounds.

Keywords reading comprehension; morphological awareness; vocabulary; word reading efficiency; adolescents; comparative studies

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Introduction

A large number of English words are constituted from two or more smaller meaningful units or morphemes, such as prefixes, suffixes, and roots (Anglin, 1993; Goulden, Nation, & Read, 1990; Nagy & Anderson, 1984). These morphologically complex words appear more frequently in written text than in spoken language (Chafe & Danielewicz, 1987). Thus, it is unsurprising that morphological awareness, that is, students' metalinguistic understanding of how such words are formed, has been found to correlate with their reading comprehension ability (e.g., Carlisle, 2000; Deacon & Kirby, 2004; Freyd & Baron, 1982; Tyler & Nagy, 1990). However, the mechanisms that underlie this association are less clear. Morphological awareness may facilitate the development of a broad vocabulary that in turn facilitates successful comprehension during subsequent reading. At the same time, morphological awareness may facilitate accurate and rapid word identification, thus freeing cognitive resources for comprehension processes. It is further possible that morphological awareness makes a direct contribution to the reading comprehension process that is independent of these two indirect mechanisms by facilitating students' extraction of semantic and syntactic information during reading.

Given the linguistic nature of these processes, they may proceed differently for students from homes in which a language other than English is spoken, a population known as language minority (LM) learners. LM learners in the United States demonstrate difficulties with English reading comprehension at higher rates than their native English-speaking counterparts (for a review, see Lesaux, Koda, Siegel, & Shanahan, 2006), but it is unclear whether underdeveloped English morphological awareness is an underlying source of these difficulties. Moreover, the LM learners' success in utilizing morphology in their second language may depend, in part, on the nature of their first language (e.g., Ramirez, 2009), given the great variation in morphological systems across languages. However, few studies have investigated whether the direct and indirect contributions of morphological awareness to reading comprehension differ between native English speakers and LM learners. Similarly, it is unknown how these contributions might be similar or different for LM learners who are exposed to differing home-language morphological systems.

The current study aims to advance our knowledge of how morphological awareness relates to reading comprehension across populations of linguistically diverse students. Using structural equation modeling (SEM) with data from a large, diverse sample of sixth-grade students, we provide correlational evidence on three possible routes by which awareness of derivational morphology may relate directly and indirectly to reading comprehension.

Further, we investigate whether these relationships differ as a function of home language background by comparing four groups of students: native English speakers, Spanish-speaking LM learners, Filipino-speaking LM learners, and Vietnamese-speaking LM learners. By determining which relationships are similar among native English speakers and LM learners from three language groups that differ considerably in their first-language morphological systems, we seek to inform models of second-language reading comprehension that can be relevant to the increasingly linguistically heterogeneous population of students in U.S. K–12 schools.

Morphological Awareness and Vocabulary Development

The majority of morphologically complex words in English have meanings that potentially can be inferred based on the meanings of their parts (Nagy & Anderson, 1984). Readers vary in their ability to decipher the meaning of complex words, leading to the suggestion that students' level of morphological awareness may influence their success in acquiring the meanings of new words that they encounter while listening or reading (for a review, see Kuo & Anderson, 2006). Readers with well-developed awareness of derivational morphology who encounter novel words such as *similarity, methodological,* or *characterization* may be better able to extract the meaning of these words with relative ease by recognizing their relationship with the meanings of more common terms such as *similar*, *method*, and *character*, thereby broadening their vocabularies.

Several studies conducted with native English-speaking students have supported this notion by demonstrating that morphological awareness predicts vocabulary size (Anglin, 1993; Carlisle, 2000; Nagy, Berninger, & Abbott, 2006; McBride-Chang, Wagner, Muse, Chow, & Shu, 2005). For instance, Anglin (1993) compared native English speakers in first, third, and fifth grade on their knowledge of a relatively large and representative sample of words from an unabridged dictionary and found that a large majority of the words known by the fifth graders, but not by the third graders, were derived words. More recently, McBride-Chang et al. (2005) found that morphological awareness predicted vocabulary size, controlling for phonological awareness, speeded naming, and word reading measures, in a sample of students in kindergarten and second grade. As suggested by recent longitudinal studies (e.g., Kieffer & Lesaux, 2012a; McBride-Chang et al., 2008), this relationship between vocabulary size and morphological awareness is likely to be bidirectional. While morphological awareness may facilitate students' ability to extract meanings from newly

encountered words, a larger vocabulary may also provide the breadth of examples of morphologically complex words from which understanding of morphological rules can be derived.[1]

Given the well-established relationship between vocabulary knowledge and reading comprehension (for reviews, see Anderson & Freebody, 1981; Grabe, 2009), the broadening of vocabulary thought to result from improved morphological awareness should, in turn, yield improved comprehension during subsequent reading. In one study with particular relevance for this hypothesis, Nagy et al. (2006) used SEM to test what portion of the contribution of morphological awareness to reading comprehension was independent of reading vocabulary and what proportion was an indirect contribution via reading vocabulary. They found that much, though not all, of the contribution of morphological awareness to reading comprehension was via its effect on reading vocabulary for native English speakers from middle class backgrounds in grades four through nine. Nagy et al. provide a valuable approach for investigating the direct and indirect mechanisms underlying the correlations among these skills, while also raising questions about whether their findings generalize to more linguistically diverse samples.

The role of morphological awareness in broadening reading vocabulary may be particularly, or at least equally, important to the English reading comprehension of LM learners. Several studies indicate that the strong relationship between vocabulary size and reading comprehension found for native English speakers also holds for LM learners (e.g., García, 1991; Lesaux & Kieffer, 2010; Proctor, Carlo, August, & Snow, 2005) as well as English-as-a-foreign-language learners (e.g., Nation, 2001; Qian, 2002). Together with evidence of the low English vocabulary levels common among LM learners (e.g., August, Carlo, Dressler, & Snow, 2005; Carlo et al., 2004; Umbel, Pearson, Fernandez, & Oller, 1992), these findings lead to a general consensus that limited vocabulary knowledge is a major source of reading comprehension difficulties in this population (August & Shanahan, 2006). If developed morphological awareness facilitates vocabulary acquisition for LM learners, it may thereby reduce their risk for reading comprehension difficulties.

Despite these theoretical reasons for believing that morphological awareness would indirectly contribute to reading comprehension via vocabulary for LM learners, few studies have investigated this question directly. In a study conducted with a cohort of 90 Spanish-speaking LM learners followed from fourth to fifth grade and assessed in English, Kieffer and Lesaux (2008) found that a measure of derivational morphological awareness correlated with oral vocabulary size in both grades and that morphological awareness made a unique

contribution to performance on both comprehension measures in fifth grade, controlling for phonological awareness, word reading accuracy, word reading fluency, and oral vocabulary size. A term for the interaction between morphological awareness and vocabulary size in predicting reading comprehension was not statically significant, suggesting the absence of a moderating effect; however, this study had relatively limited statistical power to detect small interaction effects, highlighting the need for studies in this area with larger samples of LM learners. Moreover, while this study confirmed findings from studies with native English speakers, it did not include a direct comparison between LM learners and native English speakers.

