Learning and Individual Differences 65 (2018) 195–206

Contents lists available at ScienceDirect

Learning and Individual Differences

journal homepage: www.elsevier.com/locate/lindif

Reading comprehension development in at-risk vs. not at-risk first grade readers: The differential roles of listening comprehension, decoding, and fluency☆

Emily J. Solari[a,*], Ryan P. Grimm[a], Nancy S. McIntyre[a], Carolyn A. Denton[b]

[a] School of Education, University of California, Davis, 1 Shields Ave., Davis, CA 95616, United States
[b] Children's Learning Institute, University of Texas Health Science Center Houston, 7000 Fannin, UCT 2443, Houston, TX 77030, United States

ARTICLE INFO

Keywords:
Reading comprehension
Listening comprehension
Decoding
Fluency

ABSTRACT

This study examined the relations between and predictive power of three important subcomponents skills of reading comprehension: decoding, listening comprehension, and reading fluency. Through a series of structural equation models, we examine the relations within a full sample of first grade students at the beginning of the year (N = 290). Next, we conducted analyses to determine if differential relations exist between the variables in students who are identified as at-risk for reading failure, and potentially reading disability (n = 141) and those who are not (n = 149). Results indicate that in early first grade, the relations between the subcomponent skills are different dependent upon risk status. For the full sample, fluency was the strongest predictor of reading comprehension, followed by decoding and listening comprehension. When the sample was split based on early reading skills at the beginning of first grade, for the not at-risk students, fluency, decoding, and listening comprehension each made individual contributions to reading comprehension. For the at-risk students, decoding was only significantly related to reading comprehension via fluency; listening comprehension did not significantly predict reading comprehension for this subsample. The findings are discussed and related to implications for the development and implementation of early reading interventions for students who are identified as having reading difficulties and potentially reading disability.

1. Introduction

Reading comprehension is the ability to make meaning from written, connected text; it is a multidimensional process, that is intentional and interactive, and requires precise performance of several underlying subcomponent skills. Understanding the development of these underlying subcomponent skills is essential to meet the instructional needs for all students learning to read. This is, arguably, most important for students who struggle with reading and reading related skills in the early grades, and may be at-risk of reading disability (RD). Students who do not receive adequate early reading intervention, targeted to their individual needs, tend to have persistent reading difficulties over the course of their school careers (Francis, Shaywitz, Stuebing, Shaywitz, & Fletcher, 1996; Juel & Leavell, 1988; Torgesen & Burgess, 1998). In order to develop and implement appropriate early reading interventions that target later reading comprehension, it is important to investigate specific subcomponent skills in early readers, with the goal of determining how these skills develop in readers who, during the early elementary years, appear to be at risk for RD.

While the field is well informed on the development of reading comprehension in typically developing populations, somewhat less attention has been paid to the differential development of students who show signs of early risk in both decoding and comprehension. Evidence from previous studies suggests that early reading development for students who struggle and those diagnosed with reading disability does not follow the same pattern as typically developing readers. For example, often these students never attain the same level of reading skills as their peers (e.g., Francis et al., 1996; Pennington & Lefly, 2001; Scarborough, 1998; Snowling, Muter, & Carroll, 2007; Stanovich, 1986) demonstrating that development does not simply occur at a slower pace, but rather on an atypical trajectory. Slower speech and language development associated with broader language difficulties, early

☆ This research was supported by the Institute of Education Sciences, U.S. Department of Education, through grant R324A150091 to the Regents of the University of California. The content is solely the responsibility of the authors and does not necessarily represent the official views of the Institute of Education Sciences or the U.S. Department of Education.

* Corresponding author.
E-mail addresses: Ejsolari@ucdavis.edu (E.J. Solari), rpgrimm@UCDAVIS.EDU (R.P. Grimm), nsmcintyre@ucdavis.edu (N.S. McIntyre), Carolyn.A.Denton@uth.tmc.edu (C.A. Denton).

https://doi.org/10.1016/j.lindif.2018.06.005
Received 1 June 2017; Received in revised form 29 March 2018; Accepted 6 June 2018

deficits in phonological awareness, and familial risk for reading disability often characterize struggling readers (Catts, Hogan, & Adlof, 2005; Gallagher, Frith, & Snowling, 2000; Pennington & Olson, 2005; Preston et al., 2010; Scarborough, 1990). Few studies have empirically tested differential relations between early reading predictors in young at-risk readers as compared to their peers who do not demonstrate a profile of reading risk.

1.1. Reading comprehension development

Gough and Tunmer's (1986) influential model, the Simple View of Reading (SVR), postulates that successful reading comprehension is a multiplicative model that includes two essential ingredients or subcomponent skills: word decoding and oral or listening comprehension (often referred to as listening comprehension). Empirical data supports the notion that both decoding and listening comprehension account for a large amount of variance in reading comprehension (Catts et al., 2005; Chen & Vellutino, 1997; Cutting & Scarborough, 2006; Hoover & Gough, 1990; Joshi & Aaron, 2000; Tunmer & Chapman, 2012). There is also empirical evidence that the relation between these variables changes over time (Catts et al., 2005; Francis, Fletcher, Catts, & Tomblin, 2005; Gough, Hoover, & Peterson, 1996; Kendeou, van den Broek, White, & Lynch, 2009; Kershaw & Schatschneider, 2012; Vellutino, Tunmer, Jaccard, & Chen, 2007); specifically, in the early grades, word recognition skills are paramount in their contribution to reading comprehension, while in later grades the importance of listening comprehension increases. The role of reading fluency, or the rate and accuracy of reading words and connected words text (Adams, 1990), is not specifically delineated in the SVR, although recent empirical data suggests a significant relation between reading fluency and reading comprehension (Chard, Vaughn, & Tyler, 2002; Eason, Sabatini, Goldberg, Bruce, & Cutting, 2013; Fuchs, Fuchs, Hosp, & Jenkins, 2001; Fuchs, Fuchs, & Maxwell, 1988; Jenkins, Fuchs, Van Den Broek, Espin, & Deno, 2003; Kim & Wagner, 2015; NICHD, 2000; Silverman, Speece, Harring, & Ritchey, 2013).

Very few studies have compared the relations between these three subcomponent skills, those included in the SVR (decoding and listening comprehension) and reading fluency simultaneously in early readers who are developing reading skills at a typical rate and those who are identified as at-risk for RD. Catts, Petscher, Schatschneider, Bridges, and Mendoza (2009) examined the predictive validity of reading fluency measured in first and second grade with respect to third grade reading comprehension. Third grade reading fluency was used to group students as either poor readers or not. Results demonstrated that reading fluency's predictive validity increased over time, but there was greater improvement for students at lower levels than higher levels of reading fluency. While these results demonstrate the importance of early reading fluency skills for later reading comprehension, the study did not include decoding or listening comprehension, therefore the differential impact of all of these underlying subcomponent skills to reading comprehension could not be determined.

1.2. Early subcomponent skills development

1.2.1. Phonological awareness

Phonological awareness skills have been identified as a precursor to successful decoding (e.g. Roth, Speece, & Cooper, 2002; Storch & Whitehurst, 2002; Torgesen, Wagner, & Rashotte, 1999a; Vellutino, Fletcher, Snowling, & Scanlon, 2004; Vellutino et al., 2007; Wagner & Torgesen, 1987), and successful decoding is necessary for accurate reading fluency. That is, students must be able to decode individual words if they are to string them together in connected text. Thus, it is reasonable to posit, at least indirect relations between phonological awareness and reading fluency in terms of predicting reading comprehension. These skills are generally viewed as crucial during a child's early reading development. While phonological awareness is not explicitly named in the SVR, it is controlled in this study to improve the accuracy of the coefficients depicting the relations between decoding, reading fluency, and reading comprehension.

1.2.2. Decoding

The relation between decoding and comprehension has been well established in the literature (Chen & Vellutino, 1997; Georgiou, Das, & Hayward, 2009; Hoover & Gough, 1990; Joshi & Aaron, 2000). Evidence suggests that decoding is an important precursor skill to successful reading fluency and reading comprehension. For instance, LaBerge and Samuels (1974) theorized difficulty with decoding led to an inordinate amount of mental resources being devoted to reading individual words, which impedes a child's ability to extract meaning from connected text. For this reason, it is often one of the targets of early reading intervention with struggling readers (Foorman, Francis, Fletcher, Schatschneider, & Mehta, 1998; Foorman, Francis, Shaywitz, Shaywitz, & Fletcher, 1997; Rashotte, MacPhee, & Torgesen, 2001). However, intervention that targets only word level skills, such as decoding, have not always transferred into improvements in reading comprehension, most likely because while decoding is essential for successful reading comprehension, it is not the only predictor. Therefore, improving word reading skills may not by itself improve comprehension abilities.

1.2.3. Oral language and listening comprehension

Through hierarchical regression and latent variable modeling, researchers have begun to examine reading comprehension models that expand upon including only word level skills. Most of this research has concentrated on modeling the influence of oral language or listening comprehension in tandem with word level decoding skills (Catts, Fey, Zhang, & Tomblin, 1999; Francis et al., 2005; Kershaw & Schatschneider, 2012; Storch & Whitehurst, 2002; Vellutino et al., 2007). Some studies have shown that reading comprehension difficulties are the result of poor oral language or listening comprehension (Cain, Oakhill, Barnes, & Bryant, 2001; Hulme, Nash, Gooch, Lervåg, & Snowling, 2015; Nation, Adams, Bowyer-Crane, & Snowling, 1999; Nation & Snowling, 1998, 1999, 2000). There is also emerging evidence that intervening with these skills early in a child's reading development can significantly improve reading comprehension (Bowyer-Crane et al., 2008; Clarke, Snowling, Truelove, & Hulme, 2010). While the SVR theorizes decoding predominates listening comprehension in the early grades, it clearly makes a key contribution to reading comprehension as readers develop.

