

**Technical Report # 25**

**Analysis of Reading Fluency and Comprehension Measures for First  
Grade Students**

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behavioral research & teaching

Published by

Behavioral Research and Teaching  
University of Oregon • 175 Education  
5262 University of Oregon • Eugene, OR 97403-5262  
Phone: 541-346-3535 • Fax: 541-346-5689  
<http://brt.uoregon.edu>

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## Abstract

This technical report provides data on the extent to which progress monitoring measures explain reading achievement. The four progress monitoring measures discussed are: letter sounding, phonemic segmentation, oral reading fluency, and comprehension given in either oral or written form. These measures were administered to first grade students in low- and high-income schools. A regression analysis indicated that the Letter Sounding and Phonemic Segmenting tests correlate with each other, as well as the ORF measure, the Listening Comprehension test, and the Constructed Response section of the Reading Comprehension test. However, these measures do not correlate with the Reading Comprehension test. The ORF and Reading Comprehension measures correlated with all other first-grade reading measures. Another important finding was that more students from low-income schools needed to take the Listening Comprehension test rather than the Reading Comprehension test. This finding indicates a potential area of concern for school districts.

### *Introduction*

The No Child Left Behind Act of 2001 has increased the role of assessment in K-12 education. Designed to ensure that all students meet high academic standards, the law currently requires states receiving Title I funds to test all children annually in reading and math in grades 3 through 8 and report student performance disaggregated by poverty, race and ethnicity, disability, and limited English proficiency. By the 2005-06 school year, tests must be expanded to include at least one year between grades 10-12, and by 2007-08, states also must include science assessments at least once in grades 3-5, grades 6-9, and grades 10-12. The law requires states to set annual measurable objectives to track student progress towards reaching proficiency, with the ultimate goal that “all groups of students—including low-income students, students from major racial and ethnic groups, students with disabilities, and students with limited English proficiency—reach proficiency within 12 years” (U.S. Department of Education, 2002, p. 17).

With this goal in mind, school districts are developing assessment systems that enable them to monitor student progress in a timely fashion rather than waiting for year-end statewide assessments. These district assessments serve multiple purposes: monitoring student progress, evaluating the effectiveness of particular programs and schools, and providing school personnel with valuable information about how well their students are doing. Developing easy to administer and score assessments at the district level offers schools a distinct advantage over depending exclusively on statewide assessments for progress monitoring. In the area of early reading, four measures provide essential information about students’ developing proficiency: letter sounding, phonemic segmentation, oral reading fluency (ORF), and comprehension given either orally or in written form depending on student fluency in oral reading. Taken together, these four measures should provide diagnostic information about deficiencies in students’ developing reading proficiency, allowing schools to modify their instruction as needed.

## *Methods*

### *Setting and Subjects*

This report summarizes the spring 2003, first-grade reading achievement data from 29 different schools in an urban school district in the Pacific Northwest. The original data set contained 1209 students, but some students were missing data in some but not all of the dependent variable measures, so the total sample size used for analyses varies by measure.

### *Design and Operational Procedures*

Dependent variables analyzed in this report include scores from the following measures: tests of Letter Sounding ( $n = 1145$ ), Phonemic Segmenting ( $n = 1150$ ), Oral Reading Fluency (ORF) ( $n = 1144$ ), and Comprehension with both selected response (SR) and open-ended constructed response (CR) questions that was administered either as a Listening Comprehension ( $n = 348$ ) or as a Reading Comprehension ( $n = 770$ ) test. All measures were performed within 18 weeks of one another, between January and May during the regular school year. Most students completed all tests, while a small group of students completed only a subset due to absence. Students who participated in one or more of the assessments were included in the study. Prior to analysis, schools in the district were coded into two regions, corresponding roughly with household income level. The data set contained 692 students from low-income schools and 465 students from high-income schools. One school, with a sampled student population of 52, was unable to be grouped as either high or low income, so data from these students was not included in analysis of variance by income level. Independent blocking variables analyzed in this report include school of attendance, income level (as determined by school of attendance), and gender.

