

Reading Fluency Monitor

TECHNICAL INFORMATION

The following information provides evidence for the reliability and validity of the procedures employed in the *Reading Fluency Monitor*. The data were collected primarily in Washington State over a period of three years. All data were collected in public school classrooms. The reliability and validity coefficients reported in this section are based on words read correctly per minute on a single passage. These coefficients can be considered "lower limit" estimates of the true reliability and validity when three passages are used to predict future performance.

Reliability and validity data using all three passages per grade will be collected during the 2002-2003 school year and will be reported in subsequent editions of this section (Technical Information) of the *Reading Fluency Monitor*. The already very high reliability and validity coefficients reported here will increase when based on the average of three passages. With increased reliability and validity, the standard error (margin of error) around an individual *Reading Fluency Monitor* score or predicted high-stakes standardized test score will decrease.

Reliability

Reliability is the degree to which scores produced under standard procedures will be dependably replicated on another occasion, with sets of similar passages, and with different test administrators and scores.

Evidence for the reliability of oral reading fluency measurement is provided in Table 1 and Table 2. The 121 correlations contributing to the database were meta-analyzed using Comprehensive Meta-Analysis (Borenstein and Rothstein, 1999). The results of this analysis are presented in two ways. Table 1 represents test-retest reliability coefficients for groups of children in grades one through seven leveled by three time-span categories as follows:

Reliability:	Test and re-test were done within the same academic year.
Reliability-Delayed:	Test and re-test were done in contiguous years, e.g., third and fourth.
Reliability-Delayed 2:	Test and re-test were separated by one year, e.g., third and fifth.

The data in Table 1 show that across the 121 coefficients, a point estimate is .907 with a 95% confidence interval from .899 to .915. This is well within acceptable psychometric standards. The magnitude of the correlations is remarkably stable across time-span categories although it is not surprising to note a slight inverse relationship between the size of the correlation and the length of time between test administrations.

Table 2 shows the reliability coefficients organized by grade level across time span categories. The grade-one reliability estimate (.847) is lower than that for the other grade levels and can be explained by the fact that many first-grade children are just beginning to learn to read. The reliability estimates for all other grades are above .90.

The Standard Error of Measurement

Even with substantial reliability, one must be sure to recognize that there is error involved in any single score. The magnitude of this error is interpreted with a value called the standard error of measurement. The size of the standard error of measurement is a function of the standard deviation of the measure and the reliability estimate. In our research, the standard deviation of oral reading fluency scores is in the neighborhood of 35 to 42. Using a reliability coefficient of .90, the standard error of measurement, then, is estimated to be somewhere between 11.07 and 13.28. This shows that a given individual score is best interpreted as representing a range of possible scores and that the error involved in interpreting any single score is quite large. An estimate of the stability of group performance is more accurate.

Validity and Reading Comprehension

Validity is the degree to which an assessment measures what it purports to measure. In this case, the *Reading Fluency Monitor* purports to measure reading achievement.

Evidence for the validity of oral reading fluency measures as an indicator of reading comprehension is provided in Tables 3 and 4. The combined effects were between the oral reading fluency measure and various high-stakes measures of reading and were analyzed using the meta-analysis computer program referenced above (Borenstein and Rothstein, 1999). Time between the administration of the oral reading fluency measure and administration of the criterion measure ranged from one month to two years. The analysis was done in two ways: (1) across grades 1 through 6 by criterion measure and (2) across criterion measure by grade level (see Tables 3 and 4, respectively). The overall validity estimate across grades and measures was .730 with a 95% confidence interval from .716 to .744. The variance interpretation of this correlation is that roughly half of the variability in high-stakes reading comprehension scores can be explained by oral reading fluency.

When using oral reading fluency scores to predict performance on a subsequent high-stakes measure, it is important to remember that there is error associated with any such prediction and that the error involved in making predictions about individuals is substantial. Predictions involving groups are somewhat more accurate.

