Relations among Reading Fluency (list, oral, & silent), Listening Comprehension, and Reading Comprehension for First-Grade Readers

Background/context: Description of prior research, its intellectual context and its policy context

The ability to read connected text fluently is one of the requirements for successful reading comprehension (Adams, 1990; Fuchs, Fuchs, Hosp, & Jenkins, 2001; Schatschneider et al., 2004; see also National Institute of Child Health and Human Development, 2000). According to Perfetti's (1985, 1992) verbal-efficiency account of reading, efficient word reading releases attentional resources for processing meaning in text. Thus, students who read dysfluently, i.e., slowly and with great effort, expend too many cognitive resources identifying words leaving few resources available for processing meaning.

Oral reading fluency has been widely used to monitor students' progress in reading in the early elementary grades (Ridel, 2007) due to its strong relations with reading comprehension. Theoretically, oral reading fluency has been hypothesized as a higher order skill that measures both word level reading skills and language processing/comprehension skills. However, despite its theoretical and instructional significance, surprisingly few studies have empirically examined the componential skills and developmental nature of oral reading fluency. Furthermore, even less is known about *silent* reading fluency even though proficient silent reading is the ultimate goal of instruction. Although reading aloud is a frequently-used instructional approach in primary grade classrooms, silent reading is also prevalent even during early literacy instruction (e.g., partner reading or round robin reading). Furthermore, by the end of first grade, students are expected to spend a large amount of time reading silently during independent reading and their reading comprehension is tested silently. For these reasons, first-grade represents an ideal time to study both oral *and* silent reading fluency and their relations with reading comprehension.

Purpose/objective/research question/focus of study

In the present study, we examined relations among oral reading fluency, silent reading fluency, and reading comprehension for first grade students. The goals of this study were to: (1) determine whether oral and silent reading fluency were manifestations of a single underlying reading ability or of two distinct but potentially-related abilities; (2) compare oral and silent reading fluency as predictors of reading comprehension; (3) examine the components of oral and silent reading fluency; and (4) determine whether the results varied as a function of reading skill (i.e., good vs. poor readers).

Setting: Description of where the research took place

The research took place in six elementary schools in a relatively large, semi-urban school district in northern Florida.

Population/participants/subjects

The participants included a convenience sample of 316 first-grade students. The sample students consisted of approximately equal number of boys and girls (n = 155, 49% of girls), and their ethnic and racial background reflected the student population in the district: 60% Caucasian, 25% African American, 4% Hispanic, 4% Asian, and 7% Other students. The mean age of the sample students was 85 months (SD = 5.69), with a range of from 70 to 106 months.

Intervention/program/practice & Research design
This was a cross-sectional, correlational study.

Data collection and analysis: Description of the methods for collecting and analyzing data
Constructs and their associated indicators included the following:

Oral reading fluency. Three first-grade passages from the Dynamic Indicators of Basic Early Literacy Skills assessments (DIBELS) Oral Reading Fluency (5th edition; Good, Kaminski, Smith, Laimon, & Dill, 2001) served as indicators of the latent construct of oral reading fluency.

Silent reading fluency. Two forms of the *Test of Sentence Reading Efficiency and Comprehension* (TOSREC, Wagner, Torgesen, Rashotte, & Pearson, in press) served as indicators of silent reading fluency.

List reading fluency. Two forms of the Sight Word Efficiency subtest of the *Test of Word Reading Efficiency* (TOWRE, Torgesen, Wagner, & Rashotte, 1999) served as indicators of list reading fluency.

Listening comprehension. Two measures served as indicators of the construct of listening comprehension: the *Woodcock-Johnson III* Oral Comprehension subtest (Woodcock, McGrew, & Mather, 2001) and an experimental listening comprehension task.

Reading comprehension. The *Woodcock-Johnson-III* Passage Comprehension subtest (Woodcock, et al., 2001), *Woodcock Reading Mastery Test-Revised* (WRMT-R, Woodcock, 1987) Passage Comprehension subtest, and two experimental passages were used to provide four indicators of reading comprehension.

Word reading accuracy. The *Woodcock Johnson – III* Word Identification subtest (Woodcock, et al., 2001) was administered to assess participants' word reading accuracy skills. This subtest was used to divide the sample into relatively good and poor readers.

The assessments were individually administered with the exception of the silent reading fluency measure, which was group-administered. To minimize time-sampling error, multiple indicators of each construct were administered during different testing sessions where possible.

The primary analytic strategy to address the research questions was structural equation modeling using latent variables. Preliminary analyses confirmed appropriateness of all the measurement models. Model fits were 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). In order to investigate whether relationships differed for skilled and less skilled readers, we used nested multi-group analyses. Chi-square difference tests were used to compare the fit of a model that constrained target parameters to be equal across groups to the fit of a model that did not impose the constraints.

