INTERVENTIONS FOR ADOLESCENT STRUGGLING READERS

A Meta-Analysis with Implications for Practice

CENTER ON INSTRUCTION

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Nancy Scammacca, Greg Roberts, Sharon Vaughn, Meaghan Edmonds, Jade Wexler
Vaughn Gross Center for Reading and Language Arts
The University of Texas at Austin

Colleen Klein Reutebuch
Texas Tech University

Joseph K. Torgesen
Florida Center for Reading Research
Florida State University

2007

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The authors would like to acknowledge the valuable assistance given in the preparation of this document by Jan Dole and Tim Shanahan.

The Center on Instruction is operated by RMC Research Corporation in partnership with the Florida Center for Reading Research at Florida State University; RG Research Group; the Texas Institute for Measurement, Evaluation, and Statistics at the University of Houston; and the Vaughn Gross Center for Reading and Language Arts at the University of Texas at Austin.

The contents of this document were developed under cooperative agreement S283B050034 with the U.S. Department of Education. However, these contents do not necessarily represent the policy of the Department of Education, and you should not assume endorsement by the federal government.

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Preferred citation:
Scammacca, N., Roberts, G., Vaughn, S., Edmonds, M., Wexler, J., Reutebuch, C. K., & Torgesen, J. K. (2007). *Interventions for adolescent struggling readers: A meta-analysis with implications for practice*. Portsmouth, NH: RMC Research Corporation, Center on Instruction.

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EXECUTIVE SUMMARY

This meta-analysis offers decision-makers research-based guidance for intervening with adolescent struggling readers. Here we outline major implications for practice; a more detailed account begins on page 12 and is represented in chart form in Table 3, page 15.

Implications for Practice:

1. Adolescence is not too late to intervene. Interventions do benefit older students.
2. Older students with reading difficulties benefit from interventions focused at both the word and the text level.
3. Older students with reading difficulties benefit from improved knowledge of word meanings and concepts.
4. Word-study interventions are appropriate for older students struggling at the word level.
5. Teachers can provide interventions that are associated with positive effects.
6. Teaching comprehension strategies to older students with reading difficulties is beneficial.
7. Older readers' average gains in reading comprehension are somewhat smaller than those in other reading and reading-related areas studied.
8. Older students with learning disabilities (LD) benefit from reading intervention when it is appropriately focused.
9. To learn more about instructional conditions that could close the reading gap for struggling readers, we will need studies that provide instruction over longer periods of time and assess outcomes with measures more like those schools use to monitor reading progress of all students.

INTRODUCTION

Reading instruction for older students with reading difficulties is a topic increasingly in need of well-informed support and research-based guidance (Deshler, 2005; Dole, 1996). This report summarizes aspects of recent research on reading instruction for adolescent struggling readers. It both synthesizes research findings to determine the relative effectiveness of interventions for struggling older readers and outlines the implications of these findings for practice. Its purpose is to advance the knowledge of technical assistance providers working with state departments of education and local education agencies concerning reading-related issues for students with reading difficulties and learning disabilities (LD). While our methods and general findings are described, they are presented in terms of their impact on practice and policy. Specific suggestions for implementing these and other research findings are provided in an accompanying practice brief.

This report is intended primarily for technical assistance providers at Regional Comprehensive Centers for their use in crafting evidence-based guidance for states and local educational agencies. It is *not* a comprehensive review of all aspects of the research on adolescent literacy instruction for students with LD. Rather, it addresses three important questions thoroughly and systematically, based on findings from a set of studies that met established inclusion criteria (see page 21). While we value research using single subject designs (SSD), we chose not to include these designs in this synthesis for the sake of brevity and simplicity.

This report is limited to reading interventions at the late elementary, middle, and high school levels and represents one data source for decision-making about instruction for older readers with reading difficulties or disabilities. While other elements of adolescent literacy, such as writing and oral communication skills, are critically important for older students with related deficits in these aspects of literacy, this report does not address them. It is limited to reading interventions because sufficient literature exists to warrant a meta-analytic synthesis. We encourage readers to consult other briefs and reports, including those available from the Center on Instruction (see box), for additional information related to adolescent reading.

These documents are available from the Center on Instruction at www.centeroninstruction.org.

Academic Literacy Instruction for Adolescents: A Guidance Document from the Center on Instruction
This document is a resource for reading specialists in Regional Comprehensive Centers throughout the United States as they work with states to improve educational policy and practice in adolescent reading. It includes three major sections: (1) research-based recommendations for improving academic literacy instruction for students in grades 4-12; (2) responses from experts to questions about methods for improving academic reading in adolescents; and (3) examples of state activities in support of improved adolescent reading.

Adolescent Literacy Resources: An Annotated Bibliography
This array of research summaries and policy documents on reading and reading comprehension for students in grades 4-12, while not exhaustive, includes discussions of all the current important research issues in adolescent literacy and the development of state- and district-level policies to support improvements in adolescent literacy outcomes. It is a companion piece to the recently released Academic Literacy Instruction for Adolescents: A Guidance Document from the Center on Instruction.

Effective Instruction for Adolescent Struggling Readers: A Practice Brief
Designed for teachers, principals, and instructional support staff, this booklet focuses on effective instructional practices in reading for older students with reading difficulties and disabilities. It includes a discussion of important issues, a description of research-based instructional tips, and details on other useful resources related to adolescent reading instruction. (Available Fall 2007)

Effective Instruction for Adolescent Struggling Readers: Professional Development Module
This professional development package, designed for teachers, principals, instructional support staff, and technical assistance providers, explains the research basis of recommended reading interventions for struggling adolescents and describes how to implement these interventions. The package includes a PowerPoint presentation, a speaker notes packet, and handouts. (Available Fall 2007)

Extensive Early Reading Interventions: Implications from Research
This document reports the effects of extensive reading interventions on younger students struggling to read. It summarizes the methods and results of studies published between 1995 and 2005 that delivered 100 or more sessions of intervention. Findings are discussed in terms of instructional practice and policy. (Available Fall 2007)

RESEARCH QUESTIONS

A recent consensus document issued by a group of eminent researchers states: "Enough is already known about adolescent reading—both the nature of the problems of struggling readers and the types of interventions and approaches to address these needs—in order to act immediately on a broad scale" (Biancarosa & Snow, 2006, p. 10). There is, indeed, a substantial body of research on instructional methods for adolescent struggling readers. This report attempts to bring together and synthesize findings from recent research in this area as a guide for developing policy and practice at the state, district, school, and classroom levels. It is one tool for addressing the instructional needs of struggling adolescent readers "immediately on a broad scale," as Biancarosa and Snow suggest.

Torgesen et al. (2007) identified six critical factors underlying proficient reading performance at the late elementary, middle, and high school levels. They are:

- Fluency of text reading;
- Vocabulary, or the breadth and depth of knowledge about the meaning of words;
- Active and flexible use of reading strategies to enhance comprehension;
- Background, or prior knowledge related to the content of the text being read;
- Higher level reasoning and thinking skills; and
- Motivation and engagement for understanding and learning from text.

This report focuses on interventions designed to affect fluency of text reading, vocabulary, and students' use of reading comprehension strategies. It also assesses the impact of interventions that target accurate decoding of unfamiliar words in text in order to increase reading accuracy, referred to here as "word study" interventions. We addressed three primary questions:

1. ***Overall, how effective are the reading interventions for adolescent struggling readers that have been examined in research studies?***
2. ***What is the specific impact of these reading interventions on measures of reading comprehension?***

3. *What is the specific impact of these reading interventions on students with learning disabilities?*

In the analysis related to questions 1 and 2, we investigated three variables that were thought to moderate the relative effectiveness of interventions:

a. The type of intervention (fluency, vocabulary, reading comprehension strategies, word study, or multiple components of reading instruction);

b. The grade level of students participating in the intervention (middle grades or high school); and

c. The intervention provider (teacher or researcher).

FINDINGS

The findings presented in this section are based on a meta-analysis of 31 studies. Table A (page 29) provides information on the characteristics of each study included in the analysis. Those interested in more details should review the Method section of this document (page 21) for information on how studies were selected and how the meta-analysis was conducted.

1. *Overall, how effective are the reading interventions for adolescent struggling readers that have been examined in research studies?*

The overall estimate of the effect size across all 31 studies was 0.95 ($p<.001$; 95% CI=.68, 1.22).[1] An effect size of almost 1 means that, on average, the treatment groups in these 31 studies outscored the comparison groups (or the alternate treatment groups) by nearly one standard deviation. In the 11 studies that used *standardized, norm-referenced measures,* the average effect was 0.42 ($p=.002$, 95% CI=.16, .68), which reflects an advantage for the treatment group(s) of just under one-half of a standard deviation. This finding may reflect the measurement-related differences described earlier; more rigorous measures that are less closely aligned with the instructional aims of the specific intervention(s) tend to yield smaller-sized effects. Table B (page 32) provides a brief description of the intervention used in each study and the effect sizes by measure.

