Published in final edited form as:

Learn Disabil Q. 2014 November 1; 37(4): 218–229. doi:10.1177/0731948714528806.

Why Intensive Interventions Matter: Longitudinal Studies of Adolescents With Reading Disabilities and Poor Reading Comprehension

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Abstract

We describe findings from a series of longitudinal studies utilizing a response to intervention framework implemented over 3 years with students in Grades 6 through 8 with reading disabilities and poor reading comprehension. Students were identified based on reading comprehension scores in Grade 5 ($n = 1,083$) and then randomized to treatment or comparison conditions. Beginning in sixth grade, students assigned to intervention were provided treatment for 1, 2, or 3 years based on their response to instruction in each preceding year. Screening procedures, progress monitoring tools, tiers of instruction, and findings from each year of the study are reported. Additional studies investigating reading and behavioral outcomes through multi-level, growth modeling, and studies of the cognitive and neural correlates of inadequate response are also reported.

Keywords

intensive interventions; reading disabilities; response to intervention; middle school

Evidence supporting the use of multi-tiered reading instruction within a response to intervention (RtI) framework suggests beneficial outcomes for early identification and intervention for students in the early grades (Denton, Fletcher, Anthony, & Francis, 2006). However, much less is known about approaches to intervening with students in middle grades who have already exhibited reading failure (Kamil et al., 2008). To address this gap in the evidence-base, we conceptualized and implemented a RtI framework designed to investigate the effects of multi-tiered interventions for students with reading disabilities in Grades 6 through 8 (Vaughn & Fletcher, 2012). The (RtI) service delivery framework included critical elements common to early elementary models but modified for secondary

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Authors' Note The content is solely the responsibility of the authors and does not necessarily represent the official views of the Eunice Kennedy Shriver National Institute of Child Health and Human Development or the National Institutes of Health.

Declaration of Conflicting Interests The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

students: (a) screening procedures and use of progress monitoring tools, (b) implementation of school-wide professional development to enhance reading comprehension across content areas (Tier 1), and (c) development, implementation, and evaluation of secondary (Tier 2) and tertiary (Tier 3) interventions. The multi-year investigation also permitted analyses of academic, behavioral, and cognitive correlates of differential RtI among participants, as well as investigations of what modifications are necessary when implementing RtI in middle school. Within this framework, it is important to understand the reading performance of and findings from previous intervention research for older students.

Reading Achievement Data for Older Students

In 2013, 69% of fourth graders and 60% of eighth graders with disabilities scored below the basic level on the National Assessment of Educational Progress (NAEP) reading test, indicating performance well below grade-level expectations. In contrast, for students without disabilities in 2013, only 27% of fourth graders and 18% of eighth graders without disabilities scored below basic on the NAEP reading test. These data suggest that instructional practice provided through current educational programming might not be sufficiently robust to meet the educational needs of many students with disabilities. However, there is empirical evidence to support the notion that students with reading difficulties and reading disabilities can improve their reading ability when provided intensive reading interventions (Edmonds et al., 2009; Scammacca et al., 2007; Solis et al., 2012; Wanzek et al., 2013).

Reading Interventions for Students With Reading Difficulties

Several empirical syntheses have investigated the impact of reading interventions for secondary students with reading difficulties (Edmonds et al., 2009; Scammacca et al., 2007; Solis et al., 2012; Wanzek et al., 2013). Edmonds et al. examined reading comprehension outcomes from 13 studies in which instruction in decoding, fluency, vocabulary, or comprehension was provided to students in Grades 6 through 12. The findings indicated an overall mean-weighted effect size (ES) in the moderate range ($mean\ d = 0.35$) with word-level interventions for comprehension outcomes, favoring students in the treatment conditions. Multi-component reading interventions compared with control conditions were most effective ($ES = 0.72$) for enhancing reading comprehension outcomes for students with reading difficulties. Targeted reading interventions in comprehension, multiple reading components, and word reading strategies were all identified as promising practices.

Scammacca et al. (2007) conducted a meta-analysis of 31 studies that provided instruction in decoding, fluency, vocabulary, and comprehension for students with learning disability (LD) in Grades 4 to 12. All reading-related outcomes were examined. The overall mean-weighted ES was in the moderate range ($ES = 0.35$), and multi-component reading interventions were shown to be more effective ($ES = 0.56$) versus comparison conditions on all reading-related outcomes. Several key components of effective reading comprehension instruction, such as vocabulary instruction, strategy instruction, and text selection, were documented. In a follow-up to the 2007 meta-analysis, Scammacca, Roberts, Vaughn, and Stuebing (2013) reported that the addition of studies completed since original publication resulted in much

smaller mean ESs for secondary students. Studies published after 2005 yielded a substantially smaller mean ES of 0.49 when compared with the mean ES of 0.95 reported for studies published between 1980 and 2004. For standardized measures of reading, the mean ES was 0.21 for studies published after 2005, much smaller than the 0.42 mean ES reported for studies published between 1980 and 2004. A greater number of large, randomized trials occurred after 2005, which the authors suggest may explain the smaller observed ESs in more recent research investigating reading interventions with secondary students.

