The Self-Teaching Hypothesis As It Pertains to Learning Vocabulary From Written Context

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The ability to learn new words is central to success in reading and to academic achievement (Beck & McKeown, 1999). The strength of the relationship between vocabulary knowledge and reading proficiency has long been recognized and is well documented (National Reading Panel, 2000). Children's vocabularies increase rapidly during their school years: On average, children add approximately 1000 new root words to their meaning vocabularies each year (Biemiller & Slonim, 2001). However, the difference between school-entry vocabularies of the lowest and highest quartiles is great, and the gap persists as children progress through school (Biemiller & Slonim; Chall, Jacobs, & Baldwin, 1990). One factor contributing to this variation is the well-documented disparity between vocabularies of advantaged and disadvantaged populations (Hart & Risley, 1995; Snow, Burns, & Griffin, 1998). Thus, there is a clear need for better methods of building students' vocabularies in school. The purpose of the present study was to explore the procedure of having students orally pronounce unknown words encountered during otherwise silent reading to determine whether this contributes to their learning of new vocabulary words.

Word knowledge can be conceptualized as falling along a continuum, from no knowledge (i.e. never encountered it before), to having a general sense (i.e. may have heard it, but doesn't know what it means), to having knowledge but not being able to access it easily (i.e. being able to recognize its meaning in context), to having rich, decontextualized knowledge of a word's meaning (i.e. being able to use it and recognize its relationship to other words) (Beck & McKeown, 1991; Beck, McKeown, & Omanson, 1987; Henriksen, 1999). Word knowledge involves multiple identities and dimensions (Nagy & Scott, 2000): a phonological identity including constituent phonemes and how the word is pronounced, one or more syntactic identities specifying the word's form class and function in sentences; one or more semantic identities or meanings of the word in various contexts, and an orthographic identity or the word's spelling. This knowledge may also include morphological information distinguishing roots and affixes or compound parts of multi-morphemic words. Although there are multiple dimensions to vocabulary knowledge, its essence involves remembering the pronunciations of words and their meanings.

Vocabulary learning through written context

Many researchers of vocabulary acquisition (e.g. Cunningham, 2005; Graves, 2006; Nagy, Anderson, & Herman, 1987; Sternberg, 1987) have argued that most vocabulary is learned from written context, and that vocabulary instruction should concentrate on helping children become more proficient at independently learning meanings of words encountered during reading. Researchers have pointed out that only about 5-15% of new vocabulary encountered during reading is learned well enough to be correctly identified on a multiple choice test (Nagy et. al.; Swanborn & deGlopper, 1999). However, given the volume of reading students do, this can still result in the learning of a large number of words from context (Graves, 2006).

There are a number of recent books on vocabulary instruction (Baumann & Kame'enui, 2004; Beck, McKeown, & Kucan, 2002; Graves, 2006; Hiebert & Kamil, 2005), which include descriptions of how to help children use written context to figure out words' meanings. Often, the method described is to skip the unknown word, attempt to infer the word's meaning using local and global context, and substitute a guess or known synonym in order to make sense of what is being read (Graves, 2006). While this is good advice for inferring word meanings, this strategy won't likely lead to the acquisition of new vocabulary items. Vocabulary learning is not only a matter of inferring meanings, but also involves associating new, unfamiliar terms with their definitions, and remembering these new words (Pressley, Levin & McDaniel, 1987). In order for a new term to be learned, the reader must commit to memory phonological and/or orthographic representation of the word adequate to at least recognize the word when it is reencountered. Pronunciations and/or spellings must be fairly secure in order for the learner to be able to produce the word orally or in writing.

Studies on incidental word learning have included the examination of word properties that ease or obstruct inferring words' meanings. For example, word difficulty, or whether or not the learner already knows the concept with which the unknown word is associated, affects word learning from context (Nagy et. al., Shu, Anderson, & Zhang, 1995). Morphological transparency of words affects learning for students reading in a context-dependent language such as Chinese (Shu et. al.). Nagy et. al. examined the effects of word length (number of syllables) and part of speech, but found no effect of these variables on word learning as measured by a multiple choice task. It is important to note that multiple choice items can be answered correctly with only partial word knowledge. It is not likely that inferring meaning from context leads to knowing a word well enough to produce its pronunciation (Kameenui, Dixon, & Carnine, 1987). While meaning is at the heart of vocabulary learning, so too is the learning of the new, unfamiliar term. The current study was conducted to examine if strengthening phonological representations through target word decoding could help fifth graders learn the new terms as well as infer their meanings.

It is widely agreed that individual differences vary when it comes to actually adding vocabulary through reading (Stanovich, 1986). For example, a student scoring in the 90th percentile on standardized reading tests generally has about 200 times more exposure to written language than the 10th percentile student (Nagy et al., 1987). Discrepancies have also been found between the reading volume of advantaged compared to disadvantaged populations (Chall, Jacobs, & Baldwin, 1990). Volume of reading is thought to contribute directly to "Matthew effects" in reading (Stanovich, 1986). The term Matthew effects describes how the rich-get-richer and the poor-get-poorer in reading acquisition. If most vocabulary is learned from context, students who spend more time reading will add vocabulary faster than those who read less, thereby widening the gap between their vocabularies. Although direct evidence for Matthew effects in vocabulary acquisition has been weak or nonexistent (i.e. Scarborough & Parker, 2003), that early vocabulary gaps between students tend to persist over time is a relatively undisputed claim (Biemiller & Slonim, 2001).

In addition to differences in exposure to written language between very good and very poor readers is a question of what readers do with opportunities to learn new words. As Share (1995) points out, the quantity and quality of print exposure matters, but so too does the inclination and ability to exploit opportunities to learn new words from reading. Several capabilities have been identified as sources of individual differences in learning new words from written context. General verbal ability (Sternberg, 1987), reader background knowledge (Pulido, 2004), vocabulary knowledge (Robbins & Ehri, 1994; Penno, Wilkinson, & Moore 2002), and inference making ability (Cain, Oakhill, & Elbro, 2003) have all been shown to affect children's ability to learn word meanings during reading, as measured by multiple-choice tests.

Word reading and decoding ability are thought to determine the likelihood that students will attempt to decode unknown words during reading (Tunmer & Chapman, 2002). Studies of oral reading have shown that poor decoders are far more likely to guess novel words using surrounding contextual cues (Juel, 1980). While this might allow a reader to glean sufficient information about the word's meaning to understand a passage, it certainly won't support learning of new phonological strings. Research by Ehri and colleagues (Ehri & Roberts, 1979;

Ehri& Wilce, 1980) provides some evidence for the claim that readers are more likely to attend to meanings, rather than written form, of words encountered in context. When contextual support is not available, as in when reading words in lists, readers attend more closely to, and better remember, words' spellings.