Findings/results: Description of main findings with specific details

Descriptive statistics for the entire sample and skilled and less skilled word readers are shown in Tables 1 and 2. Based on their word reading skills as indicated by their WRMT-R Word Identification scores, the skilled word reader group comprised the top third of participants (N = 109) with a mean Word Identification standard score of 123.3 with a standard deviation of 9.4. The less skilled reader group comprised the bottom third of participants (N = 106) with a mean Word Identification standard score of 101.7 with a standard deviation of 10.7. Table 3 shows correlations among latent variables created from the observed variables.

Are Oral and Silent Reading Fluency Measures Manifestations of a Single Underlying Ability?

Confirmatory factor analyses compared two nested models. The first model specified oral and silent reading fluency as distinct yet potentially correlated abilities. The second model specified the oral and silent reading fluency measures as indicators of a single latent reading fluency construct.

For the entire sample, the model specifying oral and silent reading fluency as distinct yet potentially correlated abilities provided a significantly better fit to the data, $\Delta\chi^2$ (4) = 171.19, p < .001. This was also true for both the skilled, $\Delta\chi^2$ (9) = 84.89, p < .001, and less skilled word reader subgroups, $\Delta\chi^2$ (9) = 66.05, p < .001. Oral and silent reading fluency were strongly related for the overall sample, with a standardized covariance (i.e., correlation) of .89. However, a multi-group confirmatory factor analysis also showed that oral and silent reading fluency were more strongly related for skilled (r = .79) than for less skilled word (r = .44) readers, $\Delta\chi^2$ (1) = 27.1, p < .001. Based on these results, oral and silent reading fluency were modeled as distinct yet related constructs in subsequent analyses.

How Do Oral and Silent Reading Fluency Compare as Predictors of Reading Comprehension?

For the full sample, the model yielded an excellent fit: χ^2 (24) = 35.286, p = .06; CFI = .997; TLI = .996; RMSEA = .039 (confidence interval = .00 to .064); and SRMR = .018. The model explained approximately 83 percent of total variance in the reading comprehension outcome. As presented in Figure 1a, oral reading fluency and silent reading fluency were highly related to each other (φ = .89, p < .001). With both highly correlated predictors in the model, oral reading fluency was strongly related to reading comprehension independently of silent reading fluency (γ = .89, p < .001).

When a multi-group model was fitted to the skilled and less skilled word reader subgroups, the fit indices indicated a good model fit: χ^2 (52) = 79.10, p = .009; CFI = .979; TLI = .971; RMSEA=.070 (confidence interval = .035-.099); and SRMR=.058. The standardized structural weights for less skilled and skilled readers are displayed in Figures 1b and 1c, respectively. Oral reading fluency was more strongly related to reading comprehension for less skilled readers (γ = .86, $p \leq$ .001) than for skilled readers (γ = .48, p = .002), $\Delta\chi^2$ (1) = 25.20, p <. 001. The relation between silent reading fluency and reading comprehension differed for less skilled and skilled word readers, $\Delta\chi^2$ (1) = 5.54, p <. 05, such that silent reading fluency had a suppressor effect on reading comprehension for less skilled readers (γ = -.21, p = .044) while silent reading fluency was not related to reading comprehension for skilled word readers. Finally, oral reading fluency and silent reading fluency were more strongly related for skilled word readers (φ = .79) than less skilled word poor readers (φ = .44), $\Delta\chi^2$ (1) = 27.35, p <. 001.

Components of Oral and Silent Reading Fluency

It has been hypothesized that oral and silent reading fluency require both word-level decoding skills and higher-level language comprehension skills (Fuchs et al., 2001; Jenkins et al., 2003). The purpose of these analyses was to examine decoding and language comprehension as components of oral and silent reading fluency, and to determine whether all of the variance in these components that was related to reading comprehension was captured by the measures of oral and silent reading fluency.

Components of oral reading fluency. The structural model for the entire sample yielded an excellent model fit: χ^2 (48) = 89.90, p < .001; CFI = .991; TLI = .988; RMSEA = .053 (confidence interval = .035 to .069); and SRMR = .034. As presented in Figure 2a, list reading fluency was highly related to oral reading fluency (γ =.93, p < .001) and listening comprehension

was also positively related to oral reading fluency but with a small magnitude ($\gamma = .08$, $p = .001$). In addition, list reading fluency was strongly related to reading comprehension ($\gamma = .82$, $p < .001$) and listening comprehension was also positively related to reading comprehension ($\gamma = .31$, $p < .001$). However, oral reading fluency was not related to reading comprehension ($\beta = -.03$, $p = .82$) once list reading fluency and listening comprehension were taken into consideration.

