When to Take Up Roots: The Effects of Morphology Instruction for Middle School and High School English Learners

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ABSTRACT

A majority of the challenging words that adolescent readers encounter in school texts are morphologically complex and from the Latinate layer of English. For these words, bound roots carry important meaning, such as the relation between innovative and its bound root, nov, meaning "new." This study investigated the effects of instruction about bound Latin roots on academic word learning and morphological problem-solving skill with English Learners (EL) at three grade bands: Grades 6-8, 9-10, and 11-12. Employing a within-subjects design, 82 students participated in two counterbalanced intervention conditions: an academic vocabulary without morphology (comparison condition) and a morphology-focused academic vocabulary intervention (treatment condition). The largest treatment effects were observed for oldest students, but positive effects were observed at all grade levels. Results suggest that instruction focused on the major meaning-carrying components of academic words of the Latinate layer in English—bound roots—is especially effective for ELs in the secondary grades.

Keywords: morphology, vocabulary development, English Language Learners, intervention, middle school students, high school students

Introduction

It is increasingly recognized that many English Learning (EL) students often have difficulty with English-language literacy in part because of a lack of familiarity with the lexical, grammatical, and discursive features that are associated with *academic language* (Nagy & Townsend, 2012; Scarcella, 2003; Schleppegrell, 2004; Snow & Uccelli, 2009; Uccelli, Galloway, Barr, Meneses, & Dobbs, 2015). Also referred to as *academic English* (Bailey, 2007) and *advanced literacy* (Christie, 2002), academic language relates to the forms and functions of language necessary for participation in contexts of schooling. One aspect of academic language that has been identified as a key source of reading difficulty for EL students is academic lexis—or knowledge of general academic vocabulary. General academic vocabulary comprises words that are frequently encountered in academic texts across diverse subject areas (Coxhead, 2000; Gardner & Davies, 2013). These words often carry abstract meanings and multiple senses (e.g., *diminish*, *benefit*, *innovative*). General academic words are important for conveying abstract ideas, arguing positions, and communicating complex ideas in academic contexts. As such, they are critical for reading comprehension and academic success (Corson, 1997; Nagy & Townsend, 2012; Snow & Uccelli, 2009).

Several studies have been designed to support EL adolescents to develop knowledge of general academic words in English. Intervention studies with adolescent ELs have demonstrated that instruction that provides multiple encounters with target words and analysis and use of the words—that is, instruction that may be characterized as "robust" (c.f. Beck, McKeown & Omanson, 1987)—is effective at promoting academic word knowledge (August, Branum-Martin, Cardenas-Hagan & Francis, 2009; Carlo, August, McLaughlin, Snow, et al., 2004; Lesaux Kieffer, Faller & Kelley, 2010; Snow, Lawrence, & White, 2009). These studies provide

evidence that *both* ELs and their native English-speaking peers (whose word knowledge tends to be higher initially) can increase vocabulary knowledge at comparable rates. In contrast, in the face of no intervention, disparities between these groups in both vocabulary knowledge and reading achievement tend to increase over time (Kieffer, 2008; Nakamoto, Lindsey, & Manis, 2007).

However, these interventions, while effective at promoting word learning with EL participants, have not yet succeeded in accelerating the rate of vocabulary learning for EL students at a rate sufficient to close the gap with native English speaking students (Galloway & Lesaux, 2015). Thus, while robust instruction shows promise for supporting the development of academic word knowledge as a critical element of academic language for EL adolescents, there is a pressing need to further enrich instruction to accelerate ELs' growth in knowledge of academic words.

Another possible avenue toward promoting vocabulary development and enriching academic language learning for EL students is through instruction in morphological analysis. In English, *morphemes* are the smallest units of a word that carry meaning. Morphemes can be inflectional (e.g., suffixes that change tense or number, such as the plural marker –s added to *schools*), derivational (i.e., prefixes and suffixes that alter form and/or meaning, such as un- and –ed added to *unschooled*), or they can be roots, which may be free standing units such as *school*, or bound roots such as *liter* in *literate*. Converging evidence points to positive effects of morphology instruction on a range of literacy skills (Bowers, Kirby & Deacon, 2010; Carlisle, 2010; Goodwin & Ahn, 2013). However, the overwhelming majority of research on morphology instruction has focused on derivational affixes, such as the relationship between *research* and

researcher. Attention to roots—and specifically bound roots—has been relatively scarce (Crosson & McKeown, 2016).

Yet bound roots may play an important role in academic vocabulary learning and thus academic language development more generally for EL adolescents. In English, high-frequency words that index a less formal register are often of Germanic origin. However, 75% of general academic words in English are from the Latinate layer of English (Lubliner & Hiebert, 2011), with their main semantic components being bound roots. Bar-ilan and Berman (2007) refer to this as the "Latinate Germanic divide" as seen in the distinction between the word of Germanic origin, *school,* and the word from the Latinate layer of English, *literate*, signaling an academic register.

As such, morphological analysis of words likely to appear in academic texts may call on knowledge of Latin bound roots. Following Nagy, Carlisle, and Goodwin (2014), we define morphological analysis as the use of explicit knowledge about morphemes to "infer the meanings of new morphologically complex words on the basis of familiar parts" (4). Morphological analysis of bound roots could be highly generative given that roots often carry substantial information about a word's meaning. Consider that the word *distort* contains the root *tort,* from Latin for *twist*; but if a learner does not know the meaning of *tort*, knowledge about the word's derivational affix *dis* is not likely to be helpful. Knowledge of the bound root meaning, on the other hand, might support accessing the meaning of words such as *torture* and *contorted*.

Thus learning the meanings of bound Latin roots and the analytic stance to use this knowledge for morphological analysis of academic words offers potential to accelerate EL students' word learning, above and beyond the effects of robust instruction alone. We hypothesized that instruction in bound Latin roots would produce stronger outcomes for learning

academic words by strengthening their semantic and orthographic representations. We further hypothesized that instruction in Latin roots would equip students with the knowledge and analytic processing skills to use Latin roots to infer meanings of unfamiliar words. As this is an area of morphological development and instruction that is relatively understudied, we were interested in examining whether instruction in morphological analysis using bound Latin roots would be similarly effective for EL students at different grade bands.

Research shows that there is a developmental component to morphological knowledge. Anglin (1993) argued children's increasing understanding of morphology during the elementary years drives vocabulary growth. Indeed, research on morphological development has suggested that even very young children develop an understanding of how morphemes mark tense and number (i.e., inflectional morphology, such as Berko-Gleason's (Berko, 1958) "wug" experiment: This is a wug. These are two ___.). Anglin's research showed that from first to fifth grade, children's ability to use morphological analysis to analyze words increased and fueled vocabulary growth. Berninger and colleagues (Berninger, Abbott, Nagy & Carlisle, 2010) found that while the steepest growth in knowledge of derivational morphological awareness was in the early elementary grades, such growth continued well beyond fourth grade, concluding that the "overall developmental trajectory" for morphological awareness has a much longer span than growth in areas such as phonological and orthographic awareness." Wysocki and Jenkins (1987) looked at effects of grade level on morphological problem-solving using derivational affixes and they found that students in grades 6 and 8 were more successful at using knowledge of derivational affixes to infer word meanings when compared to fourth graders. However, how morphological analysis using bound Latin roots fits into a developmental trajectory is unclear.