The act of phonological recoding of novel printed letter strings into their spoken forms allows for the amalgamation of phonological and orthographic representations in memory leading to proficient word recognition (Ehri, 1992, 2005). Contextual guessing, on the other hand, is not likely to contribute to printed word learning. Low frequency words, those that are least likely to be familiar, are the least guessable, since these tend to be the content words that carry most of the meaning of a text. The average predictability of content words is less than 10% compared to 40% for function words (Tunmer & Chapman, 2002). A child might use contextual information to make a plausible guess, which might help with immediate text comprehension, but this will not develop the child's reading vocabulary, as guesses are too often orthographically incorrect. This is especially true for the English language, due to the language's extraordinary number of synonyms and near synonyms. When discussing the incidental learning of new vocabulary words through reading, words as yet unknown orally, the inadequacy of contextual guessing becomes all the more clear.

Self-Teaching Hypothesis

According to the self-teaching hypothesis (Share, 1995) the act of decoding new words allows a learner to independently acquire word-specific orthographic information necessary for automatic word recognition. Attempts to decode unfamiliar words require readers to attend carefully to the internal structure of words, providing opportunities for the establishment of functional orthographic representations. Attempts to decode unfamiliar words require readers to attend carefully to the internal structure of words, providing opportunities to form connections between words' spellings, pronunciations, and if available, meanings (Ehri & Rosenthal, 2007; Rosenthal & Ehri, 2008). By applying letter-sound knowledge, a reader matches plausible pronunciations with words known orally; one or more successful encounters with the word allows the reader to add that word to his orthographic lexicon.

There is a growing body of research examining the self-teaching model. Studies span a number of languages including those with shallow orthographies such as Hebrew (Share, 1999) and Dutch (Reitsma, 1983; deJong & Share, 2007) as well as the less transparent English orthography (Bowey & Muller, 2005; Cunningham, 2006; Cunningham, Perry, Stanovich, & Share, 2002; Nation, Angell, & Castles, 2007). Many studies use a paradigm similar to that used by Share (1999) in which children read a text embedded with novel (generally pseudo) words. The bulk of this work has examined children's self-teaching through oral reading of texts; however, an issue central to Share's (1995) self-teaching hypothesis is that children engage in phonological recoding during *independent* reading, thereby building their orthographic lexicons on an ongoing basis. Asking children to read aloud for an adult might not simulate typical independent reading. When reading independently, children might skip over, or guess unfamiliar words (Share, 1999) whereas during oral reading, children are effectively obliged to attempt to read all words (Bowey & Muller, 2005).

Bowey and Muller (2005) examined orthographic self-teaching in third graders during silent reading. They found evidence of orthographic learning and concluded that participants must have engaged in phonological recoding of target nonwords within independent reading. It should be noted, however, that participants in this study were middle class, with average to above average reading ability. Target words were all single syllable, four letter words, with a singleton onset and a three-letter orthographic rime, each with a one vowel digraph. All grapheme–phoneme mappings were by far the most typical for each grapheme (Bowey & Muller, 2005). DeJong and Share (2007) compared orthographic learning through oral versus silent reading by native Dutch speaking third graders. Although children's decoding ability was not examined in this study, Dutch is a transparent orthography, words were all one-syllable, "simple pseudowords" and were easily decoded, with 89% accuracy. It is likely, therefore, that the words in these studies did not appear extremely challenging, were spelled similarly to known words, and children spontaneously attempted to decode them during silent reading. It is not clear that a similar level of orthographic learning would have been evident had words been multisyllabic or less regularly spelled.

Interestingly, studies of the impact of phonological recoding on orthographic self-teaching have only examined orthographic learning as measured by orthographic choice tasks, target word reading latencies, and target word spelling tests. No study to date has examined if having children attend to the internal structure of words in text sufficient to allow decoding helps students learn new vocabulary terms during reading.

In the current study, children read passages silently, except that students in the experimental condition were instructed to read target words orally when they came to them in text. Words were multisyllabic, concrete nouns. Participants were fifth graders with a range of reading abilities; many were not native English speakers. One question that this study sought to explore is if instructing urban fifth grade students with a wide range of reading abilities to orally decode unknown words encountered in context would enhance their learning of these vocabulary terms (Experiment 1). A second purpose of this study was to discover the strategies that students report using to identify new words during reading (Experiment 2). While many vocabulary researchers propose that most vocabulary is learned through reading (i.e. Sternberg, 1987), readers are likely to use context to infer word meanings and guess at words, rather than to attend to the structure of unknown words (Clay, 1993). Contextual guessing is not likely to lead to printed word learning, whereas phonological recoding is (Share, 1995).

EXPERIMENT 1: VOCABULARY LEARNING BY FIFTH GRADERS

Method

Participants

The participants were 62 fifth graders from three classrooms in a large public school serving a low-income population in a medium-size city in the Northeast; 89% of students qualified for free (76%) or reduced (13%) lunch. All children who returned permission slips were invited to participate: Students were not excluded from the study based on English language proficiency or handicapped status. Seventy-one percent of the participants spoke a language other than English at home. There were 32 males and 30 females, of whom 41 were Latin American, 17 were African American, and 4 were Arab American with a mean chronological age of 10 years, 7 months (range 9 years, 8 months – 11 years, 9 months), tested in the spring.

Materials and Procedure

Literacy Assessments. Several tests were administered to assess students' literacy skills. These assessments were administered individually prior to training; students were matched into pairs based on their word-reading scores. Members of pairs were then randomly assigned to either an "oral pronunciation" or "lexical decision" condition.

1. *Reading Words*. Graded lists of words on the subtest of the Woodcock Reading Mastery Test-Revised (WRMT-R) (Woodcock, 1987) were given to assess students' word reading level. Reliability is reported to be .98.

2. *Phonological decoding*. The Word Attack subtest of the Woodcock Reading Mastery Test-Revised (WRMT-R) (Woodcock, 1987) served as a measure of phonological decoding. In this test, children read a list of pseudowords of increasing difficulty. This test has an average reliability coefficient of .87.