1.2.4. Fluency

Reading fluency is an individual's ability to read text with speed and accuracy (Adams, 1990); it has been described as the “bridge” between word decoding and reading comprehension (Pikulski & Chard, 2005). From a theoretical perspective, the importance of reading fluency surfaces when considering the cognitive demand of comprehension of written text. When individuals are first learning how to read, many of their cognitive resources are utilized decoding individual words. As they become more skilled readers, and words are automatically recognized, word reading becomes more fluent, allowing more cognitive resources to be applied to the task of comprehending connected text (LaBerge & Samuels, 1974; Perfetti, 1985). Converging empirical evidence exists to show the important relation between reading fluency and reading comprehension (Chard et al., 2002; Fuchs et al., 1988, 2001; Jenkins et al., 2003; Kim, Petscher, Schatschneider, & Foorman, 2010; Kim, Wagner, & Foster, 2011; NICHD, 2000; Riedel, 2007; Silverman et al., 2013).

In an expansion of the SVR, the Componential Model, Joshi and Aaron (2000) proposed adding fluency to help better describe the essential ingredients in reading comprehension. However, the componential model does not specify reading fluency, instead empirical support for the model utilized speed of processing in the form of letter

naming speed. The authors viewed letter naming speed as tantamount to sight word reading, which could preclude decoding skills. However, it may be argued this operationalization of speed of processing is not akin to reading fluency as it does not consider connected text. With the intent of specifically testing the addition of reading fluency to the SVR, Adlof, Catts, and Little (2006) used a series of concurrent and longitudinal structural equation models to determine whether reading fluency accounted for unique variance in reading comprehension after controlling for decoding and listening comprehension in second, fourth and eighth grade students. Results indicated that reading fluency did not account for unique variance in reading comprehension after word decoding and listening comprehension were controlled. Through profile analyses, the authors also investigated if there were specific subgroups of individuals who presented with difficulties in reading rate or fluency, disassociated from reading accuracy, in combination with reading comprehension. In the study sample, the occurrence of this type of reading profile was extremely rare across all grade levels. These findings, coupled with the structural equation models, lead the authors to conclude that fluency should not be added to the SVR, as it did not contribute above and beyond word reading and listening comprehension skills. However, while half of their sample included students with language difficulties, they did not investigate the potential role of RD specifically. Kim and Wagner (2015) reported that oral reading fluency was not independently related to reading comprehension beyond word reading and listening comprehension, in a large sample of typically developing first graders readers. However, from second to fourth grade, data from this longitudinal sample demonstrated that oral reading fluency completely mediated the relation between word reading and reading comprehension, and partially mediated the association between listening comprehension and reading comprehension. They concluded that oral reading fluency is a dissociable construct whose role in reading changes with development. Also in an older sample, Silverman et al. (2013) investigated the role of fluency (both word and passage level) in the SVR in fourth graders, using structural equation modeling, and found that fluency fully mediated the relation between decoding and reading comprehension.

There have been fewer studies that examined the role of fluency that take into account the variability in early readers, and specifically investigated early readers who are struggling (Aaron, Joshi, & Williams, 1999; Adlof et al., 2006; Tilstra, McMaster, van den Broek, Kendeou, & Rapp, 2009). In an older sample, Eason et al. (2013) grouped 10–14-year-old students based on reading ability: average readers, poor decoders, and poor comprehenders. Both the poor decoder and poor comprehender groups performed significantly more poorly on text level oral reading rate than on decontextualized word reading efficiency, while the average readers performed similarly on both constructs. Across the entire sample, oral reading rate contributed unique variance to reading comprehension beyond word reading efficiency; this unique variance was related to oral language abilities, particularly semantics. Wolf (1999, 2001) suggest that there is a subgroup of struggling readers who may have difficulties in processes related to naming speed even when they have intact phonological processing abilities. They argue that for this particular group of individuals, who have adequate phonological processing abilities, but remain dysfluent readers, fluency is a particular difficulty and targeted instruction is necessary.

1.3. Current study

While there is a great deal of empirical evidence to support the SVR, suggesting that both decoding and listening comprehension are essential for reading comprehension, the role of reading fluency is less clear. Previous studies have demonstrated that fluency is both correlated with and predictive of reading comprehension; however, it is not clear if it is predictive above and beyond decoding and listening comprehension, particularly in younger children. Perhaps more importantly, there is a dearth of empirical research that specifically tests the differential relations of these the two subcomponent skills included in the SVR (listening comprehension and decoding) and reading fluency in readers who are at-risk for RD and in those who are not at-risk. Exploring these topics could have important implications for early prevention and intervention models in reading.

In the present study, building on previous literature, the overarching goal was to investigate the role of fluency, word reading and listening comprehension on the reading comprehension abilities of beginning first-grade readers. Specifically, this study investigates whether reading fluency, both words and connected text, accounts for unique variance in reading comprehension after controlling for decoding and listening comprehension for two subgroups of readers: those identified as at-risk for RD based on an early screening in both decoding and listening comprehension and students who were not at-risk at the beginning of first grade. To this end, this study aims to answer the following research questions: 1) Does fluency predict reading comprehension after accounting for decoding and linguistic comprehension skills in readers at the beginning of first grade?; 2) Does the role of fluency in predicting reading comprehension differ for at-risk and not at-risk readers at the beginning of first grade?

2. Method

2.1. Sample

The data for this study comes from a larger research study investigating the impact of an early reading intervention; data for this study comes from the first data collection period, before any intervention was implemented, therefore, the effects of intervention did not impact the results of the current study. The sample was recruited and treated in accordance of the university Institutional Review Board for research with human subjects. Of the sample of $N = 290$, 47.1% were female and 77.7% qualified for free lunch. In terms of ethnicity, 44.8% were Latino(a), 23.4% were African-American, 19.2% were Caucasian, 3.5% were Asian, and 8.7% were “Other” or “Mixed.” 19.7% of the total sample were classified as English language learners (ELL) according to district records. A chi-square test was performed to determine whether students classified as ELL were disproportionately represented in either the at-risk or not at-risk groups (see below). The test was non-significant ($p = .52$), which indicated the number of these students in the at-risk group ($n = 31$) and not at-risk group ($n = 28$) were comparable. Students were drawn from 30 classrooms across 15 schools between a suburban and rural region of California and a metropolitan region of Texas. A total of 384 children were recommended for screening (see screening process below); based on initial screenings, $n = 141$ students were considered at-risk. In addition to the at-risk students, $n = 149$ students who were not at-risk were assessed.

For the current study, first grade pretest data was utilized for two reasons. First, the study concentrated on the investigation of the relations among early reading skills in at-risk and not at-risk students, so that findings could inform practice for intervention development for at-risk readers. Second, we wanted to examine these relations before students receive instruction in reading, as intensive instruction in early reading skills has potential to change these relations.

2.1.1. Determining at-risk and not at-risk students

Students were identified as at-risk for RD using teacher nomination in combination with screening measures of decoding, letter sounds, phonological awareness, and listening comprehension. First, teachers were asked to identify the bottom 50% of their classroom in reading. Next, these students were screened to identify which students, of the bottom 50%, were the most at-risk for reading failure. We utilized the Texas Primary Reading Inventory (TPRI; Children's Learning Institute & Texas Institute for Measurement, Evaluation, and Statistics, 2010) in our initial screening process. The TPRI is designed to identify students in grades K-3 at-risk for reading difficulties and as a diagnostic

instrument to assist in planning instruction. The students identified as the bottom 50% readers were first given the TPRI letter sounds, word reading, and blending assessments. If the student passed all three screens, they were no longer considered at-risk and did not proceed further in the screening process; if the student failed one of the screens, they continued on to the second phase of the screening battery. Next, the research staff administered a brief word-reading screen that includes simple words that students are typically exposed to by the beginning of first grade; this measure had been used successfully to identify at-risk first graders in previous research (Denton et al., 2010; Mathes et al., 2005); additionally, a listening comprehension screen from the TPRI was utilized. In the comprehension task, students answer literal and inferential questions about text. In first grade, this test can be administered as either a reading comprehension or a listening comprehension task (i.e., the text is read aloud to the student). All students considered at-risk in this study received the listening comprehension administration. If the student had an average score (across two passages) of three or below (total possible was 6 on each passage) and a score of 5 or below (total possible score of 15) on the UTH Word Reading list, they were considered at-risk for RD. It is important to note that in this study we screened for children who had risk factors in both decoding and listening comprehension; students could not qualify as at-risk if they only demonstrated difficulties in one of the areas. In order to establish a group of students who were not at-risk for RD, students were randomly selected from the top 50% of each classroom.

2.2. Procedure

Trained research assistants administered the assessment battery. After receiving group training, each research assistant individually completed a practice administration with the researchers. Students were assessed in quiet areas outside of their classrooms. The test battery was administered to those found to be eligible for participation based on the screenings. All data were double-entered, checked for errors, and corrected by consulting original test forms.

2.3. Measures

A comprehensive reading skills battery measuring phonological awareness, decoding, text reading fluency, listening comprehension, and reading comprehension was administered. When available, age based standard scores were utilized in analyses.

2.3.1. Phonological awareness

Two measures from the Comprehensive Test of Phonological Processing (CTOPP; Torgesen, Wagner, & Rashotte, 1999b) were used to assess phonological awareness: Elision and Blending. The elision subtest requires individuals to repeat a verbally presented word while omitting a specified sound (e.g., “say bold. Now say bold without /b/”). Blending words requires students to combine separate sounds into a word. For example, the student may be presented with, “What word do these sounds make: t-oi?” The correct response would be toy. The examiner's manual reports a test-retest reliability of 0.88 for both measures with this age group.