It is possible that the developmental trajectory for morphological problem-solving using bound Latin roots may converge with derivational morphology or may extend into late adolescence and beyond. Bar-ilan and Berman (2007) examined language samples of native English speakers at ages 9, 12, 16 and adults, and yielded findings that hint at a possible later developmental trajectory for morphological analysis using Latin roots. Bar-ilan and Berman (2007) coded students' word choice in writing into words of Germanic origin in English (i.e., *talk, buy*) or Latinate (e.g., *conversation, purchase*), based on the premise that words from the Latinate layer of English represent more a formal, literate register than those of Germanic origin. They found minimal evidence of use of academic vocabulary (in their words, "Latinate") among elementary and middle school students (usage for both elementary and middle school was 20% Latinate words of all content words on average) but, importantly, they noted a dramatic increase in use of academic (Latinate) words from middle to high school (about 80% of words were Latinate on average).

The goal of this study was to examine the effects instruction in morphological analysis with bound Latin roots on the academic word learning and morphological problem-solving skills of EL adolescents at different grade bands (middle school, grades 9-10 and grades 11-12). Employing a within-subject design, a morphology intervention was tested for treatment effects on academic word learning and skills in morphological analysis when compared to a research-based academic vocabulary intervention.

Method

Context

The study took place in a large, urban school district in the northeastern U.S. in which 77% of students were eligible for free or reduced lunch. ESL classes in the district were

homogeneously grouped by grade into grade bands (6-8; 9-10 and 11-12) and homogenously grouped by English proficiency level (entering, beginning, intermediate or advanced). In this study, only intermediate and advanced classes were included, per district designations based primarily on the ACCESS-ELL exam (WIDA Consortium, 2006).

Participants

Participants were 82 EL students of diverse linguistic backgrounds enrolled in five English as a Second Language classes. Students reported speaking 20 different home languages. Just over half spoke Nepali as their home language; other languages spoken included Kiswahili, MyMy, Spanish, Urdu and Uzbek. Approximately one third of students had been in the US for less than two years and another one third had been in the US between three and five years. 78% of students were schooled in their home country or outside of the U.S. and approximately one third reported that they were able to read in their home language.

The sample included middle school students (n=25), 9th and 10th grade students (n=30) and 11th and 12th grade students (n=27). In this within-subjects design, all students experienced both interventions; conditions were counter-balanced. All students in each participating class were invited to participate in the study and all students with informed consent were included. (All communication was provided in both English and at least one of the students' home languages.) Across all five classes, eight students declined participation in the study.

Interventions

Comparison condition: Robust Academic Vocabulary Encounters (RAVE). The RAVE condition comprised approximately six weeks of instruction in which students were taught a set of 24 general academic words selected from the Academic Word List (Coxhead, 2000). The intervention was designed to reflect robust instruction techniques (Beck, McKeown,

& Kucan, 2002) such as analysis of target academic words in multiple, authentic contexts, ample opportunity for active processing of word meanings (analyzing examples of word use, producing examples, justifying use, discussing nuances of word meanings). RAVE has had significant, positive effects on word learning and comprehension for native English speaking middle school students (McKeown, Crosson, Moore, & Beck, 2018; McKeown, Crosson, Beck, Sandora, & Artz, 2012; McKeown, Crosson, Sandora, Artz, & Beck, 2013) and has shown promise for students from linguistically and culturally diverse backgrounds (Crosson, 2016).

Morphology intervention: Latin Roots. The Latin Roots condition was parallel to RAVE in that it comprised the same number of lessons, focused on the same target words, and the length of lessons was the same (20-25 minutes each). The difference between two conditions was that RAVE provided robust instruction exclusively whereas Latin Roots provided robust instruction and integrated morphological analysis of the target word's Latin roots in every lesson. Morphological analysis focused on bound Latin roots—such as *min* meaning "small" or *ben* meaning "good"—rather than root words that are freestanding morphemes and are derivations of a root word (e.g., *convention* from *convene*, *residential* from *reside*). A Latin root was taught for each target academic word for 24 target roots taught in the intervention in total. Instruction about Latin roots was incorporated into every lesson, and emphasized: 1) analysis of the relationship between the root meaning and the target word in which it appeared (e.g., the relation between *min* and *diminish* or *ben* and *benefit*); 2) analysis of the relation between the root meaning and other "root-related words" in which they appear (e.g., *min* and *mince*, *miniscule*, and *minimal*).

Procedure

Implementation. We opted for a within-subjects design in which each student serves as his or her own control. All students experienced both conditions; conditions were counterbalanced. The major advantage to this design is that it enabled us to compare associations between conditions and learning outcomes without having to establish comparison groups of ELs who vary greatly in language and literacy skills and exposure to instruction in L1 and English (Kuo & Anderson, 2008).

The RAVE and Latin Roots conditions were counterbalanced such that all students participated in both conditions, but some experienced RAVE followed by Latin Roots and others experienced the conditions in the reverse order. The condition that participants experienced first will be referred to as Session I, while the condition they experienced second will be referred to as Session II. The five participating classes were divided into three groups: Group 1 comprised two 6-8th grade ESL classes, Group 2 comprised two 9-10th grade ESL classes; and Group 3 comprised one 11-12th grade class.

Two set sets of target words, with 24 words in each set, were taught in to all students. Word Set A was taught in Session I; Word Set B was taught in Session II.

Measures

Word Meanings Task. The Word Meanings Task, which tests knowledge of target (i.e., instructed) words, was group administered as a pre and post-test for each condition. For each condition, students were tested on 16 target words. In this task, students were provided with sets of target academic words (eight per set) to match to their meanings. For each target word correctly matched to its definition, students received 1 point (i.e., min=0, max=16). The measure exhibited acceptable internal consistency (Cronbach's $\alpha = .70$).

Facets of Word Knowledge Test. The Facets of Word Knowledge Test, which tests multidimensional knowledge of 16 target words for each condition, was group administered as a pre and post-test. Each test item presented a word and four cloze sentences, and for each sentence, students had to decide whether the target word would fit. The task was designed to capture facets of word knowledge, as it tested students' knowledge of multiple senses of academic words (e.g., two of the items could be correct, such as physical and mental senses of *confine:* "He will _____ the toddlers to the little yard;" "I had lots to say, but I had to _____ my comments to the topic) and provided foils that were systematically constructed to differentiate partial knowledge. Foil types included a syntactic foil (e.g., for *confine*: We saw a _____ on the busy highway) to assess students' understanding of the target word's syntactic role, and a more difficult semantic foil with a prototypical association to the target word (*confine- jail:* "Prisoners often _____letters to send news to their families."). Each item was scored 0-4, depending on the number of sentences that students chose as matching or not matching the target word. The measure exhibited strong internal consistency (Cronbach's $\alpha = .91$).