### *Measurement/Instrument Development*

#### *Letter Sounding*

The test of Letter Sounding measured students' ability to recognize letters and make appropriate letter sounds. A meta-analysis of letter sounding studies by the National Reading Panel (2000) revealed that early letter sounding ability is critical in the development of successful readers. Students were given a page containing 80 letters and asked to move across the rows, sounding as many letters as possible from that page in one minute. The font used (Comic Sans) was selected because its features represent characteristics of common typefaces in published materials for children. Trained school district personnel following a standardized, written protocol provided by the district administered these tests.

#### *Phonemic Segmenting*

Phonemic Segmenting tests a student's ability to hear and recognize phonemes in spoken syllables and words. For example, the word *hat* can be segmented into constituent sounds of /h/ /a/ /t/. Strong early readers possess a well-developed phonemic awareness, while the inability to segment has been shown to be a good predictor of reading failure (National Reading Panel, 2000). A meta-analysis of 52 phonemic awareness studies by the National Reading Panel (2000) confirmed that teaching phonemic awareness in young children greatly improved the likelihood that they would be successful readers. Early recognition of student difficulty segmenting phonemes is critical in implementing an intervention to address the difficulty, and thereby set the student on a path toward reading success.

The Phonemic Segmenting test measured students' fluency in segmenting a series of common words. Students were shown a list of 31 words and asked to move across the rows, segmenting as many words as possible from that page in one minute. The font used (Comic

Sans) was selected because its features represent characteristics of common typefaces in published materials for children. Trained school district personnel following a standardized, written protocol provided by the district administered these tests.

### *ORF*

The test of Oral Reading Fluency was administered individually to each student by trained assessors. Students read aloud for exactly one minute one of two comparable passages deemed grade-level appropriate on the Flesch-Kincaid reading scale. At the end of one minute, assessors marked the last word read then counted the total words read, subtracting any words read incorrectly to arrive at a final ORF score. Self-corrected errors were counted as correct.

### *Comprehension*

In addition, first-grade students were administered a Comprehension test using the same story they had read for the ORF test. Students who read fewer than 29 words per minute correctly on the ORF test completed the Listening Comprehension test. They listened as the test administrator read the passage aloud and then read them five multiple choice and two open ended questions. Students who read at least 29 words per minute correctly on the ORF test completed the Reading Comprehension test. They read the passage aloud and then completed five multiple choice and two open ended questions. Each form of the reading comprehension test consisted of a reading passage followed by Selected Response (SR) as well as Constructed Response (CR) questions. Test administrators who were trained by the district scored student responses. All test administrators followed a typed administering and scoring protocol provided by the district.

*Data Preparation and Analysis*

Student performance on all measures was analyzed using analysis of variance (ANOVA), and relationships between key variables were analyzed using correlations and linear regression. Alpha was set at .05 for all analyses.

*Results*

A significant difference was found between student performance with regards to gender on the test of Phonemic Segmenting,  $F(1,1148) = 20.15, p < .05$ , with females outperforming males. It should be noted, however, that while this difference was statistically significant, the effect size was quite small, accounting for only 2% of the variation in scores on Phonemic Segmenting. No other significant differences in student performance blocked gender were found on any other measures (see Tables 1 and 2). Significant differences were also found between student performances with regards to school income level on the ORF [ $F(1,1099) = 17.75, p < .05$ ]; the test of Letter Sounding [ $F(1,1094) = 6.33, p < .05$ ]; the SR section of the Reading Comprehension test [ $F(1,814) = 22.28, p < .01$ ]; and the CR section of the Reading Comprehension test [ $F(1,814) = 30.22, p < .01$ ]. In addition, a statistically significant disproportionate number of students from low income schools were administered the Listening Comprehension test as opposed to the Reading Comprehension test [ $F(1, 1076) = 22.58, p < .01$ ], indicating a statistically significant difference in oral reading fluency by income level of school.



