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Developmental relations between reading fluency and reading comprehension: A longitudinal study from grade one to two

Young-Suk Kim¹, Richard K. Wagner², and Danielle Lopez³

¹Florida State University and Florida Center for Reading Research

²Florida State University and Florida Center for Reading Research

³Florida State University

Abstract

From a developmental framework, relations among list reading fluency, oral and silent reading fluency, listening comprehension, and reading comprehension might be expected to change as children's reading skills develop. We examined developmental relations among these constructs in a latent-variable longitudinal study of first- and second-grade students. Results showed that list reading fluency was uniquely related to reading comprehension in grade one, but not in grade two after accounting for text reading fluency (oral or silent) and listening comprehension. In contrast, text reading fluency was uniquely related to reading comprehension in grade two, but not in grade one, after accounting for list reading fluency and listening comprehension. When oral and silent reading fluency were compared, oral reading fluency was uniquely related to reading comprehension after accounting for silent reading fluency in grade one whereas in grade two, silent reading fluency was uniquely related to reading comprehension after accounting for oral reading fluency.

Keywords

Developmental relation; Oral reading fluency; Silent reading fluency; Reading comprehension; Structural equation modeling

Numerous studies have shown strong correlations between oral reading fluency and reading comprehension (e.g., Author et al., 2010; Authors et al., 2011; Fuchs, Fuchs, Hosp, & Jenkins, 2001; National Institute of Child Health and Human Development [NICHD], 2000; Ridel, 2007; Roehrig, Petscher, Nettles, Hudson, & Torgesen, 2008). Furthermore, oral reading fluency is uniquely related to reading comprehension over and above list reading fluency (i.e., context-free word reading rate) (Jenkins, Fuchs, van den Broek, Espin, & Deno, 2003; Klauda & Guthrie, 2008). However, despite much focus on and our expanding knowledge of reading fluency, we do not have a good understanding about the *developmental* nature of relations among text reading fluency, list reading fluency (i.e., reading isolated words in a list format), listening comprehension, and reading

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Corresponding author Young-Suk Kim, Assistant Professor, Florida State University & Florida Center for Reading Research, C234D, Florida Center for Reading Research, Department of Psychology, Florida State University, 1107 W. Call St., Tallahassee, FL 32306, ykim@fcr.org, Phone: 850-645-8726, Fax: 850-644-9085.

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comprehension. In the present article, we use the term text reading fluency (oral and silent reading fluency) to refer to accuracy and rate at reading connected texts including both oral and silent modes. Although we acknowledge that reading prosody is an important aspect of reading fluency (e.g., Hudson, Pullen, Lane, & Torgesen, 2009; Kuhn & Stahl, 2003; Kuhn, Schwanenflugel, & Meisinger, 2010; Valencia et al., 2010), we did not address reading prosody in the present study.

Developmental Relations among List Reading Fluency, Text Reading Fluency, and Reading Comprehension

Although strong relations exist between text reading fluency and reading comprehension (Fuchs et al., 2001; NICHD, 2000; Ridel, 2007), developmental differences in the relative strength of relations among text reading fluency, list reading fluency, and reading comprehension are suggested by the results from several studies. In studies with fourth- (Jenkins et al., 2003) and fifth-grade students (Klauda & Guthrie, 2008), oral reading fluency was uniquely related to reading comprehension after accounting for list reading fluency in the Jenkins et al. study, and after accounting for list reading fluency, silent reading fluency, background knowledge, and inferencing skills in the Klauda and Guthrie study. In comparison, text reading fluency was not independently related to reading comprehension once list reading fluency and listening comprehension were accounted for in a sample of first grade students, even for skilled word readers (Authors et al., 2011). Similarly, text reading fluency was not uniquely related to reading comprehension after accounting for list reading fluency and reading inference for first, second, and third grade students (Schwanenflugel, Meisinger, Weisenbaker, Kuhn, Strauss, & Morris, 2006).

These discrepant findings suggest, but do not actually test whether there are developmental differences in relations among list reading fluency, text reading fluency, and reading comprehension. A rationale for expecting developmental differences is that during the beginning phase of reading development, children's text reading fluency skill might largely overlap with context-free word reading because context-free word reading skill is the key building block or basis of text reading fluency (Chall, 1983; Ehri, 2002; NICHD, 2000). Thus, text reading fluency might not add uniquely to reading comprehension over and above context-free reading skill for beginning readers. With further development of reading skills, however, children's text reading fluency may become differentiated from context-free word reading (i.e., list reading fluency). The rationale is that when decoding of individual words develops sufficiently, other factors such as oral language proficiency exert more of an influence on text reading, which results in text reading fluency becoming uniquely related to reading comprehension over and above list reading fluency. Thus, children's word reading may need to reach a certain level of proficiency before text reading fluency is uniquely related to reading comprehension over and above list reading fluency and listening comprehension. Some support for this idea comes from Adlof, Catts, and Little's (2006) study, which found that list reading fluency and text reading fluency were separate constructs in grades four and eight although not dissociable in grade two. In contrast, another recent study showed that list reading fluency and text reading fluency were separate constructs even in first grade (Authors et al., 2011). These discrepant results might be due to different measures and samples used in these studies. For instance, Adlof and her colleagues had many children with language impairment in their study whereas Author et al.'s study include unselected sample of students.

In the present study, we examined whether the nature of relations between text reading fluency and reading comprehension changes as children advance in their reading skills in a sample of children who were followed longitudinally in grades one and two. We also examined relations between skilled versus less skilled word readers in grade two. This latter

is similar to the approach reported with first grade children in an earlier study (Authors et al., 2011). These two approaches allow us to investigate whether the patterns of relations are a function of normal development, individual differences between skilled and less-skilled readers within a grade, or both.

Developmental Relations among Listening Comprehension, List Reading Fluency, and Text Reading Fluency

The unique relation between text reading fluency and reading comprehension over and above list reading fluency has been attributed to listening (or oral language) comprehension – i.e., text reading fluency captures oral language processing as well word reading automaticity during connected text reading (Daane, Campbell, Grigg, Goodman, & Oranje, 2005; Fuchs et al., 2001; Jenkins et al., 2003; Samuels, 2006; Schreiber, 1980; Wolf & Katzir-Cohen, 2001). Despite the fact that many conceptualizations of text reading fluency explicitly mention ‘comprehension’ as one of the text reading fluency processes (Hudson et al., 2009; Kuhn et al., 2010; Samuels, 2006; Wolf & Katzir-Cohen, 2001), empirical examination of this conceptualization has been limited (Wolf & Katzir-Cohen, 2001). An exception is a recent study that showed that children’s listening comprehension was uniquely related to text reading fluency after accounting for list reading fluency for first grade students. However, this unique relation appears to depend on children’s developmental level of word reading proficiency such that listening comprehension was uniquely related to text reading fluency only for skilled word readers, but not for average word readers in first grade (Authors et al., 2011). Thus, a certain level of word reading proficiency might be needed for listening comprehension to play a role in text reading fluency. These results lend support for the verbal efficiency theory (Perfetti, 1985, 1992), which posits that children’s word reading proficiency influences the consolidation of fluency component skills. For readers with slow and non-automatic word reading, word reading will constrain meaning construction processes in text reading fluency and reading comprehension. For children with skilled word reading, cognitive resources are available for meaning construction (i.e., comprehension), thus allowing listening comprehension to be related to text reading fluency (Authors et al., 2011).