Morphological Analysis Task. The Morphological Analysis Task (MAT), a dynamic assessment used in previous work (Crosson & McKeown, 2016; Ye, Crosson, McKeown, & Hua, 2016), was individually administered at post-test following each condition. The task consisted of 9 sentences in each of two sets (i.e., Sets A and B). Every item comprised a sentence with a novel word that contained a root that was taught in that condition; the novel word, however, was not taught. For example, "Most of their conversations were about the minutiae of daily life," with *minutiae* sharing the root *min* from the target academic word *diminish*. Students were shown each sentence and asked to explain it (e.g., "What do you think this is saying about their conversations? How did you figure that out?"). If students did not

mention the root as one source of information that gave clues to the word meaning, the administrator would direct the student analyze the novel word by asking, "Do you see a word part or a root that you recognize? What does that root mean? Does that give you any other ideas about their conversations?" For this study, we employed a stringent scoring system. The item was scored 1 point if the student recognized the root, knew its meaning, and used this information to infer meaning about the novel word. Otherwise the item was scored 0. Two members of the research team independently coded 20% of the transcripts, yielding 93% exact agreement. Differences were resolved through discussion and final scores were used for analysis.

Novel words were selected to be unfamiliar to students by consulting Zeno and colleagues' word frequency list (Zeno, Ivens, Millard, & Duvvuri, 1995) and the *Living Word Vocabulary* (Dale & O'Rourke, 1976). Sentences were constructed to be neutral such that the novel word meaning would not be inferable from the sentence alone (e.g., The *corpulent* dog couldn't jump into the car.). To confirm that novel word meanings were not predictable from sentence contexts, we piloted the task with 16 graduate students in psychology. Novel words were deleted from each item and participants were asked to complete the sentences as a cloze task. If more than three participants guessed a synonym for the novel word. (E.g., for "The ____ dog couldn't jump into the car" if more than three graduate students responded "fat," the item was replaced.)

Sets A and B were developed to be as similar as possible along three dimensions: a) word frequency of novel word according to Zeno et al.'s (1995) SFI rating (Set A=36.82; Set B=36.41); b) phonological and/or orthographic shift from target academic word to novel word (Set A: 7 with no shift and 2 with both orthographic and phonological shift; Set B: 7 with no

shift and 2 with just phonological shift); and c) root family size based on Becker's (Becker, Dixon, & Anderson-Inman, 1980) morphographic and root word analysis (Set A=33.22; Set B=24.33).

Assessing Comprehension and Communication in English State-to-State for English Learners (ACCESS-ELL). ACCESS ELL (WIDA Consortium, 2016) is a standardized task designed to assess English language proficiency in listening, speaking, reading and writing. The assessment is administered annually by the school district. Standardized composite scores were obtained from the district to include as a covariate in the analyses.

Assessment Procedures

Teachers administered both the Word Meanings Task and the Facets of Word Knowledge Task as paper and pencil pre and post-tests for each of the two intervention conditions. The tasks were later scored by the research team. Members of the research team administered the Morphological Analysis Task. It was administered individually in a quiet space in the school and lasted approximately 12 minutes. It was audio recorded and transcribed, and all scoring was based on transcriptions.

Fidelity to Treatment

Following McKeown, Beck, and Blake (2009), we analyzed transcripts of a sample of lessons to examine whether the teachers implemented the lessons as designed, and to assure a constant level of implementation across teachers and classes. One member of the research team coded transcripts from each classroom for five lessons from Latin Roots and five lessons from the comparison condition, thus 20% of the total transcripts were coded for fidelity. Lessons 1, 2, 3, 4 and 7 were coded for each classroom for the same sets of target words, whether those words were instructed in Latin Roots or in the comparison condition. These lessons were selected

because there were no recording difficulties and thus transcripts were complete for all five classes. Transcripts were coded for the percentage of scripted questions and explanations in the teacher materials that were implemented.

Results

The purpose of study this was to examine the effects of a morphology intervention focused on analysis of academic words using knowledge of bound Latin roots on academic word learning and morphological analysis skills of EL adolescents at three different grade bands (middle school, grades 9-10 and grades 11-12). To do so, the morphology intervention (i.e., Latin Roots condition) was compared to an academic vocabulary intervention that did not contain a morphology component (i.e., RAVE condition). Below we present results from the two measures of word knowledge (Word Meanings Task and Facets of Word Knowledge Task) and the measure of morphological analysis skill (the Morphological Analysis Task) and we compare results for each of these measures by grade band.

Intervention Effects on Word Knowledge

Word Meanings Task. Descriptive results for scores in each condition are presented in Table 1. Two mixed ANCOVAs were performed on pre and posttest scores as a function of grade level, adjusting for English language proficiency based on WIDA's ACCESS test (Figure 1).

Latin Roots condition. There was a significant interaction between time (i.e., pre and posttest) and grade level: $F(2, 73) = 23.85$, $p < .001$. Specifically, posttest scores were significantly higher than pretest scores for grades 9-10 and grades 11-12 (grades 9-10: $t(73) = -8.83$, $p < .001$, mean diff = -5.57, $d = 1.46$; Grades 11-12: $t(73) = -13.36$, $p < .001$, mean diff = -9.42, $d = 2.21$). For the youngest EL participants who were in middle school (grades 6-8),

posttest scores were significantly higher than pretest scores in the Latin Roots intervention (t (73) = -3.34, p = .05, mean diff = -3.44, d = 0.57).

There were no significant differences between grade levels in pretest scores. Posttests scores for grades 9-10 and grades 11-12 were significantly higher than posttest scores for grades 6-10 (Latin Roots - grades 9-10: t (73) = -3.83, p = .02, mean diff = -5.57, d = 1.04; Latin Roots – grades 11-12: t (73) = -6.46, p < .001, mean diff = -9.42, d = 1.73) and posttest scores for grades 11-12 were significantly higher than scores for grades 9-10 (t (73) = -3.46, p = .05, mean diff = -3.21, d = 0.92).

RAVE condition. There was a significant interaction between time (i.e., pre and posttest) and grade level: F(2, 80) = 9.84, p < .001. Posttest scores were significantly higher than pretest scores for grades 9-10 and grades 11-12 (RAVE – grades 9-10: t (80) = -9.01, p < .001, mean diff = -7.16, d = 1.43; RAVE – grades 11-12: t (80) = -9.00, p < .001, mean diff = -7.78, d = 1.42). In the RAVE condition, posttest scores were not significantly higher than pretest scores for EL students at the middle school level.

There were no significant differences between grade levels in pretest scores. Posttests scores for grades 9-10 and grades 11-12 were significantly higher than posttest scores for grades 6-8 (RAVE – grades 9-10: t (80) = -4.93, p < .001, mean diff = -5.93, d = 1.34; RAVE – grades 11-12: t (80) = -5.29, p < .001, mean diff = -5.29, d = 1.47).

Summary. In sum, groups from all grade levels showed significant treatment effects for definitional knowledge of academic words in both interventions, except for the youngest learners in the RAVE condition. Effects sizes were larger at the high school level than at the middle school level consistently across both treatment conditions.

Facets of Word Knowledge Task. Descriptive results for scores in each condition are presented in Table 2. A parallel analysis was performed on the Facets of Word Knowledge Task. Two mixed ANCOVAs were performed on pre and posttest scores as a function of grade level, adjusting for English language proficiency based on WIDA ACCESS score (Figure 2).