The variance across all 31 studies was statistically significant as measured by the Q statistic ($Q=150.45$, $p<.001$; the Q statistic for the 11 studies that used standardized measures also was statistically significant, $p=.025$). In meta-analysis, the presence of significant variation means that a factor or factors in addition to the intervention may be contributing to the effect-size estimate (i.e., these factors may *moderate* the effect of the intervention). Table 1 (page 9) summarizes results for the three moderators of interest in this study: type of intervention, grade level of students, and provider of the intervention.

2. *What is the specific impact of these reading interventions on measures of reading comprehension?*

While estimates of the overall effect on all reading and reading-related (e.g., vocabulary) outcomes for the interventions included in this meta-analysis are useful, reading comprehension outcomes are generally viewed as the most important indicator of the effectiveness of reading interventions with older

[1] A p value of .05 or smaller was used to evaluate the statistical significance of effect estimates. The 95% confidence interval (95% C.I.) is the range of values within which the "true" effect is likely to fall 95% of the time (between .68 and 1.22 in this case). While the likelihood diminishes as one deviates from the .95 point estimate, effects are best interpreted in terms of their confidence intervals. Of particular importance is whether the interval includes 0. When the confidence interval does include 0, it is possible that the "true" effect is, in fact, 0.

students. Gains in reading comprehension are critical if struggling adolescent readers are to succeed in content-area classes, demonstrate proficiency on high-stakes state reading tests, or read for pleasure. For this reason, a separate meta-analysis was conducted on the 23 intervention studies that included one or more measures of reading comprehension to answer Research Question 2. The 8 studies that included a standardized, norm-referenced measure of reading comprehension were also considered separately. Results for the 23 studies that included one or more measures of reading comprehension and the 8 studies that included a standardized, norm-referenced measure of reading comprehension are discussed in order to address this research question.

With few exceptions, the pattern of results for reading comprehension mirrors the results from the overall analysis of all outcome measures. The estimate of effect size across all 23 studies was 0.97 (95% CI=.61, 1.33). Participation in the intervention(s) was associated, on average, with reading comprehension skills almost 1 standard deviation greater than the skills of students not participating in the treatment (i.e., comparison group(s) or the alternate treatment group(s)). The overall effect-size estimate for the 8 studies using standardized, norm-referenced measures of reading comprehension was 0.35 (95% CI=-.05, .75). Note that the confidence interval does *not* exclude the possibility of a "true" effect of 0. While less likely than the .35 point estimate, it is nonetheless possible.

The variance in the effect-size estimates was statistically significant for the 23 reading comprehension studies (Q=145.41, p<.001) and for the 8 comprehension studies that included standardized reading comprehension measures (p<.001). Table 1 summarizes the results of the follow-up moderator analyses.

3. *What is the specific impact of these reading interventions on students with learning disabilities (LD)?*

Information on the LD status of participants was available for all 31 studies (all studies used school reports as the indicator of LD status). When all measures were considered, there were significant differences in the outcomes of the 31 studies depending on the proportion of the sample (all, some, or none) with LD (Q-*between*=13.20, p=.001). When the analysis focused only on reading comprehension outcomes, however, there were no statistically significant differences based on the LD status of participants (Q-*between*=5.60, p=.061).

Table 1. Results for moderator variables

Moderator variable	Levels	ES for all outcome measures	ES for standardized outcome measures	ES for all reading comprehension measures	ES for standardized reading comprehension measures
Type of intervention	Comprehension strategies	1.23 (n=12, 95% CI=.68, 1.79)	0.55 (n=2, 95% CI=-.99, 2.09)	1.35 (n=12, 95% CI=.72, 1.97)	0.54 (n=2, 95% CI=-1.04, 2.11)
	Word study	0.60 (n=4, 95% CI=.25, .95)	0.68 (n=3, 95% CI=.32, 1.03)	0.40 (n=2, 95% CI=-.15, .95)	0.40 (n=2, 95% CI=-.15, .95)
	Fluency	0.26 (n=4, 95% CI=-.08, .61)	0.04 (n=2, 95% CI=-.43, .50)	0.26 (n=4, 95% CI=-.20, .73)	-.07 (n=2, 95% CI=-.54, .39)
	Multi-component	0.56 (n=6, 95% CI=.25, .95)	0.41 (n=3, 95% CI=-.08, .61)	0.80 (n=4, 95% CI=-.21, 1.39)	0.59 (n=2, 95% CI=-.21, 1.39)
	Vocabulary	1.62 (n=5, 95% CI=1.13, 2.10)	NA	NA	NA
Grade grouping	Middle grades (4-8)	1.05 (n=19, 95% CI=.70, 1.40)	0.56 (n=7, 95% CI=.23, .89)	1.11 (n=15, 95% CI=.61, 1.62)	0.47 (n=5, 95% CI=-.12, 1.06)
	High school (9-12)	0.78 (n=3, 95% CI=.19, 1.38)	0.13 (n=8, 95% CI=-.25, .51)	0.59 (n=6, 95% CI=.05, 1.14)	0.14 (n=3, 95% CI=-.28, .56)
Type of implementer	Researcher	1.49 (n=11, 95% CI=.99, 1.99)	1.08 (n=2, 95% CI=.57, 1.59)	1.89 (n=6, 95% CI=.90, 2.87)	NA
	Teacher	0.63 (n=12, 95% CI=.20, 1.07)	0.21 (n=6, 95% CI=-.09, .50)	0.65 (n=11, 95% CI=.12, 1.18)	0.06 (n=5, 95% CI=-.20, .32)

ES=Effect Size
CI=Confidence Interval

Table 2 breaks down the effects by LD status of the participants. Effects are presented separately for all outcomes and for reading comprehension outcomes. Given the absence of significant differences on reading comprehension outcomes by LD status, the data in Table 2 should be viewed as descriptive of the range of possible effects for each group.

Table 2. Effects of interventions by LD status

LD status of participants	ES for all outcome measures	ES for standardized outcome measures	ES for all reading comprehension measures	ES for standardized reading comprehension measures
All designated learning disabled	1.19 (n=19, 95% CI=.84, 1.54)	0.51 (n=3, 95% CI=.05, .98)	1.33 (n=12, 95% CI=.74, 1.92)	NA
Some designated learning disabled, some struggling	0.86 (n=6, 95% CI=.27, 1.44)	0.44 (n=3, 95% CI=-.22, 1.10)	0.82 (n=6, 95% CI=.21, 1.44)	0.43 (n=3, 95% CI=-.24, 1.10)
All struggling, none designated learning disabled	0.39 (n=6, 95% CI=.13, .65)	0.40 (n=5, 95% CI=.00, .81)	0.43 (n=5, 95% CI=-.04, .89)	0.39 (n=4, 95% CI=-.27, 1.06)

Closing the gap

Although the analysis of effect sizes provides reliable information about the extent to which an intervention being studied has a greater impact on student performance than the control condition it is compared with, it does not provide information about the degree to which students' reading skills have improved relative to grade-level standards. Standard scores reported in some of the studies were examined to determine the extent to which the interventions in these studies may have "closed the gap" between the reading skills of struggling readers and those of average readers of similar age or grade level. Not all studies reported standard scores. Of those that did, the scores were reported in different, often incomplete, ways, making the reporting of overall mean gains or mean posttest scores impossible. For example, Penney (2002) reported a mean raw score only on the Woodcock

Reading Mastery Test—Passage Comprehension (WRMT-PC); however, students in the study varied in age, making it impossible to compute a standard score to compare with the standardized mean score. Across the WRMT-PC and the Ekwall Reading Inventory, students in the Conte and Humphreys study (1989) performed on average at the 3rd-4th grade reading level at posttest (an average gain of 0.5 to 1.6 grade levels over pretest scores). However, students ranged in age from 9-13 years, making it difficult to determine how their posttest performance compared to that of their non-struggling peers.

In the Hasselbrig and Goin study (2004), the mean posttest score for reading comprehension on the Stanford Diagnostic Reading Test for students who received intervention was at a normal curve equivalent (NCE) of 20.3 (pretest score was a mean NCE of 11.0). An NCE of 50 is considered "average" and scores falling between 29 and 71 are within a standard deviation of the mean (the standard deviation for NCE scores is 21.1.) An average NCE score of 20.3 is about 1½ standard deviations below the mean. The Klingner and Vaughn study (1996) reported a mean posttest score near the 9th percentile on the Gates-MacGinitie Reading Comprehension Test for a group of middle-school students participating in an effective comprehension strategies intervention (pretest score was just below the 6th percentile). A percentile rank score of 25 is often used as the low-end cut-off for the "normal" range, meaning that the students in the Klingner and Vaughn study were still well below average levels of performance after participating in the intervention.