Silent Reading Fluency and Reading Comprehension

Despite increased attention to and understanding of text reading fluency, studies on text reading fluency have predominantly focused on oral reading fluency (e.g., NICHD, 2000). Consequently, much less is known about silent reading fluency (see Hiebert & Reutzel, 2010, for a recent review of silent reading fluency). The imbalance, however, does not reflect the reality of reading practice for most readers as silent reading is the primary mode of reading for proficient readers. Even beginning readers in first and second grades are expected to read silently during parts of reading instruction (e.g., popcorn reading or partner reading) and in the context of some reading comprehension tests. Although empirical studies on silent reading fluency are few, those few have shown that oral and silent reading fluency are dissociable constructs for both average and skilled readers in first grade. Furthermore, oral and silent reading fluency are more strongly related for skilled ($r = .79$) than average readers ($r = .44$) in first grade (Authors et al., 2011). For children in grades two to six, silent reading fluency measured by a maze task was highly related to oral reading fluency ($r = .67$ to $.88$; Jenkins & Jewell, 1993).

The relation between silent reading fluency and reading comprehension is unclear as the few previous studies showed varying results. Silent reading fluency had a strong relation with reading comprehension for second grade students ($r = .76$, Jenkins & Jewell, 1993) but weak relations were observed for fourth graders ($r = .38$ to $.47$, Fuchs et al., 2001). A recent study

with first grade students showed a fairly strong relation between silent reading fluency and reading comprehension ($r_s = .67$ & $.75$ for skilled and average readers in first grade, respectively, Authors et al., 2011). However, after accounting for oral reading fluency, silent reading fluency was not uniquely related to reading comprehension for average or skilled readers in first grade. What is unclear from these results with first grade students is whether the lack of a unique relation between silent reading fluency and reading comprehension is due to individual differences between average and skilled readers, or due to the developmental nature of the relations. According to a developmental perspective, children might primarily have experience reading orally in the beginning phase of development, and thus their oral reading fluency might have a unique relation to reading comprehension over and above silent reading fluency. However, as children's reading skill develops, children transition from oral to silent reading (Gray & Reese, 1957; Wright, Sherman, & Jones, 2010), and thus, silent reading fluency might come to play a unique role in reading comprehension over and above oral reading fluency.

Present Study

In the present study we investigated developmental relations among list reading fluency, listening comprehension, text reading fluency (both oral and silent), and reading comprehension by following a cohort of students from first- to second-grade. We attempted to answer four questions.

1. Are oral and silent reading fluency dissociable constructs?
2. If so, how are oral and silent reading fluency related to reading comprehension?
3. What are relations among text reading fluency (oral and silent, respectively), list reading fluency, listening comprehension, and reading comprehension?
4. Do differences in these relations observed previously for skilled versus less-skilled word readers in first grade represent enduring individual differences associated with reading skill or a normal developmental progression?

In order to address these research questions, we used longitudinal data from grade one to two as well as cross-sectional data in grade two for subgroup analysis of skilled and less skilled readers.

Method

Participants

A total of 270 children participated in the two-year longitudinal study. Approximately half were boys ($n = 139$, 52%) with 63% Caucasian, 22% African American, 5% Hispanic, 4% Asian, and 6% Other students. The mean ages of the sample students were 84 months ($SD = 5.41$) in grade one and 97 months ($SD = 5.20$) in grade two.

Measures

The primary constructs of interest were listening comprehension, list reading fluency, oral reading fluency, silent reading fluency, and reading comprehension. Multiple measures were used to form latent variables to represent each of these constructs. Table 1 displays descriptive statistics and reliability information for each measure. Reliabilities were high for the majority of measures except for researcher developed listening comprehension and reading comprehension measures due to some floor effects, particularly in grade one. Because we are using latent variables that capture common variance among observed indicators, the low reliabilities of a few measures are less of a problem than they would be if only observed variables were used in the analyses.

Listening comprehension—Three indicators of listening comprehension included the *Woodcock-Johnson III* (WJ-III) Oral Comprehension subtest (Woodcock, McGrew, & Mather, 2001) and two experimental passages. Oral Comprehension is a cloze task in which participants complete orally presented sentences (e.g., People sit in____). Oral Comprehension test has shown to be related to other language skills such as Verbal Comprehension ($r = .59$) and Story Recall ($r = .47$) for children six to eight years old (Woodcock et al., 2001). Students' responses were scored dichotomously (1 = correct; 0 = incorrect) following the protocol in WJ-III that specifies acceptable answers. In the experimental task, participants listened to two short passages read aloud by the examiner and then answered four open-ended comprehension questions for each passage. One passage, *Pierre's soup* was narrative and the other *Tree life* was expository with 176 and 133 words, respectively. The comprehension questions assessed children's recall of details (e.g., What did Pierre take to the town square?) and inference skills (e.g., Do you think Pierre ever got a job? Why?). Students answers were scored dichotomously (1 = correct; 0 = incorrect) for each question. The questions that had two parts (e.g., Do you think Pierre ever got a job? Why?), the child had to provide correct answer to both parts for a score of 1.

List reading fluency—Two forms (Forms A and B) of the Sight Word Efficiency subtest of the *Test of Word Reading Efficiency – 2nd Edition* (TOWRE-2, Torgesen, Wagner, & Rashotte, 2012) served as indicators of list reading fluency. In this test, the child is asked to read aloud as many words as possible within 45 seconds. Words increase in difficulty progressively (e.g., from simple single-syllable to multisyllabic words). Total score is the number of correctly read words within 45 seconds. Sight Word Efficiency has shown to be highly related to other reading measures of decoding such as the Word Identification subtest of the *Woodcock Reading Mastery Test-Revised* (WRMT-R, Woodcock, 1987) and the WJ-III ($rs = .79$ & $.76$), Gray Oral Reading Test-4 reading fluency ($r = .91$), Test Of Silent Contextual Reading Fluency ($r = .75$), and WRMT-R Passage Comprehension ($r = .88$ for normal readers) (Torgesen et al., 2011).

Oral reading fluency—Oral reading fluency was measured by three grade-level passages from the *Dynamic Indicators of Basic Early Literacy Skills* (DIBELS) Oral Reading Fluency (6th edition; Good & Kaminski, 2007). The three passages were midyear benchmark passages for each grade (e.g., for second grade, *Riding the roller coaster; Moving day; and Stars of the sea*). Children were asked to read the passages aloud for one minute and the number of words accurately read during the interval was calculated. Word omissions, substitutions, and hesitations of more than three seconds were scored as errors. DIBELS Oral Reading Fluency has shown to be highly related to other reading fluency tasks (e.g., GORT-4; $.86$ rs $.88$, Hudson, Torgesen, Lane, & Turner, in press) and to reading comprehension (Good, Simmons, & Kame'enui, 2001; Ridel, 2007; Roehrig et al., 2008).