***Latin Roots condition*.** There was a significant effect of time for the Latin Roots intervention: $F(1, 71) = 43.13$, $p < .001$. Significant differences between pre and posttest scores were found for grade band 11-12 in the Latin Roots intervention (t (71) = -5.71, $p < .001$, mean diff = -9.04, $d = 1.41$). Other grade levels did not show statistically significant changes from pre to posttest.

There was no significant difference between pretest scores and no significant differences existed between posttest scores.

***RAVE condition*.** There was a significant interaction between grade level and time (i.e., pre and posttest) for the RAVE intervention ($F(2, 80) = 3.94$, $p = 0.02$). Significant differences between pre and posttest scores were found for grade band 9-10: t (80) = -4.81, $p = .001$, mean diff = -8.81, $d = 1.36$. Other grade levels did not show statistically significant changes from pre to posttest.

There was a significant difference in pretest scores between grade band 6-8 and grade band 9-10 in the RAVE condition. In this case, the pretest score for grades 6-8 was significantly higher (t (80) = 3.50, $p = 0.04$, mean diff = 8.14, $d = 0.95$). No significant differences existed between posttest scores.

***Summary*.** In sum, significant treatment effects between pre and posttest were found only for grade band 11-12 in the Latin Roots condition and only for grade band 9-10 in the

RAVE condition, providing some uneven evidence of a larger treatment effect on multifaceted knowledge of academic words for each condition on older EL learners.

Intervention Effects on Morphological Analysis Skill

The Morphological Analysis Task was administered on only one occasion, i.e., following each condition at posttest. Following the Latin Roots condition, students in grade bands 6-8, 9-10, and 11-12 scored mean scores (and standard deviations) of 1.61 (SD = 1.23), 2.41 (SD = 1.94), and 4.14 (SD = 2.23) respectively. Following the RAVE condition with no morphology component, students in grade bands 6-8, 9-10, and 11-12 scored mean scores (and standard deviations) of 0 (SD = 0), 0.06 (SD = 0.24), and 0.14 (SD = 0.47) respectively. A mixed ANCOVA was performed on posttest scores and treatment condition, adjusting for WIDA ACCESSS English proficiency (Figure 3).

There was a significant interaction between grade level and condition ($F(2,75) = 57.86$, $p < .001$). Students' scores in the Latin Roots condition were significantly higher than RAVE scores for all grade levels.

Comparing scores in the Latin Roots condition, the oldest EL adolescents in our study—those in grades 11-12—had significantly higher posttest scores compared to all other posttest scores regardless of intervention and grade level (Latin Roots – grade 6-8: $t(75) = -5.37$, $p < .001$, mean diff = -2.26, $d = 1.49$; Latin Roots – grades 9-10: $t(75) = -3.65$, $p = .03$, mean diff = -1.70, $d = 0.97$; RAVE – grades 11-12: $t(75) = -10.32$, $p < .001$, mean diff = -4.00, $d = 1.69$; RAVE – grades 6-8: $t(75) = -7.32$, $p < .001$, mean diff = -3.86, $d = 2.03$; RAVE – grades 9-10: $t(75) = -10.56$, $p < .001$, mean diff = -2.26, $d = 1.49$).

Summary. In sum, the analysis revealed significant treatment effects for the Latin Roots intervention. Interestingly, these effects were notably larger for students at grades 11-12 than EL learners in middle school or in grades 9-10.[1]

Discussion

This study extends prior research on the value of instruction in morphological analysis in two important ways. First, while prior research has overwhelmingly focused on derivational morphology—that is morphological constituents that are prefixes and suffixes (cf., Bowers, Kirby & Deacon, 2010)—the present study examines instruction about bound Latin roots. Such roots are the major meaning-carrying constituents of many general academic words that are ubiquitous in school texts. Our findings extend prior research by providing evidence that instruction in analyzing bound Latin roots is effective for promoting both acquisition of academic word meanings and, most importantly, morphological-problem solving skills for learning words that share Latin root. When EL students are knowledgeable about the meanings of Latin roots (e.g., *nov* is a bound Latin root meaning "new") and when they have developed an analytical, problem-solving stance toward using this information to get to the meaning of unfamiliar morphologically complex words (e.g., *innovative*, *renovate*, *novice*, *novelty*), students are better positioned to accelerate academic vocabulary learning in English. Given that the bulk of academic words are from the Latinate layer in English and bound roots are major meaning carrying components in those words (Bar-ilan and Berman, 2007; Lubliner & Hiebert, 2011), bound roots may play an important role in academic vocabulary learning and thus academic language development more generally for EL adolescents.

[1] Here we report results from our most stringent coding scheme. In this scheme we give credit for comprehension only if students also recognized the root and recalled its meaning; otherwise they get a score of 0. However, we also ran a mixed analysis for three subscores for the MAT: *Recognition*, *Meaning*, and *Comprehension* and the same pattern reported above holds for all subscales.

Second, this study sheds light on *at what point in schooling* instruction in morphological analysis using bound roots may be most effective for EL learners, and *what aspects of literacy learning may be affected*. Below we first address evidence of treatment effects on learning target word meanings and, for this outcome, the patterns of learning at different grade bands. Second, we address evidence of treatment effects on morphological analysis skill using bound Latin roots, again inspecting patterns of learning by EL students in different grade bands.

With respect to learning meanings of target academic words, participants showed significant gains from pre to posttest whether they were learning words in the morphological analysis condition (Latin Roots) or the comparison condition (RAVE). The only exception to this finding was that for EL students in middle school grade band, gains in target word knowledge were observed only in the morphology instruction, with a moderate effect size (Cohen's d =.57), but not in the comparison condition. This might suggest that the morphology intervention was somewhat more effective for teaching word meanings for the youngest learners in the study. On the other hand, when measuring word knowledge with a more complex, context-embedded measure (i.e., Facets of Word Knowledge Task), treatment effects were seldom observed in either condition. Only the 11-12 grade band demonstrated gains in Latin Roots and only the 9-10 grade band demonstrated gains in RAVE. Thus, based on a measure that taps multifaceted word knowledge (Crosson & McKeown, 2019)—that is, the type of knowledge important for comprehension of academic text—neither condition in the short term was sufficient.

That said, it is well established that word learning is a long-term, cumulative process that takes place over multiple, high quality encounters with a word (Bolger, Balass, Landen, & Perfeti, 2008; Nagy & Scott, 2000). Learners acquire information about words from an

accumulation of experiences with words in meaningful contexts that lead to flexible, nuanced representations of word meanings (Perfetti, 2007; Perfetti & Hart, 2002; Nagy & Scott, 2000). As such, even while neither the morphology intervention nor the comparison, condition demonstrated observable impact on deep, multifaceted learning of target words, we would anticipate that the level of knowledge of word meaning will equip students to accumulate deeper word knowledge of the target words over a longer period of time than allowed by our relatively short intervention.

As for treatment effects on morphological problem-solving, we found that teaching about bound Latin Roots was effective for EL adolescents of diverse linguistic backgrounds in middle school and in early and late high school, at least when the morphology instruction is integrated with literacy instruction in academic language and general academic words more broadly. Compared to the condition in which students were taught a set of general academic words without a morphological analysis component, the Latin Roots condition was clearly more effective for each and every grade band. Most interestingly, we found that the oldest EL adolescents in our study—students in the 11-12 grade band—show large treatment effects compared to either students in the 6-8 grade band (d = 1.49) or the 9-10 grade band (d = 0.97).