Some students receiving intervention did score close to or within the normal range at posttest. The mean posttest standard score on the WRMT-PC for students who received intervention in Abbott and Berninger (1999) was 95.9. Students receiving intervention in Allinder (2001) had a mean posttest score of 95.48 on the WRMT-PC. Pretest scores on this measure were not reported in either study, so it is not known whether average standard scores were higher at posttest than at pretest. In Alfassi (1998), the mean posttest NCE on the Gates-MacGinitie Reading Comprehension Test for students receiving the intervention was 42.3, compared to 34.8 at pretest. Overall, these results indicate that some of the interventions considered in this review were powerful enough to accelerate students' reading growth sufficiently to narrow the gap between their reading proficiency and that of average readers at their grade level. However, we currently have little evidence that the instructional conditions in these studies were sufficient to bring struggling readers' reading skills into the average range.

IMPLICATIONS FOR PRACTICE

The findings suggest that researchers as well as teachers can influence reading outcomes of older students with reading difficulties, that students in middle and high school may benefit from intervention (though interventions provided to middle-grade students were associated with overall higher effect sizes), and that students with learning disabilities benefit from intervention, typically with larger effects than for other students who are struggling in reading but not identified as learning disabled. Table 3 (page 15) provides an overview of the key findings and interpretations. Related implications follow:

1. **Adolescence is not too late to intervene, and older students who participate in interventions can benefit.** These findings provide educational leaders with a research-based foundation for making this case with confidence. At the same time, the reported effect sizes should be considered in terms of their *practical* significance. As mentioned earlier, many older students with reading difficulties participating in these studies were compared with older students receiving little or no intervention. This research design contrasts markedly with typical practice at the primary grade level, where all students are given reading instruction. Further, school personnel may need to consider the level of intensity and amount of instruction needed to close the reading gap between struggling and average readers. Researchers and technical assistance providers should be mindful neither to over-interpret nor under-interpret the likely outcomes.
2. **Older students with reading difficulties benefit from interventions focused both at the word level and at the text level.** Identifying need and intervening accordingly *in the appropriate areas* (e.g., vocabulary, word reading, comprehension strategies, and so on) is associated with improved outcomes for older students with reading difficulties. Educators can use this framework as a heuristic for identifying needs in reading and for designing necessary interventions.
3. **This meta-analysis suggests that teaching comprehension strategies to older students with reading difficulties is associated with an overall effect equivalent to a gain of about one standard deviation.** Although the impact of these interventions on standardized measures of reading comprehension was not significantly different from zero, this may

be due to insufficient intensity, i.e., the interventions may not have been provided for a sufficient length of time. Providing comprehension strategy instruction to struggling readers at points throughout the school day, including during content-area classes in addition to instruction in specialized reading interventions, may pay schoolwide dividends. This would be no small undertaking. Successful implementation will require school-level leadership and coordinated planning. Content-area teachers would need additional professional development in order to teach these strategies effectively.

4. **Older students with reading difficulties benefit from improved knowledge of word meanings and concepts.** Reading at length and widely is a valuable way to increase vocabulary knowledge, and students with reading difficulties spend less time reading than more capable readers. Findings from this meta-analysis support the use of *more direct types* of vocabulary instruction to improve students' vocabulary. Students engaged in vocabulary interventions make gains when directly tested on the words they were taught. Since vocabulary instruction is essential to all domains of learning, it may be valuable for schools to initiate vocabulary-building practices schoolwide, thus benefiting a broad range of learners. Content-area teachers may see gains in achievement by focusing instructional time on the vocabulary necessary to understand the subject matter that students are expected to master. An important caveat: none of the studies in this meta-analysis used standardized measures of vocabulary. This is not surprising; standardized measures of vocabulary are difficult to influence because students' knowledge of specific word meanings or word types is typically the focus of intervention. Pending additional evidence, we know little about the extent to which these findings generalize to standardized types of measures.
5. **Word-study interventions for older students with reading difficulties are associated with small-to-moderate gains, even on standardized outcome measures.** For older students struggling at the word level, word-study intervention is an appropriate response.
6. **Interventions provided by both researchers and teachers are associated with positive effects,** although, in this meta-analysis, interventions provided by researchers are associated with higher effects

than interventions provided by teachers. There are several possible reasons: (a) researchers implement interventions more consistently, (b) researchers implement interventions with greater fidelity, (c) the novelty of a different teacher providing interventions positively influences students' response, and (d) studies implemented by researchers also use researcher-developed outcome measures, which are known to be associated with greater effects. Whatever the reason(s), teachers most frequently provide interventions in day-to-day school settings. Teachers of older struggling readers need additional training to implement interventions effectively. The more knowledge and expertise that teachers have, the greater their potential impact on student achievement.

7. **For older readers, average gains in reading comprehension are smaller than gains in other reading and reading-related areas** for the studies included in this meta-analysis, and the average effect size on standardized measures was associated with a very large confidence interval, suggesting a need for continued research. The effectiveness of these interventions for improving reading comprehension, the primary goal of intervention for older students, is not well established.
8. **Additional research that uses measures that more closely mirror typical group-administered reading assessments is needed.** A number of the studies in this analysis used individually administered measures of reading comprehension to assess the effects of the intervention. While these measures do provide useful information, they may not give a true indication of how students will perform in more typical classroom assessment situations. For example, individually administered standardized measures often involve reading much shorter passages than typical group-administered tests (such as state reading assessments), and often produce higher reading comprehension scores for struggling readers than group-administered tests (Torgesen, 2005). In order to provide better information about the instructional conditions necessary to close the reading gap for struggling readers, we need to invest in studies that provide instruction over longer periods of time and assess outcomes with measures that are more similar to those used by schools to monitor the reading progress of all students.

9. **Older students with learning disabilities (LD) benefit from reading intervention, when it is appropriately focused.** It is important that students with LD or reading difficulties receive appropriate intervention. The difficulty of the task should not be underestimated, and effective instruction is only one piece of the larger puzzle, albeit an important piece. The results of this meta-analysis suggest that older students with reading difficulties can benefit from well-designed, effectively delivered intervention.

Table 3. Key findings and implications

Finding	Implications
The overall effect size calculated based on standardized measures was much lower than the overall effect size calculated based on both standardized and researcher-developed measures (0.42 vs. 0.95 for reading and reading-related measures; 0.35 vs.0.97 for reading comprehension measures only).	Researcher-developed measures tend to show greater treatment effects because the measures are more directly linked to the specific intervention that was tested. Standardized measures tend to show smaller effects because they evaluate a more general skill set. Effect sizes on standardized measures reflect the ability of the participants to generalize their learning and are usually a more reliable estimate of effect in terms of how the students are likely to behave in the classroom.
The effect size for reading comprehension strategy interventions was very large (1.23 all measures; 0.55 standardized measures; 1.35 all measures of reading comprehension; 0.54 standardized measures of reading comprehension).	Reading comprehension strategy interventions can have a significant impact on the reading ability of adolescent struggling readers. This impact may generalize to more general, standardized measures in terms of the overall estimate of effect. The 95% confidence interval for these effect sizes was broad and included zero, so this finding is conditional on further research. Fortunately, rigorous research on effective instruction in reading comprehension with older students is a national priority (see Additional Resources, page 23).
Interventions focused on word study had a moderate overall effect (0.60 all measures; 0.68 standardized measures; 0.40 measures of reading comprehension).	Adolescent struggling readers benefit from word-study interventions. This may benefit reading comprehension for some students, although the "jury is still out." Based on this meta-analysis, the "true" effect of word-study interventions on reading comprehension outcomes, whether measured by norm-referenced or researcher-developed tests, may not differ from 0. This finding may reflect the "distance" between improved word-level skills and gains in reading comprehension. While word study is important for students who need such, its effect on reading comprehension may be small and difficult to detect. It may be a necessary part of improving reading comprehension for some older students; it is seldom, if ever, sufficient.

