

DOCUMENT RESUME

ED 092 911

CS 001 186

AUTHOR Biemiller, Andrew
TITLE Relationships Between Oral Reading Rates for Letters, Words, and Simple Text, and the Development of Reading Ability.
SPONS AGENCY Ontario Educational Research Council, Toronto.
PUB DATE 73
NOTE 27p.; Prepared at University of Toronto
EDRS PRICE MF-\$0.75 HC-\$1.85 PLUS POSTAGE
DESCRIPTORS Elementary School Students; *Oral Reading; *Reading Ability; Reading Development; *Reading Research; Reading Skills; *Reading Speed

ABSTRACT

The development of oral reading speed in the early elementary years and an examination of some underlying abilities that may be involved in individual differences in reading speed and ability are the concerns of this study. Cross-sectional and longitudinal data relating the time required to read orally 50 unrelated letters, 50 unrelated words, and 100 words in text among first to sixth graders and adults are presented. Metropolitan Achievement Test (M.A.T.) reading scale test scores were obtained and related to the time data. The results indicate a high level of developmental stability and strong relationships between the ability to read letters or words rapidly at an earlier age and the ability to read text rapidly at a later age. These results are interpreted on the basis that a common ability must be involved in the time required to read all three types of materials. M.A.T. scores are also highly associated with reading times both concurrently and longitudinally. These results are interpreted as indicating the existence of a developmental reading speed ability which is not primarily dependent on word identification or context-using skills. The nature of this ability and educational and research implications are discussed.
(TO)

RELATIONSHIPS BETWEEN ORAL READING RATES FOR
LETTERS, WORDS, AND SIMPLE TEXT,
AND THE DEVELOPMENT OF READING ABILITY

Andrew Biemiller¹
University of Toronto

PERMISSION TO REPRODUCE THIS COPY-
RIGHTED MATERIAL HAS BEEN GRANTED BY

Andrew Biemiller

TO ERIC AND ORGANIZATIONS OPERATING
UNDER AGREEMENTS WITH THE NATIONAL IN-
STITUTE OF EDUCATION. FURTHER REPRO-
DUCTION OUTSIDE THE ERIC SYSTEM RE-
QUIRES PERMISSION OF THE COPYRIGHT
OWNER.

This paper concerns the development of oral reading speed in the early elementary years, and an examination of some underlying abilities that may be involved in individual differences in reading speed and ability.

Since Cattell's nineteenth century work on reading (1885) it has been known that average oral reading rates for adults are about the same for letters or words in random order, and somewhat faster for words in context. Thus, in the same interval, one is apparently dealing with greater numbers of letters when arranged in words, and still greater numbers of letters when arranged in words forming text than when reading unrelated letters.

In recent years, explanations of this finding have centred on the role of structure (Smith, 1969; Garner, 1962; Gibson, 1965). It is argued that regular relationships between letters and between words reduce the number of letters or letter features (those elements of letters that discriminate them from each other) that need to be processed. Implicitly, this explanation suggests that a certain amount of time is required for each feature processed, while the application of structural information either takes less time, or can occur simultaneously with the processing of additional features.

Thus, one might expect that individual differences could occur at the level of identifying letter features rapidly, at the level of using structure within words to facilitate rapid word identification, or at the level of using contextual structure to facilitate more rapid reading of words in text.

The role of speed in reading has reappeared as an issue with the publication of Smith's (1971) seminal work on reading and Smith and Holmes' "Analysis of Fluent Reading" which appeared in the *Reading Research Quarterly* in 1971. Smith and Holmes suggest that

¹ The author wishes to thank Gail Basin, Michael Buchannan, Anne Goldman, Francine Newman, Mel Perlmutter, and Debbie Sherman for their assistance in this research. I also wish to thank the children and staffs of the Laboratory School of the Institute of Child Study and Blythwood School, Board of Education for the City of Toronto for their participation. Finally, I wish to thank the Ontario Institute for Studies in Education for providing a research assistant and equipment for parts of the study, and the Ontario Educational Research Council for financial support.

ED 092911

5001186

...unless the reader reads fast enough, that is, around 200 w.p.m. or more, he is not going to comprehend what he is reading simply because his memory system will not be able to retain, organize, and store the fragmentary information in any efficient way.

The present study emerged from an attempt to isolate differences in the rates of feature processing, word processing, and text processing. The main procedure involves obtaining oral reading rates for letters, unrelated words, and simple text.

It is clear that the rate of reading unrelated letters cannot be influenced by the reader's ability to use his knowledge of structural relationships between letters or features in words, or his knowledge of context. Similarly, the rate of reading unrelated words cannot be influenced by the reader's use of context (including both semantic and syntactic aspects of context). Hence, an examination of the development of these three types of oral reading rates should shed some light on the role of growing skill in identifying letter features, and in using within-word structure and contextual structure in reading.

In order to relate these findings to "reading ability", oral reading rates are compared with the Metropolitan Achievement Test "reading" scale scores. While admittedly this is an extremely crude measure of reading "ability" or "comprehension", above average scores on this test do usually indicate that a child is progressing reasonably well in acquiring the capacity to use reading as an effective mode of communication, while below average scores usually indicate that a child is not progressing well.

Use of the Metropolitan "Reading Scale" raises the old issue of speed versus comprehension. This has been the subject of numerous studies, e.g. Tinker, 1939; Carlson, 1949; Shores, 1968; and Witty, 1969. The findings of these studies are generally that reading rate and reading comprehension measures are highly correlated if (a) the comprehension measure is timed, and (b) the material being tested is not especially difficult for the reader. If the comprehension measure is not timed, observed correlations between comprehension scores and reading rates have been very low.

However, with one exception (Carlson, 1949) the studies I have surveyed have used samples of college students - that is, individuals who have at worst, fairly adequate reading abilities. Carlson used fifth graders. However, his method of measuring reading speed appears to be confounded with types of material and reading instructions. It is not clear from his study just what reading speed means. The main focus of the present study has been tracing the development of speed and reading ability in the early elementary years where these appear to be closely

related. With older children and adults, variations in speed may well be below a threshold level for adequate reading such as the one suggested by Smith and Holmes.