When models were fit for skilled and less skilled word readers, the model fit was good: χ^2 (102) = 145.948, $p = .003$; CFI = .974; TLI = .967; RMSEA = .063 (confidence interval = .038 - .085); and SRMR = .062. The standardized structural regression weights are presented in Figures 2b and 2c for less skilled and skilled word readers, respectively. List reading fluency was more strongly related to oral reading fluency for less skilled readers ($\gamma = .93$, $p < .001$) than for skilled readers ($\gamma = .80$, $p < .001$), $\Delta\chi^2$ (1) = 15.554, $p < .001$. In contrast, listening comprehension was positively related to oral reading fluency above and beyond list reading fluency for skilled readers ($\gamma = .20$, $p = .004$), but not for less skilled readers ($\gamma = .02$, $p = .70$), and this differences was statistically significant, $\Delta\chi^2$ (1) = 6.33, $p < .025$. Furthermore, list reading fluency was highly related to reading comprehension for less skilled readers ($\gamma = 1.16$, $p < .001$) whereas the relation was not statistically significant for skilled readers ($\gamma = .28$, $p = .13$), $\Delta\chi^2$ (1) = 11.15, $p < .01$. For both less skilled and skilled readers, oral reading fluency was not related to reading comprehension once other latent variables were accounted for ($ps \geq .17$). Listening comprehension was positively related to reading comprehension for both less skilled ($\gamma = .47$, $p < .001$) and skilled readers ($\gamma = .72$, $p < .001$) and there was no statistical difference in the magnitude of the relation, $\Delta\chi^2$ (1) = 2.89, $p > .05$. The amounts of variance explained in the outcome were as follows. For less skilled readers, 86% of variance was explained in the oral reading fluency outcome, and 96% of variance was explained in the reading comprehension outcome. For skilled readers, 75% of variance was explained in the oral reading fluency outcome, and 87% of variance was explained in the reading comprehension outcome.

Components of silent reading fluency. A structural equation model for the entire sample yielded an excellent model fit: χ^2 (38) = 77.59, $p < .001$; CFI = .988; TLI = .982; RMSEA = .057 (confidence interval = .039 - .076); and SRMR = .037. The pattern of relations was similar to that for oral reading fluency above, for the entire sample as well as for the subgroup analysis (χ^2 [81] = 86.886, $p = .307$; CFI = .994; TLI = .992; RMSEA = .026 [confidence interval = .00 - .06]; and SRMR = .06). Structural regression weights are shown in Figures 1a – 1c. For less skilled readers, only 10% of variance was explained in the silent reading fluency outcome, but 97% of variance was explained in the reading comprehension outcome. For skilled readers, 57% of variance was explained in the silent reading fluency outcome, and 88% of variance was explained in the reading comprehension outcome.

Conclusions: Description of conclusions and recommendations based on findings and overall study

The results indicate that oral and silent reading fluency task are measuring distinct though highly related underlying skills for first-grade students. The extent to which the underlying skills were related varied for relatively skilled and less skilled word readers, with a stronger relation for skilled readers than for less skilled readers. In fact, perhaps the most striking findings of the present study is differential relations between silent reading fluency and other reading skills (i.e., list reading fluency, oral reading fluency, and reading comprehension) for relatively skilled versus less skilled readers. Silent reading fluency was not related to listening comprehension

skills for less skilled readers whereas it was moderately or strongly related for skilled readers. The results further suggest that skilled readers' connected text reading fluency tends to be convergent either in oral or silent mode and both oral and silent reading fluency are related to reading comprehension in similar magnitudes (see Table 3). However, less skilled readers' performance on connected reading fluency is highly influenced by reading mode (oral or silent), and oral reading fluency is strongly related to reading comprehension skills whereas silent reading fluency is not.

The positive relation of listening comprehension skill to oral and silent reading fluency indicates that connected text reading fluency indeed may involve postlexical processes that are not captured in list reading fluency such as semantic and syntactic processing (Fuchs et al., 2001; Jenkins et al., 2003; Wolf & Katzir-Cohen, 2006). However, the positive relation of listening comprehension to oral and silent reading fluency was observed only for *skilled* readers, but not for less skilled readers. It appears that poor, dysfluent readers expend their cognitive resources on word reading and thus their cognitive resources are limited or diminished for language comprehension. In contrast, good and fluent readers have command of low-level decoding skills which allow them to take more use of language comprehension processes in their reading (Perfetti, 1985). The result that list reading fluency was more highly related to oral reading fluency and reading comprehension for poor readers than for good readers provides empirical support for this speculation.