3. *Ganske Spelling Inventory* (Ganske, 2000). Twenty progressively more difficult words were pronounced and embedded in a sentence. Children repeated the words and wrote them. The task was terminated if fewer than two words in a set of 5 were correct. Scored was the number correctly spelled. The split-half reliability was .88.

4. *Vocabulary.* The Expressive Vocabulary Test (EVT) (AUTHOR) was administered to test students' expressive vocabulary. Reliability is reported to be xx.

Vocabulary Learning – Targets and Texts. A total of eight decodable, extremely low frequency, concrete nouns were selected as target words. These words were selected from among 20 words utilized in Rosenthal and Ehri (in press). It was unlikely that students knew the words: Teachers judged that their students would not know them. Most of the words proved unfamiliar to a sample of graduate students. Also, the words were rated as occurring less than four times per million words (Thorndike & Lorge, 1972). Words and meanings appear in Table 1.

Eight short expository texts were composed in which a target appeared three times, and was underlined. Texts ranged in length from 92 to 107 words (mean length 101). Word meanings were made explicit in each story, although the words were not defined directly. Estimated grade level of passages averaged 5.1 using Flesch-Kincaid grade level formula.

The basic testing procedure for text reading sessions involved the reading of four passages, followed by tests of word learning. After a one-week interval, students were again tested on their memory for words, spellings and meanings. They then read the remaining four texts, and were tested on word learning. One week later, they were tested on their memory for words from the second set of texts.

In the first text-reading session, the task was explained along with an example. Students were told to read the passage silently to themselves, as they normally would. They were shown that some words in the passage were underlined. Students in the oral pronunciation group were told to read underlined words out loud when they came to them. A researcher recorded children's target word reading. Students in the lexical decision group were told that when they came to the underlined words in the passage, they should use a pencil to put a check mark next to words they had seen before. No assistance was given during reading. If a child sought help identifying a word, they were asked to try to read it by themselves.

Following reading of each passage, children were asked to say what the passage was mostly about, and their responses were recorded. Responses were rated on a 3 point scale, with one point given for the main idea, and one point given for each of two central details (adapted from Moss, 2004). Some passages contained more than two important details; students were given up to two points for identifying any two of the central details. Responses were scored independently by two graduate students; interrater reliability was calculated to be .91. Internal consistency on this task was .85. Comprehension scores across all 8 passages averaged 1.53, with a minimum of 91% of students recalling at least the main idea or at least one detail on each of the passages. Thus, most children understood the basic content of the passages they read.

Posttests of Word Learning. Memory for the newly learned words was tested immediately following reading of all four passages, and after a one-week delay, using three experimenter-devised tasks administered in the following order: In the *synonym-prompted word recall task*, students were asked to say a new word for its more common synonym: “From the passages you just read, what is another word for an elephant’s tusks?” Internal consistency on this task was .65. In the *spelling production task*, students heard each word and they wrote its spelling. The experimenter said each word twice, and instructed the child to spell the word as best as they were able. Internal consistency on this task was .63. In the *multiple-choice task*, students were given a written test and asked to circle the best meaning for each of the four target words. Foils consisted of meanings of the other seven target words. Internal consistency on this task was .67.

All testing was conducted with individual children during four sessions each lasting about 30 minutes. First, children were administered the tests of literacy skills. On Day 2 they read one set of passages, and were tested on their learning of Set 1 target words. On Day 3, they were retested on Set 1 target words, they read the second set of passages, and were tested on their learning of Set 2 target words. On Day 4, they were retested on Set 2 target words. Testing was conducted in the spring.

Design

This study utilized a matched pair, random assignment design (Campbell & Stanley, 1963). Participants were matched into pairs based on their scores on the word identification subtest of the WRMT-R. Members of pairs were randomly assigned to either the “oral pronunciation" or "lexical decision" reading group. Repeated measures ANOVAs were used to analyze the effect of oral word decoding on word learning; reading condition was the repeated measure and each of the post tests, immediate and delayed, were the dependent variables.

Results

Performance on the Woodcock WRMT-R word identification subtest revealed that there was a good deal of variance in fifth graders' word reading ability, with a range of 47-85 words read, M=67. On average, fifth graders were reading one year below grade level, M = 4.5 grade equivalent score (SD = 1.31). This variability provided the basis for dividing students by orthographic knowledge into a lower-level group (N=30) reading 67 or fewer words and a higher-level (N=32) group reading 68 or more words. Characteristics and mean performance of the groups on the other tests are reported in Table 2. Independent-samples t-tests revealed that the groups differed significantly in expressive vocabulary which was below the national average, and they clearly differed in their nonword decoding and spelling skills. These findings show that higher and lower level readers differed in their knowledge of the orthographic system as well as their expressive vocabulary knowledge.

Vocabulary Learning

Performance on vocabulary learning posttests was examined using repeated measures ANOVAs. The independent variables were reading condition (oral pronunciation vs. lexical decision) and reader level (higher vs. lower). The former was a repeated measure. The dependent variables were the scores on each of the posttests, immediate and delayed. Mean performance and test statistics are reported in Table 3. Spellings were scored according to whole-word and per-letter criteria, similar to Share (1999). In the whole-word analysis, only completely correct reproductions were accepted as accurate. In the per-letter scoring, letters that had homophonic alternatives, including homophonic consonants, and schwa, r-controlled, and l-controlled vowels were scored. Any other missing, added, or substituted letters were ignored.

In the ANOVA of the immediate synonym-prompted word recall posttests, significant main effects of condition and reader level were detected. Means in Table 3 reveal that word learning was superior in the oral pronunciation condition. Higher-level readers outperformed lower-level readers. The advantage provided by orally pronouncing words was stronger for lower-level readers than for higher-level readers, although the interaction was not significant, indicating that decoding words aided word recall regardless of reader level. In the ANOVA of the delayed word-production posttest, the effects of reading condition and reader level diminished to non-significant levels, although performance by higher-level readers continued to favor the oral pronunciation condition. These findings show that having students orally decode unknown words during otherwise silent reading exerted a strong effect on their learning of new vocabulary words encountered in written context.