SAMPLE AND METHODS

Over the past five years data has been obtained from one first grade class (18 children); five second grade classes (87 children); two third grade classes (33 children); three fourth grade classes (53 children); two fifth grade classes (21 children); two sixth grade classes (23 children); and 20 adults. Except for one second grade class (22 children), all the children attended the laboratory school of the Institute of Child Study. All the children are from upper middle class families.

These 235 observations involved 162 different individuals. Seventy-three repeated observations were made in different years.

Children who were unable to read the very simple primer vocabulary used were not included in the study. "Unable to read" was operationally defined as missing more than five words in the text passage. Over five years of study, three first graders have been excluded, eight second graders, and one third grader from the sample. Data on reading times for letters for the second grade children who were excluded are reported separately.

It should be noted that the children in this sample are mostly of above average reading ability.

Materials: The text passages were drawn from a first grade basal reader (Nelson series) used by some of the children. One passage occurring at the end of this book was used, the passage being slightly altered so that there were exactly 100 words in the passage. The passage was slightly modified to produce a second passage.

Two 50 word lists were selected from the 100 word passages by listing every other word going backwards from the end of the text. The procedure thus used to some extent the frequency of words occurring in the text without maintaining any meaningful structure.

Two 50 letter lists were selected by taking a random selection of all the letters of the alphabet.

All six reading passages (letters, words, text) were typed on white paper, 8 1/2 x 11 inches with an elite typewriter, double spaced. Words and letters were presented on a left to right basis with single spaces between words and letters. Two spaces followed periods in the text.

Procedures: All subjects were tested individually. They were instructed to read as quickly as possible, and not to worry about mistakes.

Order of presentation varied in different years. In the first year, each child read a text passage first, the two sets of letters next, and finally the two sets of words. The second 100 word text passage was given at a second session. The pairs of letter, word, and text materials were used to determine reliability. In all testing conducted since 1969, a single 50 item letter passage was given first, followed by a 50 item word passage, and one of the 100 word texts. This order of presentation was adopted so that subjects would have the easiest task first.² Oral reading testing was conducted in March of 1969, 1970, 1971, 1972, and 1973, and May of 1973.

Reading times were measured in two ways. In the simpler approach, a stopwatch was started when the child was told to start reading a passage and stopped at the conclusion. In the more complex approach, the child's reading was tape-recorded, converted to graphic form, and the time measured on the graph. This approach permitted correcting for regressions and errors so that only the time for reading correctly was included.³

Reading speeds are reported in terms of mean time per unit - i.e. letter or word. This index is used to facilitate comparisons with other recent studies of reading and perception which attempt to identify processing times during perceptual and identifying acts (e.g. Neisser, 1968; Smith, 1971; Gough, 1972). One graph is presented in which these data have been converted to letters or words per minute. It is important to note that very small changes in seconds per letter or word can produce very large changes in words per minute when a child is reading more than two letters or words per second.

Metropolitan Achievement Tests: M.A.T. "reading" scale data was obtained in normal classroom group testing. The Primary II form B of the 1963 edition was used with second grade children while the Elementary form B (1963) and form G (1970) were used with the grade three to six children. Raw scores were used for statistical analysis.

² Order was not varied experimentally as the main concern of the study was correlations between the different measures, rather than means for the different measures. Hence, order effects would merely add unwanted error variance.

³ The correlation between the stopwatch method and the tape-recorded method is over .90. Consequently the tape-recorded approach is not recommended if the vocabulary is easy for the sample being studied.

Analysis: Two methods are used to analyze the data:

Product-moment correlations are used to examine reliability (test-retest), longitudinal stability, and relationships between pairs of variables, both concurrently and longitudinally.

Multiple regression analysis is used to examine the contributions of letter and word time variance to text time variance, and the contributions of all three times to M.A.T. reading scale variance. In conducting multiple regression analyses, letter time was entered as the first independent variable, and word time as the second. This choice of order is based on the view that common variance between letter times and the other variables reflects a common speed ability that does not involve the use of intra- or inter-word structure to facilitate reading speed. Similarly, word time variance does not involve the use of inter-word (i.e. contextual) structure to facilitate speed. Thus by entering word time second and text time third, the additional contributions to reading speed and to M.A.T. scores of individual differences in the abilities to use the additional kinds of information can be examined.

RESULTS

Reliability: Test-retest (alternate forms) data for oral reading rates is available for part of the sample. Results are shown in Table 1.

In short, test-retest reliabilities ranged from .78 to .92, averaging .86.

Development of oral reading speeds: Figure 1 shows mean time required for letters, words, and rates for the various grades sampled. Rates in letters per word or minute are also shown in Figure 1.⁴

Clearly, speed increases with age on all three types of times. Figure 1 also indicates that sex differences are much as one might expect. Tests of statistical significance appear superfluous with these data, as boys as a group, with one exception, consistently take longer than girls to identify letters, words, and words in context.

It is worth noting that these results replicate the original Cattell (1885) finding that reading times for letters and simple words are about the same, while times for text are somewhat faster. However, no specific analysis is made here

⁴ Rates are approximate. If individual time scores were converted to rates the averages could be somewhat different than reported here as the relationship between rates and times is non-linear.

of mean differences between letter, word, and text rates as the latter two will be specific to the level of difficulty of the words and text used. Of more significance is the observation that from second grade on the difference between text times and letter times appears to be a constant.

Eight second grade children were unable to read the primer vocabulary used for unrelated words and text. Their mean time per letter was 1.34 seconds compared to the .89 seconds per letter observed among the readers.

Table 2 presents data from our longitudinal samples. Trends appear comparable to the cross-sectional data. Note that variance decreases with age.

Concurrent relationships between oral reading rates: Table 3 presents correlations between oral reading rates for letters, words, and text at the various grades sampled. Note that the variation in correlations observed between grade levels is not greater than that observed between the four classes of grade two children.

Figure 2 illustrates regression equations for the various grades relating letter times to text times. Analysis of variance indicates that the grade two and four groups do not differ significantly (analysis based on Steele and Torrie, 1960, p. 319). When grade three or grades three, five and six are included, the regression relationships do vary significantly - that is, text time variance in common with letter time variance is significantly reduced when a common regression equation is used compared to individual equations for each grade.

