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Incremental learning of difficult words in story contexts:

The role of spelling and pronouncing new vocabulary

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Abstract

In this exploratory study we examine the value of exposure to the spelling and pronunciation of word forms when introducing the meanings of new and difficult vocabulary words. Kindergarten English learners were randomly assigned to one of two types of storybook reading delivered by tutors. Students in both treatments listened to short stories containing novel vocabulary words children were unlikely to know. In both groups, students were told the meanings of the difficult words when they first appeared in the stories. However, in one of the groups (Definitions-Plus), students were also shown the printed words when they first appeared in the stories, and were asked to pronounce and spell the words aloud. Vocabulary learning was assessed with three researcher-designed measures including receptive vocabulary, vocabulary definitions, and spelling. Results showed that both groups made significant gains on all three measures, with average gains of 8%, 4%, and 3%, respectively. Moreover, the Definitions-Plus group had significantly greater spelling gains (d = .57), and exhibited similar, albeit nonsignificant, trends on vocabulary gains (ds = .30 and .41 for receptive and definitional vocabulary, respectively). Results extend previous studies' results to younger English learner students on the general vocabulary learning benefits of novel word exposure in story contexts, and the specific benefits for instruction that includes student spelling and pronunciation practice in learning new words.

Keywords: English language learners, kindergarten, vocabulary, spelling, pronunciation, random assignment, pronunciation, definitions, receptive language, story reading, individual instruction

Incremental learning of difficult words in story contexts:

The role of spelling and pronouncing new vocabulary

Early vocabulary knowledge is a robust predictor of reading success (Catts, Fey, Zhang, & Tomblin, 1999; Dickinson & Tabors, 2001) and early vocabulary size both directly and indirectly influences later language and literacy development (Lee, 2011; Rohde & Thompson, 2007). There are wide differences in the early vocabulary knowledge of children from different socioeconomic groups (Hart & Risley, 1995), and between children from homes in which English is the native language and English-language learners from homes with more limited English exposure and use (August & Hakuta, 1997; Bialystok, Luk, Peets, & Yang, 2009; Carlo et al., 2004). Children in the United States who are nonnative speakers of English are most often described as English learners (August & Shanahan, 2006). School-age students with low levels of vocabulary knowledge are further disadvantaged by having lower levels of learning new vocabulary through direct instruction (Cain, Lemmon, & Oakhill, 2004; Nation, Snowling, & Clarke, 2007). For English learners, early English vocabulary knowledge is a strong predictor of later reading achievement (Duursma, Romero-Contreras, Szuber, Proctor, & Snow, 2007; Kieffer, 2012).

Although it is imperative to begin early to close this knowledge gap, limited vocabulary instruction is provided in primary grade classrooms (National Reading Panel, 2000), and primary school experience does not appear to catch up children who enter school with low levels of vocabulary knowledge (Biemiller & Boote, 2006; Christian, Morrison, Frazier, & Massetti, 2000). Further, vocabulary interventions directed to preschool and kindergarten-age children appear to benefit at-risk middle- to upper-middle-class children more than at-risk low-income children (Marulis & Neuman, 2010). Research suggests that socioeconomic status predicts

reading outcomes better than English learner status (Kieffer & Vukovic, 2012). For many young English learners, vocabulary knowledge and learning are influenced by children's more limited exposure to spoken English in the home and broader socioeconomic factors Hart & Risley, 1995 that increase their risk for reading problems (Snyder & Dillow, 2012). Although English learners often have more limited English vocabulary than monolingual English speakers when they enter school (Carlo et al., 2004), the order of word difficulty seems to be similar for both groups of children (Leung, Silverman, Nandakumar, Quian, & Hines, 2011), supporting the benefits of instruction for both groups of children in "rich" vocabulary (Beck & McKeown, 2007). Finally, it is unlikely that schools alone can close the vocabulary gap quickly for English learners entering kindergarten with very limited knowledge of English phonology, orthography, syntax, and vocabulary. Efficient, steady, and incremental learning may be the reasonable objective.

Storybook reading has potential to support learning about many of these word features. It is a widely used practice shown to benefit basic reading and oral language and vocabulary for young preschool and kindergarten children (Bus, van IJzendoorn, & Pellegrini, 1995; Mol & Bus, 2011). Just as most vocabulary is learned incidentally from verbal context, young children acquire many word meanings by listening to storybooks read aloud (Penno, Wilkinson, & Moore, 2002; Robbins & Ehri, 1994). Studies have identified features of storybook reading that increase vocabulary learning, including repeated exposures to new words (Elley, 1989), and explicit explanations of the meaning of the new words (Coyne, Simmons, Kame'enui, & Stoolmiller, 2004; Justice, Meier, & Walpole, 2005). Beck and McKeown (2007) used a story read aloud with low-SES kindergarten students in which sophisticated vocabulary words (e.g., *concentrate, lunge, appropriate, envious*) were taught in a rich instruction approach that included explaining the meaning, contextualizing the word's use in the story, and providing other contexts

in which the word is used. Children receiving the rich instruction learned significantly more taught words than the no-instruction group when tested on a custom receptive picture vocabulary test.

Research on storybook reading features, primarily with native English speaking preschool-age children, has also identified approaches that increase children's print and alphabet knowledge. These features include explicit references by adults to printed words during shared reading (Justice, Kaderavek, Fan, Sofka, & Hunt, 2009). Justice, McGinty, Piasta, Kaderavek, and Fan (2010) found that preschool teachers can effectively implement explicit print referencing during their whole-class story readings, and underscored the "scalability" of this practice and its potential for feasible and cost-effective implementation. In their review of preschool and kindergarten interactive book reading interventions, Mol, Bus, and de Jong (2009) reported a moderate effect for expressive vocabulary, as well as for alphabet knowledge for kindergarten children. Although data on the content of these interventions were not available, the researchers suggested that by kindergarten teachers often refer to and direct children to print features in storybooks. While the direct instruction or explanation of new words is the feature most often associated with effective vocabulary instruction in the context of storybook reading, directing attention to the written spellings of vocabulary words has also been found to support vocabulary learning during read alouds in kindergarten children (Silverman, 2007) and older children (Ricketts, Bishop, & Nation, 2009).