Silent reading fluency—Silent reading fluency was measured by two forms (Forms A & O) of the *Test of Silent Reading Efficiency and Comprehension* (TOSREC, Wagner, Torgesen, Rashotte, & Pearson, 2010). Children were asked to read sentences silently and verify the veracity of the sentences for three minutes. The sentences were true or false statements that were based on fundamental knowledge that was expected to be well known to young children. Participants indicated whether they were true or false by circling 'yes' or 'no.' For example, for the statement, "A cow is an animal," the correct answer is "yes." There were two sample items (to explain the task to the student), five practice items, and 50 test items in each form. Total scores are calculated by counting the number of correct responses and subtracting the number of incorrect responses (to control for guessing). TOSREC has shown to be strongly related to a variety of reading measures such as Florida Comprehensive Achievement Test reading comprehension task and WJ-III Passage

Comprehension (.64 to .83), DIBELS Oral Reading Fluency (.77 to .96), and a silent reading fluency measure, Test of Silent Word Reading Fluency (TOSWRF, Mather, Hammill, Allen, & Roberts, 2004; .81 to .89) (Wagner et al., 2010), and Test of Silent Contextual Reading Fluency (TOSCRF, .85 to .93 for grades 6–8, Allen & Hamill, 2011) for students in grades one and two.

Reading comprehension—Reading comprehension was assessed by the WJ-III Passage Comprehension subtest (Woodcock, et al., 2001), WRMT-R Passage Comprehension subtest (Woodcock, 1987), and two experimental passages. Both Woodcock measures are cloze tasks in which children are asked to read sentences and passages and fill in a correct word based on the texts read. Students' responses were scored following the protocols in WJ-III and WRMT-R. Cloze tasks such as WJ-III and WRMT-R Passage Comprehension have shown to be related to other reading comprehension measures such as reading comprehension subtest of Peabody Individual Achievement Test ($r = .70$; Keenan, Betjemann, & Olson, 2008). For the experimental passages, participants were asked to read short passages and answer four open-ended questions that required children to recall details in the passage (e.g., Where does Harry live?) and make inferences (e.g., Why did Harry and Sally both see windows made of gold, but at different times of the day?). Student answers were scored dichotomously (1 = correct; 0 = incorrect) for each question. The two passages, *Windows of gold* and *Making the round earth flat*, were narrative and expository texts with 192 and 126 words, respectively.

Word reading accuracy—The WJ-III Word Identification subtest (Woodcock, et al., 2001) was administered to assess participants' word reading accuracy skills. Children's performance on this subtest was used to divide the sample into two groups for second grade data analysis for skilled versus less skilled word readers.

Procedures

The majority of assessments were individually administered in quiet areas (e.g., library or technology room) by trained research assistants. The TOSREC was small group-administered (typically 2–3 students). The assessments included in the present study took approximately 50–60 minutes, on average, and children were assessed in two 30-minute sessions. The assessments were administered at the end of the fall semester and during the spring semester. To minimize time-sampling error, multiple indicators of each construct were administered during different testing sessions to the extent possible. In grades one and two, assessments were administered in the following order: Oral reading fluency, WJ-III Word Identification, WJ-III Passage Comprehension, WJ-III Oral Comprehension; Researcher-developed reading comprehension, TOWRE Sight Word Efficiency, Researcher-developed listening comprehension, WRMT Passage Comprehension, and TOSREC.

Results

Descriptive Statistics and Preliminary Analyses

Descriptive statistics, reliabilities, and correlations between observed variables in grades one and two are presented in Tables 1 and 2, respectively. The sample children's mean performances were average to slightly above average compared to norms in listening comprehension (i.e., WJ-III Oral Comprehension) and list and silent reading fluency (i.e., Sight Word Efficiency and TOSREC), and Woodcock passage comprehension measures. As shown in Table 3, all the variables were statistically significantly related ($ps < .001$) except for the researcher developed listening comprehension measure 1 in grade one due to a floor effect.

Using the observed variables, five latent variables were constructed representing the constructs of listening comprehension, list reading fluency, oral reading fluency, silent reading fluency, and reading comprehension. The distributions of the variables were examined. Although a few variables had some floor effects in univariate distributions (e.g., researcher-developed listening and reading comprehension measures in grade one), these did not result in substantial violations of multivariate normality. Raw scores were used in the analyses. Mplus 5.2 was used with full-information maximum likelihood as an estimator to handle missing data. Four children had missing data in grade one: One child had missing data in WJ-III Oral Comprehension, another child in TOWRE Form 2, another child in TOSREC Form O, and one child in WJ-III Passage Comprehension. There was no missing data in grade two. Fit of the models was evaluated by multiple indices including chi-square, comparative fit index (CFI), Tucker-Lewis index (TLI), root mean square error of approximation (RMSEA), and standardized root mean square residuals (SRMR). RMSEA values below .08, CFI and TLI values equal to or greater than .95, and SRMR equal to or less than .05 are preferred for an excellent model fit (Hu & Bentler, 1999).

Measurement invariance was examined in a set of preliminary confirmatory factor analyses to establish the equivalency of loadings across grades and subgroups in grade two, following recommended procedures for multigroup analysis (see Brown, 2006; Thompson & Green, 2006 for details). For the longitudinal data in first and second grades, a baseline model of non-invariance was first specified in which the loadings were allowed to vary completely. This model demonstrated an excellent fit to the data: $\chi^2 [301] = 446.49, p = .00$; CFI = .99; TLI = .98; RMSEA = .04; SRMR = .04. When a full invariance model was fit, it was a statistically poorer fit compared to the non-invariance model: $\chi^2 (314) = 1335.98, p = .00$; CFI = .89; TLI = .87; RMSEA = .11; SRMR = .20. Thus, we fitted partial invariance models in subsequent analysis by examining the loadings of each observed variable to the latent variable, and relaxed equal loading constraints of the following variables: the researcher developed listening comprehension measure 2 in grade three; oral reading fluency passage 2 in grades one and two; and the researcher developed reading comprehension measure 2 in grades one and two. Table 5 shows standardized factor loadings and residuals for the first and second grade sample. Correlations between the five latent variables in grades one and two are shown in Table 6 ($\chi^2 [308] = 494.91, p = .00$; CFI = .98; TLI = .98; RMSEA = .047; SRMR = .05). The residuals for the four researcher developed listening comprehension and reading comprehension observed variables were allowed to covary because they were identical measures in grades one and two.

To examine whether the interrelations among list reading fluency, listening comprehension, text reading fluency, and reading fluency differed as a function of word reading skill in second grade, subgroups were formed based on children's performance on the WJ-III Word Identification subtest (Woodcock, et al., 2001) by selecting approximately 100 children in the upper and lower end of the distribution in grade two. Descriptive statistics and correlations by subgroup are presented in Tables 2 and 3, respectively. The mean performance of less skilled group's word reading efficiency (i.e., TOWRE Sight Word Efficiency) was close to the average range based on the norms, therefore we refer to them as average readers hereafter (mean standard scores = 95.83 & 97.89, $n = 105$). The mean performance of skilled group's word reading efficiency was close to one standard deviation above the mean (mean standard scores = 112.26 & 113.10, $n = 105$), and we refer to them as skilled word readers hereafter. Multivariate Analysis of Variance (MANOVA) revealed significant differences in all the observed variables ($F_s = 13.47, p_s < .001$). Follow-up univariate F tests showed that skilled readers outperformed average readers on all tasks ($F_s = 32.73, p_s < .000$). Table 4 presents correlations among observed variables for skilled and average readers in grade two. Full measurement invariance was observed and thus used for the subsample analysis in grade two. In addition, the residual variance of TOSREC Form O

for the skilled readers was set to zero based on preliminary analysis. Table 5 shows standardized factor loadings and residuals for skilled versus average readers in grade two. We now turn to results that bear directly on the four research questions we asked.