Table 4 presents results of a multiple regression analysis computing the association between letter rate variance and text rate variance, and the association of word rate variance not associated with letter rate variance and text rate variance. Statistical significance was determined by analysis of regression variance (Steele and Torrie, 1960, pp. 283 ff.).

Table 4 indicates the existence of a fairly substantial speed ability common to all three tasks (i.e. the component associated with letter times). Between grade two and grade five, this component probably accounts for 50% of text time variance. (Variations in the percentage of text variance associated with letter time variance do not appear to be systematically associated with age and probably reflect variations in testing conditions, samples, etc. See Table 3 indicating ranges of correlations with grades.) Additional variance associated with word times appears to be around 25%. The 25% of text time variance not associated with letter and word time variances is not much greater than would be expected on the basis of the reliability of the measures. Hence, context-using skills do not appear to play a major role in the time required to read the simple passage used here.

Concurrent relationships between oral reading rates and M.A.T. "reading scores": Table 5 presents correlations between oral reading rates and M.A.T. "reading" scores. Table 6 presents results of a multiple regression analysis of the association of letter rates, word rates given letter rates, and text rates given letter and word rates with M.A.T. reading scores.

Table 5 indicates that reading times are highly correlated with M.A.T. scores at all grade levels except one and six. The multiple regression analysis in Table 6 indicates that between grades two and five, 25 to 50 percent of M.A.T. variance is associated with letter times alone, with a median of 37 percent. *This suggests that the relatively simple skill of identifying a number of letters rapidly plays a major role in effective reading.* There is considerable fluctuation in M.A.T. variance associated with word and text times. This may be caused by measurement error, particularly on the word times. (Children often have greater difficulty identifying words out of context than in context.) The median percentage of M.A.T. variance associated with word times given letter times in grades two to five is 28, while the median percentage of M.A.T. variance associated with text times given letter and word times in grades two to five is 13. These median percentages of M.A.T. variance associated with letter times (37%), word rates given letter rates (28%), and text rates given letters and words (13%) match, by coincidence, the median total M.A.T. variance associated with reading rates in grades two to five: 78 percent. These medians may roughly indicate the nature of the relationship existing between reading rates for letters, simple words, simple text, and M.A.T. performance.

There is no clear developmental trend in these data between grades two and five - fluctuations of association within grades are as great as differences between grades. The lower relationships observed at grade one may reflect failure to have reached potential. Capacity (developmental or otherwise) limits can only affect performance after one has had some opportunity to master the skill in question. Until first grade, most children are not expected to rapidly identify letters or words from small squiggles arranged sequentially on paper. Furthermore, the capacity to do this rapidly may be maturing for many children during the sixth or seventh years, adding further to the unreliability of measures in the first grade year. The developmental nature of the variables in question is elaborated on in the discussion section.

Lowered relationships in grade six may reflect a "floor-effect." By this age, the magnitude of individual differences in reading times are much smaller than those in earlier years (see Table 2). Variations in comprehension test performance

become influenced more by other factors. This interpretation must be limited to the sample studied. In a less able group, the relationship between reading times and comprehension test performance would probably be stronger.

Stability of the time required to read letters, words, and text: Table 7 provides correlations over time for the three time variables studied. The observed correlations represent *developmental stabilities* - that is, all the children have improved their times as they get older; however, there is a tendency for those who are relatively quick when younger to be relatively quick when older. In this sense, the development of the ability to read letters and words quickly is analogous to the development of height or I.Q.

Table 7 also shows correlations between letter and word times at younger ages with text times at older ages. These correlations are very similar to the *direct* stability correlations.

Longitudinal relationships between letter, word, and text times at earlier ages and text times at later ages: Table 8 indicates that very substantial proportions of text variances observed in grades two to six could be predicted from earlier letter, word, and text times. In general, letter times alone accounted for the largest portion of predicted variance.⁵

Longitudinal relationships between letter, word, and text times at earlier ages and later M.A.T. "reading" scores: Tables 9 and 10 indicate substantial longitudinal relationships exist between earlier reading times and later M.A.T. scores. Regretably, M.A.T. data was available in only a few classes for children who continued in the study. However, in view of the fairly substantial correlations which exist between M.A.T. scores and text times (Table 5) and the data in these tables, one may conclude that relationships between earlier reading times and later M.A.T. scores would likely be on the same order as the relationship between earlier reading times and later text times.

⁵ Inaccurate measurement of letter times may have caused the exceptions. Error in letter rate measurement would have the effect of transferring the main association between earlier and later times to the earlier word or text times in the regression model used. Errors of measurement in word or text times would not affect the relationship between letter times and later text times.

DISCUSSION

The results presented provide very strong evidence for the existence of a common variable affecting speed of reading with or *without* the facilitation of contextual or word structure. This variable is also associated with performance on a standardized reading comprehension test.⁶ The existence of this common speed variable suggests that the role of individual differences in the use of intra-word and contextual structure to facilitate reading may have been overestimated. (See, for example, Smith and Holmes, 1971; and Goodman, 1969.)

This discussion will concern speculations regarding the nature of this common speed variable, possible factors affecting improvement, and potential educational implications. Implications for further research are suggested.

The "common speed" variable can be examined in terms of modern cognitive theory (e.g. Neisser, 1967). Identifying letters (or words) must involve discriminating *features* - those differences which permit discrimination between two or more alternatives; *pattern recognition* - relating a particular set of features to a familiar visual pattern; and finally, "*identification*" - in some way connecting the familiar visual pattern to a verbal response. Individual differences in speed could occur at any or all of these steps. Furthermore, in reading a number of letters or words, the issue of "parallel processing" (Neisser, 1967, p. 71) enters in. Some children may have a number of features, letters, or words in process at once while others may take these one at a time.

At present, two experiments shed some light on these questions. Spring (1971) has shown that dyslaxic elementary school children take longer than "normals" to report "same" or "different" for pairs of letters. However, this difference is not increased proportionately when the number of features which must be discriminated is increased as in cases where two letters are very similar but not identical. Similarly, Katz and Wicklund (1971) report that while search reaction times of poor readers are slower than those for good readers, the added time for additional items in scanning lists of two or three items is the same for both groups.⁷

⁶ It is true that the M.A.T. is a timed test; hence results doubtless partially reflect failure to complete the test. However, as noted at the beginning of this article, poor performance on standardized tests is generally indicative of inability to use reading effectively as a means of learning.