Table 3. Key findings and implications (continued)

Finding	Implications
Multi-component interventions demonstrated a moderate overall effect (0.56 all measures; 0.41 standardized measures; 0.80 all measures of reading comprehension; 0.59 standardized measures of reading comprehension).	Focusing on multiple components of reading instruction within the same intervention can produce meaningful effects. However, the average effect sizes for reading comprehension measures and for norm-referenced measures are associated with very large confidence intervals, suggesting considerable variability in effect across studies. This may be related to comparing interventions that include "multiple components." Having a greater number of "components" increases the number of possible permutations, which may result in a greater variety of average effects. As the number of multi-component studies increases, this topic can be further explored. Questions might include: What is the relative effect of the different components? What is the best mix of components? How might the mix differ depending on student need and on local capacity?
Fluency interventions had a small effect (0.26 all measures; 0.04 standardized measures; 0.26 all measures of reading comprehension; -.07 standardized measures of reading comprehension).	Repeated reading was the most prevalent fluency intervention in the studies used for this meta-analysis, and it appears that its effect on the reading ability of older readers is limited. Research using different intervention techniques is needed to determine how to effectively remediate fluency in adolescent struggling readers. The effects of fluency interventions on standardized measures and on all measures of reading comprehension were not reliably different from zero.
Vocabulary interventions had the largest overall effect size, 1.62. No vocabulary interventions used standardized measures, and most of them assessed the extent to which students learned the meaning of the words that were taught, rather than directly assessing their impact on reading.	Vocabulary interventions in the meta-analysis tended to focus on teaching words that are then assessed on the researcher-developed measures associated with the specific intervention. Generalization to standardized measures cannot be determined from these studies. While standardized measures of vocabulary are challenging to construct and use, there is a need for such. In their absence, it is difficult to determine if instructional effects generalize beyond the immediate context of the intervention. At this point, we have no evidence that relatively short-term vocabulary instruction with adolescents can produce a generalized impact on reading comprehension
Effect sizes were larger in studies where participants were middle-grade students (1.05 all measures; 0.56 standardized measures) as opposed to high school students (0.78 all measures; 0.13 standardized measures).	Consistent with research findings at the primary grade level, intervention for older struggling readers is most effective when it is provided as early as possible. If limited funding is available, focusing intervention at the middle grade level may be the best investment. However, older students do respond to intervention and all students who are struggling in reading should receive intervention.

Table 3. Key findings and implications (continued)

Finding	Implications
Across all studies, those with only participants with learning disabilities had significantly higher effects than those with no participants with learning-disabilities (ES=1.20 for all LD, 0.39 for no LD; $p<.05$).	Learning disabled students respond to intervention in meaningful ways that reflect significant improvements in reading and reading-related skills.
Effect sizes were larger for researcher-implemented interventions (1.49 all measures; 1.08 standardized measures) than for teacher-implemented interventions (0.63 all measures; 0.21 standardized).	The fidelity with which an intervention is implemented can influence the size of effects. Researcher-provided intervention is typically delivered with greater fidelity, due to training in the appropriate protocol. The result is a more appropriate level of instructional intensity by individual providers and greater consistency across providers. However, effects from teacher-implemented interventions remain sizable. When delivered with fidelity, teachers can provide effective interventions to adolescent struggling readers. Professional development is the key to establishing and maintaining high levels of fidelity. The more knowledge and expertise that teachers have about the interventions they are using, the greater the likelihood that the intervention will have a positive impact on students.

BACKGROUND ON META-ANALYSIS WITHIN SPECIAL EDUCATION

Meta-analysis is a methodology that allows for synthesizing research by using a consistent quantitative method for describing the effectiveness of interventions across studies. It is not unlike primary research in its assumptions and handling of data; however, instead of treating students as cases, it analyzes variation within and across studies, both in outcomes and in other characteristics of the studies. Meta-analysis yields an average overall effect and its standard deviation. A large (or statistically significant) standard deviation indicates the presence of considerable and systematic variation around the mean overall effect. It also suggests that factors other than the intervention may have a role in explaining the overall pattern of findings across studies. These other variables, known as moderators, can be related to research design and measurement or to more substantive factors that are associated with the intervention, such as attributes of participants in the studies, or of the settings where the interventions are implemented. Meta-analysis is useful for identifying these moderating factors.

Synthesizing research in the area of special education presents a number of challenges (as described in Berliner, 2002, and Odom et al. 2005). The sources and effects of this complexity vary in their details, but several general concerns cut across this body of work and have particular relevance to meta-analysis. First, the empirical literature in special education is characterized by a diversity of research designs. Descriptive and correlational studies predominate, although quasi-experimental designs have increased in use over the past ten years. Randomized approaches are still relatively rare, due, presumably, to the difficulty of creating comparison groups in settings where every member of the population may be entitled to the intervention in question. The absence of a comparison group, or the use of a nonrandomized treatment alternative, as in quasi-experimental studies, threatens a given study's internal validity (the confidence with which one can say "doing X causes Y").

Differences in research design also have a bearing when, as in meta-analyses, individual studies are combined. Effect sizes of similar magnitude are often discussed as though they represent comparable levels of impact. This is reasonable when they are derived from studies of equal rigor. However, when

the same-sized effects result from studies differing in the rigor of their methodology, the issue is less clear. For example, an effect of .50 from a quasi-experimental study is not truly comparable to an effect of .50 from a study with randomized groups, even when the same intervention is the subject of both studies. Meta-analysis is helpful in this context. It offers a framework for reliably unraveling the respective roles of the research method used and the underlying substantive effect, making it possible to combine a variety of study designs into a single overall estimate of impact.

While research design is the most prominent methodological variable, there are others. The fidelity with which a program is implemented increases the likelihood of obtaining a larger treatment effect. Comparing an intervention to typical classroom instruction generally provides a different estimate of the treatment effect than comparing two types of interventions does. Measurement of the dependent variable can also influence the size of an effect. Effect sizes from norm-referenced standardized tests that assess the impact of an intervention on a generalized skill are usually smaller than effect sizes from researcher-developed measures, which tend to be more closely aligned to elements of the treatment. Again, meta-analysis is a means of studying these methods-related influences to arrive at a reasonable estimate of intervention effects.

METHOD

Studies for the meta-analysis were located by searching electronic databases, by perusing reference lists of prior syntheses on related topics, and by researching citations to assure a comprehensive pool of eligible studies. To be included in the meta-analysis, studies had to have:

- been published between 1980 and 2006;
- included only students who were English-speaking struggling readers in grades 4-12 (or disaggregated data provided for this group of participants if other types of students participated in the study; only data for these students were included in the meta-analysis);
- consisted of an intervention focused on word study, fluency, vocabulary, reading comprehension strategies, or multiple components of reading instruction;
- used a multiple-group experimental or quasi-experimental design (treatment-comparison or comparison of multiple treatments);
- reported data for at least one dependent measure that assessed reading or reading-related variables; and
- reported sufficient data to allow for the computation of an effect size and a measure of standard error.

Coding. Thirty-one (31) studies met these criteria, and were coded on the following variables:

- focus of intervention (fluency, vocabulary, reading comprehension, word study, or multi-component);
- age/grade levels of the participants;
- type of participants (all with learning disabilities, some struggling and some with learning disabilities, or all struggling, none with learning disabilities); and
- provider of the intervention (researcher, teacher, or other personnel).

Table A (page 29) summarizes information for all 31 studies; background information for each study is included as well. Studies that did not report data on one or more variables were excluded from the analyses of the sub-questions

for which their data were not available. The total number of participants across all 31 studies was 1,306. Sample sizes of individual studies ranged from 13 to 115.

Effect size calculation. For all 31 studies, the Hedges (1981) procedure for calculating unbiased effect sizes for Cohen's d was used (this statistic is also known as Hedges g). In Bos and Anders (1990), multiple treatment groups were compared. Only the effect size for the semantic/syntactic feature analysis treatment and the definition instruction comparison was included in the meta-analysis. The treatment group was retained because it represented a full implementation of the intervention, while other treatments in the studies represented only a partial implementation.

In cases where a study included more than one reading-related outcome measure, effect sizes and standard errors were computed for all measures and the mean effect size was retained in the meta-analysis. The majority of outcome measures in the 31 studies were non-standardized and researcher-developed (19 of the 31 studies included only these types of measures). Previous research has demonstrated that effect sizes tend to be higher on these types of measures than on standardized, norm-referenced measures (Swanson, Hoskyn, & Lee, 1999). For this reason, two general analyses were conducted, one with effect sizes based on both standardized and non-standardized measures and a second using only studies that included one or more standardized, norm-referenced measures.

A study's design and measurement contribute to the magnitude of its effect and should be considered when interpreting its results; a small-sized effect on a standardized measure may be more meaningful than a similar-sized effect on a non-standardized measure. Stronger research designs with standardized measures typically yield more reliable estimates of a treatment's effect and may have greater value for informing practice than less rigorous designs.

A random effects model was used to analyze effect sizes. This model assumes variance is present in the effects of intervention both within each study and between the studies included in the analysis. Factors that differ between studies (e.g., differences in the focus of the intervention, LD-designation of participants) are introduced into the analysis as moderator variables in an attempt to explain the sources of the variance in effects.

ADDITIONAL RESOURCES

We recommend the following additional resources on interventions for adolescents with LD and/or struggling in reading:

Other research syntheses on interventions for struggling older readers:

Edmonds, M., Vaughn, S., Wexler, J., Reutebach, C., Cable, A., Tackett, K, & Wick, J. (in press). A synthesis of reading interventions and effects on literacy outcomes for older struggling readers. *Review of Educational Research.*

Gersten, R., Fuchs, L., Williams, J., & Baker, S. (2001). Teaching reading comprehension strategies to students with learning disabilities. *Review of Educational Research, 71,* 279-310.

Jitendra, A., Edwards, L., Sacks, G., & Jacobson, L. (2004). What research says about vocabulary instruction for students with learning disabilities. *Exceptional Children, 70,* 299-311.