Morphological Awareness and Efficient Word Reading

Unlike many other alphabetic languages, English has a deep orthography. Although many English words can be spelled using a one-to-one mapping of letters or letter patterns to sounds, other words retain morphological information in their spelling, even when such information conflicts with the words' phonetic pronunciations. Despite shifts in sound that occur with derivation (e.g., *nation* and *national*, *similar* and *similarity*), English generally maintains consistent spelling of morphemes. This consistency yields words that are less phonetically decodable, but carry more information about their semantic relationships to other words, and implicates the morphological system in word recognition. Empirical research with native English speakers supports a role for morphology in word recognition. Several correlational studies have found a robust association between explicit awareness of morphology and word reading accuracy and efficiency (Carlisle, 2000; Carlisle & Stone, 2005; Deacon & Kirby, 2004; Mahony, Singson, & Mann, 2000; Nagy et al., 2006), and experimental studies utilizing priming and frequency effects that have demonstrated that rapid word reading in English is facilitated by the implicit processing of morphological information (e.g., Deacon, Parrila, & Kirby, 2006; Nagy, Anderson, Schommer, Scott, & Stallman, 1989).

Accurate and efficient word reading is essential to successful reading comprehension for both native English speakers (for reviews, see National Institute for Child Health & Human Development, 2000; Perfetti, 1988) and second-language learners (for reviews, see August & Shanahan, 2006; Grabe, 2009); thus it is possible that part or most of the contribution of morphological awareness to reading comprehension could be via the facilitation of accurate and rapid word reading. Given that comprehension of connected text is the ultimate goal in reading development, researchers investigating the facilitating effects

of morphological awareness and processing on word reading typically assume that these effects will translate into better reading comprehension. However, the empirical data on this question remain limited for both first and second language reading. Researchers have typically investigated the contributions of morphological awareness to word reading and reading comprehension in separate analyses or in separate studies, instead of investigating whether word reading skill may function as a mediating variable through which morphological awareness contributions to the ultimate outcome of reading comprehension.

For LM learners, this hypothesized indirect role of morphological awareness via word reading efficiency may do less to explain individual differences in reading comprehension than the hypothesized indirect role via vocabulary. Although research conducted on this topic with early adolescent second-language learners is limited to only a few studies (e.g., Kieffer & Lesaux, 2008; Ramirez, Chen, Geva, & Kiefer, 2010), research conducted with adults indicates that nonnative speakers of English may be less sensitive to morphological structure when reading words and more likely to rely on processing morphologically complex words as whole units, compared to native speakers (for a review, see Clahsen, Felser, Neubauer, Sato, & Silva, 2010). Additionally, growing evidence suggests that LM children and youth frequently achieve levels of word reading performance that are equivalent to those of their native English-speaking peers, despite lower levels of reading comprehension (for a review, see Lesaux et al., 2006), suggesting that many of the reading comprehension difficulties commonly found among LM learners are due to factors other than underdeveloped word reading skills. Thus, while morphological awareness may facilitate efficient word recognition for LM learners, this effect may not necessarily explain the prevalence of reading comprehension difficulties among these learners.

Unique Contributions of Morphological Awareness to Reading Comprehension

Although these indirect routes via vocabulary and via word reading efficiency likely explain much of the correlation between morphological awareness and reading comprehension, there is reason to believe that morphological awareness may predict reading comprehension above and beyond these relationships. Several studies have demonstrated that morphological awareness independently predicts reading comprehension, even after controlling for the contributions of vocabulary in native English speakers (e.g., Carlisle, 1995; Carlisle, 2000; Nagy, Berninger, Abbott, Vaughan, & Vermeulen, 2003; Nagy et al., 2006;

Ku & Anderson, 2003) and after controlling for vocabulary and word reading efficiency in LM learners (Kieffer & Lesaux, 2008).

One explanation for this unique contribution is that morphological awareness involves semantic, phonological, and syntactic information in a fundamentally integrative process (Kuo & Anderson, 2006; Nagy, 2007). This integration of information mirrors many of the integrative processes involved in reading comprehension (Perfetti, Landi, & Oakhill, 2005; see also Nagy, 2007). As such, tasks involving morphological awareness may be a more robust indicator of general metalinguistic ability than tasks targeting phonological or syntactic awareness alone (Carlisle, 1995).

A complementary explanation that specifies a more direct mechanism is that extracting semantic and syntactic information from morphological complex words may play a role in real-time comprehension processing, independent of any role in prior language acquisition (Nagy, 2007). For instance, during a specific reading event, analysis of a morphologically complex word that is not transparent (e.g., a word such as *homophobia* that is not predictable based on the meanings of *homo-* and *–phobia* or a word such as *suicide* that has the rare morpheme *sui-* that is unlikely to have been encountered previously) may not lead to acquisition of the word's complete meaning, but might nonetheless provide some incremental knowledge about the concepts discussed in a text (e.g., that they involve fear and killing, respectively). Similarly, readers with well-developed morphological awareness who encounter *Positivist* or *Behaviorist* but are unfamiliar with the concepts of *Positivism* or *Behaviorism* are unlikely to acquire the former terms, but nonetheless can recognize that they likely refer to agents and can use this information to parse the syntax of a sentence more effectively. By extracting such partial semantic and syntactic clues during real-time comprehension processing, readers with well-developed morphological awareness may gain a foothold into comprehending the gist of a text. Although it is likely that these unique contributions of morphological awareness to reading comprehension will be similarly important for LM learners and native English speakers, this is an open question, because few studies have directly compared the two groups.

Generalizing Across First Language Groups

In exploring all three of the above hypotheses, there is a need to investigate whether these relationships generalize across different groups of LM learners from typologically differing first-language backgrounds. Kuo and Anderson (2006), in their cross-linguistic review of research conducted with monolingual

speakers of various languages, concluded that the importance of morphological awareness in reading one's first language may generalize across languages that are distinct in their morphological systems, although the aspects of morphology that are most important may differ by language. For children learning to read in their second language, the features of the target language are likely to be centrally important. In the same way that phonological processing is central to LM children learning to read in a alphabetic language such as English (for a review, see Lesaux & Geva, 2006), developing awareness of derivational morphology may be equally important for second-language learners regardless of the importance of derivations in their first language. Consistent with recent evidence that predictors of early reading development, most prominently phonological awareness, are similar among LM learners from differing language groups (e.g., Lesaux & Geva, 2006; Lipka, Siegel, & Vukovic, 2005), there is good reason to hypothesize that the predictive power of morphological awareness will generalize across language groups. Additionally, for the large number of LM learners in the United States and Canada who receive literacy instruction exclusively in English, the shared educational experiences with English may overshadow differences associated with their first-language backgrounds.

On the other hand, there is some reason to suspect that these relationships could be somewhat stronger for students who speak first languages with morphological systems that are more similar to that of English. Growing evidence indicates cross-linguistic relationships for morphological awareness among bilingual speakers of diverse languages (e.g., Deacon, Wade-Woolley, & Kirby, 2007; Ramirez et al., 2010; Wang, Cheng, & Chen, 2006), suggesting that LM learners' levels of English derivational morphological awareness may be influenced by the importance of derivation in their first language. For instance, Ramirez (2009), comparing native English speakers with Spanish-speaking and Chinese-speaking LM learners in grades four and seven, found that students' relative levels of derivational and compound awareness were predictable based on the typology of their first language. Of course, higher levels of morphological awareness do not necessarily mean that this ability will have a greater power to predict reading, but it is possible that students who have more developed awareness of morphology from their first language experiences will also be more predisposed to using this awareness during English reading. However, the empirical evidence on this latter question remains limited.