⁷ Wicklund reported in a personal communication that lists with up to five words have been used (Shankweiler and Liberman, 1972).

Both these studies suggest that differences may not be at the levels of feature discrimination or pattern recognition, but rather at the level of identification or other tasks which depend on prior recognition of patterns.

Both these studies involved single, non-verbal responses to visual displays. Differences in speed may be larger when a number of identifications are to be made, as in the reading tasks in the present study. If these are not done in "parallel", but rather item by item, the time required to identify a series of letters or words will be greater than if the reader can look at one or several letters or words while saying others and possibly having a third group in process. This, in short, is what must happen when an eye-voice span of more than zero words exists.

A related problem is the number of items identified per fixation. It is well known that poor readers identify fewer words or letters per fixation (Buswell, 1922, and Hoffmann, 1927. The latter reports results for letters as well as words based on tachistoscopic data from ages six to eighteen.) Whether this limit reflects problems at the level of vision or slowness in relating patterns to responses is unknown. However, Robinson (1934) does report that a training technique which increased speed by 58 percent had increased fixation width by 62 percent.

Future research on the nature of the common speed variable should include studies of the generality of the phenomenon in terms of both stimuli and response modes. One of my students⁸ has determined that reading times for numbers are very highly correlated with reading times for letters, words, and text. However, attempts to use pictures, abstract forms, and other stimuli have thus far been inconclusive. It is possible that the size of the display on the retina may be critical in such studies. On the response side, the author has experimented with use of a series of same-difference judgements and with cancellation tasks. The latter may be promising. Glass (1967) reports a correlation of .50 between the Stroud Rate of Perception Test (a letter cancellation task) and reading rates with college students. The effect would probably be greater with younger children. Neisser's (1967) search tasks would also be fruitful. Studies generalizing the stimuli and/or response modes which reflect the common speed variable would also be useful for working with pre-reading children, and complete non-readers.

The common speed variable appears to be a "developmental variable". In short, it improves with age (Figure 1), while showing considerable developmental stability - at least from grade two on (Table 7). Thus, children who were relatively fast

⁸ Mrs. Beatrice Casselman

in grade two are relatively fast in grade four and grade six, although all children have become faster. The common speed variable shares these characteristics with such developmental variables as height, weight, and I.Q. (Bloom, 1964). These characteristics *suggest* the possibility that the common speed variable is at least partially determined by constitutional differences, and also that maturation is likely to bring some improvement for most children.

Surprisingly, the common speed variable does not appear to be related to I.Q. Table 11 indicates that low and mostly non-significant correlations exist between I.Q.'s and reading times for the children for whom these data were available.

The developmental nature of the common speed variable raises the question of the role of practice in reducing the time required for identifying letters or words. The author has conducted some preliminary experiments involving fifteen minutes' practice per day for one to three weeks. Results with some thirty children indicate very spotty patterns of change with practice - some children showing gains up to 30 percent which generalize from practice with letters or words to speeds of reading text. Other children showed no such gains. Overall results have been statistically non-significant. No information on the stability of these results, nor on the effects of more extended practice is available. The spotty effects of practice do suggest that some children are more ready to "benefit" from practice than others at given points in time. Obviously, further research into modification of this skill would be of both practical and theoretical benefit.

For educators, the implications of this study may be that the age at which serious reading instruction is begun should be more variable. This study alone is insufficient to support such a recommendation. If, however, further evidence continues to support the finding that there is a basic speed variable which is strongly associated with reading effectiveness; and if this variable proves resistant to direct manipulation, then age should become less of a criterion for starting reading instruction.

References

- Bloom, B.S. *Stability and change in human characteristics*. New York: Wiley, 1964.
- Buswell, G.T. Fundamental reading habits: a study of their development. *Supplemental Educational Monographs*, 1922, 21.
- Carlson, T.R. The relationship between speed and accuracy of comprehension. *Journal of Educational Research*, 1949, 42, 500-512.
- Cattell, J. McK. Uber die Zeit de Erkennung und Benennung von Schreiftzeichen, Bildern, und Farben. *Philosophische Studien*, 1885, 2, 635-650. (Translated by R.S. Woodworth in *James McKeen Cattell, Man of Science*. Lancaster, Penna.: Science Press, 1947.)
- Garner, W.R. *Uncertainty and structure as psychological concepts*. New York: Wiley, 1962.
- Gibson, E.J. Learning to read. *Science*, 1965, 148, 1066-1072.
- Glass, G.R. Rate of reading, a correlation and treatment study. *Journal of Reading*, 1967, 11, 168-178.
- Goodman, K.S. Analysis of oral reading miscues: applied psycholinguistics. *Reading Research Quarterly*, 1969, v, 9-30.
- Gough, P.B. In J.F. Kavanaugh and I.G. Mattingly (eds.) *Language by ear and by eye*. Cambridge, Mass.: M.I.T. Press, 1972. Pp. 331-358.
- Hoffman, J. Experimentell-psychologische Untersuchungen uber Leseleistungen von Schulkindern. *Archiv Gesemte Psychologie*, 1927, 58, 325-388.
- Katz, L. and Wicklund, D.A. Word scanning rate for good and poor readers. *Journal of Educational Psychology*, 1971, 62, 138-140.
- Neisser, U. *Cognitive psychology*. New York: Appleton-Century-Crofts, 1967.
- Robinson, F.P. An aid for improving reading rate. *Journal of Educational Research*, 1934, 27, 453-455.
- Shankweiler, D. and Liberman, I.Y. Misreading: a search for causes. In J.F. Kavanaugh and I.G. Mattingly (eds.) *Language by eye and by ear*. Cambridge, Mass.: M.I.T. Press, 1972. Pp. 293-318.
- Shores, J.H. Dimensions of reading speed and comprehension. *Elementary English*, 1968, 45, 23-28 and 43.
- Smith, F. The use of featural dependencies across letters in the visual identification of words. *Journal of Verbal Learning and Verbal Behavior*, 1969, 8, 248-253.
- Smith, F. *Understanding reading*. New York: Holt, Rinehart and Winston, 1971.

