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What Reading Does for the Mind

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Reading has cognitive consequences that extend beyond its immediate task of lifting meaning from a particular passage. Furthermore, these consequences are reciprocal and exponential in nature. Accumulated over time—spiraling either upward or downward—they carry profound implications for the development of a wide range of cognitive capabilities.

Concern about the reciprocal influences of reading achievement has been elucidated through discussions of so-called "Matthew effects" in academic achievement (Stanovich, 1986; Walberg & Tsai, 1983). The term "Matthew effects" is taken from the Biblical passage that describes a rich-get-richer and poor-get-poorer phenomenon. Applying this concept to reading, we see that very early in the reading process poor readers, who experience greater difficulty in breaking the spelling-to-sound code, begin to be exposed to much less text than their more skilled peers (Allington, 1984; Biemiller, 1977–1978). Further exacerbating the problem is the fact that less-skilled readers often find themselves in materials that are too difficult for them (Allington, 1977, 1983, 1984; Gambrell, Wilson, & Gantt, 1981). The combination of deficient decoding skills, lack of practice, and difficult materials results in unrewarding early reading experiences that lead to less involvement in reading-related activities. Lack of exposure and practice on the part of the less-skilled reader delays the development of automaticity and speed at the word recognition level. Slow, capacity-draining word recognition processes require cognitive resources that should be allocated to comprehension. Thus, reading for meaning is hindered; unrewarding reading experiences multiply; and practice is avoided or merely tolerated without real cognitive involvement.

The disparity in the reading experiences of children of varying skill may have many other consequences for their future reading and cognitive development. As skill develops and word recog-

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nition becomes less resource demanding and more automatic, more general language skills, such as vocabulary, background knowledge, familiarity with complex syntactic structures, etc., become the limiting factor on reading ability (Chall, 1983; Sticht, 1979). But the sheer volume of reading done by the better reader has the potential to provide an advantage even here if—as our research suggests—reading a lot serves to develop these very skills and knowledge bases (Cunningham & Stanovich, 1997; Echols, West, Stanovich, & Zehr, 1996; Stanovich & Cunningham, 1992, 1993). From the standpoint of a reciprocal model of reading development, this means that many cognitive differences observed between readers of differing skill may in fact be consequences of *differential practice* that itself resulted from early differences in the *speed* of initial reading acquisition. The increased reading experiences of children who master the spelling-to-sound code early thus might have important positive feedback effects that are denied the slowly progressing reader. In our research, we have begun to explore these reciprocal effects by examining the role that reading volume plays in shaping the mind and will share many of our findings in this article.

We should say at the outset that the complexity of some of the work we will describe in this article was necessitated in large part by the fact that it is difficult to tease apart the unique contribution that reading volume affords. One of the difficulties is that levels of reading volume are correlated with many other cognitive and behavioral characteristics. Avid readers tend to be different from nonreaders on a wide variety of cognitive skills, behavioral habits, and background variables (Guthrie, Schafer, & Hutchinson, 1991; Kaestle, 1991; Zill & Winglee, 1990). Attributing any particular outcome to reading volume is thus extremely difficult.

Theoretical Reasons to Expect Positive Cognitive Consequences from Reading Volume

In certain very important cognitive domains, there are strong theoretical reasons to expect a positive and unique effect of avid reading. Vocabulary development provides a case in point. Most theorists are agreed that the bulk of vocabulary growth during a child's lifetime occurs indirectly through language exposure rather than through direct teaching (Miller & Gildea, 1987; Nagy & Anderson, 1984; Nagy, Herman, & Anderson, 1985; Sternberg, 1985, 1987). Furthermore, many researchers are convinced that reading volume, rather than oral language, is the prime contributor to individual differences in children's vocabularies (Hayes, 1988; Hayes & Ahrens, 1988; Nagy & Anderson, 1984; Nagy & Herman, 1987; Stanovich, 1986).

The theoretical reasons for believing that reading volume is a particularly effective way of expanding a child's vocabulary derive from the differences in the statistical distributions of words that have been found between print and oral language. Some of these differences are illustrated in Table 1, which displays the results of some of the research of Hayes and Ahrens (1988), who have analyzed the distributions of words used in various contexts.

The table illustrates the three different categories of language that were analyzed: written language sampled from genres as difficult as scientific articles and as simple as preschool books; words spoken on television shows of various types; and adult speech in two contexts varying in formality. The words used in the different contexts were analyzed according to a standard frequency count of English (Carroll, Davies, & Richman, 1971). This frequency count ranks the 86,741 different word forms in English according to their frequency of occurrence in a large corpus of written English. So, for example, the word "the" is ranked number 1, the 10th most frequent word is "it," the word "know" is ranked 100, the word "pass" is ranked 1,000, the word "vibrate" is 5,000th in frequency, the word "shrimp" is 9,000th in frequency, and the word "amplifier" is 16,000th in frequency. The first column, labeled Rank of Median Word, is simply the frequency rank of the average word (after a small correction) in each of the categories. So, for example, the average word in children's books was ranked 627th most frequent in the Carroll et al. word count; the average word in popular magazines was ranked 1,399th most frequent; and the average word in the abstracts of scientific articles had, not surprisingly, a very low rank (4,389).