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Table 1

Descriptive statistics and correlations among observed variables (N = 316)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. WJ-III Oral comprehension	---													
2. Experimental listening comprehension 1	.36	---												
3. Experimental listening comprehension 2	.50	.28	---											
4. Sight word efficiency Form C	.39	.06	.26	---										
5. Sight word efficiency Form D	.38	.08	.26	.97	---									
6. DIBELS ORF passage 1	.43	.12	.29	.94	.93	---								
7. DIBELS ORF passage 2	.41	.12	.29	.94	.94	.96	---							
8. DIBELS ORF passage 3	.42	.11	.29	.93	.93	.97	.96	---						
9. TOSREC Form A	.39	.09	.28	.84	.85	.86	.87	.86	---					
10. TOSREC Form D	.42	.11	.32	.77	.78	.81	.81	.81	.90	---				
11. WJ-III Passage comprehension	.50	.23	.38	.84	.83	.84	.83	.83	.74	.69	---			
12. WRMT-R Passage comprehension	.51	.17	.37	.86	.85	.84	.83	.83	.75	.69	.87	---		
13. Experimental reading comprehension passage 1	.46	.19	.38	.62	.64	.64	.63	.62	.60	.55	.69	.63	---	
14. Experimental reading comprehension Passage 2	.23	.17	.20	.37	.40	.39	.39	.37	.36	.37	.35	.35	.32	---
Mean	14.10	.62	1.88	34.98	34.94	56.53	52.85	52.62	21.48	21.42	18.01	21.06	1.17	2.09
SD	3.31	.83	1.07	16.56	16.65	37.14	35.05	36.06	9.05	8.45	5.13	8.52	1.22	1.03
Min - Max	5-23	0-3	0-4	3-70	3-70	0-176	3-142	2-184	1-44	1-45	5-31	1-38	0-4	0-4
Skewness	-.028	1.22	.10	.05	.11	.58	.39	.60	-.05	.21	.08	-.28	.71	.15
Kurtosis	-.27	.73	-.55	-1.05	-1.09	-.36	-1.02	-.28	-.47	.21	-.39	-.58	-.58	-.52
α	.70	.37	.39	---	---	---	---	---	---	---	.88	.93	.66	.31

Note: Values greater than .11 are significant at .05 level.
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; Experimental Passage 1 & Passage 2: Researcher-developed reading comprehension tests 1 & 2

Table 2
Descriptive statistics for skilled and less skilled word readers

	Skilled readers (n = 109)		Less skilled readers (n = 106)		
	Mean (SD)	Min - Max	Mean (SD)	Min - Max	F statistics (p-value)
Listening comprehension					
WJ-III Oral Comprehension	15.58 (2.88)	8-23	12.39 (3.29)	5-20	F (1, 213) = 57.37, p = .000
WJ-III Oral Comprehension (SS*)	111.39 (9.98)	93-137	102.19 (10.76)	82-132	F (1, 213) = 42.27, p = .000
Experimental listening comprehension 1	.73 (.80)	0-3	.55 (.85)	0-3	F (1, 213) = 2.74, p = .10
Experimental listening comprehension 2	2.25 (1.07)	0-4	1.55 (1.04)	0-4	F (1, 213) = 23.55, p = .000
List reading fluency					
TOWRE sight word efficiency Form C	51.76 (9.06)	23-70	17.41 (7.32)	3-39	F (1, 213) = 932.19, p = .000
TOWRE sight word efficiency Form D	52.11 (9.13)	24-70	17.36 (6.71)	3-41	F (1, 213) = 1006.60, p = .000
Oral reading fluency					
DIBELS ORF Passage 1	95.20 (26.12)	36-176	19.54 (11.43)	0-56	F (1, 213) = 750.02, p = .000
DIBELS ORF Passage 2	89.877 (21.22)	36-142	17.40 (10.09)	3-57	F (1, 213) = 1011.18, p = .000
DIBELS ORF Passage 3	89.64 (26.34)	40-184	17.04 (12.01)	2-60	F (1, 213) = 669.86, p = .000
Silent reading fluency					
TOSREC Form A	29.87 (5.72)	13-44	12.69 (6.11)	1-28	F (1, 213) = 453.34, p = .000
TOSREC Form A (SS)	129.50 (6.33)	108-144	106.46 (9.65)	85-128	F (1, 213) = 431.29, p = .000
TOSREC Form D	28.64 (6.84)	14-45	14.47 (6.56)	1-29	F (1, 213) = 240.29, p = .000
Reading comprehension					
WJ-III Passage Comprehension	22.86 (3.51)	12-31	12.96 (2.74)	5-19	F (1, 213) = 530.50, p = .000
WJ-III Passage Comprehension (SS)	113.70 (10.14)	88-136	94.88 (10.69)	68-120	F (1, 213) = 183.280, p = .000
WRMT-R Passage Comprehension	29.10 (4.64)	15-38	12.08 (5.37)	1-24	F (1, 213) = 620.73, p = .000
WRMT-R Passage Comprehension (SS)	116.66 (6.21)	102-132	99.98 (9.22)	75-118	F (1, 213) = 243.23, p = .000
Experimental Passage 1	2.06 (1.15)	0-4	.23 (.48)	0-2	F (1, 213) = 227.51, p = .000
Experimental Passage 2	2.57 (1.10)	0-4	1.79 (.75)	0-3	F (1, 213) = 36.28, p = .000

