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Enhancing Vocabulary Intervention for Kindergarten Students: Strategic Integration of Semantically Related and Embedded Word Review

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Abstract

Two approaches to systematic word review were integrated into an 18-week program of extended vocabulary instruction with kindergarten students from three high-need urban schools. Words in the embedded and semantically related review conditions received systematic and distributed review. In the embedded review condition, brief word definitions were integrated into the narratives of multiple storybooks. In the semantically related review condition, in-depth word review with explicit emphasis on semantic features and associations was provided during extension activities. Systematic review resulted in an almost twofold increase in target word learning. Embedded review was effective and time efficient, whereas semantically related review was time intensive but resulted in higher levels of word learning. There was a significant gain in *Peabody Picture Vocabulary Test–III* standard scores following the intervention.

Keywords

vocabulary, language, review, semantic relatedness

Vocabulary knowledge is a critical language skill that contributes to students' ability to comprehend text and understand academic English, the formal language used in classrooms for discourse and learning (Gersten et al., 2006). Research indicates, however, that substantial differences in vocabulary development emerge during early childhood (Hart & Risley, 1995) and persist during the primary grade years (Biemiller & Slonim, 2001). In addition, it is increasingly recognized that vocabulary instruction tends to be neglected or underemphasized in early primary grades (Beck, McKeown, & Kucan, 2002; Biemiller, 2004). A related problem is the need for further research on effective vocabulary instruction for early primary grade students. A report by the National Reading Panel (NRP, 2000), for example, noted that relatively few studies on vocabulary instruction had been conducted with students below the third grade level. These observations suggest that extending the evidence base on strategies to promote vocabulary development among early primary students should be a research priority.

Initial studies on methods to promote vocabulary development among primary grade children have explored three approaches: providing incidental exposure to words during storybook readings (incidental word learning), embedding explicit definitions of words within storybook readings (embedded instruction), and engaging students in interactive extension activities that focus on target word meanings (extended instruction). Efforts to facilitate incidental word learning through repeated storybook listening had a modest effect on student's word knowledge (e.g., Elley, 1989; Robbins & Ehri, 1994), and word learning was enhanced by embedding explicit definitions or explanations of target words within storybook readings (e.g., Elley, 1989; Justice, Meier, & Walpole, 2005; Penno, Wilkinson, & Moore, 2002). Extended instruction, designed to promote deeper levels of processing through discussions of word meanings, resulted in greater gains in target word learning than incidental exposure or embedded instruction (Beck & McKeown, 2007; Coyne, McCoach, & Kapp, 2007; Coyne, Simmons, Kame'enui, & Stoolmiller, 2004). However, the relatively full and complete word representations resulting from extended vocabulary instruction appeared vulnerable to

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decay (Coyne, McCoach, & Kapp, 2007). Moreover, implementation of extension activities is relatively time-consuming. Although extension activities appear to be a promising approach to developing primary students' vocabulary knowledge, strategies are needed to improve the effectiveness and efficiency of extended vocabulary instruction.

Systematic Review

A review of research on word learning and vocabulary instruction reveals two instructional strategies that might be employed to enhance extended vocabulary instruction. These methods are *systematic word review* and an emphasis on *semantic relatedness*. Systematic, judicious review is an empirically validated instructional strategy that benefits all learners, including students with diverse learning needs (Kame'enui, Carnine, & Dixon, 2007). Findings from four lines of research converge to suggest the potential benefits of review in promoting word learning. First, a meta-analysis by Stahl and Fairbanks (1986) and the review of research on reading instruction by the NRP (2000) indicated that repetition or multiple exposures to word meanings was an effective method of enhancing word learning. However, a majority of the studies reviewed by Stahl and Fairbanks and the NRP were conducted with students beyond the second grade, suggesting that additional research is needed to confirm the effectiveness of multiple exposures with younger students. Second, findings from several studies with early primary students (Biemiller & Boote, 2006; Penno et al., 2002; Robbins & Ehri, 1994) indicated that target word acquisition improved as the number of storybook readings increased. Third, Gray (2003) explored word learning by 4- and 5-year-old children with language impairments in response to an interactive instructional approach integrating specific word references, elicited imitation, repeated modeling, and feedback over 5 days. On average, children with language difficulties needed more than 2 times as many trials as age-matched peers to comprehend or produce a new word. A fourth line of evidence suggesting the potential utility of word review emerges from recent studies (Beck & McKeown, 2007; Biemiller & Boote, 2006; Coyne, Simmons, Kame'enui, & Stoolmiller, 2004) in which word learning among early primary students was substantially increased by formally integrating systematic word review.

Semantic Relatedness

Another approach to augmenting extended vocabulary instruction, which might be strategically integrated into systematic word review, would be to design activities that explicitly emphasize semantic relatedness, or how words are conceptually related to other words and concepts (Blachowicz, Fisher, Ogle, & Watts-Taffe, 2006). Several instructional strategies based on semantic relatedness have been empirically validated with students at or above the third grade level, including semantic mapping (Heimlich & Pittelman, 1986; Stahl, 1999), semantic feature analysis (SFA; Pittelman, Heimlich, Berglund, & French, 1991), and semantic grouping (Stahl, 1999). The effectiveness of these strategies was also noted in a review of vocabulary instruction for students with learning disabilities (Jitendra, Edwards, Sacks, & Jacobson, 2004), which included a summary of 10 investigations on cognitive strategy instruction conducted by Bos and colleagues. Large effects were reported when semantic mapping and SFA were used to promote an understanding of similarities and differences among related ideas in a semantic network of words. Similarly, Stahl (1999) cited meta-analytic research by Marmolejo on the effects of vocabulary instruction with poor readers, which indicated that students with low initial vocabularies particularly benefited from learning word meanings within a semantic field. Stahl suggested that these students may need assistance connecting novel and familiar word meanings.