2.3.2. Decoding

Two tests from the Woodcock Johnson-IV (WJ-IV; Mather & Jaffe, 2016) were utilized to assess word reading and decoding abilities: Letter Word Identification (LWID) and Word Attack (WA). The LWID subtest assesses the ability to identify letters and read words presented in a list format. The WA subtest measures phonological decoding through pseudoword reading. Both measures are untimed; administration ends when the student misses 6 responses. Reliability coefficients for the LWID for the age range in this study are between 0.96 and 0.98; for the WA they are 0.94 and 0.96.

We also used the accuracy subscale of the Gray Oral Reading Test-5 (GORT-5; Wiederholt & Bryant, 2012). Students were asked to orally read short passages while the examiner recorded deviations from text as well as the time to complete the passage. The test was discontinued when students received a fluency score ranging from 0 to 2 on two consecutive passages. The accuracy subscale is based on the number of deviations from text. The examiner's manual reports a Cronbach's alpha coefficient of 0.88 for this age group.

2.3.3. Listening comprehension

Two listening comprehension measures were used. First, we used the Understanding Spoken Paragraphs subtest from the Clinical Evaluation of Language Fundamentals (CELF; Semel, Wiig, & Secord, 2003). This assessment tests a student's ability to interpret factual and inferential information presented orally. The test manual reports a reliability using Cronbach's alpha of 0.69 and 0.65 and reliability using the split-half method of 0.74 and 0.73 for six-year olds. Second, we used the Qualitative Reading Inventory-5 (QRI-5; Leslie & Caldwell, 2012). Students were orally read a passage and asked six comprehension questions regarding implicit and explicit details. We used the total number of comprehension questions answered correctly as this assessment is non-normed. Cronbach's alpha was calculated to be 0.65 for the study sample.

2.3.4. Fluency

We used the GORT-5 (Wiederholt & Bryant, 2012) rate subscale to measure fluency of reading connected text. The rate score is normed based on the number of seconds it took the student to read the passage. The examiner's manual reports a Cronbach's alpha value of 0.86.

Two measures from the Test for Word Reading Efficiency (TOWRE-2; Torgesen et al., 1999a, 1999b) were administered: Sight Word Efficiency (SWE) and Phonemic Decoding Efficiency (PDE). For both assessments, individuals are presented with a list of real words (SWE) or pseudowords (PDE) that get progressively more difficult and are asked to read as many as they can in 45 s. Their score, for each subtest is the total correct in the allotted time.

2.3.5. Reading comprehension

Two assessments were administered to measure reading comprehension. First, the WJ Passage Comprehension (WJPC) subtest was administered, in which students read short sentences and paragraphs missing words and are required to provide the appropriate missing word. Items get progressively more difficult with each item; the assessment ends when students miss six items in a row. Reliability coefficients for the age range in this study are between 0.93 and 0.98. Reading Comprehension was also assessed with the GORT-5 (Gcomp). This assessment is comprised of 16 progressively more difficult reading passages. The passages are read aloud by a child and are followed by five open-ended comprehension questions. The test was discontinued when a student was deemed unable to read a passage fluently based on the test's stopping criterion.

2.4. Analytic approach

We fit a series of structural equation models (SEM) using M*plus* 7.3 (Muthén & Muthén, 2015). Full information maximum likelihood estimation was utilized, which allows for missing at random (MAR; Little & Rubin, 1990). This estimator allows for item-level missingness. That is, students were included as long as they had data on at least one observed variable. Of the full sample, only one student was missing data on all variables.

The SVR components, decoding and listening comprehension, were represented as latent factors measured by multiple indicators to account for measurement error, and increase the robustness of the analyses (Kline, 2011). We utilized standardized scores for all observed variables to account for demographic differences between students. The *phonological awareness* factor was measured by the elision and blending words

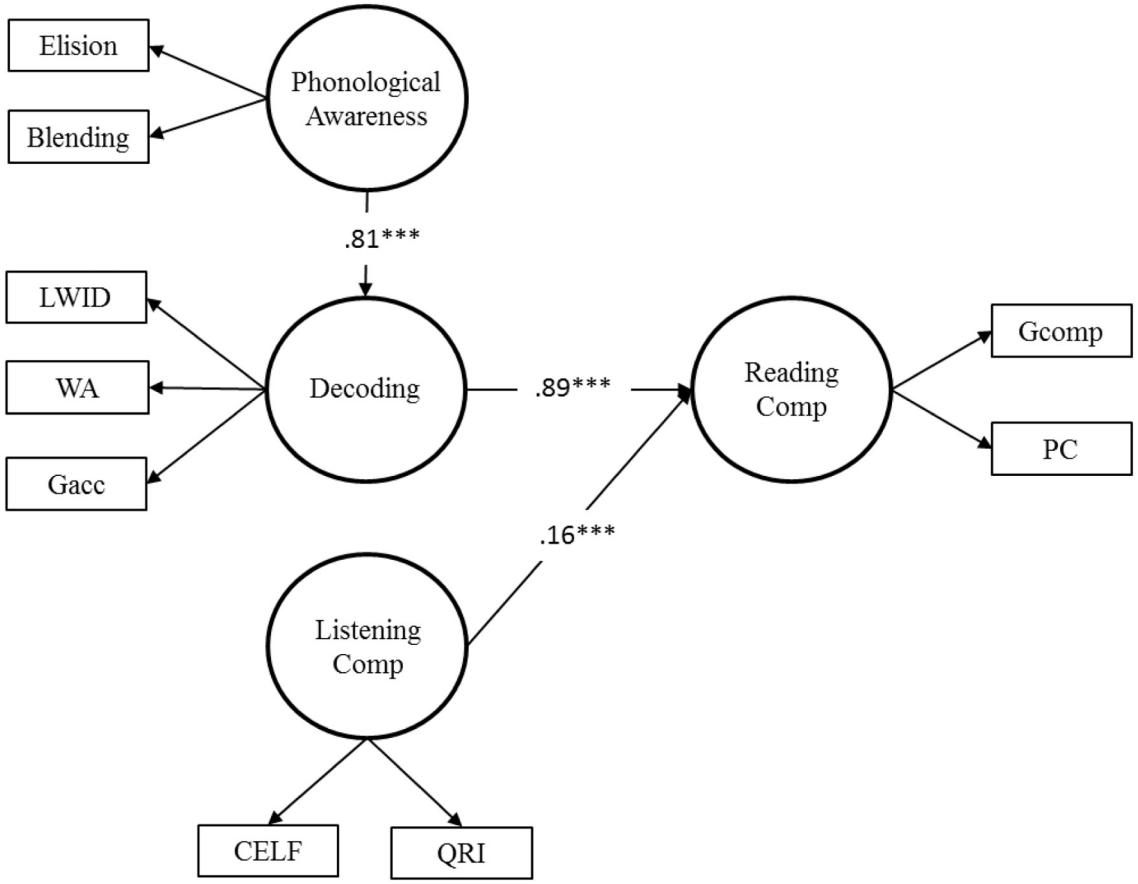

Fig. 1. Diagram of Model 1 before the inclusion of fluency. Estimates are fully standardized. LWID = Letter-Word ID; WA = Word Attack; Gacc = GORT accuracy; CELF = Understanding Spoken Paragraphs; SWE = TOWRE Sight Word Efficiency; PDE = TOWRE Phonemic Decoding Efficiency; Grate = GORT rate; PC = Passage Comprehension; Gcomp = GORT comprehension. ***$p < .001$.

subtests of the CTOPP. The *decoding* factor was measured by LWID and WA from the WJ-IV assessment battery and the accuracy subscale of the GORT-5. The *listening comprehension* factor was measured by the CELF Understanding Spoken Paragraphs subtest and the QRI-5. The *fluency* factor was measured by the rate subscale of the GORT-5 and the two TOWRE-2 subtests. The *reading comprehension* factor was measured by the PC subtest of the WJ-IV and the comprehension subscale of the GORT-5.

The SEMs compared a modified version of the traditional SVR versus a model in which reading fluency was added as a predictor of reading comprehension. We subsequently compared these models using the overall sample followed by models in which students were grouped according to risk status. Conceptual diagrams of the SEMs are presented in Figs. 1–3. Model 1 (Fig. 1) investigated the traditional SVR (i.e. predicting *reading comprehension* by *decoding* and *listening comprehension*) using the overall sample. Additionally, we controlled for *phonological awareness* when measuring *decoding*. As mentioned earlier, even though phonological awareness is not explicitly mentioned in the SVR, it is included in this study to obtain more accurate estimates of the relation between decoding and reading comprehension. Model 2 (Fig. 2) added fluency as a mediator between decoding and reading comprehension, while maintaining the other predictive relations in Model 1. Both Models 1 and 2 were conducted using the overall sample. Next, we sought to investigate whether the addition of the *fluency* mediator functioned differently across groups of at-risk and not at-risk readers. We systematically examined this via multiple-group SEMs. That is, we fit Model 2 to each subgroup simultaneously to compare the relations among the SVR components across subgroups. We began by constraining all regression paths to equality across groups to serve as a baseline multiple-group model (Model 3). However, the observed residual variances and factor means were freely estimated. Next, we relaxed the mediation constraints between *decoding*, *fluency*, and *reading comprehension* (Model 4). This allowed us to compare these relations across subgroups, but the paths from *phonological awareness* to *decoding* and *fluency* and the path from *listening comprehension* to *reading comprehension* remained constrained to equality. Finally, in Model 5 (see Fig. 3), we allowed all regression paths to be freely estimated for each group.

We assessed and compared models by interpreting commonly accepted fit indexes according to guidelines set forth by Hu and Bentler (1999). For the full sample models (i.e., Models 1 and 2), a non-significant chi-square value was indicative of good fit. However, as the chi-square fit index is known to be inflated by sample size (Bentler & Bonett, 1980), we also employed measures of approximate fit. Specifically, we used the root mean squared error of approximation (RMSEA) where values less than 0.08 indicate adequate fit and values less than 0.05 indicated good fit. Values between 0.08 and 0.10 were considered indicative of mediocre fit (MacCallum, Browne, & Sugawara, 1996). The comparative fit index (CFI) and Tucker-Lewis index (TLI) were interpreted similarly, where values greater than 0.90 indicated adequate fit and values greater than 0.95 indicates good fit. Finally, values for the standardized root mean square residual (SRMR) less than 0.08 indicated adequate fit and values less than 0.05 indicated good fit. As no singular fit index has been shown to be consistently reliable, we examined the indexes holistically to judge the adequacy of the models.