The first languages commonly spoken by LM learners in the United States, including Spanish, Filipino, and Vietnamese, differ considerably in their morphological systems. As a Latinate language, Spanish includes a large number of morphologically complex words and shares many morphological features with

English, which may facilitate the use of morphological awareness in reading for Spanish-English bilinguals (e.g., Ramirez, 2009; Ramirez et al., 2010). In particular, many common derivational suffixes in Spanish are transparently related to English suffixes (e.g., *-ción* in *información* and *–tion* in *information*), while other derivational suffixes in Spanish are not direct translations but serve similar functions and can be often matched consistently to English suffixes (e.g., *-idad* in *complejidad* and *–ity* does in *complexity*). Filipino, an Austronesian language that is the national language of the Philippines, is considered to have a rich morphological system that demonstrates many differences from that of English (Llamzon, 1976). For instance, unlike English, Filipino uses infixes and prefixes to indicate verb aspect and other grammatical role information (Lofranco, Peña, & Bedore, 2006). On one hand, the rich use of morphology in Filipino may heighten Filipino speakers' awareness of word parts during reading, while on the other hand, the specific differences between English and Filipino may lead to less use of English derivational morphology during reading. In contrast, Vietnamese is an Austroasiatic language that is considered a prototypical example of an isolating language in which morphological derivational and inflectional processes do not occur, though compounding does exist (Aronoff & Fudeman, 2005). Given this, native Vietnamese speakers would be less likely than speakers of other languages to recognize and use English derivational morphology during reading. While Spanish is the most common home language spoken by LM learners in U.S. K–12 schools, Vietnamese is the second most common and Filipino the eighth (Batalova, Fix, & Murray, 2007), highlighting the need to investigate morphology and reading development among students from these more rarely studied language groups. Improving our understanding of the role of morphological awareness in second-language reading comprehension requires empirical investigations to determine whether findings obtained for native English speakers generalize to LM learners from a variety of first-language backgrounds.

The Current Study

The current study was designed to provide correlational evidence that can begin to address the three hypotheses just outlined about the relationships between morphological awareness and reading outcomes for students from four language groups. Specifically, we used multiple-group SEM to simultaneously test: (a) the direct contribution of morphological awareness to reading comprehension controlling for reading vocabulary and word reading efficiency, (b) the indirect contributions of morphological awareness via reading

vocabulary, and (c) the indirect contributions via word reading efficiency. In so doing, we further examined whether these contributions differed between LM learners and native English speakers and/or among LM learners who speak three different home languages—Spanish, Vietnamese, and Filipino—that are commonly represented among school-aged LM learners in the U.S. and differ considerably in their morphology.

Method

Sample

The data were collected as part of a larger research project investigating the effects of an instructional intervention on vocabulary and reading comprehension outcomes for linguistically diverse students in sixth grade. In the larger project, intact classrooms of students were randomly assigned to either a treatment condition in which they received a researcher-created intervention or a control condition in which they received the standard district curriculum with no support or materials provided by the research team. The data analyzed for the current study come from the students in classrooms that were randomly assigned to the control condition, in which they did not receive the intervention, but rather were provided with the standard district English-language arts curriculum.

The participating students included 952 sixth-grade students recruited from 39 English-language arts classrooms in 14 middle schools in an urban district in southern California. The sample included 323 native English-speaking students, 499 Spanish-speaking LM learners, 48 Vietnamese-speaking LM learners, and 82 Filipino-speaking LM learners[2]; a small number of LM learners who spoke languages that were less commonly represented (i.e., by fewer than 25 students in the sample) were excluded. Consistent with the definition of LM used by the National Literacy Panel on Language Minority Children and Youth (August & Shanahan, 2006), LM learners included all students who reported that a language other than English was spoken at home, whether the student currently had a school-based English language learner (ELL) designation or not.[3] Students from each of the three LM learner groups reported speaking a combination of English and another language to comparable extents. A majority of LM learners reported speaking both languages equally (48% of Spanish speakers, 53% of Vietnamese speakers, and 65% of Filipino speakers), while others reported speaking mostly English (18% of Spanish speakers, 13% of Vietnamese speakers, 25% of Filipino speakers) or mostly another language (22% of Spanish speakers, 30% of Vietnamese speakers, and 6% of Filipino

speakers), and only a small number of students reporting speaking another language exclusively at home (11% of Spanish speakers, 4% of Vietnamese speakers, and 0% of Filipino speakers).

The schools were largely representative of those in urban settings in the western and southwestern United States in their demographics. According to district records, the student population in each school included a large percentage of students of color (median = 79.4%; ranging from 40.4% to 98.2%) and of students from low-income backgrounds (median = 51.6%; ranging from 23.0% to 100.0%). The four language groups were largely matched on school-level socioeconomic status; on average, native English speakers attended school with 54% of students from low-income backgrounds, compared to 64% for Spanish-speaking LM learners, 46% for Filipino-speaking LM learners, and 55% for Vietnamese-speaking LM learners. Of the participating students, 87% were born in the United States, while a large majority of the foreign-born participants (71%) moved to the United States when they were 6 years old or younger. Seventy-nine percent of the sample had attended school in the same city in southern California since kindergarten, and the participating students had received instruction in English.

Measures

Reading Comprehension

Two independent measures were used to assess reading comprehension, given evidence that different reading comprehension tests draw on componential skills differently (Cutting & Scarborough, 2006; Francis et al., 2006; Keenan, Betjemann, & Olson, 2008). The first was the reading comprehension subtest from the Gates-MacGinitie Reading Test, Fourth Edition (sixth-grade version*;* MacGinitie, MacGinitie, Maria & Dreyer, & Hughes, 2000). This norm-referenced measure is a widely used assessment of students' global reading comprehension, in which students have 35 minutes to read several grade-level passages from expository and narrative texts and complete multiple-choice questions. The publisher reports Kuder-Richardson Formula 20 reliability coefficients of .90 to .92 for the sixth-grade test, as well as extensive validity evidence.

The second measure of reading comprehension was the Expository Text Comprehension Task, a researcher-created test of global and inferential comprehension when reading grade-level expository text, adapted from a measure used previously with linguistically diverse sixth graders (Lesaux, Kieffer, Faller, & Kelley, 2010) that drew on research in vocabulary and reading comprehension assessment (Pearson, Hiebert, & Kamil, 2007). Unlike the

Gates-MacGinitie reading comprehension subtest, this measure was untimed. In this measure, students independently read five feature articles drawn from a magazine for early adolescents and answered three multiple-choice questions following each passage; the first question measured global comprehension of the passage (e.g., *What is the main idea of this text?*), while the second and third item required students make an inference across several statements in the passage (e.g., After students had read several sentences that describes three characters named Alex, Joshua, and Nathan, they were asked *What do Alex, Joshua, and Nathan have in common?*). The internal reliability estimate for this measure with this sample was adequate (Cronbach's alpha = .71) and correlations with other measures support the validity of this measure (details are available from the first author).

Morphological Awareness

Two researcher-created, independent measures of morphological awareness were used, given concerns that morphological awareness measures can vary in the degree to which they tap relational and syntactic aspects of morphological awareness as well as the degree to which they tap root-word vocabulary knowledge (e.g., Kuo & Anderson, 2006).