What is immediately apparent is how lexically impoverished is most speech, as compared to written language. With the exception of the special situation of courtroom testimony, average frequency of the words in all the samples of oral speech is quite low, hovering in the 400–600 range of ranks.

The relative rarity of the words in children's books is, in fact, greater than that in all of the adult conversation, except for the courtroom testimony. Indeed, the words used in children's books are considerably rarer than those in the speech on prime-time adult television. The categories of adult reading matter contain words that are two or three times rarer than those heard on television.

These relative differences in word rarity have direct implications for vocabulary development. If most vocabulary is acquired outside of formal teaching, then the only opportunities to acquire new words occur when an individual is exposed to a word in written or oral language that is outside his/her current vocabulary. That this will happen vastly more often while reading than while talking or watching television is illustrated in the second column of Table 1. The column lists how many rare words per 1000 are contained in each of the categories. A rare word is defined as one with a rank lower than 10,000; roughly a word that is outside the vocabulary of a fourth to sixth grader. For vocabulary growth to occur after the middle grades, children must be exposed to words that are rare by this definition. Again, it is print that provides many more such word-learning opportunities. Children's

Table 1

Selected Statistics for Major Sources of Spoken and Written Language (Sample Means)

	Rank of Median Word	Rare Words per 1000
I. Printed texts		
Abstracts of scientific articles	4389	128.0
Newspapers	1690	68.3
Popular magazines	1399	65.7
Adult books	1058	52.7
Comic books	867	53.5
Children's books	627	30.9
Preschool books	578	16.3
II. Television texts		
Popular prime-time adult shows	490	22.7
Popular prime-time children's shows	543	20.2
Cartoon shows	598	30.8
Mr. Rogers and *Sesame Street*	413	2.0
III. Adult speech		
Expert witness testimony	1008	28.4
College graduates to friends, spouses	496	17.3

Adapted from Hayes and Ahrens (1988).

books have 50 percent more rare words in them than does adult prime-time television and the conversation of college graduates. Popular magazines have roughly three times as many opportunities for new word learning as does prime time television and adult conversation. Assurances by some educators that "What they read and write may make people smarter, but so will any activity that engages the mind, including interesting conversation" (Smith, 1989) are overstated, at least when applied to the domain of vocabulary learning. The data in Table 1 indicate that conversation is not a substitute for reading.

It is sometimes argued or implied that the type of words present in print but not represented in speech are unnecessary words—jargon, academic doublespeak, elitist terms of social advantage, or words used to maintain the status of the users but that serve no real functional purpose. A consideration of the frequency distributions of written and spoken words reveals this argument to be patently false. Table 2 presents a list of words that do not occur at all in two large *corpora* of oral language (Berger, 1977; Brown, 1984), but that have appreciable frequencies in a written frequency count (Francis & Kucera, 1982). The words *participation, luxury, maneuver, provoke, reluctantly, relinquish, portray, equate, hormone, exposure, display, invariably, dominance, literal, legitimate,* and *infinite* are not unnecessary appendages, concocted to exclude those who are unfamiliar with them. They are words that are necessary to make critical distinctions in the physical and social world in which we live. Without such lexical tools, one will be severely disadvantaged in attaining one's goals in an advanced society such as ours. As Olson (1986) notes:

> It is easy to show that sensitivity to the subtleties of language are crucial to some undertakings. A person who does not clearly see the difference between an expression of intention and a promise or between a mistake and an accident, or between a falsehood and a lie, should avoid a legal career or, for that matter, a theological one.

The large differences in lexical richness between speech and print are a major source of individual differences in vocabulary development. These differences are created by the large variability among children in exposure to literacy. Table 3 presents the data from a study of the out-of-school time use by fifth graders conducted by Anderson, Wilson, and Fielding (1988). From diaries that the children filled out daily over several months' time, the investigators estimated how many minutes per day that individuals were engaged in reading and other activities while not in school. The table indicates that the child at the 50th percentile in amount of independent reading was reading approximately 4.6 minutes per day, or about a half an hour per week, over six times as much as the child at the 20th percentile in amount of