We compared Models 1 and 2 using chi-square difference testing to assess the addition of the fluency mediator. A significant increase in chi-square was interpreted as a significant decrement in model fit.

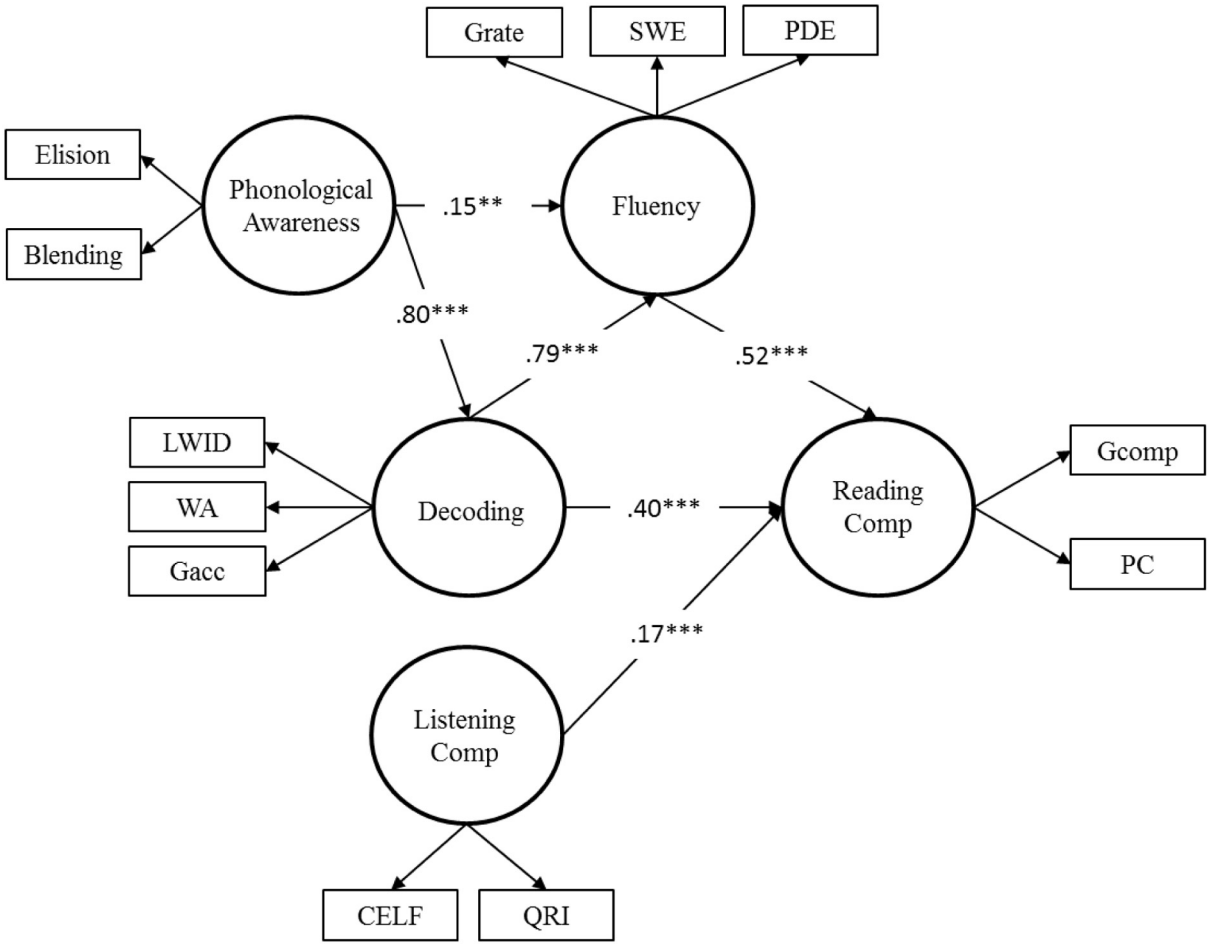

Fig. 2. Diagram of Model 2 with the addition of fluency for the overall sample. LWID = Letter-Word ID; WA = Word Attack; Gacc = GORT accuracy; CELF = Understanding Spoken Paragraphs; SWE = TOWRE Sight Word Efficiency; PDE = TOWRE Phonemic Decoding Efficiency; Grate = GORT rate; PC = Passage Comprehension; Gcomp = GORT comprehension $^{**}p < .01$, $^{***}p < .001$.

Additionally, we used chi-square difference testing to assess freeing equality constraints in the multiple-group models. In contrast to the previous chi-square difference testing, a significant decrease in chi-square indicated that relaxing the constraint resulted in an improvement.

3. Results

3.1. Descriptive statistics

Descriptive statistics disaggregated by risk status are presented in Table 1. Group means were compared using *t*-tests and, as expected, students identified as at-risk scored significantly lower on all measures; see Table 1. Additionally, in general, there was less variability in the at-risk students' scores. Correlations for the full sample are presented in Table 2. The *listening comprehension* measures exhibited relatively weak correlations with the measures of all other constructs. Additionally, the *decoding* measures were strongly related to the *fluency* measures. *Reading comprehension* measures were also relatively strongly related to both the *decoding* and *fluency* measures. The correlational findings were interpreted as further evidence for the inclusion of *fluency* as a mediator between *decoding* and *reading comprehension*.

3.2. Full sample SEMs

We report standardized coefficients for the SEMs in Figs. 1–3. Model 1 (traditional Simple View, full sample) fit the data well (see Table 3) and both *decoding* and *listening comprehension* significantly predicted *reading comprehension*. This was consistent with the original SVR in which *decoding* was a stronger predictor of *reading comprehension* ($\beta = 0.89, p < .001$) than *listening comprehension* ($\beta = 0.17, p < .001$) for early elementary students (Hoover & Gough, 1990). *Phonological awareness* significantly predicted *decoding* ($\beta = 0.81, p < .001$). Standardized factor loadings ranged between 0.72 and 0.99.

Though the addition of the fluency mediator in Model 2 resulted in a significant decrement in model fit ($\Delta\chi^2 = 421.93, p < .001$), we chose to proceed with examining this and subsequent models for two reasons. First, Hancock and Mueller (2011) demonstrated that a strong measurement model (i.e., high factor loadings) can exaggerate even minor misspecifications among a SEM's structural parameters, which can lead to over rejection of models when the traditional fit index cutoffs are used to judge the model's viability. This appeared to be the case in the present study. Second, the models are theoretically grounded in prior research (Chard et al., 2002; Fuchs et al., 1988, 2001; Jenkins et al., 2003; Pikulski & Chard, 2005) and the focus of this study was to examine the additional role of oral reading fluency rather than assess any single model for statistical fit. For the full sample, *fluency* was a stronger predictor of *reading comprehension* than either *decoding* or *listening comprehension* (see Fig. 2), but all three were significant predictors of reading comprehension. *Fluency* was only a partial mediator as *decoding* continued to significantly predict *reading comprehension* for the full sample. Next, we investigated if the three subcomponent skills functioned differently across at-risk and not at-risk students.