Research Question 1: Are Oral and Silent Reading Fluency Dissociable Constructs?

In order to test whether oral and silent reading fluency are a single latent construct or two dissociable constructs, confirmatory factor analyses were conducted. In grade one, the fit of the single construct model was poor: $\chi^2(5) = 137.64, p = .00$; CFI = .94; TLI = .89; RMSEA = .31; SRMR = .04. In contrast, the fit of the two dissociable constructs model was excellent: $\chi^2(4) = 6.45, p = .17$; CFI = 1.00; TLI = 1.00; RMSEA = .05; SRMR = .003. A chi-square difference test comparing the fit of these two nested models was statistically significant: $\chi^2(1) = 131.19, p < .001$, which indicates that the single construct model provided a significantly poorer fit to the data than did the two dissociable constructs model. Similar results were found in grade two. The fit of the single construct model was poor ($\chi^2 = 90.39 [5], p = .00$; CFI = .94; TLI = .91; RMSEA = .25; SRMR = .04) the fit of the two dissociable constructs model was excellent ($\chi^2 = 5.05 [4], p = .28$; CFI = 1.00; TLI = 1.00; RMSEA = .03; SRMR = .003), with a statistically significant chi-square difference of $\chi^2(1) = 85.34, p < .001$.

Research Question 2: How are Oral and Silent Reading Fluency Related to Reading Comprehension?

A confirmatory factor analytic model of relations between oral and silent reading fluency and reading comprehension provided an excellent fit to the data: $\chi^2(126) = 226.98, p < .01$; CFI = .98; TLI = .98; RMSEA = .05; and SRMR = .05. These relations differed in grades one and two. Figure 1a shows the standardized coefficients. In grade one, oral reading fluency was uniquely related to reading comprehension ($\beta = .84, p < .001$) whereas silent reading fluency was not ($\beta = .06, p = .37$). In grade two, oral reading fluency was not uniquely related to reading comprehension ($\beta = .13, p = .20$) whereas silent reading fluency was ($\beta = .75, p < .01$). Eighty one percent and 75% of total variance were explained in reading comprehension in grades one and two, respectively.

Research Question 3: What are relations among text reading fluency (oral and silent, respectively), list reading fluency, listening comprehension, oral reading fluency, and reading comprehension?

For oral reading fluency, the structural equation model yielded a good model fit: $\chi^2(237) = 463.33, p < .001$; CFI = .97; TLI = .97; RMSEA = .06; and SRMR = .06. A total of 93% and 87% of variance in oral reading fluency, and 92% and 86% of variance in reading comprehension were explained in grades one and two, respectively. As shown in Figure 2a, in grade one, list reading fluency was strongly related to oral reading fluency ($\beta = .93, p < .001$) and listening comprehension was also positively related to oral reading fluency but with a small magnitude ($\beta = .08, p = .002$). Listening comprehension and list reading fluency were positively related to reading comprehension ($\beta = .32$ and $.77, ps < .001$, respectively), but oral reading fluency was not ($\beta = .005, p = .96$). In grade two, list reading fluency and listening comprehension were both related to oral reading fluency ($\beta = .83$ & $.21, p < .001$). Listening comprehension ($\beta = .60, p < .001$), list reading fluency ($\beta = .21, p = .04$), and oral reading fluency ($\beta = .27, p = .01$) were all positively related to reading comprehension. The parameter estimates relating list reading fluency to oral reading fluency and reading comprehension were constrained to be equal in grades one and two in order to examine whether the magnitudes of relations in grades one and two were different. The constrained model had significantly poorer fits: $\chi^2(238) = 491.73$ for oral reading fluency and $\chi^2(238) = 476.61$ for reading comprehension. Chi-square difference tests were statistically significant for both: $\chi^2(1) = 28.40$ and $\chi^2(1) = 13.28, ps < .001$, respectively. These

results suggest that list reading fluency is more strongly related to oral reading fluency in grade one ($r = .93$) than in grade two ($r = .83$), and also more strongly related to reading comprehension in grade one ($r = .77$) than in grade two ($r = .21$).

When relations were examined with silent reading fluency, the structural equation model yielded a good model fit: $\chi^2(194) = 375.20, p < .001$; CFI = .97; TLI = .96; RMSEA = .06; and SRMR = .06. The model explained 76% and 81% of variance in silent reading fluency, and 93% and 91% of variance in reading comprehension in grades one and two, respectively (see Figure 3a). The overall pattern of relations was similar to that for oral reading fluency. In grade one list reading fluency was positively related to silent reading fluency and reading comprehension (r 's = .84 & .80, p 's < .001, respectively) whereas silent reading fluency was not ($r = .02, p = .70$). Listening comprehension was not related to silent reading fluency ($p = .11$) but was related to reading comprehension ($r = .33, p < .001$). In grade two, list reading fluency was positively related to silent reading fluency, but not to reading comprehension ($r = .13, p = .08$). In contrast, silent reading fluency was uniquely related to reading comprehension ($r = .44, p < .001$). Listening comprehension was positively related to both silent reading fluency and reading comprehension (r 's = .38 and .50, p 's < .001). When the parameter estimates relating list reading fluency to silent reading fluency and reading comprehension were constrained to be equal in grades one and two, the model fits were significantly poorer: $\chi^2(195) = 381.15$ for silent reading fluency and $\chi^2(195) = 414.72$ for reading comprehension. Chi-square differences were statistically significant for both: $\chi^2(1) = 5.95$ and $\chi^2(1) = 39.52, p$'s < .025, respectively. These results suggest that list reading fluency is more strongly related to silent reading fluency and reading comprehension in grade one than in grade two.

(4) Do differences in these relations observed previously for skilled versus less-skilled readers in first grade represent enduring individual differences associated with reading skill or a normal developmental progression?

We examined the above research questions for skilled and average word readers in second grade to further investigate whether the relations are due to developmental nature or due to individual differences among skilled and less skilled word readers. When we conducted a similar analysis in grade one (Authors et al., 2011), oral and silent reading fluency were dissociable constructs for both skilled and average word readers, but they were more strongly associated for skilled word readers ($r = .79$) than for average word readers ($r = .44$). Oral reading fluency was uniquely related to reading comprehension after accounting for silent reading fluency, but silent reading fluency was not after accounting for oral reading fluency for both skilled and average word readers. Furthermore, list reading fluency was strongly related to oral and silent reading fluency for both skilled and average word readers whereas listening comprehension was uniquely related to oral and silent reading fluency only for skilled word readers, but not for average word readers in first grade. Finally, neither oral nor silent reading fluency were uniquely related to reading comprehension after accounting for list reading fluency and listening comprehension.