In the ANOVA of immediate target word spelling using the whole word criteria, significant main effects of condition and reader level were detected. Means in Table 3 reveal that word learning was superior in the oral pronunciation condition. Higher-level readers outperformed lower-level readers. The advantage provided by orally pronouncing words was stronger for lower-level readers than for higher-level readers, although the interaction was not significant. The main effects of condition and reader level persisted after a one-week delay. The pattern was similar for the analysis of immediate spellings scored on per-letter criteria, with oral pronunciation of words exerting a powerful effect on learning of word spellings. This effect was evident for lower-level as well as higher-level readers and persisted after a one-week delay. The effect of reader-level on memory for word spellings scored on a per-letter basis persisted after a one-week delay. Based on Cohen's (1988) rule of thumb, (i.e., 0.20 is a small effect, 0.50 is a moderate effect, and 0.80 is a large effect), effect sizes ranged from moderate to large. These findings show that having students orally pronounce novel vocabulary words while reading text exerted a powerful impact on their memory for the spelling of new vocabulary words.

Posttests also assessed students' receptive knowledge of vocabulary meanings. No mean effect of condition or reader level was detected in this analysis. Performance of both higher and lower level readers was quite high on this task during immediate and delayed testing, with means ranging from 74% to 88% regardless of whether words had been pronounced or not. Inferring and remembering the meanings of words was much easier than recalling the pronunciations and spellings of words.

Predictors of Vocabulary Learning

Research has shown a relationship between word reading ability and printed vocabulary learning (Rosenthal & Ehri, in press) as well as prior vocabulary knowledge and vocabulary acquisition (Robbins & Ehri, 1994). The self-teaching hypothesis (Share, 1995, 1999) states that readers must have adequate alphabetic knowledge in order to self-teach orthographic information. Also, decoding skill (Nation, Angell & Castles, 2007) and prior orthographic knowledge (Cunningham, 2006) have been shown to predict orthographic learning in previous studies. In the present study, children varied widely in their expressive vocabulary knowledge, word reading, non-word decoding, and spelling ability. In order to assess relationships between vocabulary learning and children's expressive vocabulary and printed language knowledge, Pearson product-moment correlation coefficients were calculated. Scores on immediate and delayed posttests were correlated with scores on the various measures of printed language and vocabulary knowledge. Results, presented in Table 4, reveal significant correlations between all measures of printed language knowledge. In contrast, expressive vocabulary scores did not correlate with any of the measures of printed language ability. The relationships between scores on printed language measures and immediate posttests of synonym-prompted word recall and immediate and delayed posttests of spelling are strong, as expected. In contrast, EVT expressive vocabulary scores did not correlate significantly with any of the word learning measures. Scores on the multiple choice posttests did not correlate significantly with any of the literacy measures, although this may have been due to ceiling effects on the multiple choice tasks. Correlations between the immediate posttests of synonym-prompted word recall and spelling were quite strong. Similarly, the relationship between accurate delayed posttest spelling and delayed synonym-prompted word recall was significant. This indicates that memory for words' spellings boosted memory for the vocabulary words.

Identification of Target Words

According to the self-teaching hypothesis (Share, 1995, 1999) accurate word decoding is a prerequisite for orthographic self-teaching to take place. All students in the oral pronunciation group attempted to sound out every target word; there were no instances of students skipping the words or saying that they "did not know". Some students struggled with several of the words, reading them by syllables, or perseverating on the initial sounds. Overall decoding accuracy of target words was 58.5% (SD 24; range, 4-96). Thus, there was a good deal of variability in target word reading accuracy.

Students in the lexical decision group were asked to put a checkmark next to target words that they had seen before. Since all of the words were extremely low frequency, and participants in this study had below average expressive vocabularies, it was not expected that students would be familiar with any of the target words. However, five students checked off all of the words, six checked off over half of the words, ten checked off fewer than half, and only eleven students indicated that they had not seen any of the words before.

In order to assess the unique contribution made by accurate word reading to vocabulary learning by students in the oral pronunciation group, several hierarchical regression analyses were conducted. Several measures were entered as predictors of performance. These included scores on the word reading, non-word decoding, and spelling pretests, and number of target words decoded correctly during passage reading. Due to non-significant correlations between expressive vocabulary and word learning, this variable was excluded from the analyses. The dependent variables were the group's scores on the immediate synonym-prompted word recall and spelling posttests, and delayed spelling test. Spellings scored by whole word as well as by per-letter criteria were examined. Due to non-significant correlations between predictor variables and the multiple-choice posttests, this posttest was not analyzed.

In initial analyses, scores on the word reading, non-word decoding and spelling tasks were entered first. As evident in Table 5, these variables explained no significant variance on the synonym-prompted word recall task. They explained significant variance on the immediate, but not the delayed, spelling posttest scored by whole word and by per-letter criteria. Target word decoding accuracy was entered next. As evident in Table 5, this variable explained significant variance in all of the analyses. From these findings, we conclude accurate target word decoding was the best predictor of vocabulary and orthographic learning for students in the oral pronunciation group. To verify this, an additional set of regressions was conducted. This time, target word decoding was entered first in each of the regressions. Scores on the word reading, non-word decoding and spelling tasks were entered next. As evident in Table 5, the contribution made by the printed language measures dropped to non-significant levels for all of the regressions except for the immediate spelling test scored per letter when target word decoding was accounted for.

Results of the regression analyses show that target word decoding accuracy was the best predictor of vocabulary word and orthographic learning. This is interpreted as evidence to support and extend Share's (1995, 1999) self-teaching hypothesis. Others have shown that target word decoding accuracy predicts word specific orthographic learning. The current results indicate that the increased word specific orthographic knowledge resulting from decoding words supports memory for words' pronunciations linked to meanings.

A similar set of regression analyses was conducted to examine if reported word familiarity was a significant predictor of word learning for the lexical decision group. In these analyses, number of words checked was entered first, and the measures of printed word knowledge were entered second. The dependent variables were the lexical decision group's scores on the immediate synonym-prompted word recall and spelling posttests, and delayed spelling test. Spellings scored by whole word as well as by per-letter criteria were examined. As expected, words checked did not predict any variance in scores on the posttests. However, printed word knowledge was a strong predictor of scores on all of the posttests, accounting for a great deal of variance in scores. Others have shown word reading ability to predict learning of vocabulary words and spellings (Rosenthal & Ehri, in press).

Word Variables

To verify that the effects oral pronunciation of new vocabulary on word learning generalized across words as well as pairs of students, the number of correct responses was calculated for each word on each of the three posttests on which a main effect of condition was detected. Results are presented in Table 1. On the immediate posttests of word production and spelling, 87% of the words were recalled and correctly spelled more often when words were orally decoded than when they were not. On the delayed spelling posttest, 100% of words were correctly spelled more often when words were orally decoded than when they were not. These findings confirm that the impact of instructing students to orally pronounce words held across words as well as student pairs.