Storybook reading has also been found to be a valuable context for learning vocabulary for young English learners. Roberts and Neal (2004) demonstrated that preschool children with beginning levels of English proficiency were able to derive benefit from explicit instruction (provided by trained university students) in a storybook reading format that had an emphasis in

one of two domains; alphabet and rhyming skills, or vocabulary instruction, and their research suggests that either emphasis may enhance second-language alphabet and vocabulary learning. Collins (2010) found that use of a rich explanation approach to teaching vocabulary words in a storybook read aloud to preschool English learners resulted in high levels of learning. Most of the target words were low frequency (e.g., *submerged*, *montage*, *aperture*, *corona*), and on a pretest of target vocabulary, children performed no better than chance. Instruction included pointing to an illustration of the word, explaining the meaning, providing a synonym, using gestures, and using the word in a context different from that in which it appeared in the story. Children receiving the rich instruction learned about half of the taught target words, further supporting that sophisticated words can be learned by English learners in a storybook reading context. Connectionist theory suggests that word learning results from organizing these experiences with spoken words, printed words, and word meanings (see Adams, 1990), and that calling attention to these word features supports the learning of new vocabulary, even in young preschool and kindergarten-age children. Ehri's (1992) connectionist theory of word reading describes the semantic, phonological and orthographic connections that are activated and strengthened in learning words. As children's spelling and decoding skills become more accurate, the orthographic and phonological processors form stronger, faster, and more accurate connections with the meaning processor to allow rapid pronunciation, spelling, and word meaning access (Ehri, 1992). The most recent experiments introducing new vocabulary to students in grades two and five conducted by Ehri and Rosenthal (2007; and see Rosenthal & Ehri, 2008, 2011) strongly support the value of 1) exposing students to the written word spellings and 2) having students orally pronounce the written spellings of new vocabulary words being taught, either through definitions and sentences or in passage contexts. Second graders who were

exposed to the printed spellings of new words were able to remember the pronunciations and meanings of taught words better than the words taught without spellings (Ehri & Rosenthal, 2007). The benefit of providing the written word form in learning new oral vocabulary has also been reported for children with Down syndrome who more often have difficulty with articulation that may influence learning phonological word forms (Mengoni, Nash, & Hulme, 2013). Although there is limited support that teaching the meaning and phonological forms of words affects orthographic learning of regular words (Duff & Hulme, 2012; Ouellette & Fraser, 2009), in a study of second graders Hilte and Reitsma (2011) found that establishing connections to the meaning of a word supported learning the correct word spelling. In these studies, relatively simple procedures were used to strengthen formation of memory representations for word meanings, word pronunciations, and spellings. Helping students fully utilize these connections to read, spell, and understand words resulted from small "important details" of instruction drawn from intervention research, such as providing discrimination exercises for learning letter names and shapes, and including the written spellings to help children learn word meanings (see Roberts, 2011). Making time during instruction for children to pronounce aloud the vocabulary words being taught is another example of an important instructional detail that can feasibly be implemented by classroom teachers.

Research suggests that adults make limited references to print in shared storybook interactions with young preschool children (Baker, Mackler, Sonnenschein, & Serpell, 2001; Ezell & Justice, 2000; Hammett, van Kleeck, & Huberty, 2003) and less is known how this widely used storybook reading practice can most effectively boost learning for older students with the lowest levels of vocabulary knowledge.

Present Study

In the present study, we conducted a brief experiment designed to investigate the role of spelling and active pronunciation in learning difficult vocabulary during story reading for lower-skilled English learner kindergarteners. The study specifically builds on the recent work of two groups of researchers. First, our basic intervention and measures were drawn from Wilkinson and Houston-Price (2013) who examined the learning of "difficult" vocabulary words unlikely to be known by children through single- versus multiple-story contexts and the provision of age-appropriate definitions (children were ages 6-9 years). Words were specifically selected to be "highly unlikely to be familiar to 6- and 7-year-olds" (Wilkinson & Houston-Price, 2013, p.5) and were drawn from an upper age-level word set of the British Picture Vocabulary Scale (Dunn, Dunn, Whetton, & Burley, 1977). Results showed that all children in this study benefitted from hearing explicit definitions of difficult words in the context of listening to the stories in a typical classroom book reading setting, with significant main effects for providing definitions found at immediate posttest and at 2-week follow up. The researchers also found no differences among age and ability groups between learning the words in the same story contexts (same story read on three different days, once a week, for three consecutive weeks) or in different story contexts (three different stories read on three different days, once a week, for three consecutive weeks). Second, the present study builds on the findings from Ehri and Rosenthal (2007) on the benefits of exposure to the spellings of novel words for vocabulary learning, and the benefits of having students actively pronounce new vocabulary words during story reading (Rosenthal & Ehri, 2011). We examine the benefits of spelling and pronouncing new words as facilitators of vocabulary learning in a storybook intervention for kindergarten English learners. In this study we examine the influence of vocabulary instruction "details" provided during exposure to new words during story readings delivered individually to lower-skilled kindergarten English learner

(EL) students. Tutors in one group were trained to have students briefly pronounce and spell aloud the challenging vocabulary words featured in each story. We examined the effects of this exposure for EL kindergarteners on both vocabulary knowledge and spelling.

More specifically, we investigated the effects of providing definitions of new, difficult words as they are used in multiple story contexts (Definitions-Only) versus also seeing the printed word, pronouncing the word, and spelling the word (Definitions-Plus). Learning was assessed with experimenter-developed measures of receptive vocabulary knowledge, expressive vocabulary (definitional) knowledge, and spelling. The research questions are as follows.

1. Do kindergarten EL students with low vocabulary knowledge who are exposed to any difficult word training (with or without spelling practice) make significantly more pretest-posttest gains on target words compared to distractor words?
2. What are the direct treatment (Definitions-Plus vs. Definitions-Only) effects on target word gains over distractor word gains on measures of vocabulary and spelling?
3. Do treatment effects on these gains change after accounting for pretest expressive vocabulary knowledge?
4. Do treatment effects on these gains depend on pretest levels of expressive vocabulary knowledge? In other words, are treatment effects moderated by initial expressive vocabulary knowledge for kindergarten EL students?