Solis et al. (2012) conducted a synthesis of reading comprehension interventions for middle school students with LDs. Twelve studies between 1979 and 2009 with experimental or quasi-experimental designs and single-subject studies were identified. Intervention components included main idea-summarization, strategy instruction, mapping, mnemonics, multi-component interventions, and self-monitoring procedures. The majority of interventions ($n = 13$; several studies included more than one intervention component) utilized strategy instruction related to main idea-summarization. Several interventions included an aspect of self-monitoring procedures ($n = 7$). Overall, large ESs were reported for researcher-developed measures and medium ESs were reported for standardized measures of reading comprehension.

Wanzek et al. (2013) utilized meta-analytic techniques to investigate intensive reading interventions for students in Grades 4 to 12, which were defined as studies that provided instruction for 75 or more sessions. Of the 19 studies that met the inclusion criteria, 10 studies were in a meta-analysis if they used treatment-comparison experimental or quasi-experimental design, and reported sufficient information to allow ESs to be computed. The majority of studies implemented multi-component interventions. Other treatment conditions included multi-sensory phonics instruction, fluency instruction, vocabulary instruction, self-visual imagery, self-questioning, paraphrasing, and inference instruction. Mean ESs ranged from 0.10 to 0.16 for comprehension, word reading, word reading fluency, reading fluency, and spelling outcomes. No significant differences in students' outcomes were detected across studies related to instructional group size, number of hours of intervention, or grade level of intervention. Table 1 provides a summary of findings from previous research with struggling readers in Grades 4 to 10 with reading difficulties as it pertains to instructional practices, student learning needs, and intervention practices such as group's size and duration of instruction.

RtI Framework in Middle School

Through funding from the National Institute of Child Health and Human Development, the Texas Center for Learning Disabilities (TCLD) conducted a longitudinal program of research with a goal of generating empirical evidence about the development and implementation of RtI in middle schools. Components of the RtI framework included the development of screening and progress monitoring procedures, secondary (Tier 2) interventions, and tertiary (Tier 3) interventions. In the following sections, we describe (a) participants and screening procedures, and (b) the multi-tiered intervention. Student reading outcomes from Years 1 to 3 of the project are reported. We then present findings on assessment procedures for RtI service delivery models in middle school, including

implications for screening and progress monitoring. Finally, we present findings from studies investigating the cognitive and behavioral attributes of students and their relation to reading intervention, including the effects of intervention on behavioral attention and potential cognitive predictors of intervention response. We finish with a discussion of the implications of this interdisciplinary research program for the intervention and treatment of students with reading difficulties in middle school.

Participants and Screening Procedures

Participants were drawn from seven middle schools in two cities (three school districts) in the southwestern United States. The sample was nearly evenly split between the two cities, with four middle schools in one city and three in the other. These schools ranged in size from 500 to 1,400 students and drew students from a mix of urban and near urban neighborhoods. As part of an initial screening procedure, we used the state's criterion-referenced reading assessment (the Texas Assessment of Knowledge and Skills [TAKS]) to identify struggling readers. Although it is common to implement specific screening measures in elementary school RtI models, students from Grade 3 and beyond in most public schools are subject to mandatory accountability testing. We felt that it was important to try and reduce the assessment burden by utilizing existing assessment data as much as possible. Students who scored below a scale score 2,150 on the TAKS (the cut score was chosen to approximate a cutoff of the 30th percentile) were randomized within schools to the RtI framework or a comparison condition prior to Year 1 of the study. Initial random assignment for each student was maintained throughout all 3 years of the study. After each year of intervention, students assigned to the RtI framework were either exited from the framework or assigned to a tier of greater instructional intensity, based on end-of-year performance on TAKS. The same criterion score (<2,150) was maintained throughout all years of the study. Intervention students who scored below the criterion score were eligible to continue intervention in tiers of higher intensity (Tier 3 in Years 2 and 3). Students who scored above the criterion score were exited from the RtI framework.