Additional research is needed to examine how explicit emphasis on semantic relatedness might be used to improve extended vocabulary instruction for students in early primary grades, especially among children from populations at risk for low vocabulary knowledge, including students from low socioeconomic status (SES) backgrounds. Coyne, Zipoli, and Ruby (2006) reported promising findings from an exploratory investigation integrating explicit emphasis on semantic relatedness into extended vocabulary instruction. Participants were 36 kindergarten students from one rural and two urban school districts. Students were taught four vocabulary words in a small group format with explicit emphasis on a semantic field (size, shape, or texture). These students were also taught four target words without explicit emphasis on a semantic field. Results indicated that the students performed significantly better on two expressive measures of target word knowledge when new word meanings were explicitly related to semantic fields (i.e., how things "look" or "feel"). Coyne and colleagues postulated that instruction emphasizing target word meanings and semantic relatedness, including explicit connections between targeted words and untargeted words, might optimize word learning by combining the effects of direct instruction and incidental word learning.

Importantly, a literature search revealed no studies that directly compared different methods of systematic word review or examined the effect of review activities with an explicit emphasis on semantic relatedness. The purpose of this study was to explore how systematic review, which included a review condition with explicit emphasis on semantic relatedness, might enhance the effectiveness and

Table 1. Demographic and Racial Data by School

	School 1	School 2	School 3
Total students	552	291	276
Grades	Pre-K to 8	K to 4	K to 5
Eligible for free or reduced-price lunch (%)	73.2	80.8	91.3
Non-English language homes (%)	56.6	28.5	23.0
Fourth grade students meeting state goal in reading (%)	22.4	20.0	35.7
Black students (%)	22.8	7.6	38.0
Hispanic students (%)	70.7	60.1	40.9
White students (%)	5.4	28.5	17.4
American Indian students (%)	0.5	1.7	1.8
Asian American students (%)	0.5	2.1	1.8
Male participants (*n*)	15	18	8
Female participants (*n*)	8	17	14
Average age of participants (years-months)	5-5	5-6	5-6
Age range of participants (years-months)	4-11 to 5-11	5-0 to 5-10	4-11 to 6-2

Note: (%) refers to the percentage of all students in the school. The statewide average of fourth grade students meeting the state goal in reading was 57.8%.

efficiency of extended vocabulary instruction. The multiple-storybook format used in this investigation allowed for the design, integration, and direct comparison of two approaches to systematic word review.

The first set of research questions addressed in this study was the following: Is there a difference in word learning between target words receiving extended instruction without systematic review and target words receiving extended instruction with systematic review? What, if any, is the magnitude of this difference? The second set of research questions was the following: Is there a difference in word learning between target words taught using extended instruction with embedded review and target words taught using extended instruction with semantically related review? What, if any, is the magnitude of this difference?

Method

Participants

Participants were 80 kindergarten students from three public elementary schools in urban districts in the northeast region of the United States who were receiving a vocabulary intervention as part of a larger efficacy study (Coyne, McCoach, Zipoli, & Loftus, 2007). Three children were excluded from this investigation based on exclusionary criteria of intellectual disability, pervasive developmental disorder, severe behavior disorder, or severe speech impairment. A participant from School 2 moved away during the intervention. Demographic data on the 80 students who completed the intervention are presented in Table 1.

Each of the three schools served a high percentage of students from low SES backgrounds. Based on low schoolwide reading performance on a recent state assessment of student achievement, students in these schools were considered to be collectively at risk for reading difficulties.

Procedures

Research questions were addressed using a within-subjects experimental design. An important advantage of within-subjects designs is that each participant can receive all treatment conditions, allowing enhanced control for individual differences and an increase in statistical power (Shadish, Cook, & Campbell, 2002). The within-subjects factor, target word review, consisted of three conditions: no review, embedded review, and semantically related review. In all, 54 target words were randomly assigned to these three conditions, resulting in 18 words per condition.

In School 1, storybook readings and extended vocabulary instruction were delivered to small groups of three to five students, seated in chairs around a semicircular table. Interventionists were two graduate student interns in a master's degree program in special education, who had previously completed student teaching experiences. In Schools 2 and 3, storybook readings and extension activities were conducted by three kindergarten teachers in whole-class settings. Interventionists received training on the vocabulary intervention from research team members during a professional development day. Training included simulated delivery of extended vocabulary instruction, with immediate performance feedback on critical instructional behaviors.

Eighteen storybooks, many of which had multicultural themes, were each read twice. To allow for the systematic introduction and review of target words, texts were occasionally adapted by inserting or substituting a target word. Interventionists averaged two readings weekly over a period of approximately 18 school weeks, and three new target

words were introduced in every storybook. This schedule resulted in the reading of approximately one book per week and the introduction of approximately three new target words per week.

Target words were randomly assigned to no review, embedded review, and semantically related review conditions. The pool of target words consisted of 15 nouns, 18 verbs, and 21 adjectives that were judged by research team members to be unlikely to be known by most kindergarten students. To minimize potential word effects, words within each word type (verbs, adjectives, and nouns) were first rank ordered based on Living Word Vocabulary (LWV; Dale & O'Rourke, 1981) values, which indicate the grade level at which a word meaning was initially known by at least two thirds of children sampled (Biemiller, 2004) and the percentage of children in that grade who knew a given word's meaning. Words were then placed into sets of three based on LWV rankings (e.g., *exclaim*, *crouch*, and *grasp*) and randomly assigned to the no review, embedded review, and semantically related review conditions. The average LWV value of target words assessed on the experimenter-developed *Target Word Knowledge Measure* (TWK Measure; described below) was between the fifth and sixth grade levels (Grade 5.7). Relative rankings for eight target words with no reported LWV value were determined based on consensus judgment of research team members.