The first morphological awareness measure was the Real Word Decomposition Task, which was created based on a task originally designed by Carlisle (2000) as well as tasks used in subsequent studies with LM learners (Carlo et al., 2004; Kieffer & Lesaux, 2008; Lesaux et al., 2010). In this 18-item task, test administrators provide students with a word with a derivational suffix (e.g., complexity) and ask the children to extract the base word (e.g., complex) to complete a sentence (e.g., The problem is _____). Trained research assistants scored written answers to the task dichotomously using a detailed scoring guide that included a rubric along with sample correct and incorrect responses. Responses were scored as correct if they provided the correctly spelled form of the word or a phonetically justifiable version of the word form, such as *posess* for *possess* or *durible* for *durable*. Responses were scored as incorrect if they were morphologically unrelated words such as *have* for *possess* or *hard* for *durable*, when they were incorrectly decomposed responses such as *poss* or *dura*, or when they were ambiguous responses such as *possese* and *durabil*. In this way, we protected in part against the confounding of variation in students' ability to spell the base word with true variation in morphological awareness. The estimated internal consistency reliability in the current sample was high (Cronbach's alpha = .86) as was inter-rater agreement with a previous sample of linguistically diverse sixth grade students (Agreement = 98%; Cohen's

Kappa = .96). Several prior studies attest to the validity of tasks using this paradigm for this population, including evidence of convergent and divergent validity in native English-speaking (Carlisle, 2000) and LM populations (Carlo et al., 2004; Kieffer & Lesaux, 2008) and evidence of construct validity based on the fitting of confirmatory factor analytic models (Wagner, Muse, & Tannenbaum, 2007; see also Kieffer & Lesaux, 2012b).

The second measure of morphological awareness was the Nonword Derivation Task, which was developed based on previous research (Nagy et al., 2006). In this measure, students complete a sentence (e.g., *The man is a great* _____) by choosing a nonsense word with an appropriate derivational suffix (e.g., *tranter*) from among four choices (e.g., *tranter*, *tranting*, *trantious*, *trantiful*). The task, sometimes referred to as a suffix choice task, included 18 items. The estimated internal consistency reliability at posttest was good (Cronbach's alpha = .78). Several prior studies provide evidence for the validity of tasks using this paradigm, including evidence of convergent and divergent validity in native English-speaking (Nagy et al., 2006) and LM populations (Lesaux & Kieffer, 2010) as well as evidence of construct validity based on the fitting of confirmatory factor analytic models in native English-speaking populations (Kieffer & Lesaux, 2012b; Wagner et al., 2007).

Reading Vocabulary

Students' knowledge of vocabulary was assessed using the Reading Vocabulary subtest of the Gates-MacGinitie Reading Test, Fourth Edition (sixth-grade version*;* MacGinitie et al., 2000). This standardized, norm-referenced measure is a widely used assessment of students' grade-level vocabulary knowledge. For each item, students read a brief sentence with an underlined target word and must choose a word that means the same or nearly the same as the underlined word from four choices. The vast majority of participating students completed it in the time allotted. The publisher reports high reliability estimates and extensive validity evidence.

Silent Word Reading Fluency

Students' ability to recognize printed words accurately and quickly was assessed using the Test of Silent Word Reading Fluency (Mather, Hammill, Allen, & Roberts, 2004). In this standardized, norm-referenced test, students are provided with rows of unrelated words of increasing difficulty with no spaces separating them (e.g., *dimhowfigblue*) and given three minutes to draw lines between as many words as they can (e.g., *dim|how|fig|blue).* Unlike some word reading measures, this measure has the advantage of avoiding ceiling effects

and restriction of range; as shown in Appendix S1 in the Supporting Information online, the distribution of scores on this measure showed great variability and approximate normality. The publisher reports high estimates of reliability (i.e., test-retest reliability = .92; alternate-form reliability = .83) as well as validity evidence from several validation studies.

Procedure

All assessments were group-administered to classrooms of students by trained research assistants over two testing occasions in students' sixth grade year.[4]

Analyses

Multiple-group SEM was used to estimate and evaluate the direct and indirect contributions of morphological awareness to reading comprehension, accounting for the direct contributions and partial mediation of reading vocabulary and word reading fluency, and to investigate whether these contributions differ as a function of home language background. Multiple-group SEM has several advantages over traditional multiple regression approaches that are particularly relevant to research in this area. First, SEM allows for the creation of latent composite factors based on multiple observed indicators, which are more reliable than any individual indicator and less susceptible to task-specific influences; in the current study, this advantage was used to create factors for reading comprehension and morphological awareness, two constructs that are known to be challenging to measure with any single task (e.g., Cutting & Scarborough, 2006; Kuo & Anderson, 2006). Second, SEM allows for the specification of complex models that capture multiple, simultaneous relationships among several constructs (i.e., reading comprehension, morphological awareness, reading vocabulary, and silent word reading fluency in the present study), including mediating relationships (i.e., the indirect contributions of morphological awareness to reading comprehension via reading vocabulary and silent word reading fluency). Third, multiple-group SEM can be used to determine if and how a hypothesized model differs for specific groups of students (i.e., native English speakers, Spanish-speaking LM learners, Vietnamese-speaking LM learners, and Filipino-speaking LM learners in the current study).

Figure 1 displays a path diagram for the hypothesized model that was fitted using multiple-group SEM. As shown in Figure 1, the two latent factors for reading comprehension and morphological awareness (shown as circles) were each related to two observed indicators (shown as squares) by regression paths. Morphological awareness was hypothesized to have a direct effect on reading comprehension (shown as a single-headed, straight arrow) as well as direct

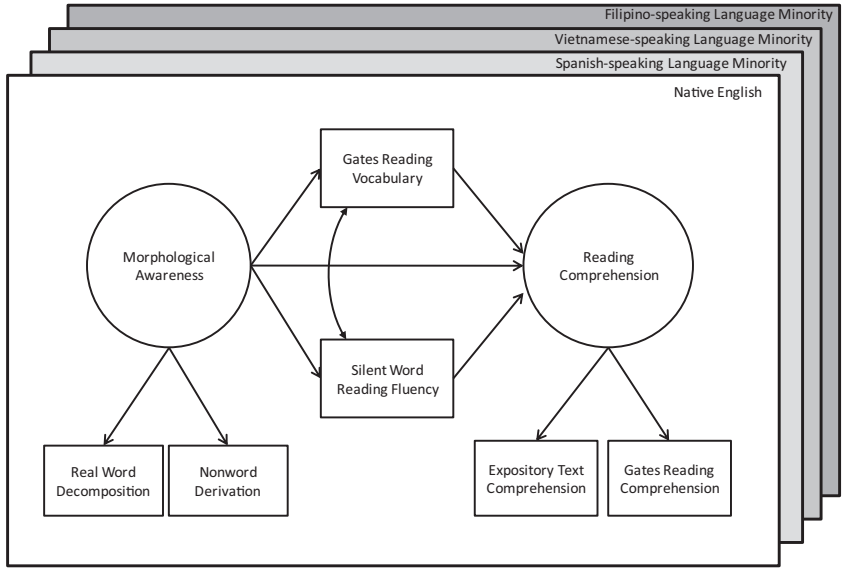

Figure 1 Path diagram representing hypothesized multiple-group structural equation model for the results shown in Table 1, with boxes representing observed indicators, circles representing latent factors, single-headed arrows representing regression paths, the double-headed arrow representing a correlation, and the differently shaded frames indicating a multiple-group analysis.

effects on reading vocabulary and silent word reading fluency, each of which in turn has a direct effect on reading comprehension. By simultaneously including the direct effects of each of these three skills on reading comprehension, their independent contributions could be estimated; thus, the estimate of the regression path between morphological awareness and reading comprehension represented the independent effect of morphological awareness, after controlling for the effects of reading vocabulary and silent word reading fluency. In addition to this direct effect, the indirect effect of morphological awareness via reading vocabulary was estimated by partialing out the portion of the contribution of reading vocabulary to reading comprehension that was predicted by morphological awareness; the indirect effect of morphological awareness via silent word reading fluency was estimated similarly. Reading vocabulary and silent word reading fluency were also hypothesized to be correlated with one another (as shown by the double-headed, curved arrow). Additionally, uncorrelated residual variances for each observed indicator were included in the model (not shown).