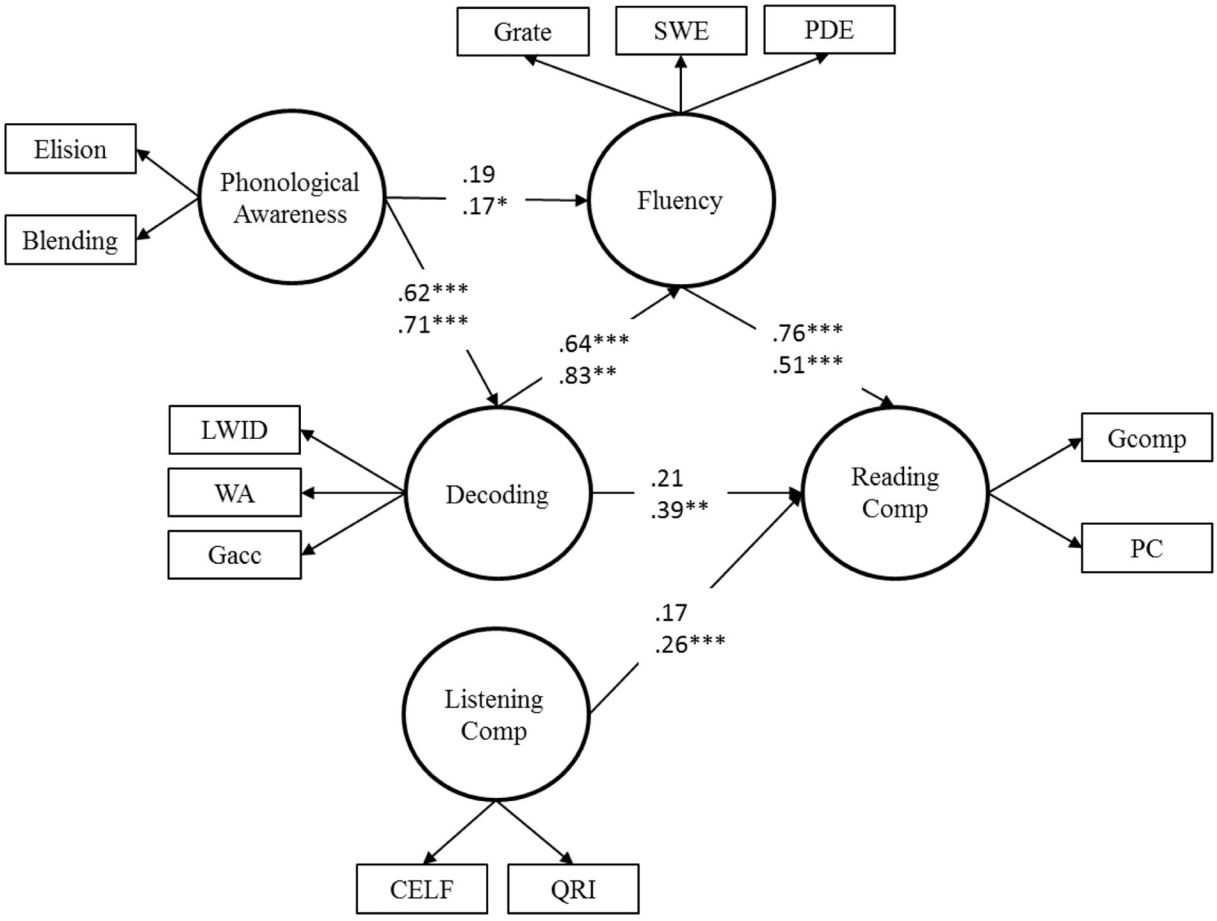

Fig. 3. Diagram of Model 5 depicting the structural parameters as freely estimated across groups. Standardized coefficients for the at-risk students are listed above the coefficients for the not at-risk students. LWID = Letter-Word ID; WA = Word Attack; Gacc = GORT accuracy; CELF = Understanding Spoken Paragraphs; SWE = TOWRE Sight Word Efficiency; PDE = TOWRE Phonemic Decoding Efficiency; Grate = GORT rate; PC = Passage Comprehension; Gcomp = GORT comprehension. *$p < .05$ **$p < .01$, ***$p < .001$.

Table 1
Descriptive statistics of all observed variables by risk status and *t*-tests comparing groups.

Variable	At-risk (n = 141)			Not at-risk (n = 149)			t
	n	*M*	*SD*	*n*	*M*	*SD*	
LWID	140	77.19	12.12	147	100.34	14.36	14.78
WA	140	83.82	16.82	147	107.40	11.56	13.78
Gacc	139	5.17	0.91	147	8.80	2.66	15.63
CELF	140	6.58	3.73	147	9.12	3.42	6.00
QRI	140	2.44	1.58	149	3.63	1.68	5.90
SWE	140	77.61	7.69	147	102.11	15.85	16.78
PDE	140	77.85	7.94	146	98.04	14.86	14.41
Grate	139	5.39	1.20	147	9.01	2.59	15.30
Elision	140	6.82	2.65	147	10.37	2.70	11.20
Blending	140	9.34	2.06	147	11.51	2.45	8.15
PC	139	81.76	10.92	147	100.14	11.13	14.08
Gcomp	140	4.34	1.02	147	8.31	2.53	17.62

All *t*-tests significant at $p < .001$. LWID = Letter-Word ID; WA = Word Attack; Gacc = GORT accuracy; CELF = Understanding Spoken Paragraphs; SWE = TOWRE Sight Word Efficiency; PDE = TOWRE Phonemic Decoding Efficiency; Grate = GORT rate; PC = Passage Comprehension; Gcomp = GORT comprehension.

3.3. Multiple-group SEMs

As seen in Table 3, Model 3 exhibited poor fit to the data, but this was not surprising given the constraints placed on the regression paths described above. Specifically, this model was not expected to fit the data well as it assumed all structural paths were functionally and statistically similar between the at-risk and not at-risk groups. This model was only used as a reference baseline model to test whether systematically freeing the structural parameters of interest led to significantly improved models. Lack of improvement - as indicated by non-significant chi-square difference tests - would suggest the relations among the SVR components functioned similarly for both subgroups. Models 4 and 5 exhibited significantly lower chi-square values, which provided evidence that the predictors functioned differently for the at-risk and not at-risk groups.

Model 4 (i.e., freeing the relations among *decoding*, *fluency*, and *reading comprehension*) fit significantly better than Model 3 ($\Delta\chi^2 = 130.98$, $p < .001$). Additionally, the mediation functioned differently for each group. For the at-risk students, *fluency* fully mediated the relation between *decoding* and *reading comprehension*. That is, once *fluency* was added for the at-risk group, *decoding* no longer significantly predicted *reading comprehension*. The standardized coefficients for the relations between *decoding* and *fluency* ($\beta = 0.61$, $p < .001$) and *fluency* and *reading comprehension* ($\beta = 0.64$, $p < .001$) were moderately strong. For the not at-risk students, *fluency* only partially mediated the relation between *decoding* and *reading comprehension*. For this group, the strongest relation was between *decoding* and *fluency* ($\beta = 0.86$, $p < .001$). Interestingly, the direct effect from *decoding* to *reading comprehension* ($\beta = 0.38$, $p < .001$) for the not at-risk students was similar to the estimate for the full sample in Model 2 ($\beta = 0.40$, $p < .001$). Coupled with the non-significant coefficient for

Table 2
Correlations among all observed variables for the full sample.

Variable	1	2	3	4	5	6	7	8	9	10	11	12
1. LWID	–											
2. WA	0.88	–										
3. Gacc	0.85	0.70	–									
4. CELF	0.35	0.36	0.35	–								
5. QRI	0.28	0.28	0.32	0.65	–							
6. SWE	0.91	0.76	0.91	0.34	0.30	–						
7. PDE	0.84	0.76	0.84	0.31	0.31	0.89	–					
8. Grate	0.82	0.66	0.90	0.30	0.26	0.91	0.79	–				
9. Elision	0.70	0.67	0.68	0.51	0.44	0.67	0.67	0.61	–			
10. Blending	0.63	0.61	0.59	0.38	0.35	0.59	0.66	0.52	0.60	–		
11. PC	0.89	0.79	0.80	0.39	0.32	0.86	0.78	0.79	0.68	0.57	–	
12. Gcomp	0.81	0.69	0.87	0.46	0.41	0.84	0.77	0.86	0.66	0.53	0.79	–

All *correlations* significant at $p < .001$. LWID = Letter-Word ID; WA = Word Attack; Gacc = GORT accuracy; CELF = Understanding Spoken Paragraphs; SWE = TOWRE Sight Word Efficiency; PDE = TOWRE Phonemic Decoding Efficiency; Grate = GORT rate; PC = Passage Comprehension; Gcomp = GORT comprehension.

Table 3
Fit statistics of the five SEMs.

Model	# parameters	χ^2	df	$\Delta\chi^2$	Δdf	RMSEA	CFI	TLI	SRMR
1	28	55.43	16			0.09	0.98	0.96	0.04
2	41	477.36	49	421.93***	33	0.17	0.90	0.86	0.05
3	58	925.30	122			0.21	0.71	0.68	0.76
4	61	794.32	119	130.98***	3	0.20	0.75	0.73	0.56
5	64	780.05	116	14.27**	3	0.20	0.76	0.72	0.53

χ^2 = chi-square test of model fit; CFI = comparative fit index; TLI = Tucker-Lewis index; RMSEA = root-mean square error of approximation; SRMR = standardized root mean square residual.

** $p < .01$.

*** $p < .001$.

the at-risk students, this might suggest the relation between *decoding* and *reading comprehension* was primarily driven by the not at-risk students.

Model 5 freed all regression paths among all latent variables across risk groups and fit significantly better than Model 4 ($\Delta\chi^2 = 14.27$, $p < .01$). In Model 5, again, we found heterogeneity in the various regression paths across groups.[1] Beginning with the mediation of *fluency*, *decoding*, and *reading comprehension*, the substantive interpretation was unchanged across groups, compared to Model 4. That is, *fluency* fully mediated the relation between *decoding* and *reading comprehension* for the at-risk students, but only partially for the not at-risk students. Freeing the functional relation between *listening comprehension* and *reading comprehension* across groups revealed additional important findings. *Listening comprehension* significantly predicted *reading comprehension* for the not at-risk students, but not the at-risk students. In sum, comparing the traditional SVR components along with the *fluency* mediator across subgroups, *decoding* was only significantly related to *reading comprehension* via *fluency* for the at-risk students. However, for the not at-risk students, *fluency*, *decoding*, and *listening comprehension* each made individual contributions to *reading comprehension*.

Finally, we report the coefficients for *phonological awareness* predicting *decoding* and *fluency* across groups. *Phonological awareness* did not significantly predict *fluency* for the at-risk students, but was a weak predictor for the not at-risk students ($\beta = 0.17$, $p < .05$). However, *phonological awareness* was a moderate to strong predictor of *decoding* for both at-risk students ($\beta = 0.62$, $p < .001$) and not at-risk students ($\beta = 0.71$, $p < .001$).

[1] An additional model was conducted that allowed fluency to also mediate the relation between listening comprehension and reading comprehension for both groups. The mediation was non-significant for both groups, so this model was not given further consideration.

4. Discussion

This paper sought to investigate the role of three subcomponent skills in the prediction of reading comprehension in first grade students. The first research question considered the entire first grade sample, while the second research question sought to determine whether the relations between the subcomponent skills and reading comprehension remained stable when the group of beginning first grade readers were split between at-risk and not-at risk readers. The goal of the second question was to add to the existing knowledge of how these subcomponent skills develop from an early age with the intent on informing early intervention practices. Previous research has often assumed early readers are a homogenous group of learners and fails to take into consideration the unique developmental trajectories of students who are developing early reading skills at a slower rate, and consequently, may be at-risk for RD. The data presented in this paper suggests that the relations among the subcomponent skills differ between students who are at-risk for RD, based on early screening in both word level skill areas and linguistic comprehension, and their not at-risk peers.