Other evidence for the overall validity of oral reading fluency measures is the observation that children identified in various ways for participation in compensatory educational programs (usually for reading problems) score significantly lower on oral reading fluency measures than children not so identified (Davidson, Blake, & Towner, 1998; Davidson, Myhre, & Towner, 1999; Davidson, M., Stage, S., & Towner, J., 1999; Davidson, M., & Towner, J., 2001; Towner, Davidson, & Howell, 2001). That is, oral reading fluency scores are consistent with more involved identification procedures commonly employed in the schools.

Validity and General School Achievement

It has often been said that reading is fundamental to all school functioning. The data presented in Tables 5 and 6 are consistent with this commonsense notion. The data in these tables are 97 correlations between oral reading fluency measures and a variety of high stakes measures other than reading, (i.e., math, language, listening, writing). Again, these correlations were analyzed using the meta-analysis program developed by Borenstein and Rothstein (1999). The data in Table 5 are organized by criterion measure across grades. In Table 6, the data are organized by grade across criterion measure. The overall correlation between oral fluency scores and scores on high-stakes measures other than reading is .577 with a 95% confidence interval from .559 to .595. The variance interpretation of this correlation is that roughly one-third of school achievement as represented by these high stakes measures can be explained by the ability to read quickly, accurately, and effortlessly.

Readability Levels of the Passages

The passages used in the *Reading Fluency Monitor* were leveled according to three commonly used readability formulas. Calculations were performed using Readability Calculations (Micro Power and Light, 2000).

Table 1: Meta-analysis of Oral Reading Fluency Reliability Coefficients

Time: Same Year or Delayed	Effect	Lower	Upper	N Total	P Value
Same Year (84)*	.915	.906	.923	12213	.000
Delayed: consecutive years (19)*	.896	.881	.909	958	.000
Delayed 2: Alternate years (18)*	.866	.820	.901	1361	.000
Total Combined (121)*	.907	.899	.915	14532	.000

* () number of correlation coefficients in meta-analysis

Table 2: Meta-analysis of Oral Reading Fluency Reliability Coefficients by Grade Level

Grade	Effect	Lower	Upper	N Total	P Value
1 (8)*	.847	.768	.901	1631	.000
2 (16)*	.914	.895	.929	3920	.000
3 (23)*	.909	.897	.920	4345	.000
4 (38)*	.905	.883	.922	2121	.000
5 (28)*	.916	.905	.925	2131	.000
6 (2)*	.922	.877	.946	122	.000
7 (6)*	.906	.861	.936	262	.000
Combined (121)*	.907	.899	.915	14532	.000

* () number of correlation coefficients in meta-analysis

Table 3: Meta-analysis of Validity Coefficients Using Oral Reading Fluency with Measures of Reading Comprehension

Test	Effect	Lower	Upper	N Total	P Value
CTBS Comprehension (4)*	.789	.726	.839	186	.000
CTBS Total Reading (8)*	.770	.730	.804	486	.000
CTBS Vocabulary (1)*	.855	.745	.920	42	.000
Gates Comprehension (8)*	.746	.703	.783	784	.000
Gates Total Reading (36)*	.782	.763	.800	2382	.000
Gates Vocabulary (9)*	.730	.684	.770	585	.000
ITBS Comprehension (11)*	.688	.655	.717	6346	.000
ITBS Total Reading (8)*	.712	.677	.743	3297	.000
ITBS Vocabulary (11)*	.610	.594	.625	6409	.000
WASL Reading (19)	.680	.647	.711	1136	.000
Combined (115)	.730	.716	.744	21653	.000

* () number of correlation coefficients in meta-analysis

CTBS: Comprehensive Test of Basic Skills

Gates: Gates MacGinitie Reading Tests (GMRT), 3rd edition

ITBS: Iowa Test of Basic Skills

WASL: Washington Assessment of Student Learning (state-mandated performance assessment)

Table 4: Meta-analysis of Validity Coefficients Using Oral Reading Fluency with Measures of Reading Comprehension by Grade Level

Grade	Effect	Lower	Upper	N Total	P Value
1 (3)*	.779	.716	.829	200	.000
2 (26)*	.731	.702	.758	10626	.000
3 (29)*	.698	.671	.723	7529	.000
4 (29)*	.748	.719	.774	1734	.000
5 (19)*	.752	.724	.778	1075	.000
6 (1)*	.760	.605	.860	47	.000
Combined (115)*	.730	.716	.744	21653	.000