Smith, F. and Holmes, D. L. The independence of letter, word, and meaning identification in reading. *Reading Research Quarterly*, 1971, *vi*, 394-415.

Spring, C. Perceptual speed in poor readers. *Journal of Educational Psychology*, 1971, *62*, 492-500.

Steele, R.G.D. and Torrie, J.H. *Principles and procedures of statistics*. New York: McGraw-Hill, 1960.

Tinker, M.A. Speed versus comprehension in reading as affected by level of difficulty. *Journal of Educational Psychology*, 1939, *30*, 81-94.

Witty, P.A. Rate of reading - a crucial issue. *Journal of Reading*, 1969, *13*, 102-106, and 154-163.

Table 1 Correlations between reading times on alternate forms of letter, word, and text passages

Grade	N	Passage		
		Letters	Words	Text
first	18	.89**	.69*	a
second	20	.92**	.86**	.88
fifth and sixth	20	.79**	.88**	.78
adults	20	.89**	.84**	a

^a No alternate form data available.

* Significant at .05 level.

** Significant at .01 level.

Table 2 Mean seconds per letter or word for cross-sectional and longitudinal samples by grade

Grade and Passage	Cross-sectional Group ^a			Longitudinal ^b					
				Group 1			Group 2		
	N	\bar{X}	S.D.	N	\bar{X}	S.D.	N	\bar{X}	S.D.
<u>Grade one</u>									
letters	18	1.09	.29	7	.96	.14			
words	18	1.25	.33	7	1.05	.25			
text	18	.92	.23	7	.84	.30			
<u>Grade two</u>									
letters	87	.85	.23	7	.76	.12	8	.79	.19
words	87	.93	.34	7	.83	.10	8	.85	.30
text	87	.64	.30	7	.55	.10	8	.54	.31
<u>Grade three</u>									
letters	33	.66	.17	6	.62	.05			
words	33	.84	.34	6	.69	.08			
text	33	.52	.23	6	.39	.07			
<u>Grade four</u>									
letters	53	.57	.13	7	.51	.06	8	.61	.16
words	53	.62	.21	7	.53	.09	8	.63	.19
text	53	.37	.15	7	.35	.12	8	.37	.32
<u>Grade five</u>									
letters	21	.52	.11	6	.47	.10			
words	21	.55	.18	6	.51	.11			
text	21	.30	.10	6	.26	.04			
<u>Grade six</u>									
letters	23	.47	.11				8	.45	.11
words	23	.45	.10				8	.49	.14
text	23	.23	.04				8	.26	.07

^a Cross-sectional samples include children from the longitudinal groups.

^b Large samples are available for comparing some pairs of years (see Tables 7, 8, 9, and 10).

Table 3 Concurrent correlations between times for reading letter, word, and text passages by grade and class

Grade ^a and Class	N	Letters by Words	Letters by text	Words by Text
<u>Grade one</u>	18	.58*	.18	.57*
<u>Grade two</u>	87	.60**	.54**	.83**
1969	20	.79**	.76**	.88**
1970(1)	17	.68**	.58*	.50*
1970(2)	21	.87**	.81**	.73**
1971	17	.24	.13	.88**
1972	12	.82**	.87**	.97**
<u>Grade three</u>	33	.78**	.85**	.92**
1971	12	.83**	.82**	.89**
1973	21	.77**	.86**	.92**
<u>Grade four</u>	53	.82**	.67**	.85**
1971	20	.85**	.51*	.82**
1972	13	.71**	.72**	.54
1973	20	.87**	.82**	.93**
<u>Grade five</u>	21	.73**	.77**	.82**
1969	9	.85**	.84**	.77
1973	12	.80**	.80**	.85**
<u>Grade six</u>	23	.77**	.59**	.55**
1969	11	.69*	.38	.63*
1973	12	.94**	.85**	.92**
<u>Adults</u>	20	.81**	.57**	.68**

^a Figures for grades represent pooled data, where more than one grade was studied.

* Significant at .05 level.

** Significant at .01 level.

Table 4 Percentage of variance for time for reading text passages associated with times for reading letter and word passages

Grade ^a and Class	N	Total text time variance associated with letter and word time variances	Text time variance associated with letter time variance	Additional text time variance associated with word time variance
<u>Grade one</u>	18	36% ^{**}	3%	33% ^{**}
<u>Grade two</u>	87	69% ^{**}	29% ^{**}	40% ^{**}
1969	20	79% ^{**}	58% ^{**}	21% ^{**}
1970(1)	17	36%*	34%*	2%
1970(2)	21	66% ^{**}	65%*	1%*
1971	17	77% ^{**}	1%	76% ^{**}
1972	12	95% ^{**}	75% ^{**}	20% ^{**}
<u>Grade three</u>	33	89% ^{**}	73% ^{**}	16% ^{**}
1971	12	99% ^{**}	68% ^{**}	31% ^{**}
1973	21	91% ^{**}	74% ^{**}	17% ^{**}
<u>Grade four</u>	53	73% ^{**}	46% ^{**}	27% ^{**}
1971	20	80% ^{**}	26% ^{**}	54% ^{**}
1972	13	52%*	52% ^{**}	0%
1973	20	87% ^{**}	68% ^{**}	19% ^{**}
<u>Grade five</u>	21	70% ^{**}	59% ^{**}	11% ^{**}
1969	9	72%*	71% ^{**}	1%
1973	12	84% ^{**}	73% ^{**}	11%*
<u>Grade six</u>	23	55% ^{**}	34% ^{**}	21% ^{**}
1969	11	40%	14%	26%
1973	12	84% ^{**}	73% ^{**}	11%*
<u>Adults</u>	20	46% ^{**}	34% ^{**}	12%

^a Figures for grades represent pooled data, where more than one grade was studied.

* Significant at .05 level.

** Significant at .01 level.

Table 5 Correlations between reading times for letter, word, and text passages, and M.A.T.^a reading comprehension scores^b

Grade ^c and Class	N	Passage		
		Letters	Words	Text
<u>Grade one</u> (1969)	18	-.09	-.38	-.51*
<u>Grade two</u>	52	-.48**	-.51**	-.82**
1969	18	-.64**	-.83**	-.91**
1970	17	-.57*	-.27	-.88**
1971	17	-.24	-.58*	-.68**
<u>Grade three</u>	31	-.66**	-.72**	-.74**
1971	11	-.61*	-.82**	-.78**
1973	20	-.71**	-.71**	-.79**
<u>Grade four</u> (1971)	18	-.57*	-.82**	-.95**
<u>Grade five</u> (1969)	9	-.70*	-.36	-.70*
<u>Grade six</u> (1969)	11	-.13	-.23	-.43

^a Metropolitan Achievement Test.