Confirmatory factor analysis was conducted to examine whether oral and silent reading fluency are best captured as a single latent variable or two dissociable latent variables for average and skilled word readers in grade two. The model in which oral and silent reading fluency were considered as two latent variables had a statistically better fit ($\chi^2[4] = 52.82, p < .001$ for skilled word readers and $\chi^2[4] = 111.87, p < .001$ for average word readers; the two latent variable model had a good fit: $\chi^2(152) = 196.17, p = .009$; CFI = .98; TLI = .98; RMSEA = .05; and SRMR = .08). These results suggest that oral and silent reading fluency are related but dissociable constructs regardless of children's word reading proficiency in grade two.

When the relations between oral and silent reading fluency and reading comprehension were examined for skilled and average word readers in second grade, the model fit was good: $\chi^2(60) = 95.15, p = .003$; CFI = .98; TLI = .97; RMSEA = .08; and SRMR = .08. As shown in Figure 1b, for average word readers, oral reading fluency was uniquely related to reading comprehension after accounting for silent reading fluency whereas silent reading fluency was not. For skilled word readers in second grade (Figure 1c), in contrast, both oral and silent reading fluency were uniquely and positively related to reading comprehension. It should be noted, however, that the magnitudes of standardized coefficients of silent reading fluency predicting reading comprehension for average versus skilled word readers were not statistically different ($\chi^2[1] = .06, p > .10$).

Next, we examined the relations among list reading fluency, listening comprehension, oral reading fluency to reading comprehension. The model fit was good: $\chi^2(112) = 153.64, p = .006$; CFI = .98; TLI = .97; RMSEA = .06; and SRMR = .08. The standardized structural regression weights are presented in Figures 2b and 2c for average and skilled word readers, respectively. For both average and skilled word readers, list reading fluency and listening comprehension were uniquely related to oral reading fluency. Listening comprehension, but not list reading fluency, was uniquely related to reading comprehension after accounting for listening comprehension and oral reading fluency for both average and skilled word readers. Oral reading fluency was uniquely related to reading comprehension for skilled word readers ($p < .001$) but was not for average word readers ($p > .05$). Approximately 83% of variance in reading comprehension and 88% of variance in oral reading fluency were explained by the model for the average word readers. A total of 74% of variance for reading comprehension and 63% for oral reading fluency was explained for skilled word readers.

A model that examined relations among list reading fluency, listening comprehension, silent reading fluency, and reading comprehension provided an excellent fit to the data: $\chi^2(90) = 103.90, p = .15$; CFI = .99; TLI = .99; RMSEA = .04; and SRMR = .08. The standardized structural regression weights are presented in Figures 3b and 3c for average and skilled word readers, respectively. For both average and skilled word readers, list reading fluency and listening comprehension were uniquely related to silent reading fluency. In addition, for the average word readers, list reading fluency, listening comprehension, and silent reading fluency were all uniquely related to reading comprehension. For the skilled word readers, listening comprehension and silent reading fluency were uniquely related to reading comprehension ($ps < .01$) whereas list reading fluency was not ($p = .85$). Approximately 85% of variance in reading comprehension and 59% of variance in silent reading fluency were explained by the model for the average word readers. The amounts of variance explained were smaller for skilled word readers with 66% of variance for reading comprehension and 37% for silent reading fluency.

Discussion

Our goal in the present study was to investigate whether the relation of text reading fluency to reading comprehension and the relations of word reading fluency and listening comprehension to text reading fluency and reading comprehension differ in grades one and two, and if so, whether the differences are as a function of children's reading development or individual differences between skilled and less-skilled word readers within a grade. By examining relations in grades one and two longitudinally, and examining relations for children who differed in their word reading proficiency in second grade (i.e., average vs. skilled word readers), we found that the relations among list reading fluency, listening comprehension, text reading fluency, and reading comprehension are not static, but change as children develop reading skills.

Component Skills of Text Reading Fluency

As expected, list reading fluency remained strongly related to text reading fluency, both oral and silent, in grades one and two, after accounting for listening comprehension. However, the magnitude of relations was stronger in grade one than in grade two for both oral and silent reading fluency. These results support the view that list reading fluency is a building block of text reading fluency (Chall, 1983; Ehri, 2002; NICHD, 2000), but it has a stronger influence during the initial phase of reading development.

Furthermore, although listening comprehension was not uniquely related to text reading fluency for average word readers in first grade, when children's word reading skill was more advanced (i.e., skilled readers in first grade and average and skilled readers in second grade), listening comprehension was uniquely related to oral and silent reading fluency after accounting for list reading fluency. Thus, as we hypothesized, it appears that a certain level of word reading proficiency is required for listening comprehension to be uniquely related to text reading fluency. According our previous and present studies, first grade average readers read approximately 17 words per 45 sec, using TOWRE-2 (Authors et al., 2011), and second grade average readers read 47 and 50 words per 45 sec. Thus, as children's word reading skill improves, their cognitive resources may be released to language processing for text reading fluency (Cohen-Mimran, 2009; Wolf & Katzir-Cohen, 2001).

Component Skills of Reading Comprehension: List Reading Fluency, Text Reading Fluency, and Listening Comprehension

Although oral reading fluency has been shown to be strongly related to reading comprehension in grades one to four (Berninger, Abbott, Vermeulen, & Fulton, 2006; Cook, 2003; Jenkins et al., 2002; Roberts, Good, & Corcoran, 2005; Roehrig et al., 2008), to our knowledge no previous studies have demonstrated a unique relation of oral reading fluency to reading comprehension over and above two important component skills of reading comprehension – context-free word reading and listening comprehension (Gough et al., 1996; Hoover & Gough, 1990). Klauda and Guthrie's (2008) study included inferencing skills and background knowledge, but no listening comprehension measures. Jenkins et al (2003) used reading comprehension as a proxy for listening comprehension. Our results showed that oral and silent reading fluency were not uniquely related to reading comprehension in the beginning phase of reading (i.e., first grade) once list reading fluency and listening comprehension were taken into account. In contrast, when children's reading skills are more advanced (e.g., grade two), oral or silent reading fluency became independently related to reading comprehension, suggesting that during the beginning phase, the role of list and text reading fluency in reading comprehension largely overlaps, but text reading fluency has an independent influence on reading comprehension at a later phase.

List reading fluency remained uniquely and strongly related to reading comprehension during the initial phase of reading (e.g., grade one) whereas in a more advanced phase (e.g., second grade), it is either not uniquely related to reading comprehension (in the case of silent reading fluency, Figure 3a), or the magnitude of unique relation to reading comprehension decreased (in the case of oral reading fluency, Figure 2a) after accounting for text reading fluency and listening comprehension.