4.1. Prediction of reading comprehension: the role of fluency

The first research question that guided this study sought to determine the roles that decoding, listening comprehension and fluency play in a group of beginning first grade readers. The data in this paper (Models 1 and 2) suggest that in early first grade, decoding, listening comprehension and fluency are all significant predictors of reading comprehension in the full sample, comprised of both at-risk and not at-risk students. Moreover, fluency was the strongest predictor of reading comprehension when examining the full sample (Model 2). This finding deviates slightly from previous work in this area. Adlof et al. (2006) found no additional significant influence of fluency when both listening

comprehension and decoding were already considered. It is important to note that there are key differences in the samples between the current study and the Adlof et al. study, perhaps most importantly a difference in the age of the students in each study. Adlof and colleagues had an older sample of second, fourth and eighth grade students. It may be that by the time they measured fluency, normative students gained decoding skills to the point of automaticity at each grade level but this obfuscated potential differences between at-risk and not at-risk readers as the latter tend to be the larger of the two groups.

4.2. Differing predictors between reading subgroups

The goal of the second research question was to determine if the predictive relations between the subcomponent skills and reading comprehension differed across at-risk and not at-risk readers. Research often uses typically-developing students as they are normative and most widely available, but this study found well-documented relations among precursors of reading comprehension that do not function similarly across heterogeneous profiles. Specifically, this study found that fluency was a significant predictor of reading comprehension for both groups. However, the mediation of fluency between decoding and reading comprehension was different for the at-risk and not at-risk groups, with full mediation for the former. That is, in Models 4 and 5, once fluency was added, decoding was no longer a significant predictor of reading comprehension for the at-risk students, but remained significant for the not at-risk students.

Beyond fluency, there were important differences in reading comprehension between the at-risk and not at-risk groups. Similar to the full sample model, all three of the subcomponent skills remained significant predictors of reading comprehension for the not at-risk sample: decoding, fluency and listening comprehension. For the at-risk group, fluency was the only significant predictor of reading comprehension. There are a few potential explanations for this finding. First, remember that the study sampling design and criteria for inclusion in the at-risk sample required students to demonstrate deficits in both decoding and listening comprehension to qualify for the at-risk sample. Therefore, we have a group of students who struggle with phonological processing, decoding, and resultant fluency skills, and who also present with deficits in language related skill areas. When educational practitioners identify at-risk students based on decoding and fluency, they are likely to encounter at least some students who also struggle with additional oral language abilities such as listening comprehension, indicating they may be affected by broader oral language impairments that extend beyond phonological processing and require appropriate intervention (Catts et al., 2005; Gallagher et al., 2000; Lyytinen, Eklund, & Lyytinen, 2005; Scarborough, 1990). These underlying oral language skills are important to consider as they contribute directly to comprehension, but also because prior research has shown that performance on comprehension and fluency assessments may be linked because they involve similar semantic and syntactic language processes (Jenkins et al., 2003; Paris & Paris, 2003). Beyond bottom-up automaticity constraints, these students would also be less likely to obtain additional benefits that top-down contextual processing might confer when encountering unknown words in text (Rumelhart, 1994).

The differing patterns of significance from the three predictors of reading comprehension across groups suggest group-specific differential functioning of the three predictors. The not at-risk readers were able to draw upon all three skill areas when comprehending connected text, and these skills likely interact, as in the classic SVR model. Fluent reading frees up cognitive resources to activate higher order processing skills associated with listening comprehension. However, fluency was the only significant predictor for the at-risk students. This could indicate that the three skills are less connected in the at-risk students compared to the not at-risk students and, thus, are not interacting. An alternative explanation may be that lack of fluency is creating a bottleneck such that the three skills are not able to interact at this point in these students' reading development. However, it is worth noting that, even if these students had intact fluency skills, the means of the listening comprehension variables suggest these skills were depressed to the point that their reading comprehension would be impeded by poor oral language skills. If so, this would be consistent with the findings of Clarke et al. (2010). They found that students who received an oral language intervention maintained greater gains in reading comprehension than those who received a text-comprehension intervention or an intervention combining both aspects, which led the authors to conclude the amount of time spent teaching oral language skills was critical to improving reading comprehension. Thus, we do not view the non-significant relation between listening comprehension and reading comprehension as evidence against remediating listening comprehension skills. While fluent text reading appeared to be the primary bottleneck impeding reading comprehension for the at-risk readers, listening comprehension may also play a role that may become more prominent in the future. Since listening comprehension contributed to reading comprehension in the not at-risk readers, data from these analyses indicate it is an important skill, even in young readers.

At early stages of reading development, differences in decoding and fluency may be the easiest to detect, but remediating these skills may only benefit the most proximal outcomes. Listening comprehension becomes an important predictor of reading comprehension in middle to late elementary, but our findings demonstrate that these difficulties can be identified in early elementary. Thus, decoding and fluency may remain the primary targets of early reading intervention, but allocating time for remediation listening comprehension may provide additional growth in reading comprehension that enables at-risk students to perform similarly to not at-risk students across multiple domains. Moreover, as students are exposed to increasingly complex texts as they progress through school, oral language and listening comprehension skills will eventually predominate decoding and fluency skills, so early listening comprehension intervention should provide long-term benefits.

Considering both the at-risk and not at-risk students, the importance appears to lie with the interaction between decoding, fluency, and listening comprehension. This finding is consistent with the original theory and empirical data underlying the SVR (Hoover & Gough, 1990), but has been largely ignored in the literature. The not at-risk students in this study had advanced to the point in which decoding and listening comprehension made measurable contributions to reading comprehension. However, the at-risk students, while exhibiting emerging decoding skills, struggled with reading comprehension. Therefore, for this sample of at-risk readers, instruction in decoding (and, by extension, fluency), in isolation, is not sufficient to improve reading comprehension. If young students who are struggling with reading comprehension are to “catch up” to typical readers, then intervention must focus on both decoding and listening comprehension.

4.3. Implications for practice

When reading difficulties are addressed aggressively in early grades, it is possible that later developing reading problems are prevented, or, their severity is reduced (Denton & Mathes, 2003; Vellutino, Scanlon, & Lyon, 2000). In kindergarten to third grade, instruction in phonological awareness and word reading are prominent parts of reading instruction and tend to be emphasized in basal reading programs. Additionally, early reading interventions for struggling readers typically concentrate on these basic word level skills, not the development of comprehension specifically. There are very few effective early reading intervention programs that specially teach comprehension skills in an explicit and systematic manner, following a comprehension scope and sequence. Typically, the focus of reading instruction changes between third and fourth grade, with the concentration of instruction moving from “learning to read” to “reading to learn” (Chall, 1983). The general belief, and practice in schools, is that once students know how to

decode and fluently read text, instructional time should be spent on teaching them to extract meaning from the text they are reading. However, it could be argued that it is appropriate to begin teaching comprehension-based skills earlier, even before students are reading fluently (Bowyer-Crane et al., 2008). Furthermore, there is some evidence that there is a reciprocally predictive relation between reading comprehension and fluency and that fluency is both a contributor to (LaBerge & Samuels, 1974), and a product of (Kuhn & Stahl, 2003; Young & Bowers, 1995) proficient comprehension. Jenkins et al. (2003) posited that this relation might vary for poor versus skilled readers, with comprehension facilitating fluency more for children with higher reading ability while weak word recognition skills could limit both fluency and comprehension development for poor readers. However, reading for meaning and the ability to apply linguistic comprehension skills such as relating prior knowledge to texts can help readers correctly anticipate words in connected texts that they might struggle with out of context (Fuchs et al., 2001) which could lead to gains in reading speed for poor readers as well (Stecker, Roser, & Martinez, 1998).

The SVR postulates that both decoding and listening comprehension are important factors in reading comprehension, but the model does not make suggestions about the developmental sequence of these important constructs, although there is some evidence to suggest that the relations between the constructs and comprehension change over time. Even though the existing evidence suggests that the relations between the constructs change over time, with listening comprehension becoming a stronger predictor as children age (e.g., Hoover & Gough, 1990; Kershaw & Schatschneider, 2012), this does not mean that comprehension strategies should not be introduced early. In fact, Hamilton, Paris, Carpenter, and Paris (2005) noted that fluency should not be viewed as necessary or sufficient for comprehension because multiple shared linguistic and cognitive processes such as vocabulary, syntax, and prior knowledge account for associations between fluency and comprehension. Considering the depressed listening comprehension skills in our at-risk group, it seems imperative these skills be explicitly taught during the early elementary years. When we consider the extraordinary amount of time it takes to improve reading performance in the later grades, estimates suggest that if intervention is not initiated until fourth grade, it takes four times as much instruction as it would have in first grade (Lyon & Fletcher, 2001) to see similar rates of improvement; early intervention in both word level reading and listening comprehension is essential. With respect to reading fluency specifically, researchers have suggested that reading fluency instruction is often neglected in classroom settings (Allington, 1983; Chard et al., 2002; Kameenui & Simmons, 2001). Our data offer some evidence that fluent reading is an important factor in reading comprehension for both at-risk and not at-risk readers, therefore, it would be important that teachers are able to effectively implement instruction that directly impacts fluency.

4.4. Limitations

Our study is limited in that we only have data on first grade early readers. While this sample provides important information about early reading instruction, we are not able to investigate developmental patterns of the subcomponent skills and how the relations between the skills may change over time. These investigations are particularly important for students who are struggling with reading development and reading comprehension so that effective interventions can be developed.

Additionally, the literature base has demonstrated that there are limitations inherent in measuring reading comprehension (e.g., Cutting & Scarborough, 2006; Fletcher, 2009; Keenan, Betjemann, & Olson, 2008). In this study, comprehension measures with varying presentation and response formats were included, as well as the utilization of a latent variable framework, in attempts to better control measurement error.

Third, a different sampling procedure might have yielded a different at-risk sample and different results. The not at-risk group did not include students who were ranked by their teachers in the lower 50% of the class, but also passed the screening. Including these students might have resulted in changes to the not at-risk group's results. Moreover, the groups might have been altered if all students were screened rather than only those ranked in the lower 50% of the class. Finally, only students who failed all three screening measures were included in the at-risk sample. A more liberal benchmark for inclusion - such as including students who struggled with either word reading or listening comprehension, but not both - could have resulted in a different sample of at-risk students.