Half of the words that students learned contained two syllables and half were three syllables. Although Nagy et. al. did not find an effect of word length on vocabulary learning through context as measured by a multiple choice test, Rosenthal and Ehri (in press) found that words with two syllables were easier to recall than words with three syllables. To examine the effect of word length on word learning, two-way ANOVAs were conducted. The independent variables were word length (two versus three syllables) and condition. The dependent variables were synonym prompted word recall, immediate and delayed in the first two ANOVAs, and spelling, immediate and delayed on the second two ANOVAs. For immediate synonym prompted word recall, no significant main effect of word length was detected, $p > .05$, but an interaction between condition and syllable length was detected, $F(1, 30) = 4.551$, $p < .05$. This indicates that attention to words sufficient to decode them enhanced learning of longer words. In the ANOVA of delayed word production, a main effect of word length was detected, $F(1, 30) = 14.810$, but the interaction between condition and syllable length fell to a non-significant level, $F(1, 30) = 3.538$, $p = .07$. In the ANOVAs of both immediate and delayed spelling, main effects of word length were large, $p\text{s} < .001$. Clearly, syllable length influenced recall of spellings as well as delayed memory for word pronunciations. Oral decoding of words enhanced learning of word pronunciations and spellings and was particularly helpful for learning longer words.

Text Retellings

An analysis of text comprehension was conducted to determine if reading condition affected how well passages were understood. The independent variables were reading condition (oral pronunciation vs. lexical decision) and reader level. The dependent variable was score on the passage retellings. No significant main effects or interactions involving treatment condition or reader level were detected, all ps > .05. Stopping to sound out unknown, multi-syllabic words did not inhibit passage comprehension for students in the oral pronunciation group, even though the cognitive demands made by decoding can sometimes hinder text comprehension for weak readers (Samuels, 2002). Students in the lexical decision group also clearly understood the passages using self-determined word identification strategies. This may have been because all target words were synonyms for concepts likely to be known by fifth graders.

Responses on passage retellings were analyzed. The number of times participants spontaneously attempted to pronounce and spontaneously correctly pronounced target words in their passage retellings was tallied, and groups were compared on these measures using a repeated measure ANOVA. The dependent variable was the number of spontaneous attempts at target word use during the text retellings. The independent variables were condition (oral pronunciation vs. lexical decision), reader level (higher vs. lower) and attempt type (correct vs. incorrect). The third variable was a repeated measure. Mean performance and test statistics are reported in Table 7. Results, reported in Table 7 revealed a significant effect of reading condition, showing that learners in the oral pronunciation condition were more likely to pronounce or attempt to pronounce target words in their retellings. Higher-level readers were more likely than lower level readers to spontaneously correctly pronounce and incorrectly attempt to pronounce target words during text retellings. Although the effect of reader level appears to be stronger for correct word pronunciation, this interaction is not significant. These findings indicate that having readers orally decode unknown words during reading increases the likelihood that they will spontaneously use the words during text retellings.

To summarize, these findings show that when fifth graders are instructed to orally decode unknown vocabulary words, their memory for words and spellings improve. Words, pronunciations, and spellings were learned better when students orally decoded words than when they read words silently. Higher-level readers recalled words and spellings better than lower-level readers, but the benefit of orally decoding words during reading held for both lower-level and higher-level readers. In addition, students who pronounced words during reading were more likely to use the new vocabulary in their passage retellings than students who read words silently. Stopping to decode unknown words did not affect how well passages were understood.

EXPERIMENT 2: FIFTH GRADERS' SELF-REPORTED WORD IDENTIFICATION STRATEGY USE

Experiment 2 was conducted to examine fifth graders' self reported word identification strategy use during normal reading. While results of Experiment 1 showed a clear advantage in word learning for students who sounded unknown words during reading, there is reason to suspect that students, especially low performing readers, might not spontaneously do so. In some reading programs, they may not in fact be encouraged to do so. Goodman (1976) called reading a "psycholinguistic guessing game" and claimed that letters in words are merely sampled during text reading. According to his theory, semantic cues support the guesswork done by readers, and words are not fully decoded. Similarly, Clay (1991) described fluent reading as efficient word *perception*, where meaning is the most important source of information, and where sounding out is a last resort (emphasis added). Children with teachers who align themselves with these theories may be encouraged to use strategies other than sounding out when they encounter new words during reading. They might be taught, for example, to think of a word that would fit the context, or to skip a word, read on, and then put in a word that makes sense (Tunmer & Chapman, 2002).

Ehri & Roberts (1979) and Ehri & Wilce (1980) found that students learned less about words' internal structures when they read words in context rather than in isolation. When unknown words are encountered in context, readers might learn more about semantic and syntactic identities, but less about words' orthographic and phonological identities. This is because the support of context allows readers to make guesses about words, and might cause them to pay less attention to the internal structure of words.

Based on the findings in Experiment 1, we suspected that most children did not spontaneously decode unknown words during text reading, but rather used a text-based strategy such as guessing using surrounding context. DeJong and Share (2007) found no significant difference in orthographic learning as measured by a spelling task between silent and oral reading by Dutch third graders. However, those students were native speakers, reading single syllable words in a language with a transparent orthography. In contrast, students in the current study were primarily non-native speakers, reading multi-syllabic words in an opaque orthography. Results in Experiment 1 showed a huge difference in target word spelling by students who were instructed to decode words versus those who were not.

We also expected that a difference in printed word knowledge would be detected for students who reported sounding out words compared to those who reported using text-based strategies. Correlations in Experiment 1 showed a strong relationship between scores on printed language measures and performance on word learning posttests. It is possible that better readers are more likely to attend to words' spellings and spontaneously attempt to decode them, thereby increasing their printed word lexicons and orthographic knowledge (Gough & Juel, 1991;Tunmer & Chapman, 2002).

Method and Results

Participants and Procedure

The participants were 32 fifth graders from the same school as Experiment 1. Eighteen of these were the final 18 to participate in Experiment 1; an additional 14 students participated only in Experiment 2 after the completion of Experiment 1. The sample included 25 Latin Americans, five African Americans, and two Arab Americans, 15 females and 17 males. Mean chronological age at time of testing was 10 years, 9 months, tested in the spring.

For the students who participated in Experiment 1, in addition to literacy assessments during the first session, participants in Experiment 2 were interviewed on their word identification strategy use during normal, independent reading. The 14 students who participated only in Experiment 2 met with researchers only once, at which time they were administered the strategy use interview and the same set of literacy assessments as in Experiment 1.