^b Raw scores taken from the "reading" scale.

^c Figures for grades represent pooled data where more than one class is involved.

* Significant at .05 level.

** Significant at .01 level.

Table 6 Percentages of M.A.T. reading comprehension variance^a associated with reading time variances for letters, words, and text

Grade ^b and Class	N	Total M.A.T. variance associated with reading time	M.A.T. variance associated with letter time variance	Addit. M.A.T. variance associated with word time variance	Addit. M.A.T. variance associated with text time variance
<u>Grade one</u> (1969)	18	27%	1%	14%	12%
<u>Grade two</u>	52	71%	23%	7%**	40%**
1969	18	85%**	41%**	28%**	16%**
1970	17	96%**	33%**	3%**	60%**
1971	17	49%*	5%	31%*	13%
<u>Grade three</u>	31	70%**	43%**	11%**	16%**
1971	11	74%*	37%*	36%*	1%
1973	20	63%**	51%**	7%	5%
<u>Grade four</u> (1969)	18	90%**	32%**	43%**	15%**
<u>Grade five</u> (1969)	9	78%*	49%*	21%	8%
<u>Grade six</u> (1969)	11	19%*	2%	4%	13%

^a Raw scores taken from the "reading" scale.

^b Figures for grades represent pooled data where more than one class is involved.

* Significant at .05 level.

** Significant at .01 level.

Table 7 Longitudinal correlations between reading times for letter, word, and text passages

Earlier grade ^e	Later grade	N	Earlier passage:	letters	words	text	letters	words
			Later passage:	letters	words	text	text	text
<u>One</u>	by <u>two</u> ^a	.15		.82**	.79**	.55*	.57**	.56**
<u>One</u>	by <u>three</u>	8		.66	-.31	.07	.65	.06
<u>Two</u>	by <u>three</u> ^a	19		.86**	.77**	.84**	.78**	.70*
1970	by 1971 ^a	10		.87**	.69*	.90**	.86**	.81**
1972	by 1973 ^d	9		.94**	.81**	.77*	.89**	.62
<u>Two</u>	by <u>four</u>	40		.33*	.59**	.76**	.38*	.49**
1969	- 1971 ^b	19		.55*	.76**	.86**	.71**	.70*
1970	- 1972 ^a	9		.46	.49	.61	.31	-.40
1971	- 1973 ^c	12		.16	.59*	.64*	-.08	.67*
<u>Two</u>	by <u>five</u> ^a	9		.40	.90**	.81**	.79*	.73*
<u>Two</u>	by <u>six</u> ^b	8		.76**	.78**	.87**	.94**	.91**
<u>Three</u>	by <u>four</u> ^a	9		.66	.21	.93**	.41	.49
<u>Three</u>	by <u>five</u> ^a	7		.78*	.69	.91**	.79*	.68
<u>Four</u>	by <u>five</u> ^a	9		.88**	.72*	.96**	.94**	.84**
<u>Four</u>	by <u>six</u> ^b	9		.66	.85**	.92**	.52	.83**

^a Longitudinal group one, first tested in grade one, 1969.

^b Longitudinal group two, first tested in grade two, 1969.

^c Longitudinal group three, first tested in grade two, 1971.

^d Longitudinal group four, first tested in grade two, 1972.

^e Figures for grade represent pooled data where more than one class is involved.

* Significant at .05 level.

** Significant at .01 level.

Table 8 Percentages of text time variance associated with earlier letter, word, and text time variances

Earlier Grade ^a	Later Grade	N	Total later text variance associated with earlier letter, word and text variances	Later text variance associated with earlier letter variance	Addit. later text variance associated with earlier word variance	Addit. later text variance associated with earlier text variance
<u>One</u>	by <u>two</u> ^a	15	53%*	33%	9%	11%
<u>One</u>	by <u>three</u> ^a	8	45%	42%	0	3%
<u>Two</u>	by <u>three</u>	19	93%**	62%**	7%**	25%**
1970	by 1971 ^a	10	92%**	74%**	11%*	6%
1972	by 1973 ^d	9	89%**	80%**	3%	6%
<u>Two</u>	by <u>four</u>	40	63%**	14%**	11%**	38%**
1969	by 1971 ^b	19	81%**	51%**	5%	25%**
1970	by 1972 ^a	9	61%	10%	16%	35%
1971	by 1973 ^c	12	48%	1%	45%	2%
<u>Two</u>	by <u>five</u> ^a	9	67%	63%	2%	2%
<u>Two</u>	by <u>six</u> ^b	8	89%*	88%*	0	1%
<u>Three</u>	by <u>four</u> ^a	9	79%*	17%*	7%	55%*
<u>Four</u>	by <u>five</u> ^a	9	97%**	89%**	5%*	2%*
<u>Four</u>	by <u>six</u> ^b	9	91%**	27%**	41%**	22%**

^a Longitudinal group one, first tested in grade one, 1969.

^b Longitudinal group two, first tested in grade two, 1969.

^c Longitudinal group three, first tested in grade two, 1971.

^d Longitudinal group four, first tested in grade two, 1972.

^e Figures for grade represent pooled data where more than one class is involved.

* Significant at .05 level.

** Significant at .01 level.

Table 9 Longitudinal correlations between later M.A.T. reading comprehension scores^d and earlier reading times for letter, word, and text passages

Earlier grade	Later grade	N	Passage		
			letters	words	text
One	by two ^a	15	-.30	-.16	-.09
Two	by three ^a	9	-.81**	-.75*	-.97**
Two	by three ^c	9	-.49	-.34	-.52
Two	by four ^b	18	-.66**	-.69**	-.81**

^a Longitudinal group one, first tested in grade one, 1969. Metropolitan Achievement Test, Elementary form B, 1963, used in grades two and three.