In the Morphological Analysis Task, EL students were asked to problem-solve the meanings of unfamiliar words that contained bound Latin roots – roots that had been taught in the Latin Roots Treatment condition. Participation in the Latin Roots Treatment condition enabled EL students to figure out meanings of words such as *minutiae* by applying knowledge of the Latin root in a neutral, sentence-level context. Thus morphology instruction addressing bound Latin roots may equip students to use bound roots for problem-solving unfamiliar words, many of which will be of the Latinate layer of English (Bar-ilan & Berman, 2007) and of an

academic register. The degree to which EL students would apply bound Latin roots to problem-solve unfamiliar words outside this experimental assessment context is, of course, a critical question to be addressed in future research. Still, given the proverbial vocabulary "gap" between EL adolescents and native English speaking peers, the potential of morphological analysis using bound Latin roots to spur generative learning new academic words is noteworthy.

Limitations and future directions

There are several directions for research to address unanswered questions that emerged from this study as well as to address its limitations. First, even while our design was fully crossed and counter-balanced, such that one group of participants received Latin Roots treatment followed by the comparison condition, and two groups received the conditions in the reverse order, a confound is nonetheless present in the data. Given that the youngest learners experience Latin Roots followed by comparison while both 9-10 and 11-12 grade bands experienced comparison followed by Latin Roots, one could argue that the larger treatment effects observed for older learners in the morphology condition was, in fact, an order effect. However, we would argue that this is unlikely. In fact, the oldest EL students outperformed all other groups for morphological problem-solving regardless of condition or grade level. Thus both the between-subjects and within-subjects comparisons point to an advantage for grades 11-12 in the morphology condition for this critical skill.

A second limitation of the current study is that we did not investigate treatment effects at different grade bands on EL adolescents' comprehension outcomes. Given that our morphology intervention was relatively brief (approximately six weeks in each condition), and given the challenge of documenting comprehension effects in intervention research (Murphy, Wilkinson, Soter, Hennessey et al., 2009) we did not expect comprehension effects. That said, many

researchers see morphological awareness as critical to developing the kind of high quality lexical representations needed for successful comprehension (Bowers, Kirby, & Deacon, 2010; Deacon, Tong, & Francis, in press; Nagy, Berninger, & Abbott, 2006). Our goal was to shed light on the effects of instruction in morphological analysis using bound Latin roots on 1) learning meanings of academic words; and 2) demonstrating morphological problem-solving skill with bound roots, both of which are associated with comprehension. In future work we would hope to implement a longer-term morphology intervention and test for comprehension effects.

Finally, a direction for future work would be to try to understand the potential moderating influences of L1 and L2 language and literacy skills on these outcomes and how instructional condition interacts with these skills. For example, although limited, there is evidence that morphological awareness is susceptible to cross-linguistic transfer (Ramirez, Chen, Geva, & Kiefer, 2010). It seems likely that the type of morphological knowledge and analysis emphasized in the treatment condition might be affected by home language literacy skills. Specifically, for EL adolescents with some literacy skill in a Latinate home language, relations between that home language and Latin roots might facilitate learning bound Latin roots for analysis of academic words in English.

The place for Latin roots in a trajectory of morphology instruction

One of the broad goals of this study was to gain insight into where morphological analysis using bound Latin roots might fit into a trajectory of morphological development. Our findings suggest that instruction about Latin roots, when integrated into academic vocabulary instruction and when compared to an academic vocabulary program without morphology instruction, is associated with stronger morphological analysis skills for EL adolescents from

middle school through the end of high school, but effects were largest for EL adolescents in grades 11 and 12.

It has long been established that young children develop an understanding of inflectional morphology (e.g., marking tense or number, such as the relation between *deter* and *deters*) early in English language acquisition (Berko, 1958). For native English speaking children, development of understanding of derivational morphology (e.g., prefixes and suffixes that alter meaning or change grammatical class, such as the relation between *deter* and *undeterred*) appears to begin developing in the early elementary grades and continue well into the middle school grades (Wysocki & Jenkins, 1987), and seems to be characterized by a protracted developmental trajectory compared to areas such as phonological and orthographic awareness (Berninger et al., 2010). However, how morphological analysis using bound Latin roots fits into a developmental trajectory is unclear. Our results with EL adolescents suggest students benefit most from morphology instruction focused on bound Latin roots at the end of high school, complementing Bar-ilan and Berman's (2007) finding that native English-speaking students in high school were more likely to use academic words from the Latinate layer of English when compared to students at the elementary and middle school levels. Students at this later point in schooling are more likely to use and acquire analytical skills for approaching words in the Latinate layer of English.

Although effects were largest for the oldest EL adolescents in our study, we do not interpret this to mean that instruction about bound Latin roots should be delayed until late high school. Even for EL students in middle school, the morphology intervention resulted in moderate to large effect sizes on learning target word meanings and morphological problem-solving, albeit not nearly as large as effects observed with EL students in grades 11-12. Our

findings do suggest, however, that there may be a developmental dimension to learning bound Latin roots, such that it may be more challenging for younger EL learners. When we consider the cognitive demands of this type of morphological analysis, this is not surprising. In a study with native English-speaking adolescents in middle school, Crosson and McKeown (2016) found that learning to use bound roots as a language resource is quite complex, entailing both the metalinguistic insight that bound roots provide information about word meaning and requiring cognitive flexibility in applying the information afforded by bound roots. Even students who are aware of the meaning of the bound root, *nov*, might encounter difficulties when applying its meaning, "new," to problem-solve the meanings of *renovate* or *novelty*. In other words, the bound root certainly provides critical insight into word meaning, but it is rarely sufficient to directly plug in the root to infer meaning of the unfamiliar word.

As such, we conclude that morphology instruction that reflects the qualities described here—that is, instruction that focuses on morphological analysis using bound Latin roots, is integrated into rich academic vocabulary instruction, and teaches EL adolescents to search for semantic connections between words that share a bound Latin roots—holds potential to promote growth in academic word learning for EL adolescents. In particular, instruction in this type of morphological analysis may be most effective late in high school. Such instruction could play an important role in promoting literacy development for English Learners (ELs) and others for whom learning academic vocabulary learning in English is a significant undertaking, and, in turn, should support development of academic language – or the forms and functions of language necessary for participation in contexts of schooling.

References

Anglin, J. M. (1993). Vocabulary development: A morphological analysis. *Monographs of the Society of Research in Child Development, Serial No. 238, Vol. 58*(10). New York: Wiley. doi:10.2307/1166112

August, D., Branum-Martin, L., Cardenas-Hagan, E., & Francis, D. J. (2009). The impact of an instructional intervention on the science and language learning of middle grade English language learners. *Journal of Research on Educational Effectiveness*, (Special Issue: *Effective Practices for English Language Learners in the Middle Grades*), *2*(4), 345-376. doi:10.1080/19345740903217623

Bailey, A. L. (2007). *The language demands of school: Putting academic English to the test*. New Haven, CT: Yale University Press.

Bar-ilan, L., & Berman, R. A. (2007). Developing register differentiation: The Latinate-Germanic divide in English. *Linguistics, 45*(1), 1-35. doi:10.1515/LING.2007.001

Beck I. L., McKeown, M. G., & Kucan, L. (2002). *Bringing Words to Life: Robust Vocabulary Instruction*. New York: Guilford Publications, Inc.