To obtain fifth graders' self-reports of their word identification strategies, we asked each child the following question: "When you are reading on your own and come to a word that you don't know, what do you usually do to try to figure out what the word is?" The children's responses were coded according to whether or not reference was made to the use of word based strategies (Tunmer & Chapman, 2002). Examples of word-based strategies include "sound it out", "break the word down into smaller parts", "look at the letters", "spell it out", "try to pronounce it", and "break it into syllables". Examples of other strategies included text-based strategies as well as "beyond the text" strategies. Text based strategies include "guess", "look at the picture", "read the rest of the sentence", and "covering the word I don't know and reading the other words". "Beyond the text" strategies include "ask my teacher", "ask my parents", "look in a dictionary", and "use the translator machine". Responses were independently rated by two graduate students. There was initially an 88% agreement on categorization of responses; disagreements were resolved by discussion so that full consensus was reached.

An analysis of responses revealed that 19 (59%) of the fifth graders reported using text-based or "beyond the text" strategies, and 13 (41%) reported using word based strategies. For this study, two groups were formed comprising children who used word-based strategies (N = 13) and those who reported using strategies other than word-based strategies (N = 19) similar to Tunmer and Chapman, 2002.

The prediction that students who reported using word-based methods of word identification would perform better on written language measures than students who reported using strategies other than word-based was tested using independent samples *t*-tests. Results showed that the two groups did not differ significantly on decoding, spelling, or expressive vocabulary measures (all *p*s > .05). However, the two groups did differ in their word reading ability, $t(30) = 1.951$, $p < .05$. This indicates that students who report attempting to sound out unknown words encountered during reading have a larger sight-word lexicon than students who report using text-based, or "beyond the text" strategies.

Discussion

To summarize, findings of the two experiments yielded several interesting findings.

Orally pronouncing unknown words during text reading aids word recall. This is an important finding since it is widely accepted that most vocabulary is learned through written context. If students are skipping over or guessing words, rather than attending to words, it is not likely that new terms will be learned.

Students who were instructed to decode words remembered far more about words' spellings than did students who were not instructed to do so. This is shown by the difference in performance on spelling posttests, immediate and delayed, scored both by whole word and per letter criteria. This finding indicates that when children are not explicitly instructed to decode unknown words during text reading, they don't in fact attend to words' spellings. Bowey and Muller (2005) and deJong and Share found orthographic learning in third graders during silent reading. However, in Bowey & Muller's study, children were not asked to spell words; orthographic learning was tested by having children engage in an orthographic choice task, and to read lists of target words and homophonic alternatives. A spelling task is a more conservative measure of orthographic learning than the tasks used by Bowey & Muller. DeJong and Share found no difference in target word spelling accuracy between students who read texts silently versus orally. However, Dutch is a comparatively shallow orthography, and words were all single syllable "simple pseudowords". The differences in posttest spelling accuracy in the current study was very large, and persisted (grew) after a one-week delay. This provides evidence that attending to the internal structure of multisyllabic words sufficient to decode the words exerts a powerful effect on memory for spellings. When students do not decode unknown words during reading, as many seemingly do not do unless instructed to, they learn far less about words' spellings.

No difference in performance between the two groups was detected on the multiple choice posttests. One possible reason for this is that multiple choice items can be answered correctly with only partial word knowledge (Kame'enui et al., 1987) and the meanings of words were made explicit in the passages. On the other hand, the test itself was flawed: All of the foils were meanings of other target words, making the test overly easy. The definitions to the tested words were given in the synonym-prompted recall task immediately preceding the multiple choice task. Hence, scores on this test for most participants were at or close to ceiling.

As in other studies examining the self-teaching hypothesis (Cunningham et al., 2002; Nation et al., 2007; Share, 1999), in the current study, target word decoding accuracy was the best predictor of word and orthographic learning for students in the oral pronunciation group. Target word decoding contributed significant variance in vocabulary and orthographic learning above and beyond students' individual differences in reading ability. When target word decoding accuracy was accounted for, the contribution to word recall and whole word spelling made by sight word and alphabetic knowledge dropped to non-significant levels. The contribution made by printed word knowledge to spelling scored per letter was significant on the immediate, but not the delayed posttest. In order for readers' vocabulary and word knowledge to develop through exposure to written context, they must exploit opportunities to learn new words by attending to words' internal structures.

In the control condition, students were asked to put a check mark next to words they had seen before. Results indicate that some students may not have understood what was requested of them: One third of students conveyed that they had seen at least half of the words previously. It is highly unlikely that students were familiar with the words: The words were rated as occurring less than four times per million words (Thorndike & Lorge, 1972) and participants' vocabularies were below average. It is therefore not surprising that reported familiarity with words accounted for almost no unique variance on posttest scores. Printed word knowledge as measured by the word reading, non-word decoding and spelling tasks accounted for a great deal of variance on all of the posttest measures, even more than these variables accounted for posttest scores for the oral pronunciation group. Combined with the results of Experiment 2, these findings are interpreted to support the claim that better word reading and decoding ability increase the likelihood that students will spontaneously attempt to decode unknown words during reading (Tunmer & Chapman, 2002). Although this is speculation, the overall results point to the possibility that the better readers in the lexical decision group did in fact (subvocally) decode target words, thereby learning more about words' pronunciations and spellings than the lower level readers in this group. When students were instructed to orally decode words, the contribution made by printed word knowledge decreased.

Spellings of three syllable words were more difficult to recall than spellings of two syllable words. Word length also effected how well words' pronunciations were remembered after a one-week delay. This is similar to results of a study by Rosenthal and Ehri (in press) in which words and spellings were more easily learned when words had two rather than three syllables. Also, Gathercole and Baddeley (1989) found that learning was more difficult when words contained more than two syllables. Interestingly, orally decoding words enhanced learning of three syllable words more than two syllable words. Attending to words' internal structures assisted learning of words that are considered more difficult. Another possible reason for this difference is that participants who were not instructed to sound out words were even more likely to skip over and guess at longer words, which appeared harder to decode.

During text retellings, students who had decoded target words were significantly more likely to spontaneously correctly pronounce, or attempt to pronounce, target words. All words were synonyms for known concepts, and students could easily have related the same meanings using the better-known synonyms. In fact, all but one of the stories ("Cats") included the better known synonym in the body of the text. Word meanings were made explicit in the passages, and students therefore were not obliged to use the target words. Students in the lexical decision group were more likely to use the better-known synonym. This indicates that learners who orally decoded target words were attempting to assimilate the new words into their vocabularies.