Note: Standard Score

Table 3
Correlations between latent variables

	1	2	3	4
Full Sample				
1. Listening comprehension	---			
2. List reading fluency	.44	---		
3. Oral reading fluency	.47	.97	---	
4. Silent reading fluency	.47	.87	.90	---
5. Reading comprehension	.87	.93	.91	.83
Skilled word readers				
1. Listening comprehension	---			
2. List reading fluency	.25	---		
3. Oral reading fluency	.40	.85	---	
4. Silent reading fluency	.43	.72	.79	---
5. Reading comprehension	.85	.59	.67	.63
Less skilled word readers				
1. Listening comprehension	---			
2. List reading fluency	.07	---		
3. Oral reading fluency	.08	.93	---	
4. Silent reading fluency	.14	.27	.44	---
5. Reading comprehension	.51	.85	.75	.17

All the coefficients are statistically significant for the full sample (*ps* < .01). For correlation coefficients for skilled and less skilled readers, coefficients greater than .25 are statistically significant at .05 level.

Figure 1a. Full Sample

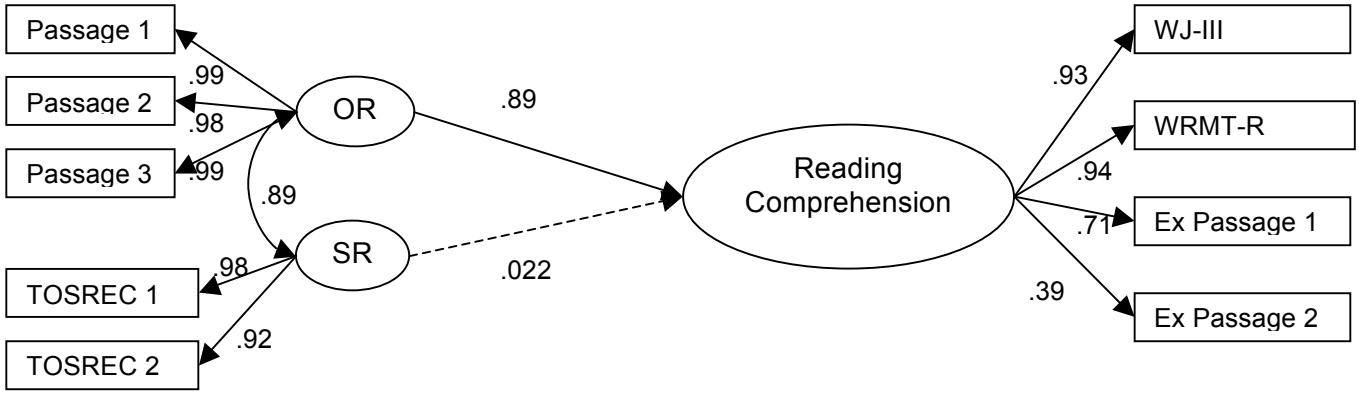


Figure 1b. Less skilled word readers

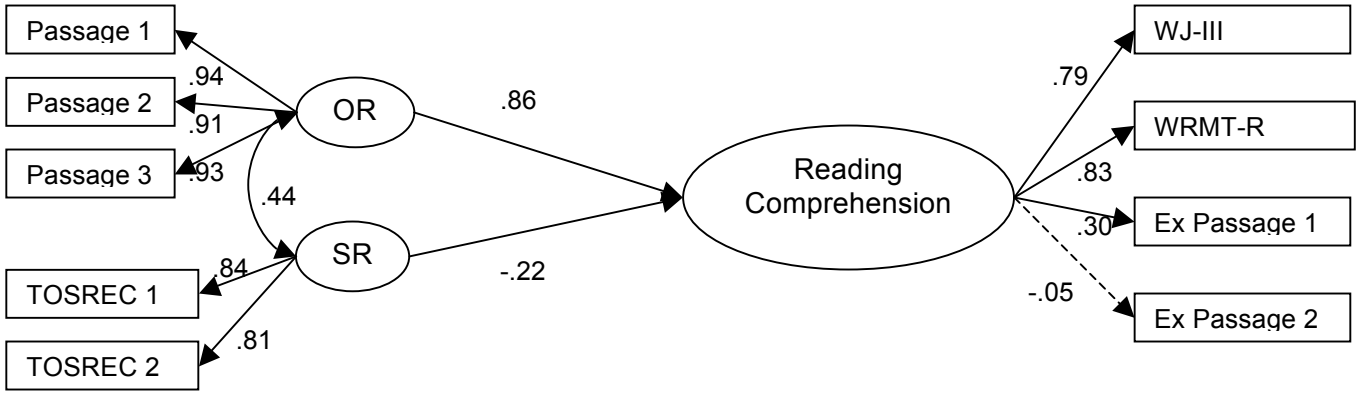
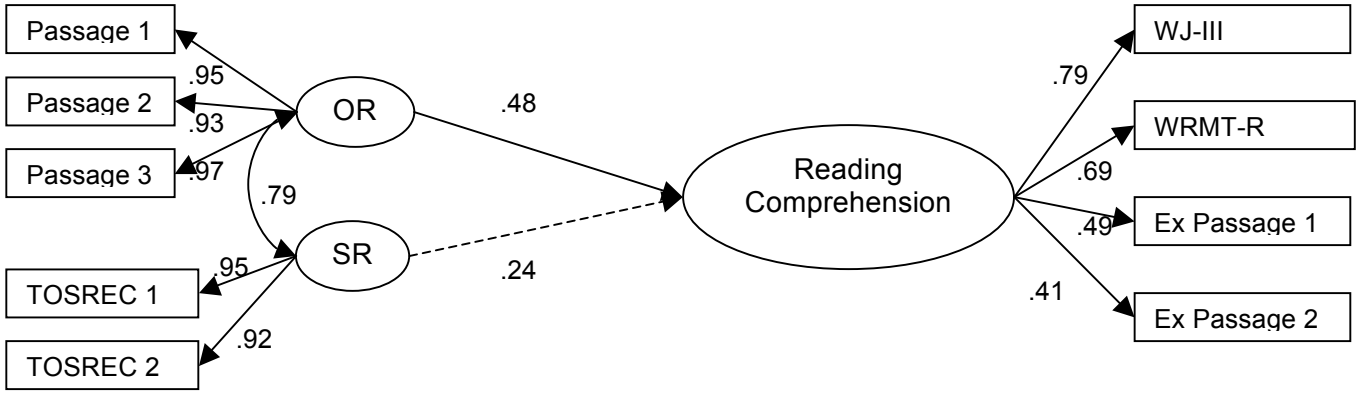