Table 1

*Descriptive Statistics for Grade 1 Reading Measures*

Group		<i>n</i>	<i>M</i>	<i>SD</i>
Letter Sounding (# of letters sounded out correctly in one minute)	Male	564	43.03	12.37
	Female	581	43.64	12.79
	High Income	437	44.30	12.75
	Low Income	659	42.33	12.58
Phonemic Segmenting (# of phonemes read correctly in one minute)	Male	570	44.77	14.30
	Female	580	48.60	14.65
	High Income	440	45.89	14.82
	Low Income	660	47.33	14.57
ORF (# of words read correctly in one minute)	Male	565	65.76	39.12
	Female	585	69.10	41.43
	High Income	442	72.45	41.65
	Low Income	659	62.20	38.12
Listening Comprehension Selected Response (raw score out of 5)	Male	173	3.75	1.31
	Female	175	3.87	1.29
	High Income	96	3.75	1.42
	Low Income	245	3.82	1.26
Listening Comprehension Open Ended (raw score out of 5)	Male	173	2.99	1.11
	Female	175	3.01	1.05
	High Income	96	3.04	1.03
	Low Income	245	2.98	1.12

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Reading Comprehension	Male	422	3.99	1.67
Selected Response	Female	433	4.19	1.46
(raw score out of 5)	High Income	368	3.79	1.88
	Low Income	442	4.31	1.25

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Reading Comprehension	Male	428	2.94	1.42
Open Ended	Female	433	3.09	1.28
(raw score out of 4)	High Income	369	2.75	1.52
	Low Income	447	3.26	1.15

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Table 2

*Analysis of Variance Summary Table for Grade 1 Reading Measures*

Source		<i>df</i>	<i>F</i>	$\eta^2$	<i>p</i>
Letter Sounding	Gender	1	0.67	.00	.41
	Error	1143	(158.31)		
	Income	1	6.33*	.01	.01
	Error	1094	(159.97)		
Phonemic Segmenting	Gender	1	20.15	.02	.00
	Error	1148	(209.65)		
	Income	1	2.54	.00	.11
	Error	1098	(215.23)		
ORF	Gender	1	1.98	.00	.16
	Error	1148	(1624.95)		
	Income	1	17.75**	.02	.00
	Error	1099	(1566.11)		
Listening Comprehension Selected Response	Gender	1	0.85	.00	.36
	Error	346	(1.69)		
	Income	1	0.18	.00	.67
	Error	339	(1.70)		

Listening Comprehension Open Ended	Gender	1	.02	.00	.88
	Error	346	(172.29)		
	Income	1	0.20	.00	.66
	Error	339	(1.18)		
Reading Comprehension Selected Response	Gender	1	3.36	.00	.07
	Error	853	(2.46)		
	Income	1	22.28**	.03	.00
	Error	808	(2.46)		
Reading Comprehension Open Ended	Gender	1	2.45	.00	.07
	Error	859	(1.82)		
	Income	1	30.22**	.04	.00
	Error	814	(1.77)		

*Note.* Values enclosed in parentheses represent mean square errors.

\* $p < .05$ , \*\* $p < .01$ .

For correlational analyses, scores on the comprehension test were separated by those students who took the test as a listening comprehension test and those who took it as a reading comprehension test. When using data from the Listening Comprehension test, a significant correlation between all of the measures was found, with the exception of CR section of the Listening Comprehension test. The strongest correlation ( $r = .37$ ) existed between the Phonemic Segmenting and Letter Sounding tests (see Table 3). When using data from the Reading Comprehension test, a significant correlation was found between all of the measures. The strongest correlation ( $r = .66$ ) existed between the SR and CR section of the Reading Comprehension Test.