^b Longitudinal group two, first tested in grade two, 1969. Metropolitan Achievement Test, Elementary form B, 1963, used in grade four.

^c Longitudinal group four, first tested in grade two, 1971. Metropolitan Achievement Test, Elementary form F, 1969, used in grade three.

^d Raw scores from the reading scale.

* Significant at .05 level.

** Significant at .01 level.

Table 10 Percentages of M.A.T. reading comprehension variance^d associated with earlier reading time variances for letters, words, and text

Earlier grade	Later grade	N	Total M.A.T. variance associated with reading time variance	M.A.T. variance associated with letter variance	Addit. M.A.T. variance associated with word variance	Addit. M.A.T. variance associated with text variance
One	by two ^a	15	12%	9%	0	3%
Two	by three ^a	9	99%**	68%**	7%**	26%**
Two	by three ^c	9	59%	24%	1%	34%
Two	by four ^b	18	69%**	43%**	8%	18%**

^a Longitudinal group one, first tested in grade one, 1969. Metropolitan Achievement Test, Elementary form B, 1963, used in grades two and three.

^b Longitudinal group two, first tested in grade two, 1969. Metropolitan Achievement Test, Elementary form B, 1963, used in grade four.

^c Longitudinal group four, first tested in grade two, 1971. Metropolitan Achievement Test, Elementary form F, 1969, used in grade three.

^d Based on raw scores from the reading scale.

* Significant at .05 level.

** Significant at .01 level.

Table 11 Correlations between I.Q.^a
and reading times for letters, words,
and text

Grade	N	Passage		
		letters	words	text
Two ^b	37	-.29	-.22	-.35*
Five and six ^c	20	-.07	-.21	-.21

^a W.I.S.C.

^b 1969 and 1970.

^c 1969.

* Significant at .05 level.