Figure 1c. Skilled word readers



Figures 1a, 1b, and 1c. Standardized structural regression weights for oral reading fluency (ORF), silent reading fluency (SRF), and reading comprehension for entire sample (N = 316, Figure 1a), less skilled readers (n = 106, Figure 1b), and skilled readers (n = 109, Figure 1c).

Figure 2a. Full Sample

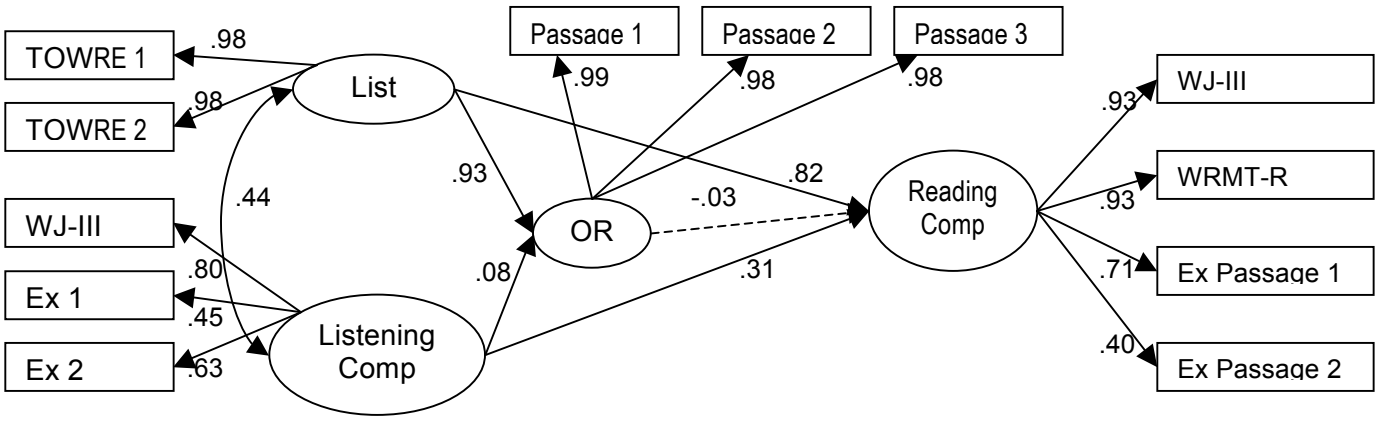


Figure 2b. Less skilled word readers