The initial sample included a total 1,748 adolescents in Grades 6 to 8. This sample represented all students available for intervention who did not meet the TAKS criterion ($n = 1,025$). In addition, 784 typically achieving students were randomly selected to facilitate understanding of whether the intervention reduced the gap in reading achievement and for additional studies involving assessment (Cirino et al., 2013). Students who were not taught in English and with educational needs that precluded significant general education placement were not included. Although the sample reflected the demographics of the schools and communities from which they were drawn, it tended to have higher representation of students who qualified for reduced/free lunch (64%) and students for whom English was not their first language (19%). Fifty percent of participants were male. A large percentage of participants were African American (40%) or Hispanic (36%). A smaller percentage of participants were White (20%) or Asian (3%). About 30% of the students had school-identified disabilities. The breakdown of disability type was not reported (Cirino et al., 2013). These demographics are consistent with characteristics that make students at risk for reading comprehension difficulties (Kamil et al., 2008).

Tier 1: Classroom Instruction

We conceptualized the Tier 1 intervention at the secondary level as instruction provided in content area classes. Students assigned to treatment and comparison conditions received content area instruction enhanced with reading practices that were associated with improved outcomes in vocabulary and comprehension. We selected vocabulary and reading comprehension practices associated with medium to high ESs (Kamil et al., 2008). The research team provided a 6-hr professional development session to content area teachers (e.g., science and social studies) as well as in classroom support for implementation at participating schools to help teachers incorporate evidence-based vocabulary and reading comprehension instruction in their classes. All students participated in a daily English language arts class. The length of the class varied by site (50–85 min). Students in the larger district also participated in a daily, 45-min reading class designed around the curriculum goals assessed by the TAKS provided by district personnel. For students assigned to treatment, this class was in addition to the supplemental reading intervention provided by the research team during an elective period. A description of the different intervention conditions over the course of the study is provided in Table 2.

Tier 2: Secondary Intervention

Students assigned to the Tier 2 intervention received daily reading instruction during their elective period for the entire year (approximately 160 sessions). We conducted two separate studies: one with sixth graders and one with seventh and eighth graders. Group size in sixth grade was uniform (10–12 students). However, for seventh and eighth graders assigned to the Tier 2 intervention, students were randomly assigned to either small group intervention (3–5 students) or large group intervention (10–15 students). Each condition was allotted 25 instructional groups. Thus, a larger number of students completed the large group intervention ($n = 208$) than the small group intervention ($n = 55$).

The small and large group interventions consisted of the same instructional content. The intervention consisted of explicit instruction on word study, reading fluency, vocabulary, and reading comprehension. Students spent 3 days a week reading expository social studies text (REWARDS Plus; Archer, Gleason, & Vachon, 2005) and 2 days per week reading narrative text in novels. The yearlong intervention proceeded in three phases, with varying emphases. In Phase 1 (~7–8 weeks), word study and fluency were emphasized. Students learned strategies for decoding multi-syllabic words and participated in structured partner reading. In addition, teachers provided explicit vocabulary and comprehension instruction. Phase 2 emphasized vocabulary and comprehension. Skills and strategies taught in Phase 1 continued, but students spent the majority of instructional time working on comprehension through reading of connected text. Instruction focused on improving comprehension through questioning skills, as well as specific strategies for comprehension, such as previewing, main idea, and self-monitoring of text. Phase 3 focused on independent student application of the skills and strategies taught for word study and vocabulary in Phases 1 and 2. Fluency and comprehension activities were embedded in novel units developed by the research team. Table 2 provides an overview of the different intervention conditions that occurred during the 3-year study.

Tier 3: Tertiary Intervention

Students who continued to demonstrate low scores on the TAKS after Year 1 were eligible the subsequent year for participation in the Tier 3 intervention. Comparison students remained in a business as usual (BAU) comparison condition, meaning that students received all instruction normally provided by their district or school, but did not receive any additional instruction from the research team. Students in the Tier 3 intervention were randomly assigned to two empirically derived, but conceptually different interventions: (a) standardized treatment protocol or (b) an individualized treatment. Participants in both conditions attended the intervention for one period (45–50 min) daily in lieu of an elective class. Students attended the Tier 3 intervention for 1 year (~160 lessons). Group size for both Tier 3 interventions was four to five students. See Table 2 for a summary of the Tier 3 intervention.

Standardized intervention—In the standardized intervention, teachers provided explicit instruction in word study, reading fluency, vocabulary, and reading comprehension. As in the Tier 2 intervention, instruction proceeded in three phases with distinct emphases. Phase 1 emphasized word study and reading fluency. Phases 2 and 3 focused on word study and vocabulary, with an emphasis on independent application of acquired skills in Phase 3.