Storybook readings. In a typical storybook reading, three new target words were introduced to students and three additional target words were presented as a part of embedded review (as discussed below). Interventionists identified six "magic words" prior to the reading of the story and prompted children to pronounce each word to reinforce phonological representations (see Brackenbury & Pye, 2005). Children were prompted to listen for magic target words during storybook readings and to raise their hands when they heard a magic word. When a target word was encountered during a storybook reading, the interventionist reinforced students for identifying the target word or prompted the students to identify the target word. The interventionist then provided a concise, clear definition of the target word's meaning and read back an anchor sentence from the storybook, substituting the simple definition for the target word. Thus, storybook readings included both definitional and contextual information about word meanings (Stahl & Fairbanks, 1986).

Extended instruction. The design of extension activities was informed by research on effective teaching strategies for diverse learners, including students with learning disabilities and those at risk for academic failure (e.g., Swanson & Hoskyn, 1998; Vaughn, Gersten, & Chard, 2000). The activities were also informed by research evidence on effective vocabulary instruction (e.g., Beck et al., 2002; Coyne, Simmons, & Kame'enui, 2004). Following the reading of a storybook, extended instruction was provided for the three new magic target words introduced during the storybook reading, regardless of each word's review condition. In addition, two or three additional words in the semantically related review condition received further extended instruction (as described below). Target words were reintroduced, pronounced, defined, and presented again in anchor sentences from the storybook. The interventionist then provided students with multiple opportunities to discuss word meanings during activities designed to promote deep processing of word meanings through extended discourse, decontextualized word exposures, and discrimination and generalization tasks (for examples of extended instruction, see Coyne, McCoach, & Kapp, 2007). Based on their responses, students received praise, corrective feedback, or instructional scaffolding.

Systematic word review. Target words in the no review condition were defined during two readings of the specific book in which a given word was introduced and then explained and discussed during the extension activities that immediately followed the two readings of that storybook. Words in the no review condition were not embedded and defined in subsequent books, nor were the meanings of these words explained or discussed during subsequent extension activities (see Table 2).

Target words in the embedded review condition were also introduced and defined during two readings of the first storybook in which a given word was introduced and then explained and discussed during extension activities following these two readings. In addition, embedded review words were reviewed by providing *definitions during readings* of subsequent storybooks. On average, words in the embedded review condition were reviewed in five subsequent storybook readings. However, embedded review words were not explained or discussed during extension activities at the conclusion of subsequent storybooks (see Table 2).

In the semantically related review condition, words were again introduced, explained, and discussed during a pair of readings and extension activities using the first storybook in which a given word was introduced. In contrast to words in the embedded review condition, semantically related review words were neither embedded into nor defined during readings of subsequent storybooks. However, these words were reviewed during *extension activities* following the readings of subsequent storybooks. Semantically related review words introduced in Books 1 to 9 were typically reviewed in five additional rounds of extension activities, whereas words introduced in Books 10 to 18 were typically reviewed in three additional rounds of extension activities (see Table 2).

Several activities were used in the semantically related review condition to draw children's attention to the *semantic features* of target words and the relationships between target words and previously known words and concepts. The first

Table 2. Mapping of Initial Vocabulary Instruction and Systematic Review for Target Words Introduced in Storybook Number 6

	No Review	Embedded Review	Semantically Related Review
Target word	regretful	sprinted	slope
Introductory storybook	Storybook 6	Storybook 6	Storybook 6
Defined during two introductory storybook readings	Yes	Yes	Yes
Extended instruction following two introductory storybook readings	Yes	Yes	Yes
Word review			
Defined during subsequent storybook readings	No	Yes (7-1, 7-2, 9-1, 9-2)	No
Extended instruction following subsequent storybook readings	No	No	Yes (7-1, 7-2, 8-2, 11-1, 15-2)

Note: Numbers in parentheses indicate storybook and reading sequences, respectively (e.g., 7-1 indicates Storybook 7, Reading 1).

review task, a semantic knowledge activity, was designed to draw children's attention to at least three critical features or properties of a target word. This activity was loosely based on SFA, a technique that has been successfully used to promote word learning among older students (Pittelman et al., 1991) and enhance retrieval of lexical information within the semantic networks of adults with neurological impairments (Boyle & Coelho, 1995; Coelho, McHugh, & Boyle, 2000). Classroom applications of SFA tend to involve tightly configured groupings of words within a category (e.g., fruits) that are compared and contrasted on lengthy lists of potential features (e.g., round, peel, red, etc.). In contrast, Boyle and Coelho (1995) used a flexible SFA technique that was designed to boost the level of activation within a semantic network by asking individuals to produce semantically related words indicating the group, use, action, properties, location, and association of a target word. An adapted version of this flexible approach to SFA was used in the present study by asking kindergarten children questions about three or four specific features of a given semantically related review word during an initial review lesson (see Table 3). The semantic features discussed in initial review lessons were based on *sound–hearing*, *appearance–seeing*, *sensation–touch*, *affect* ("feel"), *action–use*, *association* ("makes you think of"), and *location* ("found in").