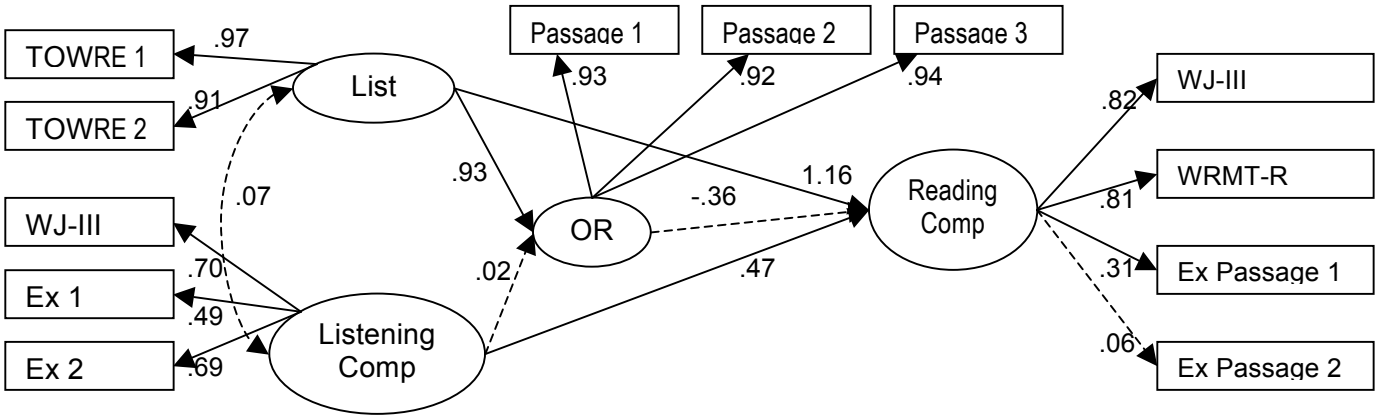
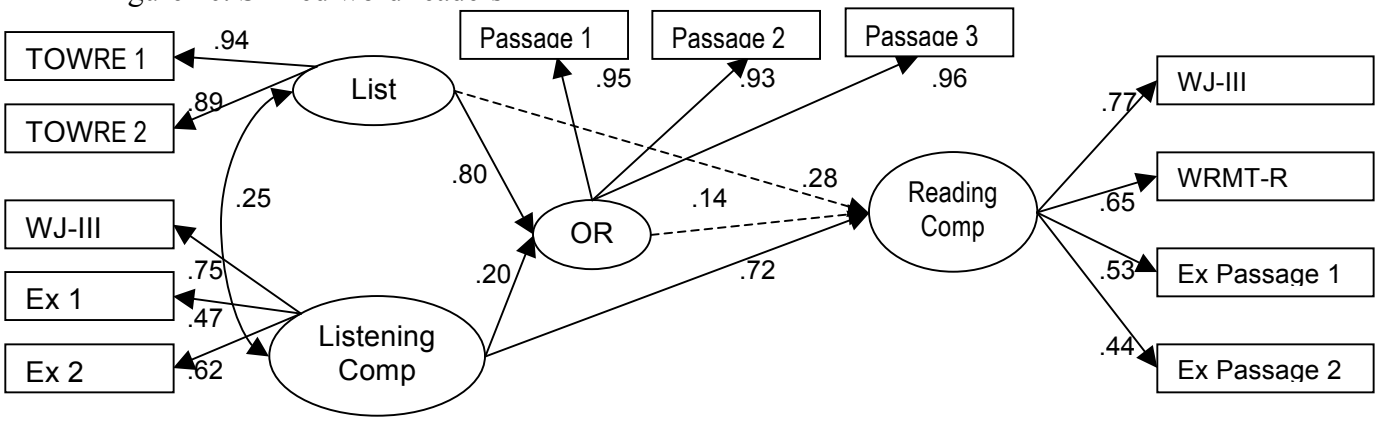


Figure 2c. Skilled word readers



Figures 2a, 2b, and 2c. Standardized structural regression weights for list reading fluency (List RF), listening comprehension (Listening Comp), oral reading fluency (ORF), and reading comprehension (Reading Comp) for entire sample (N = 316, Figure 2a), less-skilled readers (n = 106, Figure 2b), and skilled readers (n = 109, Figure 2c).