This hypothesized model was fitted simultaneously to data from the four language groups (i.e., native English, Spanish-speaking LM, Vietnamese-speaking LM, Filipino-speaking LM) using multiple-group SEM, as shown in Figure 1 by the four, differently shaded frames surrounding the path diagram. First, in a baseline multiple-group model, all paths shown in Figure 1 were fixed to be the same across the four groups, while the latent means, indicator intercepts, and residual variances were allowed to differ by group. Then, to investigate whether the relationships of interest differed by language group, each individual structural regression path of interest was allowed to differ among the groups, and a likelihood ratio chi-square test was conducted to determine if the path differed significantly among the groups.[5] If a given path was found to differ, additional models were fitted to test if any additional individual paths differed significantly among the groups, after allowing that path to differ. We also conducted additional analyses to investigate whether findings were robust after accounting for school-level socioeconomic status. They are reported in Appendix S2 of the Supporting Information online.

Three specific analytic decisions were also made to minimize the impact of potential violations of statistical assumptions. First, we accounted for a small amount of missing data (i.e., 2% to 10% of values, depending on the measure) by using full information maximum likelihood estimation to estimate the variance-covariance matrices using all available information, an approach that has been shown recently in Monte Carlo studies to yield equal or superior results to other approaches to missing data in SEM applications (e.g., Enders & Bandalos, 2001). Second, we used bootstrapping to construct 95% confidence intervals for the direct and indirect effects of interest; these confidence intervals are robust to the violations of normal theory assumptions that are common for indirect effects (Preacher & Hayes, 2004) and can occur for direct effects if there are deviations from multivariate normality. Third, because students were nested within classrooms, they cannot be assumed to be independent. To account for this nesting, robust standard errors that adjust for clustering were estimated for the final models.

Results

Prior to fitting the hypothesized SEM models, we estimated the sample means, standard deviations, and correlations on each observed measure and on the latent factors for reading comprehension and morphological awareness overall and by language groups (all shown in Appendix S2 of the Supporting Information online). Multiple-group SEM modeling indicated that morphological

awareness made a statistically significant, unique contribution to reading comprehension (standardized path coefficient = .480; $z = 8.443$; $p < .0001$), after controlling for the contributions of reading vocabulary and silent word reading fluency, as shown in the final fitted model displayed in Table 1. This direct effect was found to be the same for native English speakers, Spanish-speaking LM learners, Vietnamese-speaking LM learners, and Filipino-speaking LM learners; allowing this path to differ among the four language groups did not yield a statistically significant improvement in goodness of fit, as indicated by a likelihood ratio test (Δ-*2LL* = 1.694; *df* = 3; $p = .6383$). Similarly, this direct effect did not significantly differ among groups in a subsequent model in which the effect of morphological awareness on reading vocabulary was allowed to differ (Δ-*2LL* = 1.090; *df* = 3; $p = .7795$). The direct effect of morphological awareness on reading comprehension also remained statistically significant when tested via bootstrapped confidence intervals (see Table 1) and in an additional model that accounting for nesting within classrooms using robust standard errors ($Z = 8.557$; $p < .0001$).[6]

Unlike the direct effect of morphological awareness on reading comprehension, the effect of morphological awareness on reading vocabulary was found to differ significantly across the language groups (Δ-*2LL* = 6.321; *df* = 3; $p = .0423$). As shown in Table 1, this effect was positive and statistically significant across the four language groups (according to both traditional *z* tests and bootstrapped confidence intervals), but differed somewhat in magnitude. Filipino-speaking LM learners demonstrated the strongest standardized effect of morphological awareness on reading vocabulary (.717) whereas Vietnamese-speaking LM learners demonstrated the weakest standardized effect (.478), with the effects for native English speakers (.570) and the effects for Spanish-speaking LM learners (.512) falling between these two.

The effect of morphological awareness on silent word reading was positive, moderately sized (.574) and statistically significant ($p < .0001$); this effect was not found to differ by language groups, whether alone (Δ-*2LL* = 1.586; *df* = 3; $p = .6626$) or in a model in which the effect on reading vocabulary was also allowed to differ by group (Δ-*2LL* = 2.541; *df* = 3; $p = .4676$). Similarly, the effect of reading vocabulary on reading comprehension was positive, moderately sized (.381), and statistically significant ($p < .0001$); this effect was not found to differ by language group (Δ-*2LL* = 2.955; *df* = 3; $p = .3986$ for a model in which reading vocabulary was allowed to differ by group). Somewhat surprisingly, the effect of silent word reading on reading comprehension was small (.023) and not significant ($p = .5485$); this effect did not differ by language group (Δ-*2LL* = 2.198; *df* = 3; $p = .5323$). It is unlikely

Table 1 Final fitted direct and indirect effects for multiple-group structural equation model ($n = 952$)

Path	Regression Coefficient	Standardized Regression Coefficient	Z	Bootstrapped 95% Confidence Intervals
All Students				
Morphological Awareness→ Reading Comprehension	4.428	.480	8.443***	3.401, 5.558
Morphological Awareness → Silent Word Reading Fluency	2.329	.574	14.247***	2.027, 2.651
Reading Vocabulary → Reading Comprehension	0.306	.381	9.227***	0.233, 0.379
Silent Word Reading Fluency → Reading Comprehension	0.051	.023	0.600	−0.109, 0.221
Silent Word Reading Fluency ↔ Reading Vocabulary	−0.484	−.002	−0.054	−17.828, 15.800
Morphological Awareness → Silent Word Reading Fluency → Reading Comprehension	0.120	.013	0.604	−0.266, 0.507
Native English				
Morphological Awareness → Reading Vocabulary	7.860	.570	8.716***	5.964, 9.965
Morphological Awareness → Reading Vocabulary → Reading Comprehension	2.405	.232	6.770***	1.738, 3.316

(*Continued*)

Table 1 Continued

Path	Regression Coefficient	Standardized Regression Coefficient	Z	Bootstrapped 95% Confidence Intervals
Spanish-speaking Language Minority				
Morphological Awareness → Reading Vocabulary	5.098	.512	9.708***	4.113, 6.202
Morphological Awareness → Reading Vocabulary → Reading Comprehension	1.560	.181	7.184***	1.131, 2.103
Vietnamese-speaking Language Minority				
Morphological Awareness → Reading Vocabulary	5.061	.478	2.907**	2.079, 10.025
Morphological Awareness → Reading Vocabulary → Reading Comprehension	1.549	.219	2.833**	0.631, 3.269
Filipino-speaking Language Minority				
Morphological Awareness → Reading Vocabulary	8.607	.717	6.180***	6.062, 12.243
Morphological Awareness → Reading Vocabulary → Reading Comprehension	2.634	.243	5.259***	1.745, 3.931

***$p < .001$.

that this null finding is not due to constrained variation associated with a ceiling effect, as indicated by the relatively normal distribution for silent word reading fluency (see histogram in Appendix S1 in the Supporting Information online). Further, it is worth noting that the present sample size provides statistical power above .80 to detect a quite small correlation (i.e., $r = .10$) for analyses involving all students, providing confidence that this null finding is not due to power limitations (Cohen, 1992). At the same time, statistical power is more limited for sub-group analyses involving the smaller groups of Vietnamese and Filipino speakers, thus providing less confidence that this finding generalizes to those two groups.