* () number of correlation coefficients in meta-analysis

Table 5: Meta-analysis of Validity Coefficients Using Oral Reading Fluency with Measures of School Achievement Other Than Reading

Test	Effect	Lower	Upper	N Total	P Value
CTBS Total Battery (8)*	.741	.697	.780	478	.000
CTBS Total Language (8)*	.706	.657	.749	478	.000
CTBS Total Math (7)*	.610	.536	.674	338	.000
CTBS Writing (12)*	.448	.364	.524	572	.000
ITBS Computation (19)*	.551	.538	.564	10660	.000
ITBS Total Language (1)*	.787	.656	.872	53	.000
ITBS Total Math (9)*	.577	.559	.595	5295	.000
WASL Listening (7)*	.420	.335	.498	412	.000
WASL Math (7)*	.577	.559	.595	5295	.000
WASL Writing (13)*	.539	.468	.604	776	.000
Combined (97)*	.577	.559	.595	19886	.000

* () number of correlation coefficients in meta-analysis

CTBS: Comprehensive Test of Basic Skills

ITBS: Iowa Test of Basic Skills

WASL: Washington Assessment of Student Learning (state-mandated performance assessment)

Table 6: Meta-analysis of Validity Coefficients Using Oral Reading Fluency with Measures of School Achievement Other than Reading by Grade Level

Grade	Effect	Lower	Upper	N Total	P Value
2 (6)*	.555	.531	.578	6162	.000
3 (36)*	.555	.531	.578	10490	.000
4 (40)*	.622	.580	.660	2384	.000
5 (9)*	.673	.616	.724	432	.000
7 (6)*	.465	.379	.543	418	.000
Combined (97)*	.577	.559	.595	19886	.000

* () number of correlation coefficients in meta-analysis

Table 7: Oral Reading Fluency Reliability Coefficients

Grade	N	Time of Testing	r
1	981	November - May	.768
2	1089	September - November	.933
2	1022	November - May	.905
2	1005	September - May	.865
3	1099	September - November	.921
3	1024	September - May	.875
3	1027	November - May	.898
4	87	October - January	.957
4	94	October - March	.960
5	73	September - October	.935
5	74	September - January	.923
5	74	September - March	.902
5	83	October - January	.919
5	82	October - March	.920
1	87	January - May	.871
1	61	January - May	.803
2	54	September - January	.927
2	56	September - May	.883
2	41	January - May	.956
3	57	September - January	.922
3	56	September - May	.910
3	62	January - May	.922
4	46	September - January	.934
4	48	September - May	.925
4	74	January - May	.941
5	51	September - January	.943
5	52	September - May	.919
5	54	January - May	.934

All Correlations significant at $p < .01$

Table 7: Oral Reading Fluency Reliability Coefficients, continued

Grade	N	Time of Testing	r
4	59	September - January	.915
4	59	September - May	.885
4	59	January - May	.886
5	55	September - January	.940
5	55	September - May	.951
5	55	January - May	.946
1	63	January - May	.811
2	46	September - January	.908
2	46	September - May	.876
2	50	January - May	.949
3	64	September - January	.922
3	63	September - May	.889
3	68	January - May	.931
4	50	September - January	.939
4	47	September - May	.849
4	49	January - May	.894
5	43	September - January	.925
5	42	September - May	.885
5	47	January - May	.912
2	68	September - March	.930
2	52	September - September	.902
2	66	September - June	.885
2	66	March - June	.932
2 & 3	52	Sept. '97 - Sept. '98	.902
2 & 3	32	Sept. '97 - May '99	.836
2 & 3	51	March '98 - Feb. '99	.859
2 & 3	32	March '98 - May '99	.875
2 & 3	51	June '98 - Feb. '99	.916
2 & 3	32	June '98 - May '99	.919
2 & 4	42	Sept. '97 - Sept. '99	.811
2 & 4	42	Sept. '97 - Feb. '00	.820
2 & 4	40	Sept. '97 - May '00	.800
2 & 4	42	March '98 - Sept. '99	.849
2 & 4	40	March '98 - Feb. '00	.853
2 & 4	40	March '98 - May '00	.811
2 & 4	42	June '98 - Sept. '99	.893
2 & 4	40	June '98 - Feb. '00	.853
2 & 4	40	June '98 - May '00	.887
2 & 3	51	Sept. '97 - Feb. '99	.846