In addition to the semantic knowledge activity, several other activities were utilized to make both semantic features and associative relationships explicit during semantically related review (see Table 3). These subsequent review activities were similar to other extension activities in providing opportunities to interact with target words in varied contexts. However, the activities in these review lessons were designed to explicitly and maximally emphasize (a) additional semantic features of target words and (b) semantic associations between target words and familiar words and concepts. Based on schema theory and literature on word associations, Johnson (2001) summarized categories of word associations that substantially contribute to human word webs. Several of these associative devices were integrated into the design of semantically related review activities, providing numerous opportunities to make relationships between target words and previously known words and concepts conspicuous to students (see Table 4).

Table 3. Examples of Tasks Utilized in Semantically Related Review Activities

Semantic knowledge activity
Sound–hearing
"Can you *hear* a person who is weeping?"
Appearance–seeing
"Can you *see* a person who is weeping?"
Affect–feeling
"If your friend was weeping, would she be *feeling* silly . . . or sad?"
Association
"Which makes you *think of* the magic word weeping . . . a child going outside to play, . . . or a child who lost her favorite toy?"
Sentences with related word choice
"'We watched the ant carry a tiny breadcrumb.' . . . Does this make you think of the word minute, or the word big?"
Comparing and contrasting with sentences
"Which would you see on a boulevard: stoplights and crosswalks, or a sandy beach?"
Questions with multiple target words
"Would you be cautious or careful . . . when walking down a slippery slope covered with ice?"

Note: The meaning of the target word *weeping* was introduced and taught during storybook readings and extension activities in Lessons 4A and 4B. During the semantic knowledge activity in Lesson 5A, students were asked questions emphasizing four semantic features and asked to justify their responses.

Measures

The experimenter-developed TWK Measure was administered to participating kindergarten students at pretest and

Table 4. Examples of Associative Devices Integrated Into Semantically Related Review Activities

Synonyms: minute—*small*, *little*, and *tiny*
Antonyms: serene—*excited*
Collocation: *slope*—*slippery*
Superordinates or hypernyms: plot, cavern, and boulevard are types of *outside places*
Functions: a person might *walk*, *drive*, and *ride* on a boulevard
Subordinates or hyponyms: *serene*, *terrified*, and *elated* are types of feelings
Parts or meronyms: *stoplights*, *sidewalks*, and *crosswalks* are parts of a boulevard
Coordinates: *witches*, *ghosts*, and *monsters* might be terrifying Halloween costumes
Attributes: *slopes* are a feature of a mountain

Note: Target words are underlined, and exemplars of associative devices appear in italics.

posttest. Students were first asked to provide a *definition* for a target word in the absence of contextual information (e.g., "Tell me what the word *halt* means."). The second item was a *neutral context question*, which presented the target word in a relatively neutral context (e.g., "What would you be doing if you were *halting*?"). The TWK measure sampled student knowledge of 37 target words and consisted of 12 no review words, 13 embedded review words, and 12 semantically related review words. All items on the TWK measure were developed and reviewed by an interdisciplinary research team, and content validity was based on consensus expert opinion. A scoring rubric was also developed through consensus opinion, assigning 2 points for correct responses, 1 point for responses reflecting partial word knowledge, and no points for incorrect responses.

Two norm-referenced vocabulary tests, the *Peabody Picture Vocabulary Test–III* (PPVT-III; Dunn & Dunn, 1997) and the *Expressive One-Word Picture Vocabulary Test* (EOWPVT; Academic Therapy Publications, 2000), were administered at pretest and posttest as general measures of students' overall vocabulary knowledge. The PPVT-III, which measures receptive vocabulary acquisition, has a mean standard score of 100 and a standard deviation of 15. The median coefficient alpha, a measure of the internal consistency of test items, was reported to be .94 for the PPVT-III, whereas median test–retest reliability coefficients ranged from .91 to .94 (Dunn & Dunn, 1997). Content validity of the PPVT-III was supported by detailed descriptions of item development, and concurrent validity was established using correlations with other measures of oral language and cognitive ability (Salvia & Ysseldyke, 2007).

The EOWPVT measures an individual's ability to name pictures of objects, actions, and concepts. The EOWPVT has a mean standard score of 100 and a standard deviation of 15. The median coefficient alpha for the EOWPVT was reported to be .96, and corrected test–retest reliability coefficients ranged from .88 to .97 (Academic Therapy Publications, 2000). Item analysis was used to establish content validity of the EOWPVT, and correlations with widely used vocabulary tests were used to establish criterion-related validity.

Fidelity of Implementation

A rating form was designed to assess treatment fidelity, or the accuracy and consistency with which intervention protocols were implemented, in an attempt to monitor and control for potential threats to internal validity (Gresham, MacMillan, Beebe-Frankenberger, & Bocian, 2000). The fidelity rating form was based on a task analysis of important instructional behaviors during storybook readings and extension activities and was completed by members of the research team at intervals of approximately 2 weeks. Coefficient kappa-n, which accounts for chance agreement between observers (Brennan & Prediger, 1981), was used to measure interobserver agreement on the fidelity rating form. Kappa-n values of .97 during story readings and .94 during extension activities were obtained for seven paired fidelity ratings, indicating excellent interobserver agreement (Watkins & Pacheco, 2000). A total of 28 fidelity observations were conducted during the study, and interventionists received average fidelity ratings of 98.8% for story readings and 96.0% for extension or review activities (based on performance of critical instructional behaviors), indicating a high degree of treatment integrity.

Data Collection and Scoring

Research team members conducted pre- and posttest assessments with individual students in quiet environments outside of classrooms. Pretest measures were administered approximately 1 to 2 weeks prior to intervention, and posttest measures were administered during a 2-week interval following completion of the final storybook reading and extension activity. The TWK measure was scored during team meetings, following the completion of pretest and posttest measurements, using scoring rubrics.