Methods

Participants

Original Study. Participants in the present study were drawn from a larger efficacy trial for kindergarten English Learner (EL) students with low vocabulary knowledge in a large U.S. school district (Vadasy, Sanders, & Nelson, in press). In the main study EL status was based on

parent report of home language (other than English), and low vocabulary knowledge was defined as scoring below the 50th percentile on the *Peabody Picture Vocabulary Test* IIIA (PPVT) (Dunn & Dunn, 2006). In the original study 161 kindergarten EL students from 24 classrooms within 9 schools were randomly assigned within teacher and school, to one of two intervention groups: either a reading vocabulary treatment (n = 80) or an interactive book reading treatment (n = 81) in which students were not explicitly directed to printed words, word spellings or pronunciations. Both interventions were designed to teach high frequency root words that were primarily decodable (e.g., *act, nap, dash, list*), and both took place in small groups during the school day (pull-out) for 30 minutes per day, four days per week, for 20 weeks. By posttest, attrition due to students moving from their school included n = 8 in the first condition and n = 9 in the second condition, respectively (approximately 10% attrition per condition), for a final n = 72 in each of the two experimental conditions.

Current Study. Students in the present study were recruited from the group of students who participated in the interactive book reading condition of the larger efficacy study (n = 72). After posttest of the original study described above, these students were randomly assigned, within schools, to one of two experimental conditions: story listening with target word definitions provided (Definitions-Only) (n = 36) or story listening with definitions provided plus spelling and pronouncing (Definitions-Plus) (n = 36). (Details about conditions are given in next section.)

In the time between the posttest of the original study and the onset of the current study (two weeks), three students (4%) had moved from their school (n = 1 from the Definitions-Only and n = 2 from the Definitions-Plus). Hence, the final sample comprised N = 69 students from 23 classrooms within 9 schools, with n = 35 in the Definitions-Only and n = 34 in the Definitions-

Plus conditions. This final sample's norm-referenced performance prior to the current study's onset averaged near the 10th percentile for PPVT receptive vocabulary (Definitions-Only *M* = 77.86 (*SD* = 12.28), Definitions-Plus *M* = 77.68 (*SD* = 12.53)), near the 10th percentile on the Expressive One-Word Picture Vocabulary Test-III (EOWPVT) (Brownell, 2000) (Definitions-Only *M* = 77.34 (*SD* = 10.24), Definitions-Plus *M* = 77.97 (*SD* = 11.90)), near the 40th percentile on the spelling subtest of the Wide Range Achievement Test-4 (Wilkinson & Robertson, 2006) (Definitions-Only *M* = 94.46 (*SD* = 11.94), Definitions-Plus *M* = 94.59 (*SD* = 14.87)), and near the 70th percentile on the Word Reading subtest of the Woodcock Reading Mastery Test-Revised/Normative Update (Woodcock, 1987; 1998) (Definitions-Only *M* = 107.86 (*SD* = 9.84), Definitions-Plus *M* = 110.82 (*SD* = 13.16)). (There were no significant differences or trends for differences between the two conditions on any of these measures.) The mean observed age of the sample was *M* = 6.15 years (*SD* = 0.31), again with no significant difference between conditions. Other sample demographic characteristics, including students' home languages, are provided in Table 1. All but two of the Definitions-Only students received school English learner (EL) services, and one Definitions-Plus student received school Special Education (SPED) services. Simple 2-group chi-square tests showed no trends or significant differences between conditions on gender, school services, or each of the four highest-frequency languages.

Treatment Conditions

Students in both experimental conditions listened to the same stories read aloud to them by their tutor. Treatment was delivered individually: each day for six consecutive school days, students were pulled from their regular classroom instruction to meet with their tutor for a short session (5-10 minutes) during which their tutor read a story aloud. A new story was read each day, for a total of six stories. Three of the six stories (and corresponding target words) were

drawn from the Wilkinson and Houston-Price (2013) study in which the same eight difficult target words were introduced within each story context, appearing in random order three times per story (total of nine exposures per word). These eight original "difficult" words were randomly selected from Sets 11 and 12 of the BPVS-II and were unlikely to be known by 6- and 7-year-old subjects. We made several minor changes in these three original stories when the British usage or meaning would not be familiar to students (e.g., changed "Mum" to "Mom"; changed "spades" to "shovels"). For the present study, we added instruction in an additional eight words of the same difficulty level (also with nine exposures per word) in order to closely match the Wilkinson and Houston-Price (2013) procedures. We selected the additional words from Sets 11-15 of the PPVT (see Appendix A), including several words that were in a lower difficulty level (ages 12-16) than the Wilkinson and Houston-Price (2013) words. We wrote three additional stories similar to the original stories in length and reading level, and these three stories featured the added eight difficult words which also appeared in random order three times per story (total of nine exposures per word). All 16 target words except one ("convex") we judged to be irregular in orthography assuming typical kindergarten knowledge of individual phoneme-grapheme mappings. Appendix B shows the reading level (averaging grade level 3.52 across stories) for each story. In the present study, we used the definition condition wording and procedures found most effective in Wilkinson and Houston-Price (2013). Because our kindergarten sample received the instruction on six consecutive days (rather than once per week in the original study), and did not see story pages or pictures, we used the multiple context condition to maintain student interest and engagement. The six stories were read in the same order in each group, the original stories were read on days 1, 2, and 5, and the added stories were read on days 3, 4, and 6.

Definitions-Only Condition. Children in the Definitions-Only condition listened to the story read aloud by the tutor. The tutor provided the definition of each difficult word (written and prepared by the researchers) the first time it appeared in each story (same procedure as the Definition condition in Wilkinson and Houston-Price (2013).