Table 3

*Correlations Between the Grade 1 Reading Measures, Using Listening Comprehension*

		Letter Sounding	Phonemic Segmenting	ORF	Selected Response	Constructed Response
Letter Sounding	Pearson Correlation	1	.371**	.341* *	.214**	.056
	Sig. (2-tailed)	.	.000	.000	.000	.307
	<i>n</i>	1145	1138	1123	339	339
Phonemic Segmenting	Pearson Correlation		1	.176* *	.102	-.049
	Sig. (2-tailed)		.	.000	.059	.362
	<i>n</i>		1150	1127	343	343
ORF	Pearson Correlation			1	.259**	.081
	Sig. (2-tailed)			.	.000	.139
	<i>n</i>			1144	336	336
Selected Response	Pearson Correlation				1	.216**
	Sig. (2-tailed)				.	.000
	<i>n</i>				348	348
Constructed Response	Pearson Correlation					1
	Sig. (2-tailed)					.
	<i>n</i>					348

\*\* . Correlation is significant at the .01 level (2-tailed).

Table 4

*Correlations Between the Grade 1 Measures, Using Reading Comprehension*

		Letter Soundin g	Phonemic Segmenting	ORF	Selected Response	Constru cted Respons e
Letter Sounding	Pearson Correlation	1	.371	.341**	.018	.008
	Sig. (2-tailed)	.	.000	.000	.601	.831
	<i>n</i>	1145	1138	1123	806	806
Phonemic Segmenting	Pearson Correlation		1	.371	.002	.125**
	Sig. (2-tailed)		.	.000	.953	.000
	<i>n</i>		1150	1138	807	807
ORF	Pearson Correlation			1	.204**	.175**
	Sig. (2-tailed)			.	.000	.000
	<i>n</i>			1144	808	808
Selected Response	Pearson Correlation				1	.655**
	Sig. (2-tailed)				.	.000
	<i>n</i>				855	855
Constructe d Response	Pearson Correlation					1
	Sig. (2-tailed)					.
	<i>n</i>					861

Note: \*. Correlation is significant at the .05 level. \*\*. Correlation is significant at the .01 level (2-tailed).

*Comparison of Student Performance Based on Oral Reading Fluency*

As expected, students who read the fewest number of words aloud correctly on the ORF performed significantly more poorly on all reading measures than students who read at least 29

words per minute. Proficiency in ORF accounted for 3-10% of the variance in student performance on the other measures (see Table 5).

Table 5

*Analysis of Variance Summary Table Comparing Students Who Took the Listening Comprehension Test with Those Who Took the Reading Comprehension Test*

Source		<i>df</i>	<i>F</i>	$\eta^2$	<i>p</i>
Letter Sounding	Group	1	100.85**	.08	.00
	Error	1097	(142.13)		
Phonemic Segmenting	Group	1	42.37**	.04	.00
	Error	1101	(201.11)		
ORF	Group	1	802.60**	.42	.000
	Error	1096	(986.41)		
Comprehension Selected Response	Group	1	114.91**	.10	.00
	Error	1086	(0.89)		
Comprehension Open Ended	Group	1	32.32**	.03	.00
	Error	1087	(0.83)		

*Note.* Values enclosed in parentheses represent mean square errors.

\* $p < .05$ , \*\* $p < .01$ .

### *Regression Analysis of District Reading Assessments*

Because students do not take the statewide large-scale assessment until the spring of their third-grade year, district assessment of student progress in reading becomes even more important in the early years. At the end of their third-grade year, students' reading ability is assessed using a SR reading comprehension test administered by the state. The measure administered by the district that most closely resembles the statewide test is the SR section of the Comprehension test.

A linear regression model in which student performance on Letter Sounding, Phonemic Segmenting, ORF, and CR Listening Comprehension were used to predict performance on the SR Listening Comprehension test accounted for 10% of the variation on the SR Listening Comprehension test [ $F(4,322) = 8.60, p < .05$ ]. Table 6 presents the regression analysis using the SR Listening Comprehension test as the dependent variable.