In addition to these direct effects, two indirect effects of morphological awareness on reading comprehension were evaluated. Morphological awareness did make a significant indirect contribution to reading comprehension via reading vocabulary; as shown in Table 1, this effect was statistically significant for each language group as indicated by the bootstrapped confidence intervals (all ps $< .01$). The estimates for magnitude of this effect differed slightly among the groups (from .181 for Spanish-speaking LM learners to .243 for Filipino-speaking LM learners); these differences were statistically significant as indicated by a Wald chi-square test of parameter equality ($\chi^2 = 51.935$; $df = 3$; $p < .0001$). In contrast, the indirect contribution of morphological awareness to reading comprehension via silent word reading fluency was not statistically significant (as shown by the bootstrapped 95% confidence interval in Table 1), despite sufficient statistical power to detect a small effect. The results of the significance tests for these two indirect contributions were also robust to the use of robust standard errors that account for the clustering of students within classrooms.[7]

These findings were essentially the same when we accounted for school-level socioeconomic status. As reported in detail in Appendix S2 in the Supporting Information online, we conducted three sets of additional analyses using publically available data on the socioeconomic composition of the participating schools (i.e., percentage of students receiving free or reduced lunch) as a proxy for students' socioeconomic status. We found that the direct and indirect effects of morphological awareness as well as the relative levels of morphological awareness across the four groups were largely the same after including school-level socioeconomic status as a covariate. Additionally, we found that the relationships of interest were also largely the same when we limited to the sample to students attending the four participating schools with 100% of students receiving free or reduced lunch, that is, the subsample of students from uniformly low socioeconomic backgrounds.

Beyond these findings about the individual effects of interest, the overall hypothesized multiple-group SEM model was found to be well-fitting to the sample data. The final fitted model, including the structural regression paths listed in Table 1 along with the integrated measurement models for the latent factors for reading comprehension and morphological awareness, demonstrated "absolute" goodness of fit statistics that met commonly used standards (e.g., Kline, 2005; Reise, Widaman, & Pugh, 1993). Specifically, the root mean square error of approximation (RMSEA) of .051 was near the standard for close fit ($< .05$) and better than the standard for acceptable fit ($< .08$), the comparative fit index (CFI) of .983 and Tucker-Lewis Index (TLI) of .978 met the standards for acceptable fit ($> .90$) and in fact indicate good fit (i.e., are near 1.0). The chi-square for the overall model was 76.554 ($df = 47$; $p = .0041$); the ratio of chi-square to degrees of freedom was 1.63, which indicates good fit for models fitted to data from large samples.

To confirm that this model fit the data better than theoretically viable alternatives, the goodness of fit of the final model presented in Table 1 was compared to a variety of other model specifications. In each case, the final model yielded superior goodness of fit to alternative specifications. For instance, this model fit much better than a model that included only indirect contributions for morphological awareness to reading comprehension by fixing the direct contribution to 0 (Δ-$2LL = 84.384$; $df = 1$; $p < .0001$); this result indicates that partially mediated model is more appropriate than a fully mediated model. The final model also fit the data better than a model in which morphological awareness, reading vocabulary, and silent word reading fluency were all treated as independent, correlated predictors of reading comprehension (i.e., a model in which there were no mediating relationships), according to a variety of goodness of fit statistics[8] (difference in $\chi^2 = 3.93$, difference in RMSEA $= .004$, difference in CFI $= .006$, difference in TLI $= .004$, each favoring the final model in Table 1). The latter model is most analogous to one in which the relations between morphological awareness and vocabulary are bidirectional, to the extent possible with data from one time point (i.e., by specifying this relation as a correlation, the model does not assume that the path is from morphological awareness to vocabulary or vice versa). Additionally, the final model fit better than a model in which morphological awareness was specified as a proximal outcome of reading vocabulary and mediator of the effect of reading vocabulary and reading comprehension (difference in $\chi^2 = 2.698$, difference in RMSEA $= .003$, difference in CFI $= .005$, difference in TLI $= .004$, each favoring the final model). Although such model comparisons cannot establish the directionality of causal relationships when correlational data are analyzed,

they nonetheless provide confidence that the final model results provide the best representation of the empirical data, among theoretically viable alternatives.

Discussion

In this study, we aimed to refine our understanding of the relative strength of direct and indirect contributions of morphological awareness to reading comprehension among linguistically diverse students in early adolescence. Specifically, we sought to determine whether prior findings from research conducted with monolingual populations could be extended to LM learners from three common home language groups that differ considerably in their morphological systems—Spanish speakers, Vietnamese speakers, and Filipino speakers. In so doing, we aimed to shed light on three hypotheses about the routes by which morphological awareness may facilitate reading comprehension in these populations by explicitly testing a theoretical model for the pattern of relationships among morphological awareness, reading vocabulary, word reading efficiency, and reading comprehension.

Direct and Indirect Roles of Morphological Awareness in Reading Comprehension

Our findings provide correlational evidence to support two of the three hypotheses that have been put forth about the roles of morphological awareness in reading comprehension. First, we found that morphological awareness made a significant and substantial contribution to reading vocabulary, which in turn made a significant and substantial contribution to reading comprehension. This indirect contribution was found to be statistically significant for each of the four language groups investigated. Nagy et al. (2006), who used similar measures and analyses, found a similar indirect contribution for native English speakers from middle-class backgrounds. Our finding converges with that of Nagy et al. (2006) and extends it to Spanish-, Vietnamese-, and Filipino-speaking LM learners as well as native English speakers from more diverse socioeconomic backgrounds. In so doing, this finding suggests the importance of morphological awareness and vocabulary knowledge in explaining the reading comprehension difficulties common among LM learners (Lesaux et al., 2006; Lesaux & Kieffer, 2010).

Second, we found that morphological awareness also makes a direct, unique contribution to reading comprehension, controlling for the contributions of reading vocabulary and word reading efficiency. This finding converges with prior findings from studies conducted with smaller samples of monolingual

English speakers (Carlisle, 1995; Carlisle, 2000; Nagy et al., 2003; Nagy et al., 2006; also Ku & Anderson, 2003) and Spanish-speaking LM learners (Kieffer & Lesaux, 2008; Kieffer, Biancarosa, & Mancilla-Martinez, 2012), while extending these findings to LM learners from two additional language groups that differ considerably from English in their morphological systems (i.e., Filipino and Vietnamese speakers).