These findings are in line with developmental models of reading fluency (McCormick & Samuels, 1979; Wolf & Katzir-Cohen, 2001) and reading comprehension (Gough et al., 1996; Storch & Whitehurst, 2002) and provide evidence for the constraining role of decoding skill for the development of text reading fluency and reading comprehension (LaBerge & Samuels, 1974; Perfetti, 1985). These findings indicate that development of text reading fluency and reading comprehension requires juggling and orchestration of multiple

component processes, and the availability of one component skill (e.g., listening comprehension) is dependent on the development of the other (e.g., list reading fluency). During the beginning phase of reading, most of cognitive resources are expended on word decoding, leaving little cognitive resources available for other component skills such as listening comprehension. Thus, context-free word reading is a dominant factor for reading fluency and reading comprehension in the beginning phase. This aligns well with our finding for children in grade one that list reading fluency had the strongest relation with reading fluency and reading comprehension. As children's word reading skill develops further (i.e., word recognition becomes more automatic), however, cognitive resources become available and can be allocated to listening comprehension for text reading fluency. Thus, text reading fluency comes to incorporate listening comprehension after a certain level of list reading fluency is achieved. This is also consistent with our finding that listening comprehension was not uniquely related to text reading fluency for average readers in first grade, but was for readers with more advanced word reading skills. Then, text reading fluency, now with facilitation of listening comprehension, becomes uniquely related to reading comprehension even after accounting for the unique contribution of list reading fluency and unique contribution of listening comprehension to predicting reading comprehension. In our study, the unique contribution of text reading fluency to reading comprehension occurred in second grade.

One unique aspect of the present study was inclusion of both oral and silent reading fluency for text reading fluency, and the pattern of developmental relations for silent reading fluency were similar, although not identical, to that of oral reading fluency. Oral and silent reading fluency were highly related, but distinct constructs for second grade students regardless of their word reading proficiency, extending the results for first grade students (Author et al., 2011). Furthermore, strengths of the relation increased as children's reading skill developed. Oral and silent reading fluency were moderately related in beginning phase of reading (e.g., $r = .44$ for average word readers in first grade, Author et al., 2011) and they become stronger ($.71$ *rs* $.81$) as their word reading skills develop (i.e., skilled word readers in first grade and both average and skilled word readers in second grade). These results suggest that children's reading performance differs quite a bit as a function of reading mode in the earlier stage of reading development, but may converge as reading skill develops.

Furthermore, in the earlier stage of reading development (i.e., first grade), oral, but not silent, reading fluency was uniquely related to reading comprehension whereas in the later stage of reading development (i.e., second grade), silent reading fluency was uniquely and positively related to reading comprehension. Although it is well known that children tend to transition from oral to silent mode and some evidence suggests that, on average, children tend to read at a faster rate silently than orally by third grade (Gray & Reese, 1957), to date we have very limited knowledge about the development of oral versus silent reading. The present study is an initial step toward expanding our understanding about oral versus silent reading development. Future studies are warranted including studies of relations between oral and silent reading for different aspects of reading (e.g., word reading, text reading) and of the transition from oral to silent reading.

Several limitations of the present study should be noted. One limitation of the present study is differences in the way oral and silent reading fluency were measured. Oral reading fluency was measured at the passage level whereas silent reading fluency was measured at the sentence level. In addition, in the silent reading fluency tasks, children's comprehension was explicitly checked whereas in the oral reading fluency tasks it was not. In addition, data collection was somewhat prolonged due to practical constraints of collecting a large amount of data individually. Although the primary analysis in the study was about covariance among measured constructs within individuals, not absolute level of performance, a shorter

time span for data collection would have been ideal. Finally, as is typically the case in measuring reading and reading-related skills, we acknowledge that the predictors in the models were moderately or fairly strongly related to each other (i.e., multicollinearity), which result in large standard error in some cases. Future studies addressing these limitations are warranted.

Despite these limitations, we believe that the present study is an important step to add to our growing understanding about *development* of reading fluency, particularly including silent reading fluency, by showing that the relations among list reading fluency, text reading fluency, listening comprehension, and reading comprehension differ predictably with development.

Highlights

- Relations among word reading, reading fluency, and comprehension were examined.
- Oral and silent reading fluency were dissociable constructs in grades one and two.
- Oral reading fluency was uniquely related to reading comprehension in 2nd grade.
- Silent fluency was related to reading comprehension over oral fluency in 2nd grade.

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1a

1b

1c

Figure 1.

1a, 1b, and 1c. Standardized structural regression weights among oral text reading fluency (ORF), silent text reading fluency (SRF), and reading comprehension in grades one and two ($N = 270$, Figure 1a), average word readers in grade two ($n = 105$, Figure 1b), and skilled word readers in grade two ($n = 105$, Figure 1c). Solid lines represent statistically significant paths and dotted lines statistically nonsignificant paths. G1 = Grade one; G2 = Grade two

2b

2c

Figure 2.
 2a, 2b, and 2c. Standardized structural regression weights for list reading fluency (List RF), listening comprehension (Listening Comp), oral text reading fluency (ORF), and reading comprehension (Reading Comp) in grades one and two ($N = 270$, Figure 2a), average word readers in grade two ($n = 105$, Figure 2b), and skilled word readers in grade two ($n = 105$, Figure 2c). Solid lines represent statistically significant paths and dotted lines statistically nonsignificant paths. G1 = Grade one; G2 = Grade two

3a

3b

3c

Figure 3.

3a, 3b, and 3c. Standardized structural regression weights for list reading fluency (List RF), listening comprehension (Listening Comp), silent text reading fluency (SRF), and reading comprehension (Reading Comp) in grades one and two ($N = 270$, Figure 3a), average word readers in grade two ($n = 105$, Figure 3b), and skilled word readers in grade two ($n = 105$, Figure 3c). Solid lines represent statistically significant paths and dotted lines statistically nonsignificant paths. G1 = Grade one; G2 = Grade two

Table 1

Descriptive Statistics in Grades One and Two for the Full Sample

	G1	G2	Grade one		Grade two	
			Mean (SD)	Min - Max	Mean (SD)	Min - Max
<i>Listening comprehension</i>						
WJ-III Oral Comprehension	.70	.71	14.26 (3.22)	5–23	17.13 (3.44)	11–25
WJ-III Oral Comprehension (SS)			107.86 (10.72)	82–134	108.89 (11.42)	86–135
Ex listening comprehension 1	.37	.50	.65 (.84)	0–3	1.22 (1.06)	0–4
Ex listening comprehension 2	.39	.48	1.93 (1.07)	0–4	2.46 (1.12)	0–4
<i>List reading fluency</i>						
SWE Form 1	.97 *	.97 *	35.80 (16.47)	3–70	57.73 (11.29)	39–81
SWE Form 1 (SS)			100.91 (16.36)	57–144	106.32 (14.02)	55–138
SWE Form 2	.96 *	.96 *	35.81 (16.57)	3–70	56.32 (12.08)	45–83
SWE Form 2 (SS)			100.67 (16.84)	36–142	104.95 (14.81)	55–137
<i>Oral text reading fluency</i>						
DIBELS ORF Passage 1	**	**	58.48 (37.28)	0–176	108.81 (37.35)	60–207
DIBELS ORF Passage 2	**	**	54.49 (34.78)	3–142	100.77 (38.03)	42–206
DIBELS ORF Passage 3	**	**	54.55 (35.80)	2–184	93.72 (30.00)	60–197
<i>Silent text reading fluency</i>						
TOSREC Form A	***	***	21.89 (8.80)	1–44	28.54 (8.57)	13–55
TOSREC Form A (SS)			115.76 (17.03)	80–144	114.01 (12.68)	89–145
TOSREC Form O	***	***	21.95 (8.06)	1–45	28.14 (8.54)	16–55
<i>Reading comprehension</i>						
WJ-III Passage Comp	.88	.84	21.59 (8.42)	1–38	24.46 (4.65)	20–35
WJ-III Passage Comp (SS)			109.41 (9.80)	77–132	103.26 (10.40)	91–125
WRMT-R Passage Comp	.93	.87	18.30 (5.17)	5–31	29.95 (6.13)	23–47
WRMT-R Passage Comp (SS)			105.34 (12.61)	71–136	107.55 (9.29)	96–155
Experimental Passage 1	.66	.59	1.22 (1.23)	0–4	2.53 (1.07)	0–4
Experimental Passage 2	.31	.35	2.17 (1.00)	0–4	2.52 (1.08)	0–4