Strengths and Limitations

In the present study, the contribution of orally decoding of unknown words encountered in written passages to vocabulary and orthographic self teaching was examined using a laboratory task. Findings clearly showed that instructing students to decode new words during otherwise silent reading enhanced word learning. Although these effects were found with direct, individualized instruction, it is likely that the same effects would be found when classrooms of students are taught to attempt to decode novel words during reading, provided that the words are decodable, and the meanings of words can be inferred from the surrounding context. These possibilities await further investigation.

One strength of the present study is that *expressive* vocabulary acquisition was studied. It is much harder to teach children to produce new words than to recognize their meanings (Senechal, 1997). Present findings indicated that having children decode novel words encountered in text strengthens their ability to pronounce and use the words in speech.

Another strength of the present study is that a matched pair random assignment design was used to detect the effect of word decoding as a vocabulary self-teaching mechanism.

Some limitations of the study can be identified. The words taught were concrete nouns, which are easier to learn than other parts of speech (Elley, 1989). The words represented concepts already familiar to children rather than unfamiliar concepts. The texts were devised to make the word meanings explicit, and included pictures which depicted word meanings. Also the words' spellings conformed to the English writing system, making them easier to decode and to remember than less-regularly-spelled words (Ehri, 1997). The participants were fifth graders from urban, low SES schools with large minority populations whose parents provided written consent. Further research is needed to show that findings generalize to other types of words, texts, participants, and testing conditions.

Table 1

Number of Fifth Graders Who Correctly Recalled Each Word and Whole Word Spelling on Immediate and Delayed Posttests as a Function of Reading Condition, Oral Pronunciation (OP) or Lexical Decision (LD)

Vocabulary Words and Meanings	Immed. Word Recall		Immed. Spelling		Delayed Word Recall		Delayed Spelling	
	OP	LD	OP	LD	OP	LD	OP	LD
Wimple – a nun's head covering	12	11	19[a]	19[a]	8[a]	11[a]	20	16
Mullock – a pile of trash	6	5	10	3	4	3	6	3
Tandem – a horse-drawn carriage	6	2	18	9	2	1	18	4
Gangrel – a homeless person	12	6	13	11	4[a]	5[a]	14	13
Vibrissae – the whiskers on a cat	1[a]	2[a]	1	0	1	0	3	1
Tamarack – a type of tree	17	5	19	4	4	0	17	4
Kerfuffle – a fuss or fight	8	4	8	6	5	2	8	2
Scrivello – an elephant's tusks	13	4	9	5	1	0	6	5

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Note. The maximum number of students recalling words correctly was 31 per word.

[a]There were four exceptions to the general pattern of superior learning when words were orally pronounced compared to read silently.

Table 2

Student Characteristics and Mean Performance on Literacy and Language Tests as a Function of Reader Level as Determined by the Woodcock Word Identification Test

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Characteristics and Reader Level *t*-stat

Measures	Lower (*N*=30)	Higher (*N*=32)	
Gender (females; males)	15F; 15M	15F; 17M	
Ethnicity			
African-American	8	9	
Latin-American	22	19	
Arab-American	-	4	
Age (years; months)	10;10	10;5	
Woodcock Word Identification (106 max)	59.80 (5.9)	73.25 (4.4)	10.23**
Grade Equivalent	3.5	5.5	
Woodcock Word Attack	20.80 (8.5)	31.28 (5.2)	5.92**
Grade Equivalent	4.0	6.8	
Ganske Spelling Inventory (20 max)	6.70 (1.8)	11.03 (2.9)	6.89**
EVT Expressive Vocabulary.			
Standard Score	84.07 (9.3)	89.41 (9.4)	2.25*.

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

Table 3

Mean Performance and Test Statistics in Repeated Measures ANOVAs of performance on the Three Vocabulary Learning Posttests as a Function of Reader Level (R, Between Subjects), and Reading Condition (C, Within Subjects)

Tasks and Measures Reader Levels	Oral Pronunciation *M (SD)*	Lexical Decision *M (SD)*	Effect Size[a] *d*	Test Stat $F(1,29)$[b]
Vocabulary Production (max 8)				
Immediate Posttest	2.35 (1.7)	1.26 (1.6)	0.66	7.152*(C)
Higher Level Readers	2.94 (1.9)	2.06 (1.8)	0.48	15.409** (R)
Lower Level Readers	1.73 (1.3)	0.40 (0.6)	1.31	0.308 ns(CxR)
Delayed Posttest	0.94 (1.4)	0.71 (0.9)	0.20	0.494 ns (C)
Higher Level Readers	1.19 (1.7)	0.56 (0.8)	0.47	0.153 ns (R)
Lower Level Readers	0.67 (0.9)	0.87 (0.9)	-0.22	1.86 ns (CxR)
Target Word Spelling Whole Word (max 8)				
Immediate Posttest	3.16 (1.8)	1.84 (1.7)	0.75	11.325* (C)
Higher Level Readers	3.63 (1.5)	2.56 (2.0)	0.61	7.891* (R)
Lower Level Readers	2.67 (2.0)	1.07 (0.7)	1.07	0.462 ns(CxR)
Delayed Posttest	2.97 (1.6)	1.58 (1.3)	0.95	22.630** (C)
Higher Level Readers	3.63 (1.5)	2.00 (1.3)	1.16	7.647* (R)
Lower Level Readers	2.27(1.5)	1.13 (1.2)	0.84	0.719 ns CxR)

Table 3 (Continued)

Mean Performance and Test Statistics in Repeated Measures ANOVAs of performance on the Three Vocabulary Learning Posttests as a Function of Reader Level (R, Between Subjects), and Reading Condition (C, Within Subjects)