Individualized intervention—Students in the individualized intervention received instruction in which adjustments to the time allocated for different reading components was based on test scores and responsiveness to ongoing progress monitoring measures. Student progress through the lessons was based on individual mastery, rather than group mastery. The research team utilized assessment data to create individual student profiles in phonics, word reading, fluency, vocabulary, and comprehension. Teachers were able to tailor content, instructional materials, and pacing to meet individualized needs of students.

The individualized intervention included specific guidelines for the use of instructional time. Each week, students with higher level decoding skills received 35 to 45 min of instruction in vocabulary/morphology, 170 to 180 min in comprehension/text reading, and 15 to 25 min on a motivational component. In contrast, students with below average decoding skills spent 100 to 110 min each week on word study and text reading instruction, and 70 to 80 min on reading comprehension/text reading. The instructional time for vocabulary and morphology instruction remained consistent for students despite any differences in decoding abilities.

Year 1 Findings

Year 1 research addressed the effectiveness of the Tier 2 intervention, as well as the relative effects of intervention group size on the reading achievement of intervention students relative to BAU comparison students. These findings are reported fully in Vaughn, Cirino, et al. (2010) and Vaughn, Wanzek, et al. (2010). Among sixth graders, Tier 2 intervention students outperformed comparison students, with statistically significant differences on measures of word reading ($d = 0.15$), word attack ($d = 0.15$), reading fluency ($d = 0.19$), and reading comprehension ($d = 0.19$). In contrast, students who participated in the intervention as seventh graders demonstrated few statistically or clinically significant gains over students in the comparison condition.

Taken together, these findings suggested that the needs of older students with reading difficulties might be more extensive than can be addressed through a supplementary reading intervention provided for one class period for 1 year. Adolescent students with reading difficulties demonstrated deficits in vocabulary, background knowledge, and reading habits. Addressing these deficits in the framework of a year-long intervention did not appear to be realistic. An intervention designed to ameliorate the effects of multiple years of reading and academic difficulties may require greater intensity, longer duration, and earlier implementation.

With regards to group size, results were consistent in showing no statistically significant effect associated with large (10–12 students) or small (4–5 students) group interventions. Although the pattern of effects slightly favored the small group over the large group intervention, the effects were small and not practically meaningful. This finding suggests that the manipulation of group size is not a major factor in altering outcomes for older students with reading difficulties.

Year 2 Findings

Year 2 research addressed the efficacy of the Tier 3 intervention for students who demonstrated inadequate response to Tier 2 intervention and the relative effects of an individualized versus standardized intervention. Students in both intervention groups (individualized and standardized) demonstrated statistically significant differences for reading comprehension compared with students in the control condition ($d = .52$, individualized vs. control; and $d = .56$, standardized vs. control). However, there were noted differences between the two intervention conditions when compared with the control condition on measures of word reading ($d = 0.28$, individualized vs. control; $d = 0.44$, standardized vs. control), word attack ($d = 0.14$, individualized vs. control; $d = 0.45$, standardized vs. control), word reading fluency ($d = 0.24$, individualized vs. control; $d = 0.27$, standardized vs. control), and spelling ($d = 0.31$, individualized vs. control; $d = 0.36$, standardized vs. control).

Comparisons of the performance of students in the individualized and standardized Tier 3 interventions were not statistically significant, although students in the standardized intervention demonstrated a small advantage in word attack ($d = 0.27$). This finding runs contrary to the research hypothesis, which posited that students in individualized treatment would outperform students in the standardized intervention. One related finding was that students with school-identified disabilities also obtained significantly better outcomes with the standardized intervention than the individualized intervention (Wanzek et al., 2013). Although these findings cannot be considered conclusive, they provide important implications for intervention planning because of the substantial investment in training, supervision, and professional development necessary to implement any individualized treatment.

Year 3 Findings

Year 3 research addressed the effects of long-term intervention (continuation of Tier 3) for eighth-grade students demonstrating persistently inadequate RtI. Students who responded

inadequately to 2 years of intervention were compared with both comparison students and typically achieving peers. The goal was to determine the effectiveness of continued intervention and whether the intervention had successfully closed the gap for struggling readers. All Tier 4 participants demonstrated inadequate response to both the Tier 2 and Tier 3 interventions. Students in the continuation of the Tier 3 intervention for a second year demonstrated significantly higher scores than comparison students on measures of reading comprehension ($ES = 1.20$) and word attack ($ES = 0.49$). However, these sizable advantages largely reflected the downward trend on *standard scores* (age adjusted) with performance on reading comprehension outcomes by students in the comparison condition. The reading comprehension scores for students who participated in the Tier 3 intervention were relatively steady (based on *standard scores*) compared with their pretest scores. This finding indicated that without continued remedial instruction, middle school students with poor reading comprehension fell further behind their normative peers, which provides a compelling rationale for continued intervention for adolescents with persistent reading difficulties (Vaughn et al., 2012).