Other resources:

Clapper, A., Bremer, C., & Kachgal, M. (2002, March). Never too late: Approaches to reading instruction for secondary students with disabilities. *National Center on Secondary Education and Transition Research to Practice Brief.*

Osborn, J. & Lehr, F. (2003). *A Focus on Fluency.* Available at www.prel.org/programs/rel/rel.asp.

Torgesen, J.K. (2005). Remedial interventions for students with dyslexia: National goals and current accomplishments. In Richardson, S., & Gilger, J. (Eds.) *Research-Based Education and Intervention: What We Need to Know.* (pp. 103-114). Boston: International Dyslexia Association.

Reading to Achieve: A governor's guide to adolescent reading. (2005). National Governor's Association Center for Best Practices.

Reading at Risk: How states can respond to the crisis in adolescent reading. (2005). National Association of State Boards of Education.

Reading Next: A vision for action and research in middle and high school reading. (2006). Alliance for Excellent Education.

Creating a Culture of Literacy: A guide for middle and high school principals. (2005). National Association of Secondary School Principals.

Adolescent Reading Resources: Linking Research and Practice. (2002). Northeast and Islands Regional Educational Laboratory at Brown University.

Adolescents and Reading: Reading for the 21st Century. (2003). Alliance for Excellent Education.

Teaching children to read: An evidence-based assessment of the scientific research literature on reading and its implications for reading instruction. (2000). Report of the National Reading Panel. National Institute of Child Health and Human Development.

Ten Years of Research on Adolescent Reading: 1994-2004: A review. (2005). Naperville, IL: Learning Point Associates.

REFERENCES

Abbott, S. P., & Berninger, V. W. (1999). It's never too late to remediate: Teaching word recognition to students with reading disabilities in grades 4-7. *Annals of Dyslexia, 49,* 223-250.

Alfassi, M. (1998). Reading for meaning: The efficacy of reciprocal teaching in fostering reading comprehension in high school students in remedial reading classes. *American Educational Research Journal, 35,* 309-331.

Allinder, R. M., Dunse, L., Brunken, C. D., & Obermiller-Krolikowski, H. J. (2001). Improving fluency in at-risk readers and students with learning disabilities. *Remedial and Special Education, 22,* 48-45.

Anders, P. L. Bos, C. S., & Filip, D. (1984). The effect of semantic feature analysis on the reading comprehension of learning-disabled students. In J. S. Niles and L. A. Harris (Eds.), *Changing Perspectives on Reading/Language Processing and Instruction* (pp.162-166). Rochester, NY: The National Reading Conference.

Biancarosa, G. & Snow, C. (2006). *Reading next—A vision for action and research in middle and high school reading.* A report to the Carnegie Corporation of New York (2nd Ed.). Washington, DC: Alliance for Excellent Education.

Berliner, D. C. (2002). Educational research: The hardest science of all. *Educational Researcher, 3J(S),* 18-20.

Bhat, P., Griffin, C. C., & Sindelair, P. T. (2003). Phonological awareness instruction for middle school students with learning disabilities. *Learning Disability Quarterly, 26,* 73-87.

Bhattacharya, A., & Ehri, L. C. (2004). Graphosyllabic analysis helps adolescent struggling readers read and spell words. *Journal of Learning Disabilities, 37,* 331-348.

Bos, C. S., & Anders, P. L. (1990). Effects of interactive vocabulary instruction on the vocabulary learning and reading comprehension of junior-high learning disabled students. *Learning Disability Quarterly, 13,* 31-42.

Bos, C. S., Anders, P. L., Filip, D., & Jaffe, L. E. (1989). The effects of an interactive instructional strategy for enhancing reading comprehension and content area learning for students with learning disabilities. *Journal of Learning Disabilities (22)*6, 384-390.

Boyle, J. R. (1996). The effects of a cognitive mapping strategy on the literal and inferential comprehension of students with mild disabilities. *Learning Disabilities Quarterly, 19,* 86-98.

Chan, K. S. (1991). Promoting strategy generalization through self-instructional training in students with reading disabilities. *Journal of Learning Disabilities, (24)*7, 427-290.

Conte, R., & Humphreys, R. (1989). Repeated readings using audiotaped material enhances oral reading in children with reading difficulties. *Journal of Communication Disorders, 22,* 65-79.

Darch, C., & Gersten, R. (1986). Direct setting activities in reading comprehension: A comparison of two approaches. *Learning Disability Quarterly, 9,* 235-243.

Deshler, D. (2005). Adolescents with learning disabilities: Unique challenges and reasons for hope. *Learning Disability Quarterly, 28,* 112.

DiCecco, V. M., & Gleason, M. M. (2002). Using graphic organizers to attain relational knowledge from expository texts. *Journal of Learning Disabilities, 35,* 306-310.

Dole, J., Brown, K., & Trathen, W. (1996). The effects of strategy instruction on the comprehension performance of at-risk students. *Reading Research Quarterly, 31,* 62-88.

Edmonds, M., Vaughn, S., Wexler, J., Reutebach, C., Cable, A., Tackett, K, & Wick, J. (in press). A synthesis of reading interventions and effects on reading outcomes for older struggling readers. *Review of Educational Research.*

Fuchs, L. S., Fuchs, D., & Kazdan, S. (1999). Effects of peer-assisted learning strategies on high school students with serious reading problems. *Remedial & Special Education, 20,* 309-319.

Gajria, M., & Salvia, J. (1992). The effects of summarization instruction on text comprehension of students with learning disabilities. *Exceptional Children, 58*(6) 508-516.

Hasselbring, T. S., & Goin, L. I. (2004). Reading instruction for older struggling readings: What is the role of technology? *Reading and Writing Quarterly, 20,* 113-144.

Hedges, L. V. (1981). Distribution theory for Glass's estimator of effect size and related estimators. *Journal of Education Statistics, 6,* 107-118.

Homan, S.P., Klesius, J.P., & Hite, C. (1993). Effects of repeated readings and nonrepetitive strategies on students' fluency and comprehension. *Journal of Educational Research, 87,* 94-99.

Jitendra, A. K., Hoppes, M. K., & Xin, Y.P. (2000). Enhancing main idea comprehension for students with learning problems: The role of a summarization strategy and self-monitoring instruction. *Journal of Special Education, 34,* 117-139.

Johnson, G., Gersten, R., & Carnine, D. (1987). Effects of Instructional design variables on vocabulary acquisition of learning disabilities students: A study of computer-assisted instruction. *Journal of Learning Disablities, 20*(4), 206-213.

Kennedy, K. M., & Backman, J. (1993). Effectiveness of the Lindamood Auditory in Depth Program with students with learning disabilities. *Learning Disabilities Research & Practice, 8*(4) 253-259.

Klingner, J. K., & Vaughn, S. (1996). Reciprocal teaching of reading comprehension strategies for students with learning disabilities who use English as a second language. *Elementary School Journal, 96,* 275-293.

Mastropieri, M. A., Scruggs, T., Mohler, L., Beranek, M., Spencer, V., Boon, R. T., & Talbott, E. (2001). Can middle school students with serious reading difficulties help each other and learn anything? *Journal of Learning Disabilities, 16,* 18-27.

Mastropieri, M. A., Scruggs, T. E., Levin, J. R., Gaffney, J., & McLoone, B. (1985). Mnemonic vocabulary instruction for learning disabled students. *Learning Disability Quarterly, 8,* 57-63.

McLoone, B. B., Scruggs, T. E., Mastropieri, M. A., & Zucker, S. F. (1986). Memory strategy instruction and training with learning disabled adolescents. *Learning Disabilities Research, 2*(1), 45-52.

Moore, P. J., & Scevak, J. J. (1995). The effects of strategy training on high school students' learning from science texts. *European Journal of Psychology of Education, 10,* 401-410.

O'Shea, L. J., Sindelar, P., & O'Shea, D. J. (1987). Effects of repeated readings and attentional cues on the reading fluency and comprehension of learning disabled readers. *Learning Disabilities Research, 2,* 103-109.

Odom, S., Brantlinger, E., Gersten, R., Horner, R., Thompson, B., & Harris, K. (2005). Research in special education: Scientific methods and evidence-based practices. *Exceptional Children, 71,* 137-148.

Penney, C. G. (2002). Teaching decoding skills to poor readers in high school. *Journal of Literary Research, 34,* 99-118.

Reutebach, C. (2006). *Reading intervention research for secondary students with learning disabilities.* Unpublished doctoral dissertation. The University of Texas, Austin.

Snider, V. E., (1989). Reading comprehension performance of adolescents with learning disabilities. *Learning Disability Quarterly, 11,* 87-96.

Swanson, H. L., Hoskyn, M., & Lee, C. (1999). *Interventions for students with learning disabilities: A meta-analysis of treatment outcomes.* New York: Guilford Press.