Note: SS = Standard Score; SWE = Sight Word Efficiency of Test of Word Reading Efficiency; G2 = Grade two; Reliabilities in grade one is reported in Authors et al. (2011)

* test-retest reliability (Torgesen et al., in press)

** DIBELS oral reading fluency test-retest reliability has been reported to range from .92 to .97 (Shaw & Shaw, 2002).

*** The average alternate form reliability was reported to be .92 for grade one students, and .95 for grade two students (Wagner et al., 2010).

Table 2

Descriptive Statistics for Skilled and Average Readers in Grade Two

	Skilled readers (n = 105)		Average readers (n = 105)		F statistics [†]
	Mean (SD)	Min - Max	Mean (SD)	Min - Max	
<i>Listening comprehension</i>					
WJ-III Oral Comprehension	18.50 (2.98)	11–25	15.81 (3.51)	5–24	F = 35.89***
WJ-III Oral Comprehension (SS)	112.77 (10.09)	86–135	104.82 (11.72)	76–130	F = 20780.25***
Ex listening comprehension 1	1.54 (1.07)	0–4	.82 (.92)	0–3	F = 293.41***
Ex listening comprehension 2	2.88 (0.93)	0–4	2.12 (1.19)	0–4	F = 1152.96***
<i>List reading fluency</i>					
SWE Form A	65.02 (7.74)	39–81	49.62 (10.80)	12–68	F = 141.17.19***
SWE Form A (SS)	113.10 (10.75)	83–138	97.89 (13.73)	55–125	F = 79.94***
SWE Form B	64.20 (7.99)	45–83	47.41 (11.25)	12–70	F = 155.39***
SWE Form B (SS)	112.26 (10.79)	92–137	95.83 (14.75)	55–126	F = 84.86***
<i>List reading accuracy~</i>					
WJ-III Word ID	52.42 (4.00)	48–66	39.10 (3.56)	26–43	F = 648.42***
WJ-III Word ID (SS)	117.86 (7.17)	103–136	100.70 (8.44)	72–120	F = 251.88***
<i>Oral text reading fluency</i>					
DIBELS ORF Passage 1	134.70 (27.61)	60–207	80.33 (28.03)	11–158	F = 199.33***
DIBELS ORF Passage 2	126.23 (29.74)	42–206	72.55 (28.03)	9–169	F = 181.12***
DIBELS ORF Passage 3	112.85 (25.73)	60–197	71.21 (22.83)	10–130	F = 153.87***
<i>Silent text reading fluency</i>					
TOSREC Form A	34.49 (6.52)	13–55	22.19 (6.76)	7–38	F = 179.78***
TOSREC Form A (SS)	122.66 (10.63)	89–145	105.30 (9.40)	84–128	F = 157.21***
TOSREC Form O	34.14 (6.83)	16–55	22.05 (5.90)	8–37	F = 188.40***
<i>Reading comprehension</i>					
WJ-III Passage Comp	27.72 (3.21)	20–35	20.80 (3.63)	12–30	F = 214.74***
WJ-III Passage Comp (SS)	109.27 (8.48)	91–125	95.94 (8.26)	72–116	F = 133.07***

	Skilled readers (n = 105)			Average readers (n = 105)			F statistics +
	Mean (SD)	Min - Max		Mean (SD)	Min - Max		
WRMT-R Passage Comp	33.91 (4.08)	23–47		25.65 (5.60)	8–37		F = 137.02 ***
WRMT-R Passage Comp (SS)	112.46 (8.47)	96–155		101.98 (8.15)	77–119		F = 83.40 ***
Experimental Passage 1	3.01 (0.81)	0–4		2.09 (1.14)	0–4		F = 45.86 ***
Experimental Passage 2	2.97 (0.96)	0–4		2.18 (1.05)	0–4		F = 32.73 ***

Note:

~Word reading accuracy (i.e., WJ-III Word Identification) was used to form two subgroups, skilled and average word readers

SS = Standard Score;

[†]Wilks Lambda F 13.47, *ps* < .001, Degrees of freedom is (1, 208).

***
p < .001

Table 3
Correlations among Observed Variables for Full Sample in Grade One and Two (N = 270)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. WJ-III Oral Comprehension	---	.33	.47	.39	.38	.43	.40	.42	.38	.41	.50	.51	.46	.22
2. Ex listening comprehension 1	.39	---	.27	.05 ⁺	.07 ⁺	.11 ⁺	.11 ⁺	.10 ⁺	.07 ⁺	.08 ⁺	.14	.22	.18	.15
3. Ex listening comprehension 2	.52	.37	---	.25	.25	.27	.27	.27	.24	.26	.34	.38	.38	.17
4. Sight Word Efficiency Form 1	.32	.30	.20	---	.96	.93	.93	.93	.84	.76	.86	.83	.59	.39
5. Sight Word Efficiency Form 2	.33	.30	.18	.92	---	.93	.93	.93	.85	.77	.85	.83	.62	.42
6. DIBELS ORF passage 1	.43	.40	.27	.82	.83	---	.96	.97	.86	.81	.82	.83	.61	.41
7. DIBELS ORF passage 2	.37	.39	.26	.85	.84	.94	---	.96	.86	.80	.82	.82	.60	.41
8. DIBELS ORF passage 3	.41	.37	.26	.84	.85	.92	.92	---	.86	.80	.82	.82	.60	.38
9. TOSREC Form A	.41	.37	.27	.72	.73	.78	.79	.77	---	.89	.73	.74	.57	.36
10. TOSREC Form O	.40	.38	.28	.70	.72	.78	.81	.78	.89	---	.67	.68	.51	.35
11. WJ-III Passage comp	.59	.40	.42	.64	.63	.75	.71	.72	.73	.70	---	.87	.61	.35
12. WRMT-R Passage comp	.56	.41	.42	.61	.59	.69	.65	.66	.68	.65	.81	---	.67	.36
13. Ex reading comprehension 1	.42	.38	.46	.41	.39	.47	.44	.48	.49	.48	.61	.59	---	.31
14. Ex reading comprehension 2	.36	.20	.22	.25	.23	.34	.31	.30	.33	.32	.44	.51	.41	---

Note: Below diagonal in grade two and above diagonal in grade one.

⁺ p values greater than .05.