All Correlations significant at $p < .01$

Table 7: Oral Reading Fluency Reliability Coefficients, continued

Grade	N	Time of Testing	r
3 & 4	47	Sept. '98 - Sept. '99	.916
3 & 4	46	Sept. '98 - Feb. '00	.902
3 & 4	46	Sept. '98 - May '00	.868
3	72	Sept. '97 - March '98	.956
3	69	Sept. '97 - June '98	.939
3 & 4	62	Sept. '97 - Sept. '98	.868
3	71	March '98 - June '98	.940
3 & 4	62	March '98 - Sept '98	.893
3 & 4	63	June '98 - Sept. '98	.876
3 & 5	46	Sept. '97 - Sept. '99	.909
3 & 5	42	Sept. '97 - Feb. '00	.876
3 & 5	42	Sept. '97 - May '00	.908
3 & 5	46	March '98 - Sept. '99	.927
3 & 5	43	March '98 - Feb. '00	.899
3 & 5	42	March '98 - May '00	.935
3 & 5	46	June '98 - Sept. '99	.919
3 & 5	43	June '98 - Feb. '00	.860
3 & 5	43	June '98 - May '00	.910
3 & 4	60	Sept. '97 - Feb. '99	.925
3 & 4	57	Sept. '97 - May '99	.861
3 & 4	60	March '98 - Feb. '99	.934
3 & 4	60	June '98 - Feb. '99	.928
3 & 4	57	June '98 - May '99	.875
4	72	Sept. '98 - Feb. '99	.923
4	67	Sept. '98 - May '99	.910
4	68	Feb. '99 - May '99	.943
4 & 5	36	Sept. '97 - Sept. '98	.939
4	41	Sept. '97 - March '98	.948
4	41	Sept. '97 - June '98	.945
5	58	Sept. '97 - March '98	.930
5	58	Sept. '97 - June '98	.913
7	47	Fall '94 - Winter '95	.935
7	45	Fall '94 - Spring '95	.921
7	45	Winter '95 - Spring '95	.948
7	43	Winter '95 - Winter '96	.870
7	44	Spring '95 - Spring '96	.829
7	38	Fall '95 - Spring '96	.879
1	108	Oct. '98 - Jan '99	.834
1	113	Oct. '98 - Mar. '99	.716

All Correlations significant at $p < .01$

Table 7: Oral Reading Fluency Reliability Coefficients, continued

Grade	N	Time of Testing	r
1	112	Sept. '96 - Oct. '96	.957
1	106	Sept. '96 - Jan. '97	.880
2	85	Oct. '97 - Jan. '98	.947
2	87	Oct. '97 - March '98	.899
2	87	Oct. '97 - May '98	.869
3	85	Oct. '98 - Jan. '99	.937
3	83	Oct. '98 - March '99	.903
3	81	Oct. '98 - May '99	.908
4	87	Oct. '98 - Jan. '99	.957
4	94	Oct. '98 - March '99	.960
4	80	Oct. '98 - May '99	.943
5	73	Sept. '98 - Feb. '99	.810
5	73	Sept. '98 - May '99	.837
6	61	Sept. '98 - Feb. '99	.906
6	61	Sept. '98 - May '99	.935

Table 8: Oral Reading Fluency Validity Coefficients With Reading Anchor Tests

N	Grade Level	Anchor Test	Time of Testing	r
990	2	ITBS - Total Reading	September - May	.673
1009	2	ITBS - Total Reading	November - May	.696
1040	2	ITBS - Total Reading	Both May	.694
990	2	ITBS - Comprehension	September - May	.665
1009	2	ITBS - Comprehension	November - May	.701
1041	2	ITBS - Comprehension	Both May	.709
1003	2	ITBS - Vocabulary	September - May	.602
1022	2	ITBS - Vocabulary	November - May	.613
1054	2	ITBS - Vocabulary	Both May	.605
1018	3	ITBS - Vocabulary	September - May	.613
1021	3	ITBS - Vocabulary	November - May	.605
1033	3	ITBS - Vocabulary	Both May	.608
1010	3	ITBS - Comprehension	September - May	.630
1013	3	ITBS - Comprehension	November - May	.639
1024	3	ITBS - Comprehension	Both May	.641
130	4	WASL - Reading	Both Spring	.650
53	7	WASL - Reading	Both Spring	.700
53	7	ITBS - Vocabulary	Both Spring	.580
53	7	ITBS - Comprehension	Both Spring	.812
53	7	ITBS - Total Reading	Both Spring	.784