Finally, this study was cross-sectional and did not investigate whether relations among variables changed over time with respect to predicting reading comprehension. This study was also limited in terms of the variables that were included in the models. Future studies should include additional variables that have been shown to impact reading comprehension such as socioeconomic status, home literacy practices, and ELL status.

5. Conclusion

Advances in statistical modeling have allowed the field to garner a more in-depth understanding of the development of reading comprehension in recent years. Most of the evidence suggests that decoding and listening comprehension play important roles in reading comprehension and that the relations between these variables change as children age. Existing data does not converge on the role of reading fluency. Recent studies suggest that there is a predictive relation between reading fluency and comprehension, but its contribution above and beyond that of decoding and listening comprehension is less clear. Less is understood about early readers who demonstrate weaknesses in both decoding and listening comprehension in the early grades, and as they progress through the school year. More research is needed that specifically investigates potential differential impacts of listening comprehension, decoding, and fluency on reading comprehension across grade levels.

Early identification of reading risk is necessary to develop and implement preventive intervention models for struggling readers. This paper demonstrates differential relations between not at-risk readers and those who are struggling in the areas of decoding and listening comprehension, the two areas defined by the SVR to predict later reading comprehension performance, as well as early reading fluency, a measure that has been shown to be predictive of reading comprehension in extant data. The findings add to the growing body of knowledge on early preventative reading intervention; the differential relations help to inform a more targeted approach of early reading intervention specific to struggling readers.

References

Aaron, P. G., Joshi, M., & Williams, K. A. (1999). Not all reading disabilities are alike. *Journal of Learning Disabilities, 32*(2), 120–137.

Adams, M. J. (1990). *Beginning to read: Thinking and learning about print.* Cambridge, MA: MIT Press.

Adlof, S. M., Catts, H. W., & Little, T. D. (2006). Should the simple view of reading include a fluency component? *Reading and Writing, 19*, 933–958. http://dx.doi.org/10.1007/s11145-006-9024-z.

Bentler, P. M., & Bonett, D. G. (1980). Significance tests and goodness of fit in the analysis of covariance structures. *Psychological Bulletin, 88*, 588–606. http://dx.doi.org/10.1037/0033-2909.88.3.588.

Bowyer-Crane, C., Snowling, M. J., Duff, F. J., Fieldsend, E., Carroll, J. M., Miles, J., ... Hulme, C. (2008). Improving early language and literacy skills: Differential effects of an oral language versus a phonology with reading intervention. *Journal of Child Psychology and Psychiatry, 49*, 422–432. http://dx.doi.org/10.1111/j.1469-7610.2007.01849.x.

Cain, K., Oakhill, J. V., Barnes, M. A., & Bryant, P. E. (2001). Comprehension skill, inference-making ability, and their relation to knowledge. *Memory & Cognition, 29*(6), 850–859.

Catts, H., Hogan, T. P., & Adlof, S. M. (2005). Developmental changes in reading and

reading disabilities. In H. Catts, & A. Kamhi (Eds.). *Connections between language and reading disabilities*. Mahwah, NJ: Erlbaum.
Catts, H. W., Fey, M. E., Zhang, X., & Tomblin, J. B. (1999). Language basis of reading and reading disabilities: Evidence from a longitudinal investigation. *Scientific Studies of Reading, 3*, 331–361.
Catts, H. W., Petscher, Y., Schatschneider, C., Bridges, M. S., & Mendoza, K. (2009). Floor effects associated with universal screening and their impact on the early identification of reading disabilities. *Journal of Learning Disabilities, 42*, 163–176. http://dx.doi.org/10.1177/0022219408326219.
Chall, J. (1983). *Stages of reading development.* New York: McGraw Hill.
Chard, D. J., Vaughn, S., & Tyler, B. J. (2002). A synthesis of research on effective interventions for building reading fluency with elementary students with learning disabilities. *Journal of Learning Disabilities, 35*(5), 386–406.
Chen, R., & Vellutino, F. R. (1997). Prediction of reading ability: A cross-validation study of the simple view of reading. *Journal of Literacy Research, 29*, 1–24.
Clarke, P. J., Snowling, M. J., Truelove, E., & Hulme, C. (2010). Ameliorating children's reading-comprehension difficulties: A randomized controlled trial. *Psychological Science, 21*, 1106–1116. http://dx.doi.org/10.1177/0956797610375449.
Cutting, L. E., & Scarborough, H. S. (2006). Prediction of reading comprehension: Relative contributions of word recognition, language proficiency, and other cognitive skills can depend on how comprehension is measured. *Scientific Studies of Reading, 10*, 277–299. http://dx.doi.org/10.1207/s1532799xssr1003_5.
Denton, C. A., & Mathes, P. G. (2003). *Intervention for struggling readers: Possibilities and challenges. Preventing and remediating reading difficulties: Bringing science to scale*229–251.
Denton, C. A., Nimon, K., Mathes, P. G., Swanson, E. A., Kethley, C., Kurz, T. B., & Shih, M. (2010). Effectiveness of a supplemental early reading intervention scaled up in multiple schools. *Exceptional Children, 76*(4), 394–416.
Eason, S. H., Sabatini, J., Goldberg, L., Bruce, K., & Cutting, L. E. (2013). Examining the relationship between word reading efficiency and oral reading rate in predicting comprehension among different types of readers. *Scientific Studies of Reading, 17*(3), 199–223.
Fletcher, J. M. (2009). Measuring reading comprehension. *Scientific Studies of Reading, 10*, 323–330. http://dx.doi.org/10.1207/s1532799xssr1003_7.
Foorman, B. R., Francis, D. J., Fletcher, J. M., Schatschneider, C., & Mehta, P. (1998). The role of instruction in learning to read: Preventing reading failure in at-risk children. *Journal of Educational Psychology, 90*(1), 37.
Foorman, B. R., Francis, D. J., Shaywitz, S. E., Shaywitz, B. A., & Fletcher, J. M. (1997). *The case for early reading intervention*.
Francis, D. J., Fletcher, J. M., Catts, H., & Tomblin, J. B. (2005). Dimensions affecting the assessment of reading comprehension. In S. G. Paris, & S. A. Stahl (Eds.). *Children's reading comprehension and assessment.* Mahwah, NJ: Erlbaum.
Francis, D. J., Shaywitz, S. E., Stuebing, K. K., Shaywitz, B. A., & Fletcher, J. M. (1996). Developmental lag versus deficit models of reading disability: A longitudinal, individual growth curves analysis. *Journal of Educational Psychology, 88*(1), 3.
Fuchs, L. S., Fuchs, D., Hosp, M. K., & Jenkins, J. R. (2001). Oral reading fluency as an indicator of reading competence: A theoretical, empirical, and historical analysis. *Scientific Studies of Reading, 5*, 239–256.
Fuchs, L. S., Fuchs, D., & Maxwell, L. (1988). The validity of informal measures of reading comprehension. *Remedial and Special Education, 9*, 20–28.
Gallagher, A., Frith, U., & Snowling, M. J. (2000). Precursors of literacy delay among children at genetic risk of dyslexia. *Journal of Child Psychology and Psychiatry, and Allied Disciplines, 41*(2), 203–213.
Georgiou, G. K., Das, J. P., & Hayward, D. (2009). Revisiting the "simple view of reading" in a group of children with poor reading comprehension. *Journal of Learning Disabilities, 42*, 76–84.
Gough, P. B., Hoover, W. A., & Peterson, C. L. (1996). Some observations on a simple view of reading. In C. Cornoldi, & J. Oakhill (Eds.). *Reading comprehension difficulties: Processes and intervention* (pp. 1–13). Mahwah, NJ: Lawrence Erlbaum.
Gough, P. B., & Tunmer, W. E. (1986). Decoding, reading, and reading disability. *Remedial and Special Education, 7*(1), 6–10.
Hamilton, E. E., Paris, A. H., Carpenter, R. D., & Paris, S. G. (2005). Spurious and genuine correlates of children's reading comprehension. *Children's reading comprehension and assessment* (pp. 149–178). Routledge.
Hancock, G. R., & Mueller, R. O. (2011). The reliability paradox in assessing structural relations within covariance structure models. *Educational and Psychological Measurement, 71*(2), 306–324.
Hoover, W. A., & Gough, P. B. (1990). The simple view of reading. *Reading and Writing, 2*(2), 127–160.
Hu, L., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling: A Multidisciplinary Journal, 6*, 1–55. http://dx.doi.org/10.1080/10705519909540118.
Hulme, C., Nash, H. M., Gooch, D., Lervåg, A., & Snowling, M. J. (2015). The foundations of literacy development in children at familial risk of dyslexia. *Psychological Science, 26*(12), 1877–1886.
Jenkins, J. R., Fuchs, L. S., Van Den Broek, P., Espin, C., & Deno, S. L. (2003). Sources of individual differences in reading comprehension and reading fluency. *Journal of Educational Psychology, 95*(4), 719.
Joshi, R. M., & Aaron, P. G. (2000). The component model of reading: Simple view of reading made a little more complex. *Reading Psychology, 21*(2), 85–97.
Juel, C., & Leavell, J. A. (1988). Retention and nonretention of at-risk readers in first grade and their subsequent reading achievement. *Journal of Learning Disabilities, 21*(9), 571–580.
Keenan, J. M., Betjemann, R. S., & Olson, R. K. (2008). Reading comprehension tests vary in the skills they assess: Differential dependence on decoding and oral comprehension. *Scientific Studies of Reading, 12*, 281–300. http://dx.doi.org/10.1080/10888430802132279.
Kendeou, P., van den Broek, P., White, M. J., & Lynch, J. S. (2009). Predicting reading comprehension in early elementary school: The independent contributions of oral language and decoding skills. *Journal of Educational Psychology, 101*, 765–778. http://dx.doi.org/10.1037/a0015956.
Kershaw, S., & Schatschneider, C. (2012). A latent variable approach to the simple view of reading. *Reading and Writing, 25*, 433–464. http://dx.doi.org/10.1007/s11145-010-9278-3.
Kim, Y. S., Petscher, Y., Schatschneider, C., & Foorman, B. (2010). Does growth rate in oral reading fluency matter in predicting reading comprehension achievement? *Journal of Educational Psychology, 102*(3), 652.
Kim, Y. S., & Wagner, R. K. (2015). Text (oral) reading fluency as a construct in reading development: An investigation of its mediating role for children from grades 1 to 4. *Scientific Studies of Reading, 19*(3), 224–242.
Kim, Y. S., Wagner, R. K., & Foster, E. (2011). Relations among oral reading fluency, silent reading fluency, and reading comprehension: A latent variable study of first-grade readers. *Scientific Studies of Reading, 15*, 338–362. http://dx.doi.org/10.1080/10888438.2010.493964.
Kline, R. B. (2011). *Principles and practice of structural equation modeling* (3rd edition). New York: The Guilford Press.
Kuhn, M. R., & Stahl, S. A. (2003). Fluency: A review of developmental and remedial practices. *Journal of Educational Psychology, 95*(1), 3.
LaBerge, D., & Samuels, S. (1974). Toward a theory of automatic information processing in reading. *Cognitive Psychology, 6*, 293–323.
Leslie, L., & Caldwell, J. (2012). *Qualitative reading inventory-II (QRI-V).* 1900 E. Lake Ave., Glenview, IL 60025: Harper Collins College Publishers.
Little, R. L., & Rubin, D. B. (1990). *Statistical analysis with missing data.* New York, NY: Wiley.
Lyon, G. R., & Fletcher, J. M. (2001). *Early identification, prevention and early intervention for children at-risk for reading failure.* Publication of the Council for Basic Education.
Lyytinen, P., Eklund, K., & Lyytinen, H. (2005). Language development and literacy skills in late-talking toddlers with and without familial risk for dyslexia. *Annals of Dyslexia, 55*(2), 166–192.
MacCallum, R. C., Browne, M. W., & Sugawara, H. M. (1996). Power analysis and determination of sample size for covariance structure modeling. *Psychological Methods, 1*(2), 130.
Mather, N., & Jaffe, L. E. (2016). *Woodcock-Johnson IV: Reports, recommendations, and strategies.* John Wiley & Sons.
Mathes, P. G., Denton, C. A., Fletcher, J. M., Anthony, J. L., Francis, D. J., & Schatschneider, C. (2005). The effects of theoretically different instruction and student characteristics on the skills of struggling readers. *Reading Research Quarterly, 40*(2), 148–182.
Muthén, L. K., & Muthén, B. O. (2015). *Mplus: Statistical analysis with latent variables (version 7.3) [computer software].* Los Angeles, CA: Muthén & Muthén.
Nation, K., Adams, J. W., Bowyer-Crane, C. A., & Snowling, M. J. (1999). Working memory deficits in poor comprehenders reflect underlying language impairments. *Journal of Experimental Child Psychology, 73*(2), 139–158.
Nation, K., & Snowling, M. J. (1998). Individual differences in contextual facilitation: Evidence from dyslexia and poor reading comprehension. *Child Development, 69*(4), 996–1011.
Nation, K., & Snowling, M. J. (1999). Developmental differences in sensitivity to semantic relations among good and poor comprehenders: Evidence from semantic priming. *Cognition, 70*(1), B1–B13.
Nation, K., & Snowling, M. J. (2000). Factors influencing syntactic awareness skills in normal readers and poor comprehenders. *Applied PsychoLinguistics, 21*(02), 229–241.
National Reading Panel (US), National Institute of Child Health, & Human Development (US) (2000). *Report of the national reading panel: Teaching children to read: An evidence-based assessment of the scientific research literature on reading and its implications for reading instruction: Reports of the subgroups.* National Institute of Child Health and Human Development, National Institutes of Health.
Paris, A., & Paris, S. (2003). Assessing narrative comprehension in young children. *Reading Research Quarterly, 38*(1), 36–76.
Pennington, B. F., & Lefly, D. L. (2001). Early reading development in children at family risk for dyslexia. *Child Development, 72*(3), 816–833.
Pennington, B. F., & Olson, R. K. (2005). *Genetics of dyslexia.*
Perfetti, C. A. (1985). *Reading ability.* Oxford University Press.
Pikulski, J. J., & Chard, D. J. (2005). Fluency: Bridge between decoding and reading comprehension. *The Reading Teacher, 58*(6), 510–519.
Preston, J. L., Frost, S. J., Mencl, W. E., Fulbright, R. K., Landi, N., Grigorenko, E., ... Pugh, K. R. (2010). Early and late talkers: School-age language, literacy and neurolinguistic differences. *Brain, 133*(8), 2185–2195.
Rashotte, C. A., MacPhee, K., & Torgesen, J. K. (2001). The effectiveness of a group reading instruction program with poor readers in multiple grades. *Learning Disability Quarterly, 24*(2), 119–134.
Riedel, B. W. (2007). The relation between DIBELS, reading comprehension, and vocabulary in urban first-grade students. *Reading Research Quarterly, 42*(4), 546–567.
Roth, F. P., Speece, D. L., & Cooper, D. H. (2002). A longitudinal analysis of the connection between oral language and early reading. *The Journal of Educational Research, 95*, 259–272. http://dx.doi.org/10.1080/00220670209596600.
Rumelhart, D. E. (1994). *Toward an interactive model of reading.* International Reading Association.
Scarborough, H. S. (1990). Very early language deficits in dyslexic children. *Child Development, 61*(6), 1728–1743.
Scarborough, H. S. (1998). *Early identification of children at risk for reading disabilities: Phonological awareness and some other promising predictors. Specific reading disability: A*