Overall Efficacy of the RtI Framework

A subsequent study by Roberts, Vaughn, Fletcher, Stuebing, and Barth (2013) evaluated the effectiveness of the RtI framework at improving reading outcomes across years. In contrast to the previously described studies, Roberts et al. evaluated initial assignment to the RtI framework or the comparison condition as the independent variable. Likely 3-year trends were estimated and compared for students assigned to the RtI framework and students participating in the comparison condition. A framework of multi-tiered, sustained interventions, in which the amount of intervention varied by student depending on response, served as the conceptual basis of the study. A multiple-indicator, multi-level model was fit to estimate the effect of the RtI framework and to address questions about the potential acceleration of student learning. This type of approach maximizes the advantages of structural equation modeling in longitudinal studies by explicitly modeling measurement error in observed variables and by constraining measurement variance across time points, which yields more precise trend estimates (Wu, Li, & Zumbo, 2007). Treatment effects between students in the intervention and comparison condition were estimated, in addition to the extent to which treatment may have narrowed the achievement gap in relation to the group of typical readers included in the study design.

Results indicated that middle school students with low reading comprehension who participated in the treatment, on average, outperformed students in the comparison condition ($ES = 0.26$). Students in the intervention condition also outperformed typical readers when achievement was characterized in terms of slope over time. The average slope estimate for treatment students was statistically greater than the slope of typical readers. Although it is encouraging that the slope of the treatment group indicates progress in relation to the comparison and typical reader groups, at the end of 8th grade, a considerable gap remained between the typical readers group and the treatment group. The trajectories indicated that the intervention group could “catch up” to the group of typical readers by the end of 12th grade. However, the likelihood of this occurring would be contingent upon many factors, including reliable and sustained implementation of comprehensive, intensive interventions, consistent

allocation of staffing and coaching for this purpose, and overall repurposing of some of the common structures (e.g., scheduling, credits toward graduation, teacher training) that are typical of schools in the United States.

Screening and Progress Monitoring

The use of benchmark testing and ongoing progress monitoring is critical elements of the RtI framework for implementation in the middle school setting. We investigated ways to maximize the accurate assessment of student needs while minimizing the amount of assessment administered. Below we describe the screening procedures, and the use of oral reading fluency for progress monitoring.

Screening—A major assessment issue was whether the state accountability reading test, the TAKS could be used as an initial screening assessment. One question was whether the TAKS validly measured reading comprehension. To answer this question, we administered multiple measures of reading comprehension, along with assessments of decoding and fluency skills, to the entire sample of participants. These measures included Woodcock–Johnson III (WJ III) Letter Word Identification, Word Attack, and Comprehension subtests; Test of Word Reading Efficiency (TOWRE) sight word and phonemic decoding; Word List Fluency; Passage Fluency; Group Reading Assessment and Diagnostic Evaluation (GRADE) reading comprehension; TCLD reading comprehension; Test of Sentence Reading Efficiency (TOSRE); AIMS web maze; and Test of Sentence Comprehension Fluency (TOSCRF). Cirino et al. (2013) reported a confirmatory factor analysis indicating that the assessment battery measured four constructs: word decoding accuracy, word and passage reading fluency—comprehension/fluency as assessed by timed maze and sentence verification tests, a comprehension factor representing reading and listening comprehension, and oral language vocabulary. The TAKS was loaded on the comprehension factor. Cirino et al. (2013) also reported that identification rates for struggling readers from the TAKS overlapped significantly with norm-referenced assessments of reading comprehension. Less than 20% of the students with reading problems had specific problems with reading comprehension. About one third of the sample was impaired in decoding, fluency, and comprehension, whereas another third was impaired in fluency and comprehension.

Progress monitoring—The TAKS is untimed and does not discriminate between the different components of reading that may need to be assessed to successfully guide instruction. We therefore evaluated whether a short reading probe assessing fluency. As part of our assessment, we gave multiple norm-referenced and criterion-referenced measures that could be used for progress monitoring. We also constructed word reading and passage reading fluency measures specifically designed for adolescents and equated for the difficulty level of the stories (Barth et al., 2012). These passages were administered every 2 months for a total of 5 times to assess growth (Tolar et al., 2012). Last, we compared fluency estimates from 1-min samples versus full passages and conducted reliability and validity studies (Barth et al., 2012; Barth et al., in press).