Torgesen, J. K., Houston, D. D., Rissman, L. M., Decker, S. M., Roberts, G., Vaughn, S., Wexler, J., Francis, D. J., Rivera, M. O., & Lesaux, N. (2007). *Academic literacy instruction for adolescents: A guidance document from the Center on Instruction.* Portsmouth, NH: RMC Research Corporation, Center on Instruction.

Torgesen, J. K. (2005). Remedial Interventions for students with dyslexia: National hoals and current accomplishments. In Richardson, S., & Gilger, J. (Eds.) *Research-Based Education and Intervention: What We Need to Know.* (pp. 103-114). Boston: International Dyslexia Association.

Veit, D. T., Scruggs, T. E., & Mastropieri, M. A. (1986). Extended mnemonic instruction with learning disabled students. *Journal of Educational Psychology, 78*(4), 300-308.

Wilder, A. A., & Williams, J. P. (2001). Students with severe learning disabilities can learn higher order comprehension skills. *Journal of Educational Psychology, 93,* 268-278.

Williams, J. P., Brown, L. G., Silverstein, A. K., & deCani, J. S. (1994). An instructional program in comprehension of narrative themes for adolescents with learning disabilities. *Learning Disabilities Quarterly, 17,* 205-221.

Table A. Study Characteristics

Study	Number of Participants	Total number of sessions	Total Min of Intervention	Person Implementing	Grade/Age	Student Type	Intervention Type
Abbott & Berninger (1999)	20	16	960	Other School Personnel	4th-7th	none LD	Word Study
Alfassi (1998)	75	20	750	Teacher	9th	none LD	Comprehension
Allinder, Dunse & Obermiller-Krolikowski (2001)	49	NR[1]	NR	Teacher	7th	some LD	Fluency
Anders, Bos, & Filip (1983)	62	2	100	Teacher-Researcher	9-11th	all LD	Vocabulary
Bhat, Griffin, & Sindelar (2003)	40	18	NR	Teacher	6th-8th	all LD	Word Study
Bhattacharya & Ehri (2004)	40	4	110	Researcher	6th-9th	none LD	Word Study
Bos & Anders (1990)	30	8	400	Researcher	Avg=13.8 yrs.	all LD	Multi-component
Bos, Anders, Filip, & Jaffe (1989)	50	2	230	Teacher-Researcher	Avg=16.2 yrs.	all LD	Multi-component
Boyle (1996)	30	11	550	Researcher	6th-8th	some LD	Comprehension
Chan (1991)	20	5	200	Teacher	5th-6th	all LD	Comprehension
Conte & Humphreys (1989)	26	30	600	Teacher	9-13 yrs.	none LD	Fluency
Darch & Gersten (1986)	24	9	450	Teacher-Researcher	9th-11th	all LD	Comprehension
DiCecco & Gleason (2002)	24	20	800	Teacher-Researcher	6th-8th	all LD	Comprehension
Fuchs, Fuchs, & Kazdan (1999)	102	NR	NR	Teacher	9th	some LD	Multi-component

Table A. Study Characteristics (continued)

Study	Number of Participants	Total number of sessions	Total Min of Intervention	Person Implementing	Grade/Age	Student Type	Intervention Type
Gajria & Salvia (1992)	30	NR	NR	Researcher	6th-9th	all LD	Comprehension
Hasselbring & Goin (2004)	125	NR	NR	NR	6th-8th	none LD	Multi-component
Homan, Klesius, & Hite (1993)	26	21	420	Teacher	6th	none LD	Fluency
Jitendra, Hoppes, & Xin (2000)	33	8	240-320	Researcher	6th-8th	some LD	Comprehension
Johnston, Gersten, & Carnine (1987)	24	11	220	Researcher	9th-11th	all LD	Vocabulary
Kennedy & Backman (1993)	20	90	4500	Teacher-Other School Personnel	11-17 yrs.	all LD	Multi-component
Klingner & Vaughn (1996)	26	27	945-1080	Researcher	7th-8th	some LD	Comprehension
Mastropieri, Scruggs, Levin, Gaffney, & McLoone (1985)	31	1	NR	Researcher	7th-9th	LD	Vocabulary
Mastropieri, Scruggs, Mohler, Berabek, Spencer, Boon, & Talbot (2001)	24	25	1150	Teacher	7th	some LD	Multi-component
McLoone, Scruggs, Mastropieri, & Zucker (1986)	60	1	25	Researcher	7th-8th	all LD	Vocabulary

Table A. Study Characteristics (continued)

Study	Number of Participants	Total number of sessions	Total Min of Intervention	Person Implementing	Grade/Age	Student Type	Intervention Type
Moore & Scevack (1995)	21	7	420	Teacher	14-15 yrs.	none LD	Comprehension
O' Shea, Sindelar, & O'Shea (1987)	31	1	NR	Researcher	5th-8th	all LD	Fluency
Penney (2002)	32	15-18	840-1008	Teacher	9th-11th	none LD	Word Study
Snider (1989)	26	13	650	Researcher	Avg=14 yrs.	all LD	Comprehension
Veit, Scruggs, & Mastropieri (1986)	64	5	50	Researcher	6th-8th	all LD	Vocabulary
Wilder & Williams (2001)	91	11	540	Teacher	6th-8th	all LD	Comprehension
Williams, Brown, Silverstein, & deCani (1994)	93	9	360	Teacher	5th-8th	all LD	Comprehension

[1] NR=Not reported

Table B. Outcomes by intervention type and design

Intervention	Measure[a]	Findings/results
Comprehension		
Alfassi (1998) • *T (Reciprocal teaching):* Working in small groups, students read text aloud, generated questions, summarized the text for their peers, discussed and clarified difficulties, and made predictions (n=53). • *C (Current practices):* School's typical remedial reading instruction consisting of skills acquisition (n=22).	Gates MacGinitie Reading comprehension subtest *(standardized)* Gates MacGinitie Reading vocabulary subtest *(standardized)* Reading assessments	*T vs. C* ES=-.23 *T vs. C* ES=-.17 *T vs. C* ES=.98
Boyle (1996) • *T (strategy instruction):* Students taught to create cognitive maps from reading passages (n=15). • *C (no treatment):* Administered measures only (n=15).	Literal below grade level comprehension questions Inferential below grade level comprehension questions Literal on grade level comprehension questions Inferential on grade level comprehension questions Formal Reading Inventory Silent reading subtest	*T vs. C* ES=.76 *T vs. C* ES=.96 *T vs. C* ES=.87 *T vs. C* ES=1.33 *T vs. C* ES=.34
Chan (1991) • *T (intensive self-questioning strategy instruction):* Extensive training in how to generalize a self-questioning strategy for identifying main ideas (n=10). • *C (no generalization):* Self-questioning strategy was introduced briefly and students practiced on their own (n=10).	Multiple choice comprehension test Main idea identification test (with prompt to use strategy) Main idea identification test (no prompt to use strategy) Rating sentences test (with prompt to use strategy) Rating sentences test (no prompt to use strategy)	*T vs. C* ES=.38 *T vs. C* ES=.28 *T vs. C* ES=1.92 *T vs. C* ES=-.28 *T vs. C* ES=.38
Darch & Gersten (1986) • *T1 (Basal pre-reading activities):* Improve comprehension through developing student interest and motivation; connect relevance of the passage to students' past experience; offer a general introductory discussion (n=11). • *T2 (Advanced organizer):* A text outline designed to help student's process text information (n=11).	Multiple choice content knowledge test (per unit) Unit 1 Unit 2 Unit 3 Multiple choice content posttest	*T1 vs. T2* ES=.74 ES=.63 ES=1.16 *T1 vs. T2* ES=1.66

Table B. Outcomes by intervention type and design (continued)

Intervention	Measure	Findings/results
DiCecco & Gleason (2002) • *T (Graphic organizers):* Direct instruction using a graphic organizer of concept relationships (n=11). • *C (No graphic organizer):* Instruction in the same content using guided discussions and note-taking (n=11).	Multiple choice content knowledge test	*T vs. C* ES=.48
	Fact recall	*T vs. C* ES=.08
	Number of relational knowledge statements essays	*T vs. C* ES=1.62
Gajria & Salvia (1992) • *T (Summarization strategy):* Five rules of summarization taught to students with LD in resource classes (n=15). • *C (typical instruction):* School's typical reading instruction provided to students with LD in resource classes (n=15).	Multiple choice comprehension of expository passages	*T vs. C* ES=5.98
	5 condensation questions 5 factual questions	*T vs. C* ES=2.68
Jitendra, Hoppes, & Xin (2000) • *T (Main idea):* Main idea strategy instruction using prompt cards and self-monitoring (n=18). • *C (Current practices):* School's typical reading instruction (n=15).	Main idea: trained passages (identification/production of main idea statements)	*T vs. C* ES=2.18
	Main idea: near transfer (similar narrative passages)	*T vs. C* ES=2.18
	Main idea: far transfer (expository passages)	*T vs. C* ES=2.51
Klingner & Vaughn (1996) • *T1 (Reciprocal teaching + tutoring):* Reciprocal teaching plus peer tutoring on comprehension strategies (n=13). • *T2 (Reciprocal teaching + cooperative learning):* Reciprocal teaching plus strategy practice in cooperative learning groups (n=13).	Gates MacGinitie Reading comprehension subtest (standardized)	*T1 vs. T2* ES=1.38
	Passage comprehension test (% correct)	*T1 vs. T2* ES=.34
Moore & Scevack (1995) • *T (SLIC: Summarize, Link, Image, Check):* Explicit instruction in a set of strategies: summarize text, link text and visual aids, visually depict the relationship(s), and check for understanding (n=11). • *C (Current practices):* School's typical reading instruction (n=10).	Free recall (# details)	*T vs. C* ES=-.55
	Free recall (# of main ideas)	*T vs. C* ES=.07
	Multiple choice comprehension test	*T vs. C* ES=-.36
	Transfer: free recall details	*T vs. C* ES=-.37
	Transfer: free recall main idea	*T vs. C* ES=-.54
	Transfer: multiple choice test	*T vs. C* ES=-.35