*view of the spectrum*75–119.
Semel, E., Wiig, E., & Secord, W. (2003). *Clinical evaluation of language fundamentals-IV.* Marickville: Harcourt Assessment.
Silverman, R. D., Speece, D. L., Harring, J. R., & Ritchey, K. D. (2013). Fluency has a role in the simple view of reading. *Scientific Studies of Reading, 17*(2), 108–133.
Snowling, M. J., Muter, V., & Carroll, J. (2007). Children at family risk of dyslexia: A follow-up in early adolescence. *Journal of Child Psychology and Psychiatry, 48*(6), 609–618.
Stanovich, K. E. (1986). Matthew effects in reading: Some consequences of individual differences in the acquisition of literacy. *Reading Research Quarterly,* 360–407.
Stecker, S. K., Roser, N. L., & Martinez, M. G. (1998). Understanding oral reading fluency. In T. Shanahan, & F. V. Rodriguez-Brown (Eds.). *47th yearbook of the national reading conference* (pp. 295–310). Chicago: National Reading Conference.
Storch, S. A., & Whitehurst, G. J. (2002). Oral language and code-related precursors to reading: Evidence from a longitudinal structural model. *Developmental Psychology, 38*, 934–947. http://dx.doi.org/10.1037//0012-1649.38.6.934.
Tilstra, J., McMaster, K., Van den Broek, P., Kendeou, P., & Rapp, D. (2009). Simple but complex: Components of the simple view of reading across grade levels. *Journal of Research in Reading, 32*(4), 383–401.
Torgesen, J. K., & Burgess, S. R. (1998). Consistency of reading-related phonological processes throughout early childhood: Evidence from longitudinal-correlational and instructional studies. *Word recognition in beginning literacy* (pp. 161–188). .
Torgesen, J. K., Wagner, R., & Rashotte, C. (Wagner and Rashotte, 1999b). *TOWRE–2 test of word reading efficiency.* Austin, TX: Pro-Ed.
Torgesen, J. K., Wagner, R. K., & Rashotte, C. A. (Wagner and Rashotte, 1999a). Preventing reading failure in young children with phonological processing disabilities: Group and individual responses to instruction. *Journal of Educational Psychology, 91*, 579–594.
Tunmer, W. E., & Chapman, J. W. (2012). The simple view of reading redux: Vocabulary knowledge and the independent components hypothesis. *Journal of Learning Disabilities, 45*, 453–466. http://dx.doi.org/10.1177/0022219411432685.
Vellutino, F. R., Fletcher, J. M., Snowling, M. J., & Scanlon, D. M. (2004). Specific reading disability (dyslexia): What have we learned in the past four decades? *Journal of Child Psychology and Psychiatry, 45*, 2–40.
Vellutino, F. R., Scanlon, D. M., & Lyon, G. R. (2000). Differentiating between difficult-to-remediate and readily remediated poor readers more evidence against the IQ-achievement discrepancy definition of reading disability. *Journal of Learning Disabilities, 33*(3), 223–238.
Vellutino, F. R., Tunmer, W. E., Jaccard, J. J., & Chen, R. (2007). Components of reading ability: Multivariate evidence for a convergent skills model of reading development. *Scientific Studies of Reading, 11*, 3–32. http://dx.doi.org/10.1080/10888430709336632.
Wagner, R. K., & Torgesen, J. K. (1987). The nature of phonological processing and its causal role in the acquisition of reading skills. *Psychological Bulletin, 101*, 192–212. http://dx.doi.org/10.1037//0033-2909.101.2.192.
Wiederholt, J. L., & Bryant, B. R. (2012). *Gray oral reading tests*.
Wolf, M. (1999). What time may tell: Towards a new conceptualization of developmental dyslexia. *Annals of Dyslexia, 49*(1), 1–28.
Wolf, M. (Ed.). (2001). *Dyslexia, fluency, and the brain.* York Press.
Young, A., & Bowers, P. G. (1995). Individual difference and text difficulty determinants of reading fluency and expressiveness. *Journal of Experimental Child Psychology, 60*(3), 428–454.