All Correlations significant at $p < .01$

Table 8: Oral Reading Fluency Validity Coefficients With Reading Anchor Tests, continued

N	Grade Level	Anchor Test	Time of Testing	r
246	2	Gates - Total Reading	Both Fall	.860
336	2	Gates - Comprehension	Both Fall	.760
49	4	CTBS - Reading Total	Both Fall	.798
49	4	CTBS - Vocabulary	Both Fall	.734
49	4	CTBS - Comprehension	Both Fall	.797
150	2	CTBS - Terra Nova Reading Total	Both Fall	.780
47	6	CTBS - Total Reading	Both Spring	.760
58	2	Gates - Total Reading	Both Fall	.795
66	2	Gates - Total Reading	Both Spring	.745
40	2	Gates - Total Reading	Both Fall	.853
74	3	Gates - Total Reading	Both Fall	.812
78	3	Gates - Total Reading	Both Spring	.667
73	3	Gates - Total Reading	Both Fall	.758
50	4	Gates - Total Reading	Both Fall	.775
56	4	Gates - Total Reading	Both Spring	.817
65	5	Gates - Total Reading	Both Fall	.849
62	5	Gates - Total Reading	Both Spring	.704
41	4	WASL - Reading	Fall - Spring	.670
74	7	WASL - Reading	Fall - Spring	.606
68	4	WASL - Reading	Fall - Spring	.822
96	4	Gates - Total Reading	Both Spring	.716
44	4	WASL - Reading	Both Spring	.659
36	4	WASL - Reading	Both Spring	.738
36	4	CTBS Comprehension	Fall - Spring	.809
36	4	CTBS - Vocabulary	Fall - Spring	.777
66	1	Gates - Total Reading	Both Spring	.787
66	2	Gates - Total Reading	Both Spring	.745
78	3	Gates - Total Reading	Both Spring	.667
56	4	Gates - Total Reading	Both Spring	.746
62	5	Gates - Total Reading	Both Spring	.704
43	4	WASL - Reading	Fall - Spring	.706
52	4	ITBS - Vocabulary	Winter - Spring	.789
52	4	ITBS - Total Reading	Winter - Spring	.848
43	4	WASL - Reading	Winter - Spring	.706
50	4	WASL - Reading	Both Spring	.584
53	4	ITBS - Comprehension	Winter - Spring	.845
59	3	CTBS - Vocabulary	Both Spring	.799
59	3	CTBS - Comprehension	Both Spring	.767

All Correlations significant at $p < .01$

Table 8: Oral Reading Fluency Validity Coefficients With Reading Anchor Tests, continued