Results

Target Word Learning

Target word learning was measured using a TWK composite derived by summing scores from the definitions and neutral context questions of the TWK measure. Among the 37 target words included on the TWK composite, there were 12 words in the no review condition, 13 words in the embedded review condition, and 12 words in the semantically

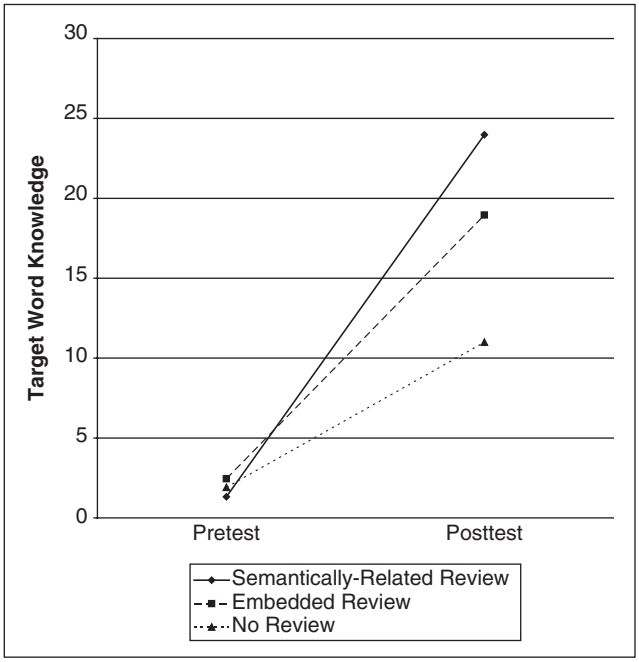

Figure 1. Average Target Word Knowledge composite score at pretest and posttest by condition

related review condition. To allow for more consistent comparisons of word learning across the three conditions, embedded review scores were rescaled to a 0 to 12 metric. Thus, the maximum total score a student might obtain for each of the three conditions on the TWK composite was 48 (12 × 2 points on definitions and 12 × 2 points on neutral context questions). Cronbach's alpha was .98 for the posttest TWK measure, indicating a high degree of internal consistency among test items.

Students' mean TWK composite scores at pretest were 1.94 (4.0%) in the no review condition, 2.45 (5.1%) in the embedded review condition, and 1.32 (2.8%) in the semantically related review condition. Collectively, these scores indicate that students were unfamiliar with the pool of target words used in this study prior to intervention. At posttest, mean TWK composite scores were 10.99 (SD = 9.75) for no review words, 18.96 (SD = 13.19) for embedded review words, and 23.98 (SD = 15.5) for semantically related review words. Figure 1 depicts target word learning as function of word condition.

Omnibus Analysis

To compare overall word learning in the no review, embedded review, and semantically related review conditions, a repeated measures ANOVA was conducted using mean TWK composite scores at posttest as the dependent variable. A statistically significant result was found, $F(2, 78) = 71.19$, $p < .001$, indicating a difference in target word learning across the three conditions. The highest level of word learning occurred in the semantically related review condition, whereas the lowest level of learning occurred in the no review condition. The results of follow-up paired-samples t tests are presented in the next two sections.

Effect of Systematic Word Review

The first research question asked, is there a difference in word learning between target words receiving extended instruction without systematic review and target words receiving extended instruction with systematic review? If so, what is the magnitude of this difference? To answer the first part of this question, a paired-samples t test was used to compare students' mean posttest performance on the no review and average review TWK composites. The average review TWK composite was computed by averaging TWK composite scores from the embedded and semantically related review conditions. The mean no review composite score was 10.99 out of 48 (SD = 9.75), and the mean average review composite score was 21.47 out of 48 (SD = 13.98). A statistically significant difference was found, $t(79) = 11.89$, $p < .001$, indicating higher levels of target word learning when systematic review was strategically integrated into vocabulary instruction.

Effect sizes were computed to address the magnitude of difference in word learning between target words receiving systematic review and those receiving no review. Pooled standard deviations were used to compute effect size indexes for dependent means (Grissom & Kim, 2005). Effect size values for d were interpreted following guidelines by Cohen (1992), who suggested that 0.20 represents a small effect, 0.50 represents a medium effect, and 0.80 represents a large effect. The d value for the comparison between average review and no review composites was 0.88, indicating a large effect. Additional effect sizes were separately computed to compare the embedded and semantically related review conditions, respectively, with the no review condition. For the comparison between embedded review and no review composites, a d value of 0.69 suggested a medium to large effect. The d value for the comparison between semantically related review and no review composites was 1.03, indicating a large effect.

Taken together, these findings indicate that a substantial increase in target word learning resulted when extended vocabulary instruction was augmented with systematic, distributed word review.

Comparison of Review Conditions

The second research question asked, is there a difference in word learning between target words taught using

Table 5. Review Effect Sizes

	Posttest				
	Systematic Review		No Review		
	M	*SD*	*M*	*SD*	*d*
Average review	21.47	13.98	10.99	9.75	0.88
Embedded review	18.96	13.19	10.99	9.75	0.69
Semantically related review	23.98	15.50	10.99	9.75	1.03
	Posttest				
	Semantically Related Review		Embedded Review		
	M	*SD*	*M*	*SD*	*d*
	23.98	15.50	18.96	13.19	0.35

Note: Embedded review scores were scaled to a 0–12 metric, consistent with no review and semantically related review scores. Mean comparisons are based on *Target Word Knowledge* composites that were derived by summing scores on definition and neutral context questions. Therefore, performance in the no review, average review, embedded review, and semantically related review conditions is based on a maximum score of 48.

embedded review and target words taught using semantically related review, and what, if any, is the magnitude of difference? To answer the first part of this question, posttest performance on the embedded review and semantically related review TWK composites were compared using a paired-samples *t* test. The mean embedded review composite score was 18.96 out of 48 (*SD* = 13.19), and the mean semantically related review composite score was 23.98 out of 48 (*SD* = 15.50). A statistically significant difference was found, $t(79) = 6.54$, $p < .001$, indicating that students learned more target words in the semantically related review condition than in the embedded review condition. A *d* value of 0.35 was obtained, suggesting a small to moderate effect. A compilation of review effect sizes is presented in Table 5.