Ex = Experimental; DIBELS ORF = Dynamic Indicators of Basic Early Literacy Skills Oral Reading Fluency; TOSREC = Test of Silent Reading Efficiency and Comprehension; WJ-III Oral comprehension = Woodcock Johnson-III Oral Comprehension test; WJ-III Passage comp = Woodcock Johnson-III Passage Comprehension

Table 4

Correlation Matrix for Average (n = 105, above diagonal) and Skilled Readers (n = 105, below diagonal) for Observed Variables in Grade Two

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. WJ-III Oral Comprehension	---	.34**	.58***	.22*	.22*	.34**	.23**	.33**	.25**	.25**	.62***	.55***	.47***	.33**
2. Ex listening comprehension 1	.22*	---	.40***	.08	.10	.21*	.17	.18	.17	.17	.28*	.30**	.26**	.14
3. Ex listening comprehension 2	.33**	.17	---	.11	.08	.20*	.20*	.19*	.19*	.24**	.43**	.41***	.40**	.24*
4. Sight Word Efficiency Form C	.11	.18	-.05	---	.88***	.80***	.87***	.86***	.68***	.62***	.58**	.56***	.41*	.18
5. Sight Word Efficiency Form D	.10	.15	-.10	.86***	---	.75***	.79***	.82***	.62***	.57***	.50***	.46***	.36**	.13
6. DIBELS ORF passage 1	.22*	.28**	.02	.60***	.64***	---	.88***	.89***	.69***	.62***	.70***	.60***	.47**	.25**
7. DIBELS ORF passage 2	.14	.27**	.00	.66***	.68***	.87***	---	.90***	.73***	.70***	.61***	.50***	.41***	.18
8. DIBELS ORF passage 3	.22*	.25*	.02	.68***	.73***	.87***	.87***	---	.72***	.66***	.68***	.58***	.49**	.16
9. TOSREC Form A	.26**	.24*	.08	.40**	.47**	.53***	.58***	.53***	---	.81***	.61***	.54***	.50***	.20*
10. TOSREC Form O	.29**	.22*	.01	.46**	.52***	.62**	.71**	.64**	.85***	---	.55***	.47***	.49**	.21**
11. WJ-III Passage Comprehension	.32**	.25*	.14	.13	.17	.44***	.41***	.38***	.40***	.44***	---	.77***	.62***	.34***
12. WRMT-R Passage Comprehension	.40**	.26**	.24*	.19*	.23*	.48***	.44***	.43***	.40***	.46***	.55***	---	.56**	.47**
13. Ex reading comprehension 1	.41***	.24*	.31**	.08	.07	.20*	.18	.20*	.15	.19	.37***	.44**	---	.34***
14. Ex reading comprehension 2	.27**	.14	-.02	-.04	-.03	.15	.13	.09	.16	.18	.43***	.32**	.30**	---

Note:

* p < .05,

** p < .01,

*** p < .001

Ex = Experimental; DIBELS ORF = Dynamic Indicators of Basic Early Literacy Skills Oral Reading Fluency; TOSREC = Test of Silent Reading Efficiency and Comprehension; WJ-III Oral comprehension = Woodcock Johnson-III Oral Comprehension test; WJ-III Passage comp = Woodcock Johnson-III Passage Comprehension

Table 5
Standardized Loadings and Residuals for Full Sample in Grade One and Two; and Skilled and Average Readers in Grade Two

	Grade one			Grade two			G2 skilled readers			G2 average readers		
	Loading (SE)	Residuals (SE)	Loading (SE)	Residuals (SE)	Loading (SE)	Residuals (SE)	Loading (SE)	Residuals (SE)	Loading (SE)	Residuals (SE)	Loading (SE)	Residuals (SE)
<i>Listening comprehension</i>												
WJ-III Oral Comprehension	.76 (.04)	.42 (.05)	.83 (.03)	.32 (.05)	.65 (.08)	.57 (.11)	.84 (.05)	.29 (.08)				
Ex listening comprehension 1	.48 (.04)	.77 (.04)	.47 (.05)	.78 (.04)	.32 (.06)	.90 (.04)	.54 (.07)	.71 (.07)				
Ex listening comprehension 2	.60 (.04)	.64 (.05)	.64 (.04)	.59 (.05)	.52 (.07)	.73 (.07)	.66 (.06)	.57 (.08)				
<i>List reading fluency</i>												
SWE Form 1	.98 (.003)	.04 (.006)	.97 (.007)	.07 (.01)	.91 (.02)	.17 (.04)	.96 (.02)	.08 (.03)				
SWE Form 2	.98 (.003)	.04 (.006)	.95 (.008)	.10 (.02)	.94 (.02)	.11 (.04)	.92 (.02)	.16 (.03)				
<i>Oral reading fluency</i>												
DIBELS ORF Passage 1	.99 (.002)	.03 (.005)	.97 (.005)	.07 (.01)	.93 (.02)	.13 (.03)	.93 (.02)	.14 (.03)				
DIBELS ORF Passage 2	.98 (.003)	.05 (.006)	.96 (.006)	.07 (.01)	.94 (.02)	.12 (.03)	.95 (.01)	.10 (.02)				
DIBELS ORF Passage 3	.98 (.002)	.03 (.005)	.96 (.006)	.08 (.02)	.91 (.02)	.16 (.03)	.96 (.01)	.09 (.02)				
<i>Silent reading fluency</i>												
TOSREC Form A	.97 (.009)	.06 (.02)	.93 (.01)	.14 (.02)	.85 (.02)	.24 (.04)	.91 (.03)	.18 (.05)				
TOSREC Form O	.92 (.01)	.15 (.02)	.91 (.01)	.18 (.03)	1.00* (.00)	.00	.89 (.03)	.20 (.05)				
<i>Reading comprehension</i>												
WJ-III Passage Comp	.93 (.01)	.13 (.02)	.89 (.01)	.21 (.03)	.78 (.05)	.40 (.07)	.94 (.02)	.12 (.04)				
WRMT-R Passage Comp	.92 (.01)	.15 (.02)	.91 (.02)	.18 (.02)	.75 (.05)	.44 (.07)	.79 (.04)	.37 (.06)				
Experimental Passage 1	.71 (.03)	.50 (.05)	.66 (.03)	.57 (.04)	.51 (.05)	.74 (.05)	.56 (.05)	.69 (.06)				
Experimental Passage 2	.40 (.05)	.84 (.04)	.51 (.05)	.74 (.05)	.34 (.05)	.88 (.04)	.43 (.05)	.82 (.05)				

All the loadings were statistically significant at .001.

* Residual variance was fixed at zero based on preliminary results.

Table 6

Correlations between Latent Variables for Full Sample in Grade One and Two

	1	2	3	4	5	6	7	8	9
1. G1 Listening comprehension	---								
2. G1 List reading fluency	.43	---							
3. G1 Oral reading fluency	.48	.96	---						
4. G1 Silent reading fluency	.44	.88	.90	---					
5. G1 Reading comprehension	.66	.92	.90	.81	---				
6. G2 Listening comprehension	.96	.42	.44	.41	.61	---			
7. G2 List reading fluency	.34	.79	.74	.63	.71	.42	---		
8. G2 Oral reading fluency	.46	.81	.82	.72	.77	.53	.91	---	
9. G2 Silent reading fluency	.55	.83	.84	.77	.85	.63	.82	.89	---
10. G2 Reading comprehension	.78	.74	.74	.65	.89	.80	.70	.79	.89

Note: G1 = Grade one; G2 = Grade two. All the coefficients are statistically significant ($ps < .001$).