N	Grade Level	Anchor Test	Time of Testing	r
59	3	CTBS - Total Reading	Both Spring	.813
137	4	WASL - Reading	Both Spring	.650
140	4	CTBS - Total Reading	Both Spring	.730
57	1	Gates - Total Reading	Winter - Spring	.729
38	2	Gates - Total Reading	Fall - Spring	.786
38	2	Gates - Total Reading	Winter - Spring	.782
40	2	Gates - Total Reading	Both Spring	.817
55	5	CTBS - Total Reading	Fall - Spring	.778
46	5	CTBS - Total Reading	Winter - Spring	.748
48	5	CTBS - Total Reading	Both Spring	.717
77	1	Gates - Total Reading	Both Spring	.803
58	3	Gates - Total Reading	Both Fall	.804
57	3	Gates - Total Reading	Fall - Spring	.762
57	3	Gates - Total Reading	Winter - Spring	.783
55	5	Gates - Total Reading	Both Fall	.801
55	5	Gates - Total Reading	Fall - Spring	.753
55	5	Gates - Total Reading	Winter - Spring	.799
55	5	Gates - Total Reading	Both Spring	.736
68	2	Gates - Vocabulary	Both September	.824
68	2	Gates - Comprehension	Both September	.829
68	2	Gates - Total Reading	Both September	.872
67	2	Gates - Vocabulary	September - May	.742
67	2	Gates - Total Reading	September - May	.740
67	2	Gates - Comprehension	September - May	.616
51	2 & 3	ITBS - Reading Vocabulary	Sept. '97 - March '99	.546
51	2 & 3	ITBS - Reading Comprehension	Sept. '97 - March '99	.683
51	2 & 3	ITBS Reading Total	Sept. '97 - March '99	.671
67	2	Gates - Vocabulary	March '98 - May '98	.753
67	2	Gates - Comprehension	March '98 - May '98	.673
67	2	Gates - Reading Total	March '98 - May '98	.772
51	2 & 3	ITBS - Reading Vocabulary	March '98 - March '99	.660
51	2 & 3	ITBS - Reading Comprehension	March '98 - March '99	.758
51	2 & 3	ITBS - Reading Total	March '98 - March '99	.778
51	2 & 3	ITBS - Reading Vocabulary	June '98 - March '99	.703
51	2 & 3	ITBS - Reading Comprehension	June '98 - March '99	.758
51	2 & 3	ITBS - Reading Total	June '98 - March '99	.778
73	3	Gates - Vocabulary	Sept. '97 - Sept. '97	.744
73	3	Gates - Comprehension	Sept. '97 - Sept. '97	.763
73	3	Gates - Total Reading	Sept. '97 - Sept. '97	.776

All Correlations significant at $p < .01$

Table 8: Oral Reading Fluency Validity Coefficients With Reading Anchor Tests, continued

N	Grade Level	Anchor Test	Time of Testing	r
69	3	Gates - Vocabulary	Sept. '97 - May '98	.747
70	3	Gates - Vocabulary	March '98 - May '98	.759
55	3 & 4	WASL - Reading	Sept. '97 - Spring '99	.669
55	3 & 4	WASL - Reading	March '98 - Spring '99	.753
55	3 & 4	WASL - Reading	June '98 - Spring '99	.698
55	4	WASL - Reading	Sept. '98 - Spring '99'	.695
42	4	CTBS - Vocabulary	Sept. '97 - Spring '98	.855
42	4	CTBS - Comprehension	Sept. '97 - Spring '98	.793
42	4	CTBS - Total Reading	Sept. '97 - Spring '98	.855
41	4	WASL - Reading	Sept. '97 - Spring '98	.670
36	4	Terra Nova - Reading	Sept. '97 - March '98	.774
59	5	Gates - Vocabulary	Both Sept. '97	.614
59	5	Gates - Comprehension	Both Sept. '97	.776
59	5	Gates - Total	Both Sept. '97	.756
55	5	Gates - Vocabulary	Sept. '97 - May '98	.655
57	5	Gates - Comprehension	Sept. '97 - May '98	.736
57	5	Gates - Total	Sept. '97 - May '98	.812
57	5	Gates - Vocabulary	March '98 - May '98	.640
57	5	Gates - Comprehension	March '98 - May '98	.741
57	5	Gates - Total	March '98 - May '98	.807
40	7	Metro. Ach. Test	Fall '94 - Spring '94	.778
45	7	Metro. Ach. Test	Fall '94 - Spring '95	.741
40	7	Metro. Ach. Test	Winter '95 - Spring '94	.714
45	7	Metro. Ach. Test	Winter '95 - Spring '95	.726
40	7	WASL - Reading	Fall '94 - Spring '97	.697
42	7	WASL - Reading	Winter '95 - Spring '97	.689
74	7	WASL - Reading	Sept. '97 - Spring '98	.606

All Correlations significant at $p < .01$

Tests: Gates MacGinitie Reading Tests
 Metropolitan Achievement Test
 Washington Assessment of Student Learning
 Terra Nova CTBS
 Iowa Test of Basic Skills
 Comprehensive Test of Basic Skills