To summarize, we found that oral reading fluency measures are reliable and valid measures for middle school students for both good and poor readers (Barth et al., 2012). The mean and

median scores were comparable and there was little additional value of longer assessments lasting more than 1 min, including assessments that require reading entire passages (Barth et al., in press). However, results also indicated that equating different probes is essential to deal with form effects. Passage difficulty accounted for more than 50% of the variance in fluency rates (Barth et al., 2012). In addition, our research indicated that growth rates in oral reading fluency were much lower than those observed in elementary students. Grade 8 students read only 15 words correct per minute faster than Grade 6 students. Growth over the five administrations across the school year was about 12 words correct per minute. This small amount of growth observed in oral reading fluency among middle school students has two important implications for assessment. First, it suggests that progress monitoring could be conducted less frequently and at longer intervals than is typically done with early elementary students. In addition, there was a little evidence of value-added information from computations of the slope for a determination of inadequate RtI (Tolar, Barth, Francis, Fletcher, & Vaughn, 2013). Instead, multiple final status indicators in different reading domains may represent a practical and sensitive battery for determining individual RtI.

Adding a 1-min passage reading assessment increased the information provided by TAKS scores, which were much lower for students with decoding, fluency, and comprehension difficulties. However, the TAKS could not differentiate students with fluency and comprehension versus only comprehension difficulties. Students' instructional needs could be more accurately distinguished with the addition of the fluency assessment, so we also administered a brief fluency assessment for students who did not meet criteria on the TAKS. We did not find evidence supporting the need for more extensive assessments of students who would include cognitive and behavioral measures, an issue addressed in more detail in the next sections. More information on this approach to screening and progress monitoring is available at <http://www.texasldcenter.org/>

Cognitive and Neural Correlates of Inadequate Intervention Response

Other studies addressed factors that may help elucidate bases for inadequate response. These included studies of inattention, and specific cognitive processes and their relation to intervention and intervention response.

Results of Reading Interventions on Teacher-Rated Attention

To address problems with attention often displayed by students with reading disabilities, reading outcomes were evaluated in relation to teacher ratings of attention for students in Grades 6 to 8 (Roberts et al., 2014). Eligible students were identified as struggling readers based low performance on their spring of fifth grade state reading test. These students were randomized in early summer of 2006 within schools to the response-based, tiered intervention condition or to a comparison condition using a 2:1 assignment ratio to maximize the potential benefits of treatment. The sample for this analysis included those with low reading comprehension in sixth grade, who were randomly assigned within school to intervention ($n = 278$) or to the comparison condition ($n = 141$). Intervention components consisted of a combination of explicit instruction of word reading and vocabulary, and reading comprehension strategy instruction. Notably, although components of the tiered

interventions addressed self-regulation, the intervention was not directly developed for students with inattentive behavior.

A multiple-indicator, multi-level latent variable growth model estimated the effects of treatment trends in reading and attention. Measurement models for growth in reading ability and attention were fit. Reading ability was estimated as a latent variable on each of the four measurement time points using three subtests of the Woodcock–Johnson. Attention was estimated using the first nine items of the Strength and Weaknesses of ADHD symptoms and Normal Behavior (SWAN) rating scale (Swanson et al., 2006). The SWAN rating scale consists of items derived from the Diagnostic and Statistical Manual of Mental Disorders (4th ed.; *DSM-IV*; American Psychiatric Association [APA], 1994; APA, 2000), which measures attention on a continuum from attention problems to positive attention skills using a 7-point scale. It was hypothesized that the reading intervention would affect reading behavior, which in turn would affect behavioral attention.

Results indicated that participation in the reading interventions was associated with changes in students' attention as measured through teacher reports (Roberts et al., 2014). Intensive interventions over 3 years improved reading achievement and behavioral attention in middle school students with low comprehension and reading disabilities. Contrary to expectations, the causal order was improved reading to improved behavioral attention. One potential explanation is that to the extent difficulties with attention and self-regulation are related, the self-regulation components of the intervention led to improvement in teacher ratings of attention. It is also possible that motivation to read may be linked to improved reading and improved attention. Motivation to read is a multi-faceted construct and may be increasingly predictive of reading comprehension as students get older (Guthrie et al., 2007).