Definitions-Plus Condition. The tutor also read each story aloud to children in the Definitions-Plus condition, but were shown a word card for each target word.. When a target word first appeared in a story, the tutor told the definition (just like the Definitions-Only condition), and then showed the student a card with the printed target word. The tutor read the word to the student, and asked the student to pronounce the word, to spell it aloud (say the letters aloud) while looking at the printed letters, and to pronounce the word again. In this brief step of having the student say the word and name the letters, tutors did not incorporate phonemic awareness.

Tutor Training. Seven experienced reading tutors (with at least two years' experience) drawn from the local school community were trained to implement instruction (five were assigned to only one school; two were assigned to two or three schools to cover scheduling needs). Students were assigned to tutors based on classroom and tutor availability schedules Each tutor was individually trained by the first author to use both the Definitions-Only and the Definitions-Plus procedures the week prior to study onset. Tutors were instructed to follow the procedures carefully, depending upon which condition the student was assigned to, and tutors completed a form to record completion of each story and condition. For all students, the tutor used a picture of Jess and Patch, the story characters used in the Wilkinson and Houston-Price (2013) study, and the student was shown the picture for each story reading. As in the Wilkinson and Houston-Price (2013) study, the tutors were instructed not to add emphasis or discussion

about the story or words, and not to add phonemic awareness emphasis, or comprehension or vocabulary questions for either group of students.

Treatment Fidelity. The first author observed each tutor implement instruction at least twice, for a total of 75 observations (36 for the Definitions-Only condition and 39 for the Definitions-Plus condition), during which adherence to the treatment protocols was recorded using a 9-point checklist for the Definitions-Only condition and a 12-point checklist for the Definitions-Plus condition (three extra items for this latter condition). For the Definitions-Only condition, fidelity averaged 99% (*SD* = 4%); for the Definitions-Plus condition, fidelity averaged 99% (*SD* = 2%). Field notes were also recorded during these onsite observations, including student behavior, attentiveness, and any spontaneous responses (tutors did not elicit responses, but listened to and acknowledged any student response to the story). These field notes showed that there was a range of student engagement in the stories: while most students were very attentive during the reading, a small subset of students were difficult to engage, possibly because there were no pictures to look at, and the reading procedure was not interactive.

Student Assessments

Student assessments were individually administered in English at pretest (the week before instruction began) and posttest (the week after instruction ended) by trained testers who were unaware of students' experimental assignment. The same words (in random order) were used on each of the three experimenter-developed measures.

Calculation of Variables. With the exception of the expressive vocabulary pretest, students' percent correct on target and distractor items (based on their maximum points possible) as well as the difference between target and distractor percent correct were calculated for each student. Difference score gains between pretest and posttest were then computed and used for

final analyses (use of difference scores allowed us to more precisely estimate the percentage gained on target items after excluding distractor item knowledge). All percentages were multiplied by 100 for data analysis and ease of results interpretation (i.e., a percent value of .2857 is represented as 28.57). Details for each of the three measures are given below.

Expressive Vocabulary (pretest only). One week prior to instruction students were assessed on the norm-referenced measure of expressive vocabulary using the EOWPVT-II. For this test, students were presented with pictures and asked to orally provide the names of the pictures. Reliabilities published in the test manual for kindergarten ages range from .93 to .95, and the sample's internal consistency (Cronbach's alpha) was .95. Age norm-referenced standard scores (with a normative distribution of $M = 100$ and $SD = 15$) were available and therefore employed for analyses.

Receptive Vocabulary. At pretest and posttest students were assessed on a 26-item experimenter-developed measure of receptive vocabulary similar to the PPVT. Picture plates were created for the 16 target words and 10 distractor words. For each word item the student was asked to point to the correct picture of the spoken target word from four possible picture choices. The percent correct was the number of target word items the student correctly responded to out of a maximum of 16 for target word items and 10 distractor word items. The difference between target and distractor item percentages was also computed and subsequently used in analysis. Sample internal consistencies (Cronbach's alpha) for target words were .13 and .21 at pretest and posttest, respectively (for distractor words, internal consistencies were .29 and .10 at pretest and posttest). These low reliabilities likely reflect chance (guessing) performance on forced-choice items with four possible answers: as will be seen in the forthcoming results, students across

conditions averaged 28% and 19% correct on target and distractor items at pretest, with little change by posttest.

Vocabulary Definitions. At pretest and posttest students were also assessed on an experimenter-developed vocabulary definitions measure including the16 target words, along with the 10 distractor words. The tester presented the test to each student with: "I will say a word and ask you what it means. Tell me as much as you can about the word. For example, if I asked you to tell me what *dash* means, you might say it means to run fast or rush. Or, if I asked you to tell me what *dangerous* means, you might say it means when something could hurt you and makes you feel scared." The tester read each word item and transcribed the student's response. Items were scored as correct or incorrect with a maximum score of 16 points for target words and 10 points for distractor words. Percent correct on each set of items was then computed, as well as the difference in percentage correct between target and distractor items. Internal consistencies (Cronbach's alpha) for target words were again lower than optimal, at .19 and .64 at pretest and posttest, respectively (for distractor words, both pretest and posttest internal consistencies were <.01). The low reliabilities observed for this assessment are again most likely due to the difficulty of the word items: as will be seen in the results, the sample averaged near 0% correct on both target and distractor items at pretest, with little growth by posttest.

Spelling. At pretest and posttest students were also assessed on an experimenter-developed spelling measure of the same 26 words in the previous measures. For this assessment, students were asked to spell each word dictated by the tester. **"**I will say a word and ask you to spell it. Some of these are big words. It's okay if you can't spell the whole word. Just try to spell as much of the word as you can. I will say the word two times for you." Students were given a sheet of lined paper on which to write the spellings. Due to the difficulty of the words and their

irregular nature and the early spelling skills expected of kindergarten students, we applied the Tangel and Blachman (1992) developmental scoring rubric to all responses, allowing for crediting partial and less phonemically sophisticated responses. Items were scored from 0 (no attempt or a random string of letters) to 7 (entire word correctly spelled). The maximum total is 112 points for the target words, and 70 points for the distractor words. Again, percent correct out of the total possible points on each set of items was computed, as well as the difference in percentage correct between target and distractor words. Sample internal consistencies (Cronbach's alpha) were high: for target words they were .96 and .95 at pretest and posttest, respectively (for distractor words, .94 and .91 for pretest and posttest, respectively).