Instructional Efficiency

Instructional time is a critical aspect of instructional design specificity and an important consideration when assessing the efficiency of instruction. To more fully explore the relationship between the effectiveness and efficiency of instruction, the average amount of time spent directly teaching a target word was obtained for each of the three instructional conditions. Estimates of average instructional time per word were based on time intervals recorded during 20 fidelity observations and a video recording of a teacher delivering intervention. Target words in the no review condition received approximately 10 min 36 s of explicit instruction per word during two storybook readings (i.e., word definitions and insertion into anchor sentences) and two extension activities. Target words in the embedded review condition received approximately 13 min 13 s of explicit instruction per word. Thus, embedded review added 2 min 37 s of instructional time per word over and above the time used to deliver traditional extended vocabulary instruction in the no review condition. Each target word in the semantically related review condition received approximately 20 min 29 s of explicit instruction. This represented an additional 9 min 53 s of instructional time for each word in the semantically related review condition over and above extended vocabulary instruction provided in the no review condition.

An *instructional efficiency index* was derived for each condition by dividing mean performance on the TWK composite by estimates of total minutes of explicit instruction per word, yielding a measure of word learning as a function of instructional time. The instructional efficiency index was 1.04 for the no review condition, 1.43 for the embedded review condition, and 1.17 for the semantically related review condition. These values indicate that instruction was more efficient in both systematic review conditions than in the no review condition and that embedded review was more efficient than semantically related review.

Growth of General Vocabulary Knowledge

Experimenter-developed measures are sensitive to target word learning (NRP, 2000) but rarely designed to capture growth in children's overall vocabulary knowledge. Given the high levels of target word knowledge demonstrated at posttest by kindergarteners in this study as well as the relatively long duration of the intervention (36 lessons delivered over 18 school weeks), two secondary analyses were conducted to investigate potential changes in students' overall vocabulary knowledge between pretest and posttest. Paired-samples *t* tests were used to analyze changes in students' general vocabulary knowledge, as measured by standard scores on the PPVT-III (Dunn & Dunn, 1997) and the EOW-PVT (Academic Therapy Publications, 2000). The inclusion of these analyses is consistent with a recommendation by Gersten et al. (2006) that intervention studies include both measures that are closely aligned with instruction and broad measures that assess students' ability to transfer skills.

The mean PPVT-III standard score at pretest was 94.28 (*SD* = 16.96), with a range from 40 to 129. The posttest mean was 98.99 (*SD* = 13.96), revealing a gain of 4.71 in children's average standard score. A statistically significant increase was found from pre- to posttest, using a paired-samples *t* test, $t(74) = 4.07$, $p < .001$, indicating improved performance on

this global, norm-referenced measure of receptive vocabulary. An effect size comparing dependent means was computed using pooled standard deviations (Grissom & Kim, 2005), and the *d* value of 0.30 suggested a small effect size. In terms of percentile rankings on the PPVT-III, students moved from an average percentile rank between 34 and 37 at pretest to an average percentile rank of 47 at posttest.

The mean EOWPVT standard score at pretest was 87.13 (*SD* = 16.12), with a range from 55 to 142. The posttest mean was 87.16 (*SD* = 16.22), and no statistically significant difference was found between pre- and posttest scores on the EOWPVT, $t(76) = 1.79$, $p > .05$, $d = 00$.

Collectively, these findings indicate that children receiving extended vocabulary instruction with a component of systematic review demonstrated significant growth on a standardized measure of general receptive, but not expressive, vocabulary knowledge. These findings are consistent with findings from a larger efficacy study that used a between-subjects methodology to examine transfer effects (Coyne, McCoach, Zipoli, et al., 2007).

Discussion

The purpose of this study was to investigate whether an extended approach to vocabulary instruction, which had previously been validated with kindergarten students from populations at risk for reading difficulties (Coyne , McCoach, & Kapp, 2007; Coyne, Simmons, Kame'enui, et al., 2004), might be made more efficacious by integrating systematic and distributed word review. A second purpose was to directly compare the effectiveness and efficiency of two approaches to systematic review, embedded review and semantically related review, in promoting word learning among kindergarteners in high-need urban schools.

Systematic Word Review

The first research question addressed the overall effect of systematic review on word learning and the potential magnitude of difference between words instructed with and without review. Students' average review performance, or average word learning across the embedded and semantically related review TWK composites, was compared to their performance on the no review TWK composite. The finding of a statistically significant difference favoring systematic word review (i.e., average review) is not surprising in light of two recent studies indicating that review appears to enhance target word learning by early primary students (Beck & McKeown, 2007; Biemiller & Boote, 2006). However, the large magnitude of difference in word learning between words receiving systematic review and words receiving no systematic review ($d = 0.88$) is notable, particularly given the challenging expressive format used in the TWK measure. In terms of absolute levels of word learning, students performed almost twice as well on the TWK composite when words received systematic review (21.47 out of 48) than when words received no systematic review (10.99 out of 48). Therefore, judicious word review resulted in a substantial and educationally meaningful payoff.