Tasks and Measures	Oral Pronunciation	Lexical Decision	Effect Size[a]	Test Stat
Reader Levels	*M (SD)*	*M (SD)*	*d*	*F*(1,29)[b]
Target Word Spelling Per Letter (max 20)				
Immediate Posttest	11.52 (4.0)	8.58 (2.9)	0.84	15.176** (C)
Higher Level Readers	12.88 (3.2)	10.06 (2.8)	0.94	10.750* (R)
Lower Level Readers	10.07 (4.5)	7.00 (2.2)	0.87	0.028 ns(CxR)
Delayed Posttest	11.23 (4.2)	8.32 (3.6)	0.74	11.095* (C)
Higher Level Readers	12.88 (3.5)	10.44 (1.3)	0.92	20.994** (R)
Lower Level Readers	9.47(4.2)	6.07 (2.5)	0.98	0.302 ns(CxR)
Multiple Choice (max 8)				
Immediate Posttest	6.81 (1.3)	6.39 (1.8)	0.27	1.266 ns (C)
Higher Level Readers	6.82 (1.3)	6.63 (1.4)	0.14	0.211 ns (R)
Lower Level Readers	6.87 (1.2)	6.13 (2.1)	0.43	0.636 ns(CxR)
Delayed Posttest	6.42 (1.9)	6.61 (1.7)	-0.11	0.162 ns (C)
Higher Level Readers	7.00 (1.5)	6.81 (1.8)	0.11	3.480 ns (R)
Lower Level Readers	5.87(2.1)	6.40 (1.7)	-0.28	0.420 ns(CxR)

Note. There were 32 higher-level readers and 30 lower-level readers. $*p < .01$; $**p < .001$; ns not statistically significant.

[a]Calculation of effect size: Difference between means divided by pooled standard deviation.

[b]*F*-values in ANOVAs for main effects of condition (C), reader level (R), and interaction between condition and level (CxR).

Table 4

Intercorrelations Among Word Learning and Printed Language Measures

Measure												M (SD)
Vocabulary Learning	2. Im. Sp WW	3. Im Sp PL	4. Im MC	5. Del Word Prod	6. Del Sp WW	7. Del Sp PL	8. Del MC	9. Word ID	10. Word Attack	11. Ganske	12. EVT	
1. Immediate word prod.	.71**	.67**	.21	.45**	.49**	.50**	.17	.41**	.37**	.46*	.08	1.9 (1.7)
2. Immediate spelling whole word	.	.87**	.24	.37**	.61**	.68**	.11	.42**	.48**	.48**	.12	2.6 (1.9)
3. Immediate spelling per letter			.17	.41*	.61**	.73**	.09	.42**	.51**	.51**	.12	10.0 (3.8)
4. Immediate mult. choice				.06	.00	.18	.43**	.21	.20	.18	-.03	6.6 (1.5)
5. Delayed word prod.					.36**	.20	.05	.08	.11	.15	.21	0.8
6. Delayed spelling whole word						.70**	-.06	.40**	.29*	.38**	.04	2.3 (1.1)
7. Delayed spelling per letter							.00	.47**	.51**	.57**	.08	9.8 (4.1)
8. Delayed mult. choice								.23	.20	.20	.05	6.5 (1.8)
Literacy Assesment												
9. Word ID									.77**	.75**	.10	67 (8.7)
10. Word attack										.69**	.14	26.4 (8.8)
11. Ganske											.12	9.0 (3.3)
12. EVT standard score												86.8 (9.6)

Note: Correlations are based on $N = 62$ children. *$p < .05$ (2-tailed). **$p < .01$ (2-tailed). No other correlations were significant. EVT is the Expressive Vocabulary Task. Word ID is the Woodcock word-reading task. Word attack is the Woodcock nonword reading task. Ganske is a spelling task.

Table 5

Hierarchical Regression Analyses to Assess the Unique Contribution (R^2 Change) to Oral Pronunciation Group Posttest Performance Made by Word Reading, Decoding, and Spelling Ability (entered first) and Accurate Target Word Decoding (entered second) or of Accurate Target Word Decoding (entered first) and Word Reading, Decoding, and Spelling Ability (entered second)

Order of Entry	Immediate Word Recall	Immed. Spell Whole Word	Immed. Spell Per Letter	Delayed Spell Whole Word	Delayed Spell Per Letter
1. Word ID, Word Attack, Spelling	.204 ns	.252*	.366**	.234 ns	.204 ns
2. Target word decoding	.137*	.220**	.103*	.221**	.166*
1. Target word decoding	.220**	.365**	.252**	.352**	.272**
2. Word ID, Word Attack, Spelling	.121 ns	.107 ns	.217*	.102 ns	.098 ns

Note: Regressions are based on N=31 children. *p < .05; **p <.01; ns not statistically significant. Word ID is the Woodcock word-reading task. Word Attack is the Woodcock nonword-reading task. Spelling is the Ganske spelling task.

Table 6

Hierarchical Regression Analyses to Assess the Unique Contribution (R^2 Change) to Lexical Decision Group Posttest Performance Made by Reported Word Recognition (entered first) and Word Reading, Decoding, and Spelling Ability (entered second)

Order of Entry	Immediate Word Recall	Immed. Spell Whole Word	Immed. Spell Per Letter	Delayed Spell Whole Word	Delayed Spell Per Letter
1. Reported word recognition	.029ns	.042ns	.012ns	.005ns	.004
2. Word ID, Word Attack, Spelling	.373**	.475**	.500**	.255*	.726**

Note: Regressions are based on N=31 children. *$p < .05$; **$p < .01$; ns not statistically significant. Word ID is the Woodcock word-reading task. Word Attack is the Woodcock nonword-reading task. Spelling is the Ganske spelling task.

Table 7

Mean Performance on Spontaneous Target Word Use as a Function of Reader Level, Reading Condition, and Attempt Type

	Oral Pronunciation	Lexical Decision	Effect Size[a]	Test Stat
Reader Levels	*M (SD)*	*M (SD)*	*d*	$F(1,29)$[b]
				18.453* (C)
Correct Use (max 8)	2.71 (1.6)	1.55 (1.8)		21.665** (R)
Higher Level Readers	3.44 (1.3)	2.25 (1.3)	0.25	0.077ns(CxR)
Lower Level Readers	1.93 (1.5)	0.80 (1.9)	1.13	6.342* (T)
Incorrect Attempt	1.87 (1.4)	1.03 (1.0)		3.091ns(TxR)
Higher Level Readers	2.06 (1.5)	1.38 (1.1)	-0.06	0.331ns(TxC)
Lower Level Readers	1.67 (1.3)	0.67 (0.9)	0.44	
0.11ns(RxCxT)				

Note. There were 32 higher-level readers and 30 lower-level readers. *p <.05, **p < .01; n.s. not statistically significant.

[a]Calculation of effect size: Difference between means divided by pooled standard deviation.

[b]F-values in ANOVAs for main effects of condition (C), reader level (R), attempt type (T) and interaction between variables.

[b]*F*-values in ANOVAs for main effects of reader level (R), condition (C), attempt type (T) and interaction between variables.

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