Analytic Plan

Although the treatments in this experiment were delivered individually to students (i.e., students are the appropriate unit of analysis), preliminary multilevel model analyses (using unconditional models to estimate intraclass correlations) showed that school and classroom membership accounted for 4% and 9% of the variance in students' initial expressive vocabulary performance, respectively (for a total of 13%), and an average of 3% and 1% (for a total of 4%) of the variance at pretest across target-distractor differences on the three experimenter-based measures, respectively (for a total of 4%). The same proportions were observed on pretest-posttest gains on just target word measures as well. In other words, students' scores were non-independent due to classroom and/or school membership. Additional preliminary analyses were also conducted to test for any tutor effects on student outcomes (noting that, although most tutors provided instruction at only one school, two tutors provided instruction at more than one school); results showed that tutor effects were found only for initial (pretest) expressive vocabulary (12%), but this is highly likely due to school membership (rather than pretreatment tutor effects),

since most tutors were only at one school. Given that 1) schools and classrooms together accounted for slightly more variance in students' expressive vocabulary compared with tutors, and 2) there are only two tutors cross-classified with schools (precluding the use of cross-classified modeling due to sparse cell sizes), we employed 3-level multilevel models to analyze the student pretest-posttest gains while accounting for classroom and school membership, with students at Level 1 (n = 69), classrooms at Level 2 (n = 23), and schools at Level 3 (n = 9).

Sequential hierarchical linear models were conducted to test the research questions for each experimenter-based measure (i.e., gains in percent correct on the difference between target and distractor items) as follows: Model 1 is an intercept-only model that tested whether pretest-posttest gains on target words vs. distractor words were significantly different from zero (across both conditions) as well as evaluated how much variance classroom and school membership accounted for; Model 2 included condition as a sole predictor (effect coded +1 = Definitions-Plus, -1 = Definitions-Only), Model 3 included pretest expressive vocabulary as a covariate (standardized in z-scores for ease of interpretation), and Model 4 included the interaction between experimental condition and expressive vocabulary. In essence, Model 1 is analogous to a 1-group t-test that evaluates whether there was significantly more growth on target items compared with distractor items across both groups of students; Model 2 (direct effects test) is analogous to the traditional 2-group t-test, Model 3 is analogous to the traditional 2-group analysis of covariance, and Model 4 (moderator effects test) is analogous to the traditional 2-group aptitude-by-treatment-interaction regression model. The general mixed models were as follows.

Model 1: $\textit{\%Correct Gain on Target vs. Distractor}_{ijk} = \gamma_{000}$

$$+ U_{00k} + r_{0jk} + e_{ijk}$$

Model 2: $\textit{\%Correct Gain on Target vs. Distractor}_{ijk} = \gamma_{000} + \gamma_{100}*\text{Condition}_{ijk}$

$+ U_{00k} + r_{0jk} + e_{ijk}$

Model 3: $\textit{\%Correct Gain on Target vs. Distractor}_{ijk} = \gamma_{000} + \gamma_{100}*\text{Condition}_{ijk}$

$+ \gamma_{200}*\text{ZExprVoc}$

$+ U_{00k} + r_{0jk} + e_{ijk}$

Model 4: $\textit{\%Correct Gain on Target vs. Distractor}_{ijk} = \gamma_{000} + \gamma_{100}*\text{Condition}_{ijk}$

$+ \gamma_{200}*\text{ZExprVoc} + \gamma_{300}*\text{Condition*ZExprVoc}$

$+ U_{00k} + r_{0jk} + e_{ijk}$

In all the models above, the gain for the i^{th} student in the j^{th} classroom in the k^{th} school is the sum of the conditional grand mean pretest-posttest percent correct gain on target over distractor items (γ_{000}) and the effect of the treatment condition on this average gain (γ_{100}), plus the school, classroom, and student residual error in gains (U_{00k}, r_{0jk}, and e_{ijk}, respectively). In Models 3 and 4, the unique effect of expressive vocabulary on gains (γ_{200}, in gain change per standard deviation of expressive vocabulary) is tested, and in Model 4, the unique effect of the interaction between condition and pretest expressive vocabulary (γ_{300}) is tested.

All multilevel models were estimated using full maximum likelihood in *HLM7*; other analyses conducted using ordinary least squares in *SPSS/PASW18*. We note that an *approximate* Cohen's *d* was computed for treatment effects by dividing the model-implied difference between groups (twice the γ_{100} coefficient for Condition due to effect coding used) by the approximate pooled standard deviation (the square root of the sum of the school, classroom, and residual variance estimates). Further, an *approximate* R^2 value was also computed to report the approximate percent in the reduction in the unexplained variance as each predictor was entered

into the model (total variance for each model computed as the sum of the three variance components).

Results

Descriptives. Observed (disaggregated) means and standard deviations for each assessment, including target, distractor, and difference scores are provided by condition in Table 2. As can be seen, students in both conditions scored near chance levels on the receptive vocabulary measure (recalling that this was a multiple choice measure with four options per item) at both pretest and posttest, with very little gain. Further, group means were near 0% correct on vocabulary definitions and approximately 21% correct on developmental spelling. Although not shown here, multilevel analyses using the direct treatment effects model on pretests (described previously in the Analysis Plan) showed no significant differences (or trends for differences) between the two experimental conditions on any pretest measure, including target, distractor, and target – distractor difference scores.

Validity Check for Custom Measures. To further consider the validity of the custom experimenter-developed measures, we examined simple zero-order correlations. Pretest expressive vocabulary (as measured by the norm-referenced EOWPVT) was significantly correlated with pretest target word vocabulary definitions percent correct and target-distractor difference percent correct on pretest vocabulary definitions (both *r*s = 0.27), but none of the other pretests. It was also correlated with all three posttest target word measures (*r* = 0.37 for receptive vocabulary, 0.51 for vocabulary definitions, and 0.46 for spelling percent correct), posttest distractor spelling percent correct (*r* = 0.38), and posttest target-distractor percent correct on receptive vocabulary and vocabulary definitions (*r*s = 0.32 and 0.48, respectively). Finally, pretest expressive vocabulary was also correlated with gains in target word vocabulary

definitions and spelling percent correct (*r*s = 0.46 and 0.30, respectively), as well as gains in the target-distractor percent correct for vocabulary definitions (*r* = .42).