Figure 1
Development of Reading Ability

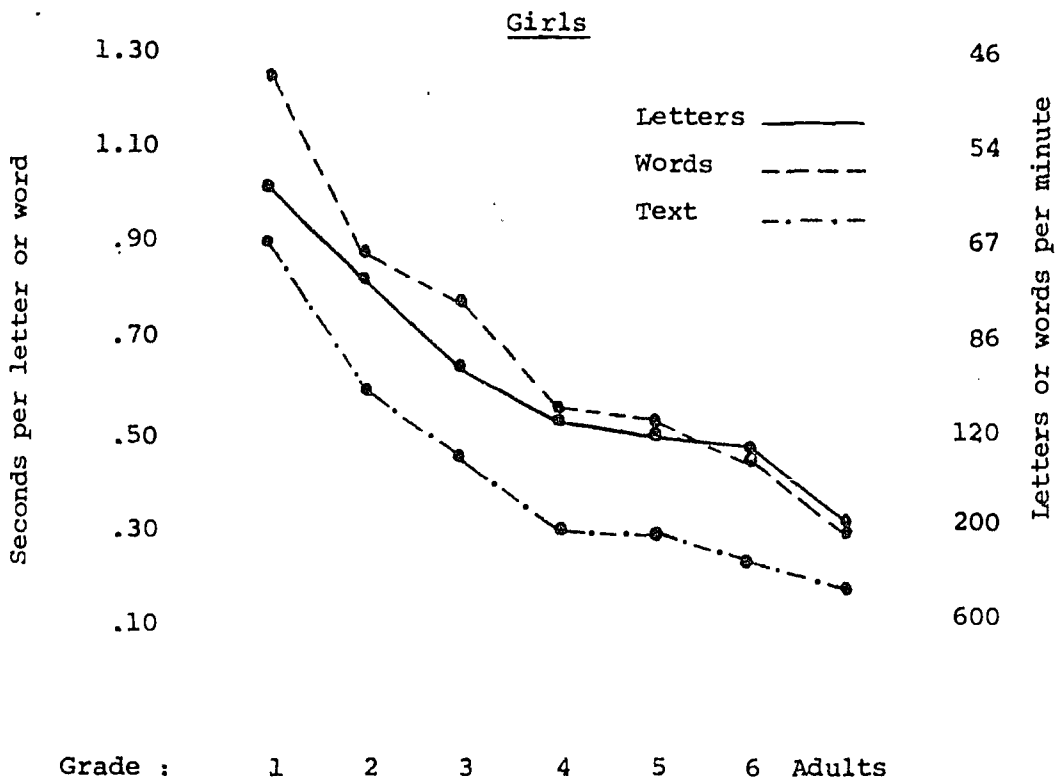
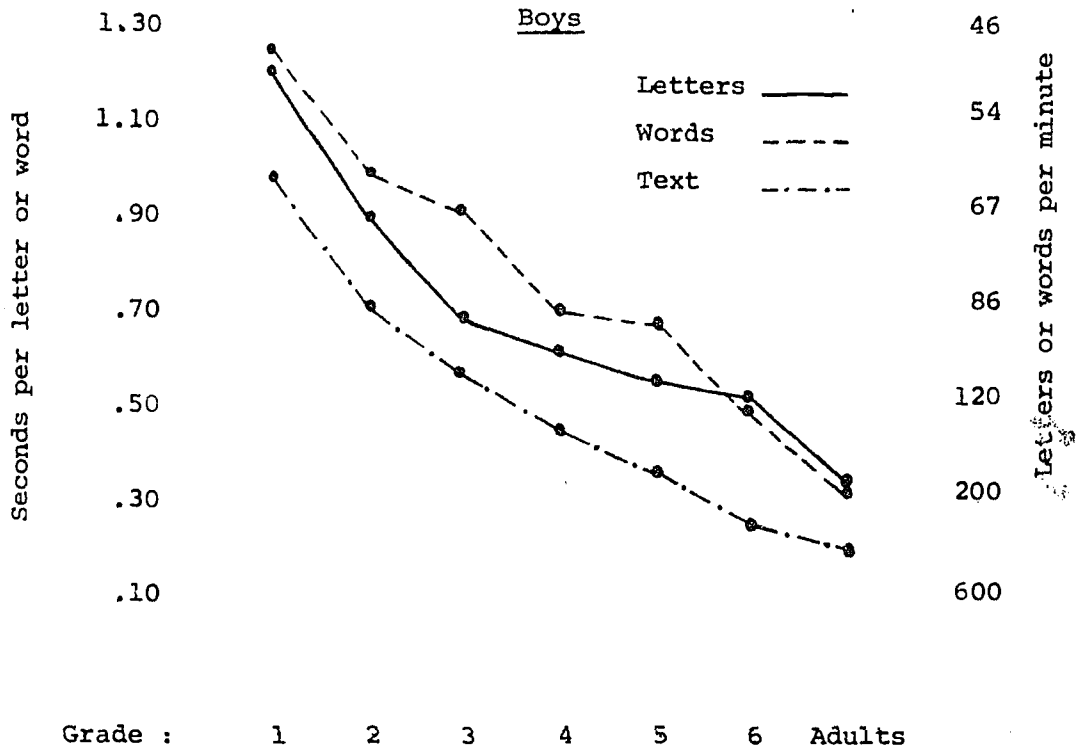
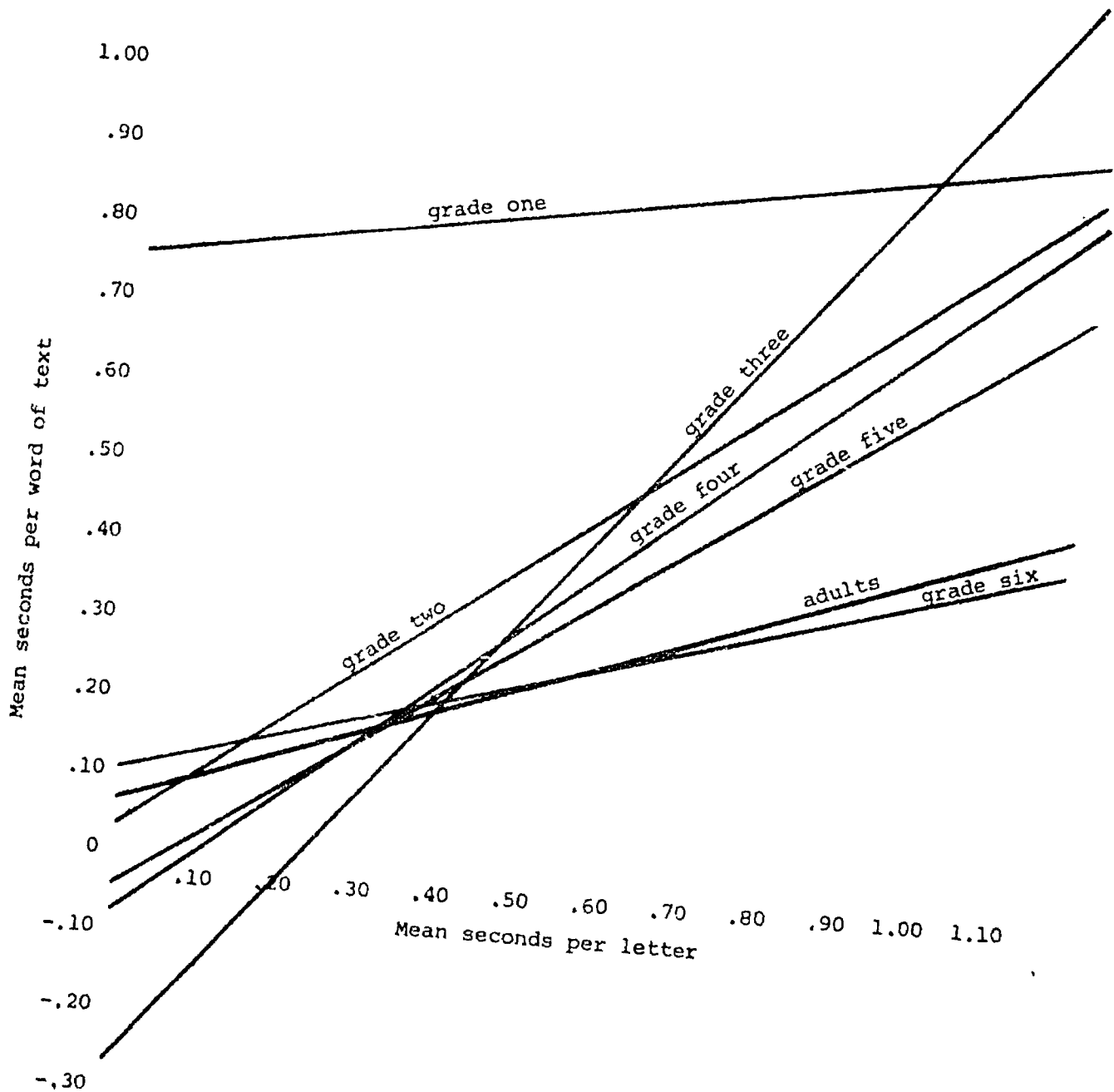


Figure 2

Letters, words, and Simple Text, and the Development of Reading Ability



Abstract

Presents cross-sectional and longitudinal data relating the time required to read orally 50 unrelated letters, 50 unrelated words, and 100 words in text among first to sixth grade children and adults. Metropolitan Achievement Test Reading scale test scores are related to the time data. Results include concurrent correlations between letter, word, and text times ranging between .18 and .92 with a median of .77. Longitudinal correlations between grades two and six ranged from .21 to .96 with a median of .78 indicating a high level of developmental stability and strong relationships between the abilities to read letters or words rapidly at an earlier age and reading text rapidly at a later age. These results are interpreted on the basis that a common ability must be involved in the time required to read all three types of materials. Multiple regression analyses indicate that letter time variance is associated with a median of 46 percent of text time variance, while additional skills affecting word time variance is associated with a median of 27 percent of text time variance between grades two and six. Reading achievement scores are also highly associated with reading times both concurrently and longitudinally, with medians of 32 percent of letter time variance, 11 percent of additional word time variance, and 15 percent of additional text time variance being associated with M.A.T. reading score variance concurrently between grades two and six, while longitudinally, medians of 43 percent of grade two letter time variance, 7 percent of additional word time variance, and 26 percent of additional text time variance are associated with grade three or four reading comprehension score variances. These results are interpreted as indicating the existence of a developmental reading speed ability which is not primarily dependent on word identification or context-using skills. The nature of this ability and educational and research implications are discussed.