Beck, I. L., McKeown, M. G., & Omanson, R. C. (1987). The effects and uses of diverse vocabulary techniques. In M. G. McKeown & M. E. Curtis (Eds.), *The Nature of Vocabulary Acquisition* (pp. 147-163). Hillsdale, NJ: Lawrence Erlbaum Associates.

Becker, W. C., Dixon, R., & Anderson-Inman, L. (1980). *Morphographic and root word analysis of 26,000 high frequency words*. Technical Report 1980-1. University of Oregon Follow Through Project. Eugene, Oregon.

Berko, J. (1958). The child's learning of English morphology. *Word, 14*, 150-177.

Berninger, V. W., Abbott, R. D., Nagy, W., & Carlisle, J. (2010). Growth in phonological, orthographic, and morphological awareness in grades 1 to 6. *Journal of Psycholinguistic Research, 39,* 141–163. doi:10.1007/s10936-009-9130-6

Bolger, D. A., Balass, M., Landen, E., & Perfetti, C. A. (2008). Context variation and definitions in learning the meanings of words: An instance-based learning approach. *Discourse Processes, 45*, 122-159. doi:10.1080/01638530701792826

Bowers, P. N., Kirby, J. R., & Deacon, S. H. (2010). The effects of morphological instruction on literacy skills: A systematic review of the literature. *Review of Educational Research, 80* (2), 144-179.

Carlisle, J. F. (2010). Effects of instruction in morphological awareness on literacy achievement: An integrative review. *Reading Research Quarterly, 45*(4), 464-487.

Carlo, M. S., August, D., McLaughlin, B., Snow, C. E., Dressler, C., Lippman, D. N., Lively, T. J., & White, C. E. (2004). Closing the gap: Addressing the vocabulary needs of English-language learners in bilingual and mainstream classrooms. *Reading Research Quarterly, 39*(2), 188-215. doi:10.1598/RRQ.39.2.3

Christie, F. (2002). The Development of Abstraction in Adolescence in Subject English. In M. J. Schleppegrell & M. C. Colombi (Eds.), *Developing advanced literacy in first and second languages: Meaning with power* (pp. 45-66). Mahwah, NJ: Lawrence Erlbaum.

Corson, D. (1997). The learning and use of academic English words. *Language learning, 47*(4), 671-718.

Coxhead, A. (2000). A new academic word list. *TESOL Quarterly, 34*(2), 213-238. doi:10.2307/3587951

Crosson, A. C. (2016). Supporting linguistically diverse students to develop deep, flexible knowledge of academic words. In C. P. Proctor, A. Boardman, & E. Hiebert (Eds.), *English learners and emergent bilingualism in the Common Core era* (pp. 82-98). New York, NY: Guilford Publishing.

Crosson, A. C., & McKeown, M. G. (2016). How effectively do middle school learners use roots to infer the meaning of unfamiliar words? *Cognition and Instruction, 34*(2), 148-171. doi:10.1080/07370008.2016.1145121

Crosson, A. C., & McKeown, M. G. (2019). An innovative assessment to assessing depth of knowledge of academic words. *Language Assessment Quarterly, 16*(2), 196-216. doi:10.1080/15434303.2019.1612899

Dale, E., & O'Rourke, J. (1979). *Living Word Vocabulary*. Boston, MA: Houghton Mifflin Company.

Deacon, S. H., Tong, X., & Francis, K. (in press). The relationship of morphological analysis and morphological decoding to reading comprehension. *Journal of Research in Reading.* doi:10.1111/1467-9817

Galloway, E. P., & Lesaux, N. (2015). Reading comprehension skill development and instruction for adolescent English language learners: A focus on academic vocabulary instruction. In K. L. Santi & D. K. Reed (Eds.), *Improving reading comprehension of middle and high school students* (Vol. 10 of the series Literacy Studies, pp. 153-178). Switzerland: Springer International Publishing. doi:10.1007/978-3-319-14735-2_7

Gardner, D., & Davies, M. (2013). A new academic vocabulary list. *Applied Linguistics,35*, 305-327. doi:10.1093/applin/amt015

Goodwin, A. P., & Ahn, S. (2013). A meta-analysis of morphological interventions in English: Effects on literacy outcomes for school-age children. *Scientific Studies of Reading, 17*(4), 257-285. doi:10.1080/10888438.2012.689791

Kieffer, M. J. (2008). Catching up or falling behind? Initial English proficiency, concentrated poverty and the reading growth of language minority learners in the United States. *Journal of Educational Psychology, 100*(4), 851-868. doi:10.1037/0022-0663.100.4.851

Kuo, L., & Anderson, R. C. (2008). Conceptual and methodological issues in comparing metalinguistic awareness across languages. In K. Koda & A. M. Zehler (Eds.), *Learning to read across languages: Cross-linguistic relationships in first- and second-language literacy development* (pp. 39-67). New York: Routledge.

Lesaux, N. K., Kieffer, M. J., Faller, E., & Kelley, J. (2010). The effectiveness and ease of implementation of an academic vocabulary intervention for linguistically diverse students in urban middle schools. *Reading Research Quarterly, 45*, 198-230. Retrieved from http://www.jstor.org/stable/20697183

Lubliner, S. & Hiebert, E. (2011). An analysis of English-Spanish cognates as a source of general academic language. *Bilingual Research Journal, 34*, 76-93.

McKeown, M. G., Beck, I. L., & Blake, R. G. K. (2009). Rethinking reading comprehension instruction: A comparison of instruction for strategies and content approaches. *Reading Research Quarterly, 44*(3), 218-253. doi:10.1598/RRQ.44.3.1

McKeown, M. G., Crosson, A. C., Beck, I. B., Sandora, C., & Artz, N. (2012, April). *Development of an academic word vocabulary intervention to enhance word knowledge and comprehension for middle school students.* Paper presented at the 2012 Annual Meeting of the American Educational Research Association, Vancouver, Canada.

McKeown, M. G., Crosson, A. C., Moore, D. W., & Beck, I. B. (2018). Word knowledge and comprehension effects of an academic vocabulary intervention for middle school students. *American Educational Research Journal, 55*(3), 572-616. doi:10.3102/0002831217744181

McKeown, M. G., Crosson, A. C., Sandora, C., Artz, N., & Beck, I. B. (2013). In the media: Expanding students' experience with academic vocabulary. *The Reading Teacher, 67*(1), 45-53. doi:10.1002/TRTR.1179

Murphy, P. K., Wilkinson, I. A. G., Soter, A. O., Hennessey, M. N., & Alexander, J. F. (2009). Examining the effects of classroom discussion on students' high-level comprehension of text: A meta-analysis. *Journal of Educational Psychology, 101*, 740-764.

Nagy, W. E., Berninger, V. W., & Abbott, R. D. (2006). Contributions of morphology beyond phonology to literacy outcomes of upper elementary and middle-school students. *Journal of Educational Psychology, 98*(1), 134-147.

Nagy, W. E., Carlisle, J. F., & Goodwin, A. P. (2014). Morphological knowledge and literacy acquisition. *Journal of Learning Disabilities, 47*, 3-12.