Preliminary Models for Gains on Target and Distractor Words

Prior to analyzing difference scores between target and distractor words, we examined growth separately on each using the same 3-level modeling approach described in the analytic plan (student gains nested within classrooms, within schools). Results of models for distractor items showed no significant pretest-posttest growth on distractor words, nor were there any significant differences between conditions. For target word items, significant growth was observed on each of the three outcomes (across both groups), with again no significant differences between groups.

Model Results for Pretest-Posttest Gains on Target-Distractor Percent Correct

Formal analysis results of the pretest-posttest percent correct gains on target-distractor word differences, which accounted for classroom and school dependencies, are provided in Table 3. For each of the three measures, all four models are displayed (recall that the first model tested whether pretest-posttest gains on target vs. distractor items were significantly different from zero across entire sample; the second model tested for direct treatment differences; the third tested treatment differences after adjusting for pretest expressive vocabulary; and the fourth tested for moderated treatment effects).

Mean Pretest-Posttest Gains. In Model 1, we see that the mean pretest-posttest gain on target-distractor differences was significantly greater than zero for all three word measures (for receptive vocabulary a 7.61% gain, for vocabulary definitions a 3.83% gain, and for spelling a 2.78% gain). Thus, across both conditions, students made significant gains within 6 days of word exposure.

Treatment Effects . As can be seen across measures for Model 2, there was a trend for Definitions-Plus to have higher vocabulary definitions gains than Definition-Only (a difference of approximately 2.80% gain by doubling the model coefficient; $p < .10$, $d = .41$) as well as a significant treatment effect on developmental spelling (a predicted gain of 4.44% more correct for Definitions-Plus over Definitions-Only, $p < .05$, $d = .57$). No difference was detected between groups on receptive vocabulary gains (although the pattern of the difference again favored Definitions-Plus, $p > .10$, $d = .30$).

Adjusted Treatment Effects. As can be seen in results for both Models 3 and 4, there were no substantive changes in treatment effect magnitudes or direction after accounting for initial expressive vocabulary scores or after adding an interaction term (no evidence for moderation). This said, a trend for a small, ordinal interaction between condition and pretest ($p < .10$) suggested the possibility of increased treatment effects favoring Definitions-Plus for students with relatively higher initial expressive vocabulary. Specifically, model-implied values indicate a 5.34% difference favoring Definitions-Plus on vocabulary definitions gains for students who were one standard deviation higher than average on pretest expressive vocabulary (i.e., at approximately the 25th percentile), whereas this difference favoring Definitions-Plus was only 2.80% for students who were at sample average (i.e., at approximately 10th percentile on expressive vocabulary).

Post-hoc Analysis: Do Spelling Gains Predict Vocabulary Gains?

Given that Definitions-Plus students exhibited an advantage over Definitions-Only students on target word spelling gains over distractor word gains, we became interested in whether spelling gains were uniquely predictive of vocabulary gains. We hypothesized that the orthographic features of the words may bootstrap learning their meanings, in particular for

children with more limited general vocabulary knowledge, and that spelling gains might interact with treatment condition on vocabulary definition gains (i.e., that gains in spelling might have a stronger influence on vocabulary gains for the Definitions-Plus condition). To this end, we employed a fifth model just for each of the vocabulary target-distractor gains in which we added spelling target-distractor gains as a predictor (standardized in *z*-scores for ease of interpretation) as well as a condition-by-spelling gain interaction term. Results showed that neither of these terms (spelling gains or its interaction with condition) significantly predicted gains in receptive vocabulary or vocabulary definitions (all coefficient *p*s > .10).

Discussion

Results of this study suggest that when difficult words are introduced to English learner kindergarten children in the context of stories read aloud, there were significant positive benefits for all children (mean gains on target words vs. distractor words were statistically significant from zero across all three outcomes). Moreover, we observed that the Definitions-Plus instruction resulted in higher gains compared with Definitions-Only in the spelling of target words (d = .57), as measured in a developmental scoring framework. Further, there was a trend observed for children to benefit from Definitions-Plus over Definitions-Only on gains in target word vocabulary definitions (p < .10, d = .41), as well as a similar, albeit nonsignificant, pattern for target word receptive vocabulary gains (p > .10, d = .30). The significant advantages we found for defining words in the story contexts were similar to the advantages for presenting definitions reported by Wilkinson and Houston-Price (2013): at both immediate posttest and at 2-week follow up children who were told the definitions of the words scored higher on comprehension of the taught words than children in a story context only condition. Similar to

the findings reported by Ehri and Rosenthal (2007; Rosenthal and Ehri, 2008, 2011) vocabulary learning was enhanced by exposure to and pronunciation of the written word spellings.

Several factors may account for the limited amount of learning for definitions in the present study. Words chosen for replication purposes were irregular in orthography, were multisyllabic, and sometimes difficult to pronounce, in particular for English learners. Although with regard to their semantic dimension, most of the words could be considered less common terms for concepts that children were very likely to know (e.g., *attire*/clothing, *exterior*/outside, *physician*/doctor, *spherical*/round, *pedestrian*/person walking). Children did not learn most of the words through simple exposure to the words in a familiar story context with the added explanation of the meanings. More intensive instruction and interactions appear needed to learn difficult words. Others have reported successful learning of similar sophisticated words by preschool and kindergarten children with rich explanations of the word meanings (Beck & McKeown, 2007; Collins, 2010), although the receptive language skills for the children in the present study were quite low. In our study the words were presented on consecutive days across a short six-day period, and a longer extended intervention may have better supported consolidated word learning. Words in this study were presented in different story contexts which Wilkinson and Houston-Price (2013) found to be as effective as the use of the same stories.