Table B. Outcomes by intervention type and design (continued)

Intervention	Measure	Findings/results
Snider (1989) • *T (Direct teaching of informational and vocabulary concepts):* Adapted worksheets from *Reading Mastery III* and *IV* were used to present information and vocabulary orally; apply as a group; and provide individual written practice of the newly acquired information (n=13). • *C (Current practices):* School's typical reading instruction (n=13).	Test of passage comprehension (1 multiple choice question for each of the 24 lessons)	*T vs. C* ES=1.36
Wilder & Williams (2001) • *T1 (Theme identification):* Scaffolded instruction that included a pre-reading discussion, reading the story, post-reading discussions guided by organizing questions, identifying the story theme and relating the theme to real-life experiences (n=47). • *T2 (Story comprehension):* Comprehension instruction emphasizing vocabulary and plot through teacher-generated questions and discussion (n=44).	Transfer: Story details in novel text (# recalled)	*T1 vs. T2* ES=.41
	Transfer: Story components in novel text (main ideas)	*T1 vs. T2* ES=.59
	Theme concepts (understanding explicitly taught themes)	*T1 vs. T2* ES=1.67
	Theme identification	*T1 vs. T2* ES=5.88
	Theme application	*T1 vs. T2* ES=1.73
	Vocabulary definitions	*T1 vs. T2* ES=.25
	Using vocabulary in sentences	*T1 vs. T2* ES=.55
Williams et al. (1994) • *T1 (Themes instruction):* Scaffolded instruction in prereading discussion, reading the story, participating in discussions guided by organizing questions, identifying the story theme and relating that theme to real-life experiences (n=53). • *T2 (Basal reading instruction):* Instruction on the same content using a basal reader series adapted to the structure of prereading discussion, vocabulary development, story reading and postreading discussion (n=40).	Theme concept (understanding explicitly taught theme)	*T1 v. T2* ES=1.40
	Theme identification	*T1 vs. T2* ES=2.06
	Theme application	*T1 v. T2* ES=2.93

Table B. Outcomes by intervention type and design (continued)

Intervention	Measure	Findings/results
Word Study		
Abbott & Berninger (1999) • *T1 (Structural analysis):* Instruction in the alphabetic principle, phonological decoding (applied phonics and structural analysis), structural analysis focused on affixes and suffixes, and repeated oral reading with error correction (using structural analysis) and comprehension monitoring (n=10). • *T2 (Study skills):* T1 with synthetic phonics strategies (i.e., letter-sound correspondence) and study skills instruction (workbook pages on note-taking, outlining and paragraph writing) in place of structural analysis instruction and application (n=10).	WRMT-R[b]: Comprehension *(standardized)* WRMT-R: Word identification *(standardized)* WRMT-R: Word attack *(standardized)* Qualitative Reading Inventory *(standardized)* TOWRE *(standardized)* TOWRE: pseudo-words *(standardized)*	*T1 vs. T2* ES=.11 *T1 vs. T2* ES=.16 *T1 vs. T2* ES=.08 *T1 vs. T2* ES=.18 *T1 vs. T2* ES=.30 *T1 vs. T2* ES=.04
Bhattacharya & Ehri (2004) • *T1 (Syllable chunking strategy):* Students were taught to orally divide multisyllabic words into syllables, state the number of syllables, match them to their spelling and blend the syllables to say the whole word. Corrective feedback was provided after each step (n=20). • *T2 (Whole word reading):* Students practiced reading multisyllabic words with no applied strategy. Corrective feedback was provided (n=20). • *C1 (Current practices):* School's typical reading instruction (n=20).	WRMT-R Word attack *(standardized)* Syllable segmentation Decoding words Decoding subtle misspellings Decoding pseudo-words by analogy	*T1 vs. C* ES=1.37 *T2 vs. C* ES=.42 *T1 vs. C* ES=1.11 *T2 vs. C* ES=.20 *T1 vs. C* ES=.64 *T2 vs. C* ES=.41 *T1 vs. C* ES=1.11 *T2 vs. C* ES=.50 *T1 vs. C* ES=.49 *T2 vs. C* ES=.03
Bhat et al. (2003) • *T (Great Leaps Reading Program + phonemic awareness):* Phonological and phonemic awareness lessons from Great Leaps reading program supplemented with additional	CTOPP[c] *(standardized)* WRMT-Word identification *(standardized)*	*T vs. C* ES=1.56 *T vs. C* ES=.15

Table B. Outcomes by intervention type and design (continued)

Intervention	Measure	Findings/results
phonemic awareness activities including phoneme blending, segmenting, reversal and substitutions (n=20). • *C* (Current practices): School's typical reading instruction (n=20).		
Penney (2002) • *T (Phonemic decoding):* Students read aloud from text; words read slowly or incorrectly were then taught using the Glass Analysis method of rehearsing the pronunciation of letter sequences that form pronounceable parts of words (n=21). • *C (Current practices):* School's typical reading instruction (n=11).	PPVT *(standardized)* WRMT: Word identification (standardized) WRMT: Word attack WRMT: Passage comprehension	*T vs. C* ES=.80 *T vs. C* ES=.47 *T vs. C* ES=.42 *T vs. C* ES=.63
Fluency		
Allinder (2001) • *T1 (Specific Fluency Strategy Instruction):* Students taught to focus on using a strategy during read aloud conferences; strategies included reading with inflection, self-monitoring for accuracy, reading at appropriate pace, watching for word endings, and tracking with finger (n=33). • C (No Strategy Instruction): Students asked to do their best while reading aloud (n=16).	WJRM-Word identification *(standardized)* WJRM-Word attack *(standardized)* WJRM-comprehension *(standardized)* Slope on Maze Task	*T1 vs. C* ES=-.02 *T1 vs. C* ES=.08 *T1 vs. C* ES=-.03 *T1 vs. C* ES=.78
Conte & Humphreys (1989) • *T1: (Repeated Reading with Audiotaped Material):* In RRT, the teacher and student previewed the text. Next, the student listened to a short passage (1st paragraph) once or twice and then began to track the words in the book as they were read on tape. The student reads the passage along with the tape and then without the tape. Prior to the session and after the session the teacher reviewed the content (n=13).	Oral reading: Ekwall reading grade Silent reading: Ekwall reading grade Oral reading: Ekwall speed scores Silent reading: Ekwall speed scores WRMT-Word attack *(standardized)* WRMT- Passage comprehension *(standardized)* Boder Test of Reading and Spelling Patterns	*T1 vs. C* ES=.22 *T1 vs. C* ES=.00 *T1 vs. C* ES=.94 *T1 vs. C* ES=.98 *T1 vs. C* ES=-.77 *T1 vs. C* ES=-.16 *T1 vs. C* ES=-.64

Table B. Outcomes by intervention type and design (continued)