A linear regression model, in which student performance on Letter Sounding, Phonemic Segmenting, ORF, and CR Reading Comprehension was used to predict performance on the SR Reading Comprehension test, accounted for 28% of the variation on the SR Listening Comprehension test [ $F(4,789) = 77.74, p < .05$ ]. Table 7 presents the regression analysis of the SR Reading Comprehension test as the dependent variable.

Table 6

*Regression Summary for Grade 1 SR Listening Comprehension Test*

Independent Variables	Unstandardized Coefficients		Standardized Coefficients	t	95% Confidence Interval for B	
	B	Std. Error	Beta		Lower Bound	Upper Bound
Letter Sounding	1.E-02	.01	.13	1.95	.00	.03
Phonemic Segmenting	2.E-02	.01	.02	0.34	-.01	.01
ORF	2.E-02	.01	.16	2.70	.01	.04
District Listening Comprehension (CR)	0.20	.06	.17	3.07	.07	.32
Constant	2.12	.33		6.53	1.48	2.76



Table 7

*Regression Summary for Grade 1 SR Reading Comprehension Test*

Independent Variables	Unstandardized Coefficients		Standardized Coefficients	t	95% Confidence Interval for B	
	B	Std. Error	Beta		Lower Bound	Upper Bound
Letter Sounding	2.E-03	.00	.02	0.71	-.00	0.01
Phonemic Segmenting	*****	.00	-.07	-2.28	-0.01	-0.00
ORF	4.E-03	.00	.10	3.12	.00	0.01
District Reading Test (CR)	0.58	.04	.51	16.66	.51	0.64
Constant	2.36	.22		10.92	1.94	2.79

*Discussion**District Letter Sounding Test*

The District Letter Sounding test is significantly correlated with performance on first-grade Phonemic Segmenting, ORF, and the CR section of the District Reading Comprehension test. While it provides information that can be used by means of a regression equation to predict student performance on the Listening Comprehension test, it does not serve this same purpose for the Reading Comprehension test. Like the Phonemic Segmenting test, the Letter Sounding test will be most useful to the district as a screening mechanism to allow teachers to group students appropriately for instruction and to enable schools to allocate additional resources to ensure that all students are making adequate progress in terms of their reading development.

*District Phonemic Segmenting Test*

The District Phonemic Segmenting test is significantly correlated with performance on first-grade ORF, Letter Sounding, and the CR section of the District Reading Comprehension test. It does not, however, provide useful information that can be used by means of a regression equation to predict student performance on the Reading and Listening Comprehension tests. It

will be most useful to the district as a screening mechanism to allow teachers to group students appropriately for instruction and to enable schools to allocate additional resources to ensure that all students are making adequate progress in terms of their reading development.

### *ORF*

The ORF is significantly correlated with all other first-grade reading measures administered by the district. It provides useful information that can be used by means of a regression equation to predict student performance on the SR section of the Reading and Listening Comprehension tests. The ORF is easy to administer and does not require much time or training to score; it can continue to be a useful source of information for teachers monitoring student growth in reading.

### *District Comprehension Tests*

Both the Listening and Reading Comprehension tests provide useful information to the District about the progress students are making in reading. The disproportionate number of students whose scores on the ORF indicated a need to administer the Listening Comprehension test as opposed to the Reading Comprehension test from schools identified as serving low-income students should alert the district to a potential area of concern. An aggressive focus on ensuring that all students are making adequate progress in developing reading skills regardless of income level or school of attendance is recommended.

The district's current reading assessment kit can offer insights into strengths of particular programs, schools, and teachers and provides school personnel with information that can help them measure student progress towards reading proficiency. It will continue to be revised, and the revisions will be analyzed using Item Response Theory (IRT) in subsequent years as the district works to improve the reliability and validity of the instruments for the various ways they

are used. Additional technical reports will be written to follow up on these analyses and document the changes being made to the reading assessment kit.

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