Nagy, W. E., & Scott, J. A. (2000). Vocabulary processes. In M. L. Kamil, P. B. Mosenthal, P. D. Pearson, & R. Barr (Eds.), *Handbook of Reading Research* (Vol. III, pp. 69-284). Mahwah, NJ: Erlbaum.

Nagy, W. E., & Townsend, D. (2012). Words as tools: Learning academic vocabulary as language acquisition. *Reading Research Quarterly, 47*(1), 91-108. doi:10.1002/RRQ.011

Nakamoto, J., Lindsey, K. A., & Manis, F. R. (2007). A longitudinal analysis of English language learners' word decoding and reading comprehension. *Reading and Writing: An Interdisciplinary Journal, 20*(7), 691-719. doi:10.1007/s11145-006-9045-7

Perfetti, C. A. (2007). Reading ability: Lexical quality to comprehension. *Scientific Studies of Reading, 11*(4), 357-383.

Perfetti, C. A., & Hart, L. (2002). The lexical quality hypothesis. In L. Verhoeven, C. Elbro, & P. Reitsma (Eds.), *Precursors of functional literacy*. (Published as Vol. 11 of the series Studies in Written Language and Literacy). Philadelphia, PA: John Benjamins Publishing Company.

Ramirez, G., Chen, X., Geva, E., & Kiefer, H. (2010). Morphological awareness in Spanish-speaking English language learners: Within and cross-language effects on word reading. *Reading and Writing: An Interdisciplinary Journal, 23*(3), 37-358.

Scarcella, R. (2003). Academic English: A conceptual Framework. *Linguistic Minority Research Institute Newsletter*. University of California, Santa Barbara.

Schleppegrell, M. J. (2004). *The Language of Schooling: A functional linguistics perspective*. Mahwah, NJ: Erlbaum.

Snow, C. E., Lawrence, J. F., & White, C. (2009). Generating knowledge of academic language among urban middle school students. *Journal of Research on Educational Effectiveness*, (Special Issue: *Effective Practices for English Language Learners in the Middle Grades), 2*(4), 325-344. doi:10.1080/19345740903167042

Snow, C. E., & Uccelli, P. (2009). The challenge of academic language. In D. R. Olson & N. Torrance (Eds.), *The Cambridge handbook of literacy* (pp. 112-133). Cambridge, NY: Cambridge University Press.

Uccelli, P., Galloway, E. P., Barr, C., Meneses, A., & Dobbs, C. (2015). Beyond vocabulary: Exploring cross-disciplinary academic language proficiency and its association with reading comprehension. *Reading Research Quarterly, 50*(3), 337–356.

WIDA Consortium. (2006). *Assessing comprehension and communication in English state to state for English language learners: ACCESS for ELLs: Interpretive guide for score reports*. Madison: Wisconsin Center for Education Research, University of Wisconsin.

Wysocki, K., & Jenkins, J. R. (1987). Deriving word meanings through morphological generalization. *Reading Research Quarterly, 22*(1), 66-81.

Ye, F., Crosson, A. C., McKeown, M. G., & Hua, M. (2016, July). *A multidimensional assessment of morphological analysis tasks with bound Latin roots.* Interactive paper presented at the 23rd Annual Meeting of the Society for the Scientific Studies of Reading, Porto, Portugal.

Zeno, S. M., Ivens, S. H., Millard, R. T., & Duvvuri, R. (1995). *The Educator's Word Frequency Guide*. Brewster, NY: Touchstone Applied Science.

Tables

Table 1. Descriptive statistics for performance on the Word Meanings Task.

		Latin Roots								RAVE							
		Pretest				Posttest				Pretest				Posttest			
Grade	*N*	Min	Max	Mean	*SD*	Min	Max	Mean	*SD*	Min	Max	Mean	*SD*	Min	Max	Mean	*SD*
6-8	25	0.00	4.00	1.68	1.28	0.00	12.00	4.40	3.00	0.00	7.00	2.40	1.55	0.00	12.00	4.96	2.84
9-10	30	0.00	14.00	4.13	3.44	0.00	16.00	10.03	4.56	1.00	12.00	4.17	2.57	1.00	16.00	11.53	4.61
11-12	27	0.00	7.00	3.63	2.06	6.00	16.00	13.04	2.86	1.00	8.00	4.33	2.09	0.00	16.00	12.11	4.77

Note. All descriptives are unadjusted.

Table 2. Descriptive statistics for performance on the Facets of Word Knowledge Task.

		Latin Roots								RAVE							
		Pretest				Posttest				Pretest				Posttest			
Grade	*N*	Min	Max	Mean	*SD*	Min	Max	Mean	*SD*	Min	Max	Mean	*SD*	Min	Max	Mean	*SD*
6-8	25	23.00	39.00	32.16	4.37	15.00	45.00	33.28	6.46	0.00	42.00	29.28	10.17	0.00	51.00	34.68	12.04
9-10	30	12.00	49.00	31.97	11.41	21.00	53.00	37.80	7.70	15.00	47.00	29.43	7.82	19.00	52.00	38.13	7.97
11-12	27	12.00	50.00	31.30	8.88	20.00	54.00	38.89	8.14	19.00	47.00	30.33	6.09	0.00	52.00	34.74	13.89

Note. All descriptives are unadjusted.

Figures

Figure 1. Descriptive results from Word Meanings Task.