In contrast, we found little evidence for the hypothesis that morphological awareness predicts reading comprehension through the facilitation of word reading for the populations studied. Morphological awareness significantly predicted word reading efficiency across the language groups, consistent with findings from several prior studies (e.g., Carlisle, 2000; Carlisle & Stone, 2005; Deacon & Kirby, 2004; Kieffer, Biancarosa, & Mancilla-Martinez, 2012; Mahony et al., 2000; Nagy et al., 2006); however, word reading efficiency did not in turn predict reading comprehension, leading to a nonsignificant indirect contribution. This null result was consistent across the three LM learner groups as well as the native English speakers. Given the large sample size and associated statistical power to detect small correlations, it is unlikely that this null result is simply due to random sampling error.

This finding suggests that the facilitative effects of morphological awareness on word reading efficiency may not necessarily lead to improved reading comprehension among early adolescents, at least for those with relatively well-developed word reading skills. While improved awareness of derivational morphology may yield some increases in the speed with which students recognize words, the importance of such increases for students' ultimate reading comprehension may depend on students' age and whether their comprehension performance is constrained by weaknesses in word recognition. As the Simple View of Reading (Gough & Tunmer, 1986; Hoover & Gough, 1990) and several supporting empirical studies (e.g., Catts, Hogan, & Adlof, 2005; Mancilla-Martinez, Kieffer, Biancarosa, Christodoulou, & Snow, 2011; Vellutino, Tunmer, Jaccard, & Chen, 2007) suggest, the relative contribution of word recognition to explaining individual differences in reading comprehension ability declines as students grow older, whereas the relative contribution of linguistic comprehension increases. Our findings suggest that by sixth grade, most students—including both native English speakers and U.S.-educated LM learners—have reached a threshold for adequately efficient word reading, consistent with converging evidence from other studies (see Lesaux et al., 2006 for a review); given this, the remaining variation in word reading speed (i.e., differences that are largely among low-average, average, and fast word readers) may not explain much variation in their reading comprehension. Thus, while

morphological awareness may predict how far above a threshold readers perform in their word reading efficiency, such differences may not translate into commensurate gains in reading comprehension.

At the same time, it is worth noting that this finding may be somewhat limited by the specific measures used in the current study. Although the silent word reading fluency measure used has good evidence of validity as a measure of word reading efficiency, it did not allow us to distinguish between accuracy and speed in word reading or to determine whether relationships differ by the morphological complexity of the words read. In addition, the reading vocabulary measure may also have captured variation in students' word reading skills, thus reducing the contribution of the word reading efficiency measure. Further research using individually administrated oral tasks is thus needed to confirm this finding.

Language Backgrounds, Morphological Awareness, and Reading Comprehension Difficulties

By directly comparing first-language learners and second-language learners, this study was designed to build on prior research that has studied these populations separately. Despite differences on several variables between the four language groups investigated, we found evidence for relationships of similar magnitude among native English speakers and LM learners from three quite different home language backgrounds. While suggesting only a tentative conclusion, subject to replication, this finding supports the conclusions of prior studies of second-language reading. Specifically, we add Vietnamese and Filipino speakers to the growing list of first language groups for which there is evidence that morphological awareness is important to reading in English, including Arabic speakers (Saiegh-Hadadd & Geva, 2008), Chinese speakers (e.g., Zhang et al., 2010), French speakers (Deacon et al., 2007), Hebrew speakers (Schiff & Calif, 2007), Korean speakers (Wang, Ko, & Choi, 2009), and Spanish speakers (Kieffer & Lesaux, 2008; Ramirez et al., 2010). Extending research findings to speakers of Vietnamese and Filipino is important for informing future educational research, because these groups constitute two of the most commonly spoken languages in U.S. schools, yet their language and literacy development has rarely been studied. Moreover, like Spanish speakers, students from these two language groups often face socioeconomic and schooling disadvantages that place them at greater risk for reading difficulties (e.g., Portes & Rumbaut, 2001; Zhou & Bankston, 1998).

In their review of research conducted with monolinguals reading in various languages, Kuo and Anderson (2006) concluded that the importance of

morphological awareness in reading development generalizes across languages, while which aspects of morphology that are most important may differ by language. Our findings suggest that similar generalizations may also be appropriate for the importance of awareness of English derivational morphology in second-language reading for students from varying home language backgrounds. In particular, we found that speakers of Vietnamese, a language characterized by very limited use of affixes, demonstrated significant direct and indirect contributions of English morphological awareness to English reading comprehension. Although the indirect contribution of morphological awareness via reading vocabulary was slightly weaker for this language group than those found for native English speakers and Filipino-speaking LM learners, it was nonetheless a meaningful contribution, even after controlling for the direct effects of vocabulary and word reading efficiency. Moreover, the direct, unique contribution of morphological awareness to reading comprehension was equally strong for Vietnamese-speaking LM learners as for the other language groups studied.

While the role of English morphological awareness across groups may speak to its generalized importance in English reading, this finding may also highlight the role of the accumulated educational experiences that are shared by the different language groups. The current sample of LM learners, like many LM learners in the United States, had overwhelmingly been educated in U.S. schools since kindergarten and had received literacy instruction in English. It is possible that LM learners who immigrated after having received more instruction in their home countries or LM learners in bilingual education settings would demonstrate greater differences by first-language background or demonstrate relationships that are more distinct from those of their native English-speaking counterparts. Future research is necessarily to investigate how these findings might differ across instructional and linguistic settings. Given the consistent relationships found across language groups, the findings provide insight into the sources of reading comprehension difficulties that are disproportionately prevalent among LM learners. In particular, the Spanish-speaking and Vietnamese-speaking LM learners studied demonstrated significantly and meaningfully lower morphological awareness levels on average, when compared to native English speakers in the same classrooms and schools (see Table S1 of Appendix S1 in the Supporting Information online). These deficiencies are, in turn, associated with reading comprehension levels that are substantially lower than their native English-speaking classmates, suggesting that underdeveloped English morphological awareness may be an important source of reading comprehension difficulties for these populations. Future

empirical research is necessary to verify the extent to which this is the case in various settings.

Limitations and Future Research

This study has several limitations that warrant future research. First, the absence of measures in students' first languages made it difficult to investigate questions about the cross-linguistic relationships in morphological awareness and other skills that may be underlying these patterns. It also makes it difficult to determine whether the differences in levels of morphological awareness between the first-language groups found can be attributed to differences in their first-language morphological systems, per se, or rather due to differential opportunities to develop first language abilities. Although all of the students had received school instruction in English, it is possible that the Filipino-speaking, Spanish-speaking, and Vietnamese-speaking students had differential opportunities to develop oral and written skills in their first languages at home or in their communities. Future research should include measures of first-language skills, including overall proficiency measures as well as morphological awareness measures, when possible. Such research will require the careful development and validation of measures of morphological awareness in languages that have been studied more rarely, such as Vietnamese and Filipino, with consideration of how to make such assessments comparable to English measures despite differences in morphological systems between languages.

Second, it was not possible in the current study to conduct parental interviews that would have shed light on important aspects of the socioeconomic status and home language and literacy environments of the different language groups. As a result, it is unclear whether the differences between language groups in levels of morphological awareness may be attributable to differences in home environments, rather than to differences in first languages. Although our analyses of school-level socioeconomic status data (cf. Appendix S2 of Supporting Information online) indicate little reason to believe that such differences threaten the validity of our results, future studies should consider collecting more detailed information on students' socioeconomic and linguistic environments when feasible.