The spelling benefits observed for the Definitions-Plus instruction might be considered in light of the incremental nature of vocabulary learning. Partial knowledge of vocabulary is most often considered in terms of semantic depth (Reichle & Perfetti, 2003; Stahl, 2003). Yet orthographic depth reflected in spelling accuracy, in particular for complex and academic words like those taught in the stories, may also develop through repeated encounters with the words in written contexts. Although we did not find that spelling gains bootstrapped semantic learning in

this short study, more exposures to the complex words may be needed to learn their orthographic features. The recent studies by Ehri and Rosenthal (see Ehri, 2014) demonstrate the value of spelling and pronouncing words in vocabulary learning to build the grapho-phonemic connections with word meanings. In this study, our findings suggest that it may be of particular benefit to include spelling words as part of building incremental vocabulary knowledge during story reading encounters. Spelling had benefits for English learner children who are less likely to have had printed or spoken exposure to these words at home. Exposure to the printed word and practice repeating new sophisticated vocabulary words might easily be included in effective rich vocabulary approaches that focus on teacher explanations and verbal elaborations.

The primary outcome measures often used in vocabulary interventions with preschool and kindergarten children have been experimenter-designed or standardized measures of receptive and expressive vocabulary, and reported effect sizes have been significantly lower on standardized assessments (Marulis & Neuman, 2010). One limitation of the present study is our use of custom measures to detect effects, particularly the very low reliability of the receptive vocabulary measure due to the difficulty of the words selected in the treatments. Future research might examine use of less difficult words, partial-credit scoring, or multiple response selections to assess depth of meaning knowledge with young learners. Despite this limitation, it is worth noting that the receptive vocabulary posttest target words percent correct was modestly correlated with the norm-referenced pretest expressive vocabulary (r = .37) as well as posttest vocabulary definitions target words percent correct (r = .50), which provides some evidence of construct validity despite the lack of internal consistency. The limitations of our custom vocabulary measures preclude examining whether orthographic learning was associated with semantic learning. Further, the at-risk kindergarteners in this study may not have had adequate

orthographic knowledge to test this association. It may also be that the orthographic learning we observed simply reflected the practice students had in spelling words that kindergarten students are rarely expected to be able to spell, and this spelling aspect of the lesson accounts for the greater attempts and persistence on the spelling posttest. In future studies researchers may be better to include first and second graders with a slightly more developed orthographic foundation to draw upon to bootstrap semantic learning of taught words. The English learner children in the present study had very low pretest levels of English vocabulary knowledge. Although we adopted the multiple context condition to maintain student interest in the 6-consecutive day readings, the subjects in this study may have struggled with the multiple contexts, similar to the younger children in Wilkinson and Houston-Price (2013). The small trend for an interaction between condition and pretest ($p < .10$) on vocabulary definitions gains suggests that treatment effects favoring Definitions-Plus were greater for students who were one standard deviation higher on pretest expressive vocabulary (which, for our sample, is 78+11 = 89 standard score points, corresponding to the 25th percentile) compared to those with average expressive vocabulary skills (in our sample, 10th percentile). Students with relatively higher levels of expressive vocabulary knowledge may have been able to utilize story context to support orthographic and semantic learning of target words. Future research should examine the contribution of printed word form exposure to vocabulary learning for less at-risk kindergarten children than those in this study. Children in today's kindergarten classrooms are often highly engaged and motivated by reading and spelling words. In many kindergarten contexts students with somewhat stronger language skills may benefit from vocabulary instruction that incorporates exposures to written spellings and pronunciations of vocabulary words that are introduced.

Our experiment was brief and was implemented by tutors in multiple school sites, yet in as many sessions as we were able to observe, kindergarteners did not appear daunted by the difficult words introduced in the stories, either when told the meanings or when asked to pronounce and spell the words. Children seemed to enjoy demonstrating their learning of these difficult words. In a less controlled and more natural instructional context, teachers would provide individualized language production opportunities for students to practice using the taught words. In this sense, semantic depth was deprived in this experiment. In a natural classroom context teachers would also notice and build upon students' alphabet and orthographic knowledge to help students learn the spellings of target words. Future research warrants examining the value of adding similar spelling and pronunciation of more basic English vocabulary during interactive storybook interventions for at-risk and English learner children. Brief spelling and pronunciation practice could easily be added to open-ended questions and prompts most typically used to support children's use of the new words. In this exploratory study, measures were limited to proximal learning outcomes, and future research should include both more general measures to examine the contribution of phonological and orthographic knowledge to vocabulary learning, as well as a more explicit test of children's learning of word pronunciations.

Results of the study are specific to lower-performing EL students from diverse language backgrounds (i.e., not a primarily Spanish-speaking sample) who received a brief intervention (i.e., only 1 week of instruction). Future research should expand on impacts with a larger sample size that is able to detect modest effects, and increase the duration of instruction. In this experiment, the storybook instruction was designed to test the role of definition, spelling, and pronouncing features with learning difficult words. Future research may test these findings in the

instruction of grade-level and content area academic words in storybook contexts that include "best practices" for interacting with and processing new vocabulary. Spelling and pronouncing vocabulary words are easily incorporated as routine aspects of active processing to complement learning semantic word identity.

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Table 1.

Sample Demographic Characteristics

	Definitions-Only (n = 35)		Definitions-Plus (n = 34)	
Characteristic	*N*	*(%)*	*N*	*(%)*
Female	15	(43%)	14	(41%)
School Services				
EL	33	(94%)	34	(100%)
SPED	0	(0%)	1	(3%)
Home Language				
African language	15	(43%)	9	(26%)
Burmese	0	(0%)	1	(3%)
Chinese	5	(14%)	5	(15%)
French	1	(3%)	0	(0%)
Khmer	1	(3%)	0	(0%)
Korean	1	(3%)	1	(3%)
Laotian	1	(3%)	0	(0%)
Punjabi	0	(0%)	1	(3%)
Spanish	7	(20%)	13	(38%)
Vietnamese	4	(11%)	4	(12%)

Table 2.