Cognitive Correlate of Inadequate Response

Miciak, Fletcher, Stuebing, Vaughn, and Tolar (2013) evaluated cognitive correlates of different RtI. A sample of students who participated in the Tier 2 intervention and completed a comprehensive academic and cognitive assessment in Year 2 of the study were identified as a means to investigate cognitive differences associated with inadequate RtI. Inadequate response was defined as a standard score of 90 or below on standardized measures in three reading domains: (a) basic decoding (WJ III Basic Reading), (b) reading fluency (TOWRE), and (c) reading comprehension (WJ III Passage Comprehension). The application of response criteria allowed the classification of participants into three discrete groups of inadequate responders: (a) poor comprehenders, (b) impaired fluency, and (c) globally impaired readers. The three groups were compared with adequate responders and to each other on external academic and cognitive variables (i.e., variables not used to determine adequate RtI).

Results indicated a clear hierarchy on both cognitive and academic variables, with the adequate responder group scoring higher on both academic and cognitive variables, the groups with specific fluency or comprehension impairments scoring similarly, and the globally impaired readers scoring lowest on both cognitive and academic measures (Miciak et al., 2013). A significant group-by-task interaction was found when comparing inadequate responder groups on the set of cognitive variables. As seen in Figure 1, the inadequate

responders demonstrated striking differences in their cognitive profile. Poor comprehenders demonstrated significantly lower performance on measures of listening comprehension and vocabulary, both constructs strongly associated with reading comprehension (Catts, Adlof, & Weismar 2006). In contrast, fluency-impaired readers demonstrated specific deficits in rapid naming, a construct strongly associated with reading fluency (Barth, Catts, & Anthony, 2009). Finally, the globally impaired group demonstrated significant deficits in phonological awareness, a construct that has been linked to basic decoding, even among students in the middle school (Catts et al., 2006). These findings suggest there may be unique cognitive correlates associated with deficits in different domains of reading.

However, such a finding does not necessarily indicate that cognitive testing following a determination of inadequate response is necessary or meaningful. To address this question, a second analysis investigated whether cognitive differences found between adequate and inadequate responders reflect unique cognitive attributes associated with response status, or reflect differences in the severity of the reading impairment (Vellutino, Scanlon, Small, & Fanuele, 2006). Recent studies have found that inadequate and adequate responders can be differentiated on a large number of academic and cognitive variables with a clear stepwise progression indicating differences in level, but not pattern of achievement (Fletcher et al., 2011; Vellutino et al., 2006). However, the fundamental question is whether there is a unique cognitive variance associated with responder status, beyond that explained by the level of reading impairment. A series of regression analyses predicted cognitive achievement based on reading ability (using the three criterion measures as predictors) and a dichotomous contrast indicating responder status (adequate or inadequate responder). If the contrast was significant, it would indicate that there is a unique variance in the cognitive variable associated with responder status and not explained by reading achievement. Such a finding would suggest that cognitive testing following a determination of inadequate response provides meaningful information. Of the seven contrasts performed, only one was significant, suggesting that cognitive differences may be explained by differences in the level of reading achievement only. Such findings raise questions about the utility of cognitive assessment following a determination of inadequate response, because cognitive assessment does not appear to contribute additional, meaningful information beyond that contained in tests of reading achievement.

Discussion

Using findings from a set of studies based on a multi-year, database of students in Grades 6, 7, and 8 with significant reading difficulties, we provide a summary from 1-, 2-, and 3-year interventions conducted within a RtI framework. We also describe the overall results of implementing a RtI framework in middle school, as well as the cognitive and neural correlates of inadequate RtI. Overall, these studies provide a compelling case for continued reading interventions for students with reading difficulties well-beyond third grade, particularly for students with the most intractable reading difficulties (i.e., students who participated in treatment for 3 years). While we interpret extant research with younger students as suggesting positive impact from early interventions and consider early intensive interventions a necessary element of a well-developed reading approach (Wanzek & Vaughn, 2009), our findings with sixth through eighth graders confirm that many students

will continue to demonstrate reading difficulties beyond third grade and that these difficulties are not readily remediated. Beyond the instructional practices reported in Table 1, there are several other key findings to highlight.

First, whether students are in small groups or moderately small groups was not associated with statistically significant differences (Vaughn, Wanzek, et al., 2010). We think that these two group sizes were too close in size, represent findings only for the selected age range (i.e., not younger students), and may need to be replicated with larger differences in group size (e.g., $n = 1-3$ students and $n = 12-15$ students). Second, we think that the finding that students receiving individualized instruction did not differentially benefit from students receiving standardized instruction requires further research and consideration particularly for students with the most significant reading disabilities. We anticipate for example, that examining the relative effects of data-based, decision-making as a format for instructional modifications may be a valuable path for further research. Third, we think that the findings from this research should be considered within a conceptual framework that relies heavily on an understanding of the complex, language and knowledge-based function of reading for understanding. Students whose language and knowledge skills are further behind each year will be challenged to “make up” this difference in a system that provides 50 min of reading a day. Rather, these students will require this intensive intervention within a school-wide practice of providing text and vocabulary-based instruction across the curriculum.