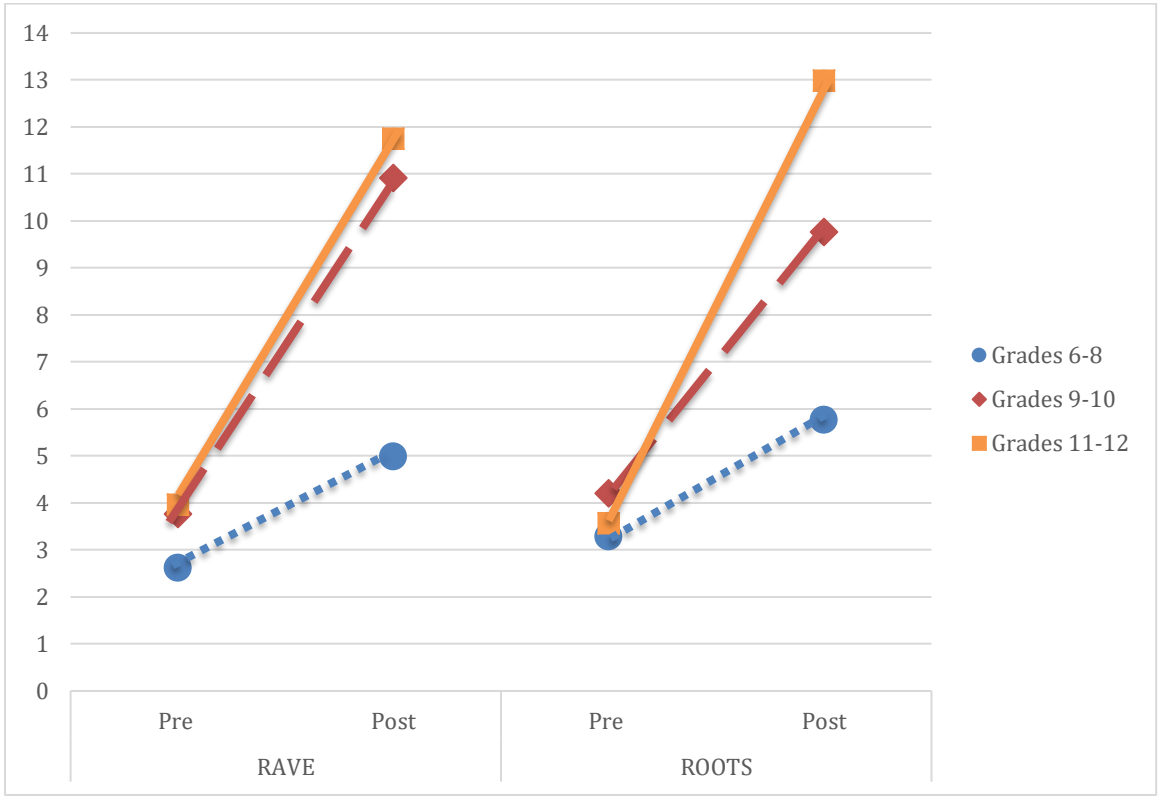
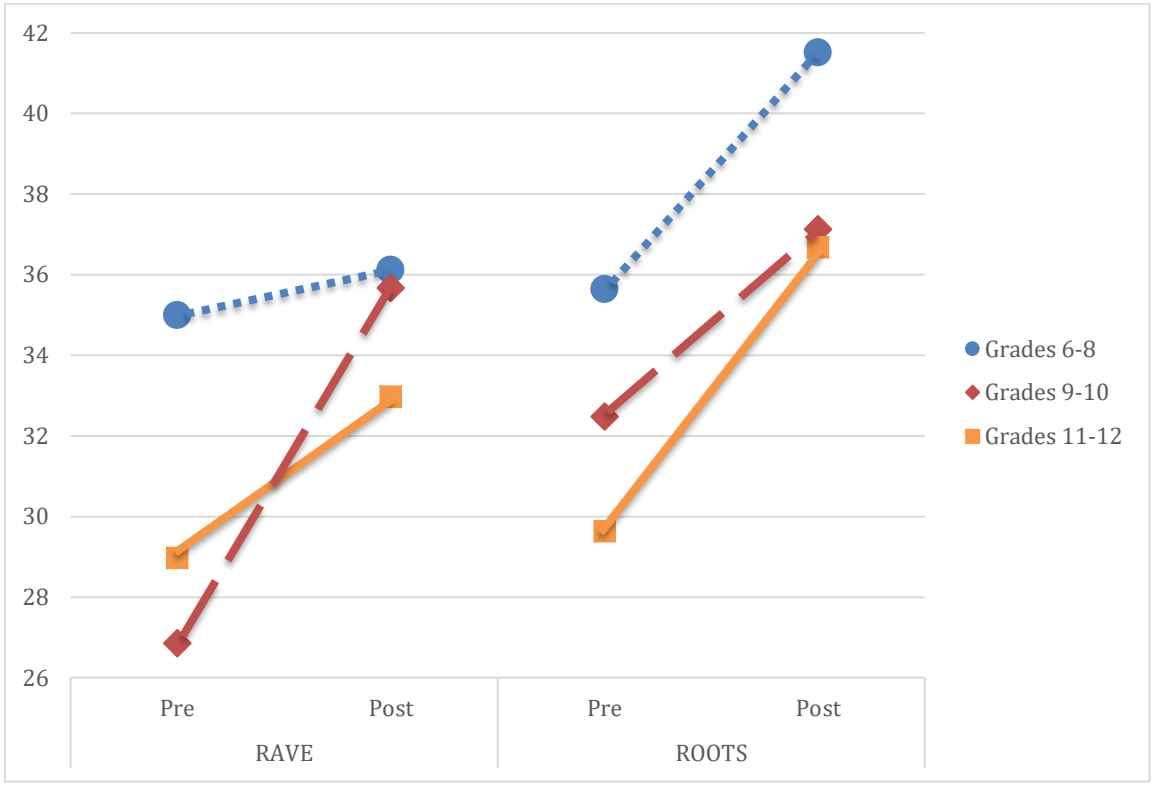
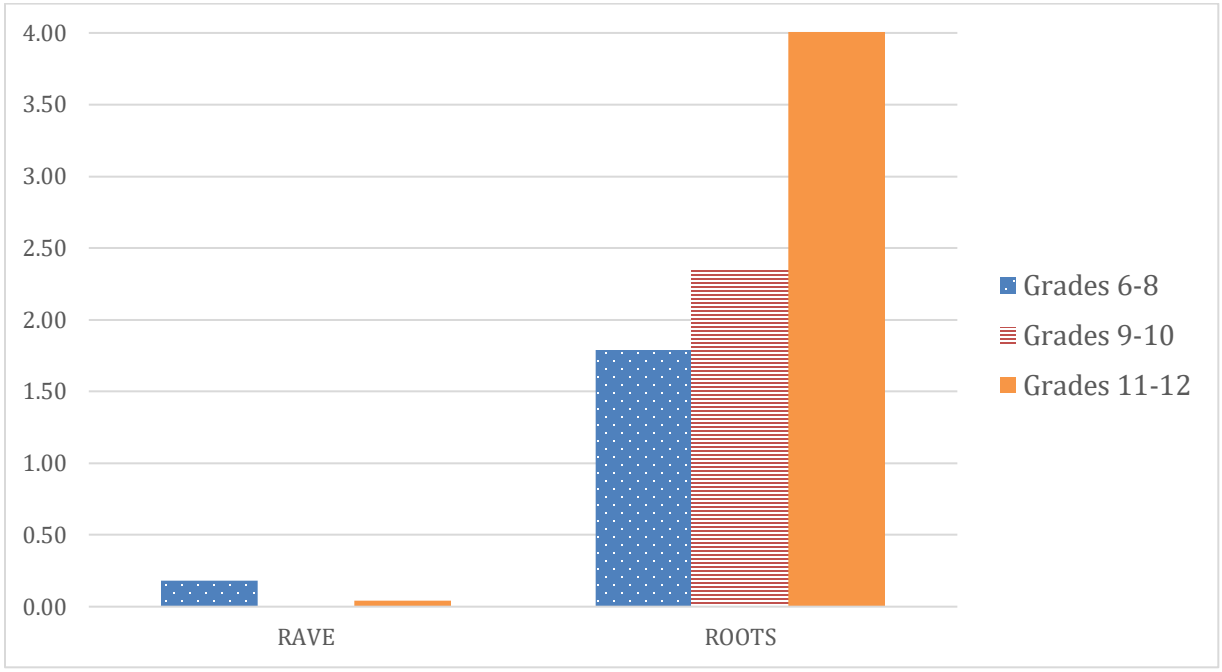


Figure 2. Descriptive results from Facets of Word Knowledge Test.



Note. RAVE = academic vocabulary intervention without morphology instruction; ROOTS = academic vocabulary intervention infused with instruction about Latin roots.

Figure 3. Descriptive results from Morphological Analysis Task.



Note. RAVE = academic vocabulary intervention without morphology instruction; ROOTS = academic vocabulary intervention infused with instruction about Latin roots.