Observed Student Assessment Means and Standard Deviations

	Definitions-Only (n = 35)						Definitions-Plus (n =			
	Pretest		Posttest		*Gain*		Pretest		Posttest	
Measure	*M*	*(SD)*	*M*	*(SD)*	*M*	*(SD)*	*M*	*(SD)*	*M*	*(SD)*
Expressive Vocabulary	77.34	(10.24)	--		--		77.97	(11.90)	--	
Receptive Vocabulary										
% Target Words Correct (max: 16)	28.57	(10.20)	34.11	(13.24)	5.54	(16.45)	27.57	(13.07)	34.38	(12.04)
% Distractor Words Correct (max: 10)	18.86	(14.09)	20.57	(13.49)	1.71	(16.89)	19.12	(14.64)	14.41	(10.50)
% Target - Distractor Difference	9.71	(19.56)	13.54	(20.66)	3.82	(28.54)	8.46	(22.48)	19.96	(15.19)
Vocabulary Definitions										
% Target Words Correct (max: 16)	0.18	(1.06)	2.86	(5.94)	2.68	(5.93)	0.74	(2.56)	5.70	(8.05)
% Distractor Words Correct (max: 10)	0.00	(0.00)	0.86	(2.84)	0.86	(2.84)	0.00	(0.00)	0.00	(0.00)
% Target - Distractor Difference	0.18	(1.06)	2.00	(6.40)	1.82	(6.65)	0.74	(2.56)	5.70	(8.05)
Developmental Spelling										
% Target Points Earned (max: 112)	20.31	(17.69)	23.14	(18.89)	2.83	(15.23)	18.54	(15.58)	26.26	(16.41)
% Distractor Points Earned (max: 70)	22.57	(19.15)	24.82	(19.64)	2.24	(13.03)	23.99	(18.76)	26.68	(16.26)
% Target - Distractor Difference	-2.27	(6.09)	-1.68	(5.68)	0.59	(7.16)	-5.45	(7.37)	-0.42	(7.74)

Note. N = 69 students within 23 classrooms (Level 2) in 9 schools (Level 3). All measures in percentage correct except Expressive Vocabulary, which is given in standard scores.

Table 3.

Multilevel Model Results for Student Pretest-Posttest Gains on Target-Distractor Percent Correct

	Receptive Vocabulary				Vocabulary Definitions				Devel	
	Model 1	Model 2	Model 3	Model 4	Model 1	Model 2	Model 3	Model 4	Model 1	Mo
Fixed Effects	*Coeff*	*Coeff*	*Coeff*	*Coeff*	*Coeff*	*Coeff*	*Coeff*	*Coeff*	*Coeff*	*Co*
Conditional Mean	7.61 *	7.66 *	7.66 *	7.75 *	3.83 **	3.82 **	3.69 **	3.63 **	2.78 *	2
Condition (1=DP)		3.84	3.78	3.77		1.40 †	1.39 †	1.40 †		2
Pretest Express Vocab			2.22	2.65			2.87 ***	2.73 ***		
Condition*Pretest				-3.15				1.27 †		
Random Effects	*Var*	*Var*	*Var*	*Var*	*Var*	*Var*	*Var*	*Var*	*Var*	*V*
Schools	0.04	0.08	0.04	0.04	0.01	0.01	0.01	0.01	0.00	0
Classrooms	0.31	0.07	0.25	0.23	10.29 **	9.64 **	7.47 **	5.87 *	0.04	0
Residual	663.09	648.45	643.51	633.92	39.77	38.05	31.63	31.12	65.56	60
Approximate R^2 *change*	--	2.2%	0.8%	1.5%	--	4.3%	16.9%	1.6%	--	7

Note. N = 69 students (Level 1; n = 35 Definitions-Only and n = 34 Definitions-Plus) within 23 classrooms (Level 2) in 9 schools (Level 3) used in analyses. Coeff = estimated model coefficient. Receptive Vocabulary, Vocabulary Definitions, and Developmental Spelling are all experimenter-developed measures of the difference between percentage of target words correct and percentage of distractor words correct. Condition was effect coded (+1 = Definitions-Plus, -1 = Definitions-Only) and Pretest Expressive Vocabulary standardized in z-scores.
† $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$.

Appendix A

Target and Distractor Word Characteristics

Target Words: Each in Stories 1-3	*Part of Speech*	*Zeno List Frequency*
attire	N	24
culinary	A	4
deciduous	A	76
exterior	A	87
incline	N	32
physician	N	316
submerging	A	2
trajectory	N	18
Stories 1-3: Mean (SD)	--	*69.88 (104.26)*
Target Words: Each in Stories 4-6	*Part of Speech*	*Zeno List Frequency*
aquatic	A	93
blazing	A	136
cascade	N	41
hatchet	N	40
ladle	N	23
pedestrian	N	58
spherical	A	51
transparent	A	182
Stories 4-6: Mean (SD)	--	*78.00 (55.26)*
Distractor Words: No Exposure	*Part of Speech*	*Zeno List Frequency*
arable	A	29
colt	N	227
converging	A	14
convex	A	79
fowl	N	52
inoculation	N	11
lever	N	216
nautical	A	15
oasis	N	58
pillar	N	37
Distractors: Mean (SD)	--	*73.80 (80.82)*

Note. Words sorted alphabetically within Story Target and Distractor type. A = adjective, N = noun. Distractor words selected to match with target word Zeno frequencies and type of part of speech.

Appendix B

Story Characteristics

			Flesch-Kincaid	
Order	Title	No. Words	Reading Ease	Grade Level
1	*Day of Adventures*	897.0	89.2	3.1
2	*Go to the Beach*	878.0	86.5	3.9
3	*Go to the Circus*	987.0	86.2	4.1
4	*Go to the Mountains*	938.0	90.0	3.7
5	*Goes to a Farm*	998.0	90.7	3.2
6	*Goes on a Class Trip*	910.0	90.1	3.1
	Mean	*934.67*	*88.78*	*3.52*
	(SD)	*(48.99)*	*(1.95)*	*(0.44)*