Intervention	Measure	Findings/results
• *C:* These students received an alternative reading program similar to T1 (with respect to creative writing, spelling, phonics, and vocabulary development), but differed in terms of passage reading exercises. This group read from basal readers (n=13).		
Homan et al. (1993) • *T1 (Repeated Reading):* In pairs with close teacher supervision, student read the same passage four times. Peers did not give feedback when a word could not be pronounced (n=13). • *T2 (Assisted Non Repetitive Reading):* Students used three strategies: echo reading (the students echo the teacher's reading), unison reading (the students and teacher read together), cloze reading (the teacher reads the selection pausing to let students randomly read words aloud). Students did not repeat any passages previously read (n=13).	Errors: Words read incorrectly (not counting hesitations, proper name mispronounciations, repetition of one word, and repetitions of a word for self correction)	*T1 vs. T2* ES=.04
	Time: Number of minutes required for a student to read each selection	*T1 vs. T2* ES=.50
	Comprehension retellings: Based on unprompted story retellings	*T1 vs. T2* ES=.35
O'Shea et al. (1987) • *T1 (Fluency Cue):* Students were given a cue to read quickly and accurately. Students were exposed to all three levels of the repeated reading condition: one, three, and seven readings (n=16). • *T2 (Comprehension Cue):* Students were given a cue to read for comprehension. Students were exposed to all three levels of the repeated reading condition: one, three, and seven readings (n=16).	Reading rate: The number of words read correctly divided by the total reading time	*T1 vs. T2* ES=.03
	Comprehension: The percentage of story propositions (POP) retold during the final reading	*T1 vs. T2* ES=.89
Multi-component		
Bos & Anders (1990) • *T1 (Definition instruction activity):* Directly teaching vocabulary terms from the content area text with an emphasis on oral recitation;	Multiple choice comprehension posttest	*T1 v. T2* ES=1.29 *T1 vs. T3* ES=.43 *T1 vs. T4*

Table B. Outcomes by intervention type and design (continued)

Intervention	Measure	Findings/results
correct and automatic pronunciation; and memorization of precise definitions (n=11). • *T2 (Semantic mapping strategies):* Construction of a hierarchical relationship map from the vocabulary list on which important ideas of the passage are listed across the top and related vocabulary is listed down the side (n=19). • *T3 (Semantic feature analysis condition):* Predictions were made about the relationships among concepts using a relationship matrix on which important ideas of the passage are listed across the top and related vocabulary is listed down the side (n=17). • *T4 (Semantic/syntactic feature analysis condition):* Predictions were made about the relationships among concepts using a relationship matrix and participant predicted the answers for cloze-type sentences using the matrix as a guide (n=14).		ES=1.14 *T2 v. T3* ES=.33 *T2 vs. T4* ES=.08 *T3 vs. T4* ES=.20
	Multiple choice vocabulary posttest	*T1 vs. T2* ES=1.24 *T1 vs. T3* ES=1.00 *T1 vs. T4*[d] ES=.62 *T2 vs. T3* ES=.04 *T2 vs. T4* ES=.65 *T3 vs. T4* ES=.53
	Written recall posttest	*T1 vs. T2* ES=.22 *T1 vs. T3* ES=.23 *T1 vs. T4*[d] ES=.07 *T2 vs. T3* ES=.62 *T2 vs. T4* ES=.22 *T3 vs. T4* ES=.46
	Scriptal knowledge recall posttest	*T1 vs. T2* ES=.17 *T1 vs. T3* ES=.20 *T1 vs. T4*[d] ES=.01 *T2 vs. T3* ES=.52 *T2 vs. T4* ES=.23 *T3 vs. T4* ES=.31
Bos et al. (1989) • *T1 (Semantic feature analysis condition):* Predictions were made about the relationships among concepts using a relationship matrix on which important ideas of	Multiple choice comprehension test: vocabulary	*T1 vs. T2* ES=.94
	Multiple choice conceptual knowledge items	*T1 vs. T2* ES=.69

Table B. Outcomes by intervention type and design (continued)

Intervention	Measure	Findings/results
the passage are listed across the top and related vocabulary is listed down the side (n=25). • *T2 (Dictionary method/typical instruction):* Participants used the dictionary to write definitions of words supplied on their vocabulary list. Teacher first read the words, then students repeated. Finally students used a dictionary to write a definition and sentence using the word as it related to their social studies content (n=11).		
Fuchs, Fuchs, & Kazdan (1999) • *T (Peer-assisted learning strategies: PALS):* Partner reading, paragraph shrinking, and prediction relay implemented using a dyadic structure (n=52; LD n=35). • *C (Current practices):* School's typical reading instruction with no peer-mediated learning activities (n=50; LD n=39).	Comprehensive Reading Assessment Battery: Oral reading fluency *(standardized)*	*T vs. C* ES=.05
	Comprehensive Reading Assessment Battery: Comprehension questions *(standardized)*	*T vs. C* ES=.31
Hasselbring & Goin (2004) • *T (Computer-based reading instruction):* Instruction in Peabody Reading Lab: Reading Lab with videos to support students in building mental models from text; Word Lab with practice reading words on timed tasks; Spelling Lab with practice typing a word that is pronounced, broken into parts and used in a sentence plus additional spelling fluency practice (n=63). • *C (Current practices):* School's typical reading instruction (n=62).	SDRT[e]: Comprehension *(standardized)*	*T vs. C* ES=.99
	SDRT: Auditory vocabulary *(standardized)*	*T vs. C* ES=.75
	SDRT Phonetic analysis *(standardized)*	*T vs. C* ES=.23
	SDRT Structural analysis *(standardized)*	*T vs. C* ES=.44
Kennedy & Backman (1993) • *T (Remedial typical reading and spelling instruction plus Lindamood auditory discrimination in depth program):* Taught through individual tutorial sessions with spelling taught through a combination of a phonetic approach based on learning	LAC[f] May *(Standardized)*	*T vs. C* ES=1.55
	SORT[g] May *(Standardized)*	*T vs. C* ES=.13
	SAT-Sp[h] May *(Standardized)*	*T vs. C* ES=.57

Table B. Outcomes by intervention type and design (continued)

Intervention	Measure	Findings/results
patterns, principles, and rules; sight words and common sequences; and word families and homonyms. Plus, Lindamood reading and spelling multisensory approach to develop phonological awareness. Questioning techniques are used to stimulate awareness of motor feedback from articulatory movements. Blocks are used to represent syllables, which in turn helps make the connection between sounds and orthographic symbols (n=10). • *C (Typical remedial instruction):* Taught through individual tutorial sessions with spelling taught through a combination of a phonetic approach based on learning patterns, principles, and rules; sight words and common sequences; and word families and homonyms (n=10).	GORT[1] May *(Standardized)*	*T vs. C* ES=-.28
Mastropieri et al. (2001) • *T (Peer Tutoring Condition):* Partner reading with error correction, passage summarization (Get the Gist), and questioning strategies for during and after reading implemented using same-age peer tutoring sessions (n=11). • *C (Current practices):* School's typical reading instruction (n=11).	Open-ended comprehension test	*T vs. C* ES=1.14
Vocabulary:		
Anders, Bos, & Filip (1983) • *T (Semantic feature analysis):* Students learn how to categorize words and determine differences and similarities among ideas (n=31). • *C (typical instruction):* Look up words in dictionary (n=31).	Comprehension test total	*T vs. C* ES=1.66

Table B. Outcomes by intervention type and design (continued)

Intervention	Measure	Findings/results
Johnson, Gersten, & Carnine (1987) • *T1 (small set):* Computer drill & practice on a small set of words with cumulative review (n=11). • *T2 (large set):* Computer drill & practice on a large set of words without cumulative review (n=11).	 Percent correct Percent correct Sessions to mastery	*T1 vs. T2* ES=.18 ES=.41 ES=.85
Mastropieri, Scruggs, Levin, Gaffney, & McLoone (1985) • *T1 (pictorial mnemonic strategy):* Taught 14 words using a keyword and an associated picture with a strategy for remembering meaning of words (n=16). • *T2 (direct instruction):* Taught 14 words by showing picture; no strategy for remembering meaning of words (n=16).	Recall	*T1 vs. T2 exp. 1* ES=2.45 *T1 vs. T2 exp. 2* ES=1.05
McLoone, Scruggs, Mastropieri, & Zucker (1986) • *T1 (mnemonic strategy):* Taught 14 words using a keyword and an associated picture with a strategy for remembering meaning of words (n=30). • *T2 (directed rehearsal):* Taught 14 words by repeating words and their definitions (n=30).	Training task Transfer task	*T1 vs. T2* ES=3.00 *T1 vs. T2* ES=1.65
Viet, Scruggs, & Mastropieri (1986) • *T1 (mnemonic strategy):* Taught dinosaur attributes using a pictorial method (n=32). • *T2 (direct instruction):* Taught dinosaur vocabulary and facts using teacher-directed questioning, group responding, and review (n=32).	 Attribute learning Delayed recall identification Delayed recall production Extinction learning Vocabulary application Vocabulary loose scoring Vocabulary strict scoring	*T1 vs. T2* ES=1.70 ES=1.95 ES=1.38 ES=2.25 ES=1.33 ES=1.48 ES=1.16

a. All measures are researcher-developed unless indicated by a parenthetical note (e.g., standardized)
b. WRMT=Woodcock Reading Mastery Test; WRMT-R=Woodcock Reading Mastery Test – Revised
c. CTOPP=Comprehensive Test of Phonological Processing
d. Only this comparison was included in the meta-analysis
e. SDRT=Stanford Diagnostic Reading Test
f. LAC=Lindamood Auditory Conceptualization Test
g. SORT=Slosson Oral Reading Test
h. SAT-Sp=Stanford Achievement Test -Spelling
i. GORT=Gray Oral Reading Test