Table 2

Examples of words that do not appear in two large corpora of oral language (Berger, 1977; Brown, 1984) but that have appreciable frequencies in written texts (Carroll, Davies & Richman, 1971; Francis & Kucera, 1982):

display	literal
dominance	legitimate
dominant	luxury
exposure	maneuver
equate	participation
equation	portray
gravity	provoke
hormone	relinquish
infinite	reluctantly
invariably	

reading time (less than a minute daily). Or, to take another example, the child at the 80th percentile in amount of independent reading time (14.2 minutes) was reading over twenty times as much as the child at the 20th percentile. Anderson et al. (1988) estimated the children's reading rates and used these, in conjunction with the amount of reading in minutes per day, to extrapolate a figure for the number of words that the children at various percentiles were reading. These figures, presented in the far right of the table, illustrate the enormous differences in word exposure that are generated by children's differential proclivities toward reading. For example, the average child at the 90th percentile reads almost two million words per year outside of school, more than 200 times more words than the child at the 10th percentile, who reads just 8,000 words outside of school during a year. To put it another way, the entire year's out-of-school reading for the child at the 10th percentile amounts to just two days reading for the child at the 90th percentile! These dramatic differences, combined with the lexical richness of print, act to create large vocabulary differences among children.

Examining the Consequences of Differential Degrees of Reading Volume

It is one thing to speculate on how these differences in reading volume may result in specific cognitive consequences in domains like vocabulary; it is another to demonstrate that these effects are occurring. In our research, we have sought empirical evidence for the specific effects of reading volume, effects that do not simply result from the higher cognitive abilities and skills of the more avid reader. Although there are considerable differences in amount of reading volume in school, it is likely that differences in *out*-of-school reading volume are an even more potent source of the rich-get-richer and poor-get-poorer achievement patterns. Therefore, we have sought to examine the unique contribution that independent or out-of-school reading makes toward reading ability, aspects of verbal intelligence, and general knowledge about the world. As part of this research program, our research group has pioneered the use of a measure of reading volume that has some unique advantages in investigations of this kind (Cunningham and Stanovich, 1990; Stanovich and West, 1989).

In all, we developed two measures of adults' reading volume and one for children's reading volume. Briefly, the children's measure, named the Title Recognition Test (TRT), requires children to pick out the titles of popular children's books from a list of titles that includes

Table 3

Variation in Amount of Independent Reading

%	Independent Reading Minutes Per Day	Words Read Per Year
98	65.0	4,358,000
90	21.1	1,823,000
80	14.2	1,146,000
70	9.6	622,000
60	6.5	432,000
50	4.6	282,000
40	3.2	200,000
30	1.3	106,000
20	0.7	21,000
10	0.1	8,000
2	0.0	0

Adapted from Anderson, Wilson, and Fielding (1988).

equal numbers of made-up titles. This task is easy to administer to large numbers of children, it does not make large cognitive demands, and its results are reliable—it is not possible for children to distort their responses toward what they perceive as socially desirable answers. Because the number of wrong answers can be counted against correct ones, it is possible to remove the effects of guessing from the results (see Cunningham & Stanovich, 1990; 1991; and Stanovich and West, 1989 for a full description of these instruments and a discussion of the logic behind them). The adults' measures, named the Author Recognition and Magazine Recognition Test, have the same task requirements and are described fully in Stanovich and West (1989).

A score on the Title Recognition Test, of course, is not an absolute measure of children's reading volume and previous literacy experiences, but it does provide us with an index of the *relative* differences in reading volume. This index enables us to ask what effects reading volume (rather than general reading comprehension and word decoding ability) has on intelligence, vocabulary, spelling, and children's general knowledge. In short, it enables us to ask the question, does reading—in and of itself—shape the quality of our mind?

The titles appearing on the TRT were selected from a sample of book titles generated in pilot investigations by groups of children ranging in age from second grade through high school. In selecting the items that appear on any one version of the TRT, an attempt was made to choose titles that were not prominent parts of classroom reading activities in these particular schools. Because we wanted the TRT to probe out-of-school rather than school-directed reading, an attempt was made to choose titles that were not used in the school curriculum.

In our technical reports on this work, we have used a powerful statistical technique known as *hierarchical multiple regression* to solve the interpretive problem that avid readers excel in most domains of verbal learning and that, therefore, our measures of reading volume might be spuriously correlated to a host of abilities (Cunningham & Stanovich, 1990, 1991; Stanovich & Cunningham, 1992, 1993; Stanovich & West, 1989). We have found that even when performance is statistically equated for reading comprehension and general ability, reading volume is still a very powerful predictor of vocabulary and knowledge differences. Thus, we believe that reading volume is not simply an indirect indicator of ability; it is actually a potentially separable, independent source of cognitive differences.

Reading Volume as a Contributor to Growth in Verbal Skills

In several studies, we have attempted to link children's reading volume to specific cognitive outcomes after controlling for relevant general abilities such as IQ. In a study of fourth-, fifth-, and sixth-grade children, we examined whether reading volume accounts for differences in vocabulary development once controls for both general intelligence and specific verbal abilities were invoked (Cunningham & Stanovich, 1991). We employed multiple measures of