Figure 3a. Full Sample

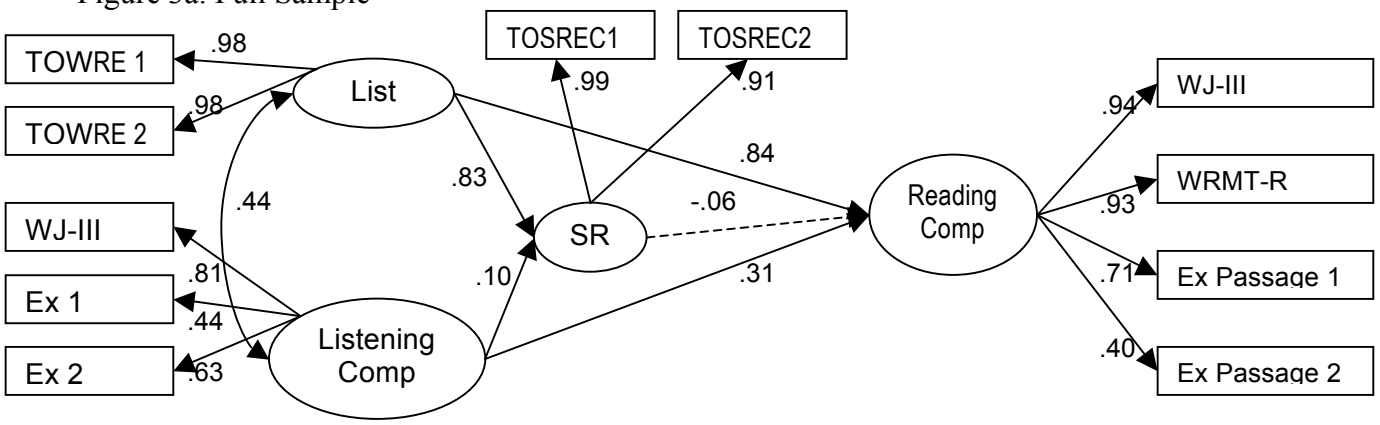


Figure 3b. Less skilled word readers

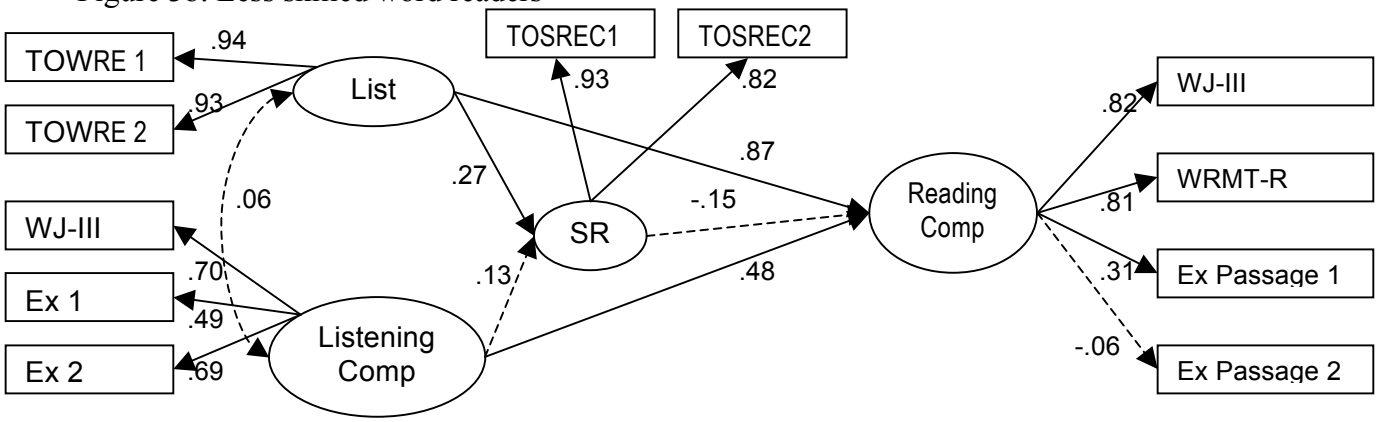
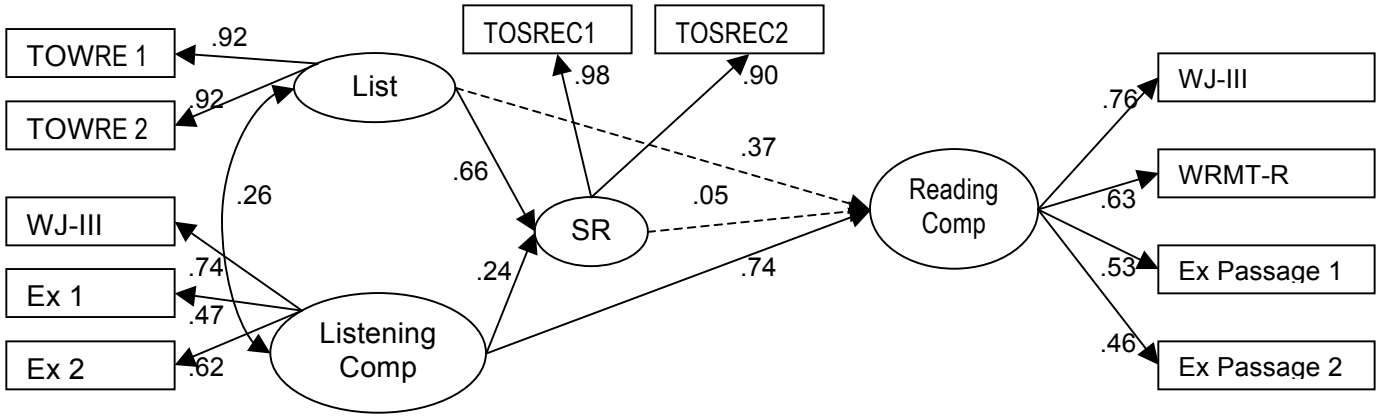


Figure 3c. Skilled word readers



Figures 3a, 3b, and 3c. Standardized structural regression weights for list reading fluency (List RF), listening comprehension (Listening Comp), silent reading fluency (SRF), and reading comprehension (Reading Comp) for entire sample (N= 316, Figure 3a), less skilled readers (n = 106, Figure 3b), and skilled readers (n = 109, Figure 3c).