It should be noted that words in the no review condition were taught using a research-validated method of extended vocabulary instruction that was found to result in large effect sizes when compared to incidental word learning (*d* ranging from 0.91 to 2.57) during storybook readings (Coyne et al., 2006). Specifically, target words in the no review condition were defined and inserted back into an anchor sentence during two readings of a storybook; the target words were then discussed in depth during extension activities following these two storybook readings. The finding that systematic word review resulted in a large effect size in comparison to an already robust method of vocabulary instruction highlights the importance of strategically integrating systematic, distributed word review as an instructional feature when designing vocabulary interventions for early primary students from populations at risk for reading difficulties.

Two Approaches to Word Review

Effectiveness of the two approaches to systematic word review. The second research question addressed potential differences in target word learning in the embedded review and semantically related review conditions. No studies were found that directly compared two different approaches to systematic word review during a vocabulary intervention with early primary students, and it was hypothesized that semantically related review would result in higher levels of target word learning. Consistent with this prediction, a statistically significant difference was found favoring words taught in the semantically related review condition, with a small to moderate effect size ($d = 0.35$).

Three closely related instructional design features differed markedly between the embedded and semantically related review conditions and may have contributed to the higher level of word learning in the semantically related review condition. These features are depth of instruction, instructional time, and semantic relatedness. Semantically related review involved continued interactions with target word meanings during ongoing extension activities that were designed to promote deep processing. In contrast, words in the embedded review condition were defined only during storybook readings, and minimal student responses were solicited, aside from repetition of target words. Semantically related review afforded ample time to participate in discussions of word meanings and structured discrimination and generalization tasks, whereas embedded review

involved only brief exposures to word definitions and anchor sentences. Finally, semantically related review was specifically designed to make critical semantic features of target words and a large number of word associations explicit to students.

A primary role of applied intervention research is to examine questions of external validity rather than to analyze the components of an intervention or probe underlying processes that may account for its effectiveness (Whitehurst et al., 1994). Consistent with this premise, the semantically related review condition in this study was designed to integrate and optimize several instructional features, but the relative contribution of each of these features could not be "teased out" for quantitative analysis. An important aspect of replication studies, however, is to determine the essential components of complex instructional practices (Gersten et al., 2006). Thus, future experimental research on semantically related review should include component analyses of instructional depth, instructional time, and semantic relatedness. Findings from this research could be used to further inform the instructional design specificity of extended instruction with systematic word review.

Efficiency of the two approaches to systematic word review. Embedded review added approximately 2.5 min of instruction to the 10.5 min of extended instruction provided per word in the no review condition. This appears to be a modest increase in instructional time, particularly given the magnitude of difference in word learning ($d = 0.69$) between the embedded review and no review conditions. In contrast, semantically related review added almost 10 min of instruction over and above the 10.5 min of extended instruction provided per word in the no review condition. Although this was a substantial investment of instructional time, semantically related review resulted in an impressively large magnitude of difference ($d = 1.03$) in comparison to word learning in the no review condition.

To quantitatively analyze the efficiency of each condition, instructional efficiency indexes were calculated, measuring word learning as a function of instructional time. Inspection of these data reveals two noteworthy findings. First, both approaches to systematic word review were more efficient than extended instruction without review. Importantly, this finding supports the added investment of instructional time needed for systematic word review. The second finding is that a higher instructional efficiency index was obtained for embedded review (1.43) than for semantically related review (1.17), indicating that embedded review was indeed the more efficient approach to systematic and distributed word review.

Implications of Systematic Review Findings for Teaching and Instructional Design

Simultaneous inspection of effect sizes and instructional efficiency indexes reveals a relative trade-off between effectiveness and efficiency when comparing the semantically related and embedded review conditions. Semantically related review was more time intensive but yielded a higher absolute level of target word learning and a large effect size. However, embedded review was a highly time-efficient approach that resulted in a moderate effect size.

This trade-off has practical implications for educators and interventionists engaged in vocabulary instruction or curricular design. Embedded review, for example, might be easily integrated into the design of storybooks or texts used for early reading instruction. A given vocabulary word could be embedded into a series of books and presented to students in a predetermined sequence. This would allow for systematic word review at regular intervals with minimal time for lesson preparation and instructional delivery, thus optimizing instructional efficiency. The efficiency of embedded review might also be appealing to teachers and interventionists when time for extended vocabulary instruction is limited by practical considerations, such as competing curricular demands and half-day kindergarten classes.

Using a different approach, semantically related review might be strategically incorporated into ongoing extension activities, particularly with children who appear most at risk for language and literacy difficulties. Notably, Alt, Plante, and Creusere (2004) found that children with language impairments had trouble recognizing semantic features, and Paul (2001) observed that children with language difficulties may exhibit delays in their ability to develop word associations and categorize words into semantic classes. The relatively in-depth and explicit nature of semantically related review would allow for increased emphasis on semantic features and associations with these at-risk students.

Finally, children might benefit from the application of both approaches to systematic word review, balancing the efficiency of embedded review with the intensive instruction afforded by semantically related review. The intervention implemented in this study, in which one third of target words received embedded review and one third of target words received semantically related review, represents such a combined approach to systematic review. Alternately, a taught word might initially be reviewed during extension activities with an emphasis on semantic features and associations, allowing children to elaborate initial word representations. Embedded review might then be distributed throughout the later phases of review cycles to maintain students' word knowledge.