Third, SEM modeling with observational data offers a valuable tool for testing multiple direct and indirect relationships simultaneously, but that it cannot determine the direction or causality of those relationships. Thus, the current study provides valuable correlational evidence for the three causal hypotheses proposed, but experimental evidence will be necessary to test those

causal hypotheses directly. Such evidence is particularly necessary in light of the possibility of bidirectional relationships among morphological awareness, vocabulary size, and reading comprehension, as suggested by longitudinal research (Kieffer & Lesaux, 2012a; McBride-Chang et al., 2008). Several intervention studies conducted with monolingual speakers of several languages have used experimental and quasi-experimental designs to establish the impacts of morphology instruction on reading-related outcomes (see Bowers, Kirby, & Deacon, 2010 for a review) as have a few studies conducted with LM learners (Carlo et al., 2004; Lesaux et al., 2010). However, because most of these studies have combined morphology instruction with instruction in word reading and/or root-word vocabulary, they cannot necessarily isolate the specific mechanisms by which gains in morphological awareness do or do not influence reading comprehension. The decision to teach morphology in the context of other skills in these studies certainly has a strong pedagogical basis (Bowers et al., 2010; Kieffer & Lesaux, 2007, 2010), but it renders it difficult to identify the specific proximal and distal effects of improving morphological awareness. Future experimental studies utilizing competing instructional conditions that do and do not include morphology instruction and document gains in vocabulary growth, word reading efficiency, and reading comprehension would be valuable to ultimately answer these questions.

Fourth, as mentioned above, the selection of predictor, outcome, and control measures in the current study was constrained by the need to assess a sufficiently large number of classrooms and sample of students to allow statistical power for detecting small interactions and to capture a sufficient number of students in the smaller language groups (i.e., Vietnamese and Filipino speakers). As a result, it was not feasible to utilize individually administered oral assessments of vocabulary, word reading efficiency, or morphological awareness, as has been done in studies with smaller samples (e.g., Carlisle & Stone, 2005; Deacon & Kirby, 2004). Although the morphological awareness tasks were read aloud and neither these tasks nor the reading vocabulary tasks were speeded, students' scores on these tasks may have nonetheless captured some variation in word reading accuracy. The group administration format also prevented us from assessing and including phonological awareness as a control variable, as has been done in prior studies (e.g., Deacon & Kirby, 2004; Nagy et al., 2006) or from investigating other cognitive variables, such as verbal working memory, which may explain further the relationships between morphological awareness and reading comprehension. Additionally, while we were able to use two measures for each of the constructs that are known to be more difficult to assess, morphological awareness and reading comprehension, we were limited

to single measures of reading vocabulary and word reading efficiency by practical concerns about testing time. Future studies, when possible, should include multiple, oral measures of these skills. They should also consider including research-created measures that can carefully manipulate the morphological complexity of the vocabulary and word reading items included.

Conclusion

This study provides supporting evidence for two hypotheses about the contributions of morphological awareness to reading comprehension for linguistically diverse students in early adolescence. Our findings suggest that morphological awareness contributes directly to reading comprehension as well as indirectly via its contribution to reading vocabulary. These relationships were found to be similar for native English speakers and for LM learners from Spanish-speaking, Filipino-speaking, and Vietnamese-speaking backgrounds. These findings support a small but growing body of research that highlights the importance of morphological awareness to reading outcomes, across languages.

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Notes

1 Of course, another explanation of these correlations is that morphological awareness is, in fact, a facet of vocabulary knowledge. Indeed, when the construct of vocabulary is broadly defined to include depth of knowledge about word meanings (Stahl & Nagy, 2006), morphological awareness can be considered an aspect of this larger domain. Nonetheless, researchers have generally distinguished between morphological awareness as conceptually distinct from vocabulary *breadth* and vocabulary size (e.g., Nagy et al., 2006; McBride-Chang et al., 2005). Evidence from confirmatory factor analysis supports the notion that these are measurably separable (Kieffer & Lesaux, 2012b).

2 The unequal sizes of the language groups are representative of the distribution of language backgrounds in the participating schools. It is worth noting that the resulting statistical power to detect differences in relationships between the smaller Vietnamese-speaking and Filipino-speaking LM groups, relative to the larger groups is more limited than the power to detect differences in relationships between Spanish-speaking LM learners and native English speakers.

3 Descriptive analyses of data from school records indicated that the sample of LM learners included many students who no longer had a school-based ELL designation. Among the Spanish-speaking and Vietnamese-speaking LM learners, a plurality was currently classified as ELL (38.6% and 38.3%, respectively), a

substantial proportion was classified as "redesignated fluent English proficient" indicating that they were previously designated as ELL (28.0% and 29.8%, respectively), and a smaller proportion were classified as "initially fluent English proficient," indicating that they reported another language spoken at home but were sufficiently proficient to not be classified as ELL at school entry (11.0% and 19.1%, respectively). Among the Filipino-speaking LM learners, few students (4.9%) were currently designated as ELL, although substantial proportions were formerly ELL (24.7%) and initially fluent English proficient (22.2%). The remaining proportion of each language group reported a language other than English at home on the survey in the current study but had been designated as "English only" in school records.

4 The Silent Word Reading Fluency and Reading Vocabulary measures were administered in the fall, and the Morphological Awareness and Reading Comprehension measures were administered in the spring.

5 The loadings for the latent factors for reading comprehension and morphological awareness were fixed to be the same across groups in all of these models, in order to hold the measurement of these constructs constant across groups. This decision is supported by the consistency across groups in the correlations between the indicators for each of these factors. Although there was some evidence of measurement invariance, our substantive interest was in the structural relationships holding measurement constant across the groups, so we concluded that this was the most appropriate approach. To check whether the results were spuriously influenced by the measurement model specified, we also fitted a multiple-group path analysis model using simple composites of morphological awareness and reading comprehension (i.e., averages of the *z*-scores of their respective indicators) and found that the results were the same as those reported here (details available from the first author).

6 This robustness check utilized a single-group SEM model rather than the multiple-group model in Figure 1, because the number of classrooms (39) was fewer than the number of parameters to be estimated in the multiple-group model, rendering this model impossible to fit when this cluster adjustment is used. Nonetheless, given that the direct effect of morphological awareness on reading comprehension was the same across the four groups, this model is an appropriate check that this finding was not spurious due to the influence of class effects.

7 As with the previous robustness check, these tests were conducted with single-group SEM models. As such, they confirm the significance of the average indirect contribution of morphological awareness on reading comprehension via reading vocabulary across the four groups as well as the nonsignificance of the indirect contribution via silent word reading fluency, but they cannot be used to investigate whether the former effect varied across language groups.

8 For this model comparison and the one that follow it, a variety of goodness of fit statistics were used to compare the two models, rather than a likelihood ratio test,

because they are not nested within one another and have the same degrees of freedom. In such cases, consistent differences across multiple goodness of fit can indicate which model should be preferred.

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Supporting Information

Additional Supporting Information may be found in the online version of this article:

Appendix S1. Distribution Scores for Silent Reading Fluency Test.
Appendix S2. Preliminary and Additional Analyses.

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