Implications for Research and Practice

Research on secondary students with low reading comprehension and reading disabilities yields the following implications for the key components of RtI including screening, assessment, and intervention. The use of the state-level reading assessment provides a reliable, valid, and efficient starting point for screening of secondary students along with the use of an additional fluency measure as an initial diagnostic tool and as an ongoing progress monitoring measure. The change of scores with progress monitoring is much lower when compared with primary students and therefore can be administered less frequently. Also contrary to RtI with younger students is the need for students to work through tiers of interventions over time. Rather, older students can be assigned to more or less intensive interventions based on their current reading achievement scores (Fuchs, Fuchs, & Compton, 2010). For adolescents with low reading skills, intensive interventions should be considered using texts that build background knowledge and understanding of content learning (e.g., social studies, science, English) throughout the secondary grades.

Acknowledgments

Funding The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: This research was supported by Grant P50 HD052117 from the Eunice Kennedy Shriver National Institute of Child Health and Human Development.

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Figure 1.
Implications from research on students in Grades 4 to 10 with reading difficulties.

Table 1

Implications From Research on Students in Grades 4 to 10 With Reading Difficulties.

Implications	Edmonds et al. (2009)	Kamil et al. (2008)	Roberts, Vaughn, Fletcher, Stuebing, and Barth (2013)	Scammacca et al. (2007)	Solis et al. (2012)	Wanzek et al. (2013)
Adolescents with reading difficulties benefit from intensive interventions. However, it is unrealistic to expect that complex reading-related problems can be easily and quickly remediated.	X	X	X	X		X
Most of the adolescents with reading difficulties have deficits in multiple reading components (e.g., vocabulary, word study) and can benefit from daily, multi-component interventions that target both word and comprehension. Most of the older students with reading difficulties continue to struggle with word reading including high utility words and multi-syllable words.		X	X			X
Adolescents with reading difficulties benefit from explicit instruction designed to support understanding of text, including frequent modeling, feedback, and opportunities for practice.	X	X	X	X	X	X
Interventions that teach multiple reading comprehension strategies are associated with positive effects.	X	X	X	X	X	X
Teachers should utilize strategies to enhance students' motivation to read and increase engagement in the reading task.		X	X			
There is a little evidence to suggest that group size or intervention individualization influence intervention outcomes.			X	X		X
Interventions for adolescents with reading difficulties are likely to require multi-year interventions to adequately meet students' needs.	X	X	X	X		X

Table 2**Intervention Features Across Studies.**

Intervention type	Grade(s)	Key features	Group size	Duration
Year 1				
Vaughn, Cirino, et al. (2010)				
Tier 1: Enhanced core instruction	6	Professional development for all content area teachers to enhance vocabulary and reading comprehension instruction.	Whole class	—
Tier 2: Standardized protocol		Explicit instruction in word study, fluency, vocabulary, and comprehension. Strategies included question generation, summarization, and main idea.	10+ students	45–50 min
Vaughn, Wanzek, et al. (2010)				
Tier 1: Enhanced core instruction	7 and 8	Professional development for all content area teachers to enhance vocabulary and reading comprehension instruction.	Whole class	—
Tier 2: Small group		Explicit instruction in word study, fluency, vocabulary, and comprehension. Strategies included question generation, summarization, and main idea.	3–5	45–50 min
Tier 2: Large group		Explicit instruction in word study, fluency, vocabulary, and comprehension. Strategies included question generation, summarization, and main idea.	10–15	45–50 min
Year 2				
Vaughn, Wexler, et al. (2011)				
Tier 1: Business as usual	7 and 8	All instructions were typically provided by the participating school.	—	—
Tier 3: Standardized protocol		Explicit instruction in word study, fluency, vocabulary, and comprehension. Instruction addressed all components without regard to individual student deficits.	3–5	45–50 min
Tier 3: Individualized protocol		Explicit instruction in word study, fluency, vocabulary, and comprehension. Instructional allocation was based on individual student needs. Advancement and pacing were based on content mastery.	3–5	45–50 min
Year 3				
Vaughn, Wexler, et al. (2012)				
Tier 1: Business as usual	8	All instructions were typically provided by the participating school.	—	—
Tier 3/4: Intensive reading intervention		Instruction tailored to meet individual needs. Lessons were designed to address students' needs in phonics, word reading, fluency, and comprehension. Instructional time allocation was adjusted biweekly based on progress monitoring data.	2–4	50 min