Growth of General Vocabulary Knowledge

A statistically significant gain was found in children's general receptive vocabulary knowledge. This cohort increased from an average pretest PPVT-III standard score of 94.28 to an average posttest standard score of 98.99. Stated differently, these kindergarteners moved from an average percentile

rank between 34 and 37 at the beginning of the study to an average percentile rank of 47 following the 18-week intervention. This growth in standard scores is unlikely to reflect typical maturation; pretest to posttest growth in standard scores indicates that skills have grown at a faster rate than average in comparison to a normative sample, revealing that instruction is "closing the gap" (Torgesen, Rashotte, Alexander, Alexander, & MacPhee, 2003; p. 281). The finding of growth in children's general vocabulary knowledge is also consistent with findings from a larger efficacy study employing a between-subjects methodology (Coyne, McCoach, Zipoli, et al., 2007). Results from the efficacy study indicated that children receiving 18 weeks of extended vocabulary instruction with a component of systematic word review demonstrated significantly higher PPVT-III standard scores in comparison to a control group that had not received vocabulary instruction.

Implications of Generalized Vocabulary Growth for Teaching and Instructional Design

As previously noted, researchers have documented the early emergence of a vocabulary gap among children from low SES backgrounds (Hart & Risley, 1995), a tendency for disparities in word knowledge to persist through the primary grades (Biemiller & Slonim, 2001), and a positive relationship between vocabulary knowledge and reading comprehension (Stahl & Fairbanks, 1986). Moreover, general risk factors for reading difficulty include living in a family receiving welfare or whose primary language is other than English (U.S. Department of Education, National Center for Education Statistics, 2001, cited in Silliman & Wilkinson, 2004).

The kindergarten students in this study were predominantly from low-income families, and a high proportion were from homes in which English was not the primary language. In addition, all participants were from schools with a recent history of low reading scores on statewide assessments. Therefore, the finding that these children demonstrated significant improvement on a broad measure of receptive vocabulary following a circumscribed period of intervention is interesting and encouraging, and has two important implications. First, it appears plausible that implementation of an intervention program strategically integrating extended vocabulary instruction with judicious word review might help to reduce disparities in young children's word knowledge. This approach might be particularly valuable if intensive vocabulary instruction were formally integrated into kindergarten curricula and sustained throughout the school year.

A second implication of growth in PPVT-III standard scores pertains to the amount of instructional time needed for extended vocabulary instruction. Extended instruction provides in-depth teaching through discussions of word meanings (e.g., Beck & McKeown, 2007), and this method appears to result in comparatively full and complete word knowledge (Coyne, McCoach, & Kapp, 2007). However, advocates of an embedded approach to vocabulary instruction have questioned whether the additional time required for extended instruction is justified (e.g., Biemiller & Boote, 2006).

Findings from this investigation appear to support the additional investment of time needed for extended instruction. An 18-week vocabulary intervention program, consisting of extended instruction with a high proportion of words receiving systematic review, resulted in a significant degree of generalized word learning on a norm-referenced measure of receptive vocabulary. This finding is unlikely to be directly accounted for by target word learning because none of the 56 target words taught during the intervention appeared on the PPVT-III.

A more plausible explanation for generalized word learning is development or enhancement of word consciousness. Word consciousness is a metalinguistic awareness of words that includes interest in word meanings, morphological and syntactic awareness, knowledge and beliefs about word learning, and awareness of differences between oral and written language (Scott & Nagy, 2004). Because the vast number of words in the English language makes it impractical to provide direct instruction on the meanings of all important words, Anderson and Nagy (1992) asserted that the development of word consciousness should be a primary goal of vocabulary instruction. On a related note, Blachowicz and Fisher (2004) suggested that word play emphasizing semantic "relatedness in rehearsal and practice" (p. 224) helps students to develop an increased awareness of words. Interestingly, interventionists in this study reported that children were more likely to recognize unfamiliar words and ask about their meanings as the intervention progressed. This pattern was also corroborated on the fidelity rating form, with research team members commenting on children's increased inquiries regarding the meanings of nontarget words.

Further research is needed to examine the role of word consciousness and elucidate mechanisms that might account for broad, generalized word learning. Nonetheless, the results of this study suggest that several months of extended instruction with systematic word review might have primed kindergarten students from high-need schools for incidental learning of words that did not receive direct, explicit instruction. The "value added" finding of generalized word learning suggests that the additional instructional time needed for extended vocabulary instruction might indeed be warranted.

Conclusion

This research study contributes to the emerging body of evidence on scientifically based vocabulary intervention for early primary students from populations with risk factors for literacy difficulties. The results indicate that kindergarten students from high-need urban schools might demonstrate

educationally meaningful gains in target word knowledge when systematic word review is strategically integrated into a program of extended vocabulary instruction. A comparison of two approaches to systematic review reveals a relative trade-off between instructional effectiveness and efficiency. Semantically related review might be used to promote high levels of word learning, but embedded review appears to be a more efficient approach to word review. Extended vocabulary instruction with a component of systematic word review might also stimulate generalized gains in children's receptive vocabulary. Findings from this study may be used to inform the instructional design of vocabulary intervention programs implemented in schools serving a high proportion of kindergarten students from low SES backgrounds.

Authors' Note

Findings from this study were submitted to the University of Connecticut by the first author in partial fulfillment of the requirements for a PhD in special education in the Department of Educational Psychology. A paper summarizing this study was presented at the 2007 annual meeting of the American Educational Research Association. Findings from a larger efficacy study were presented at the 2007 Institute of Educational Sciences Research Conference, and a manuscript reporting on the related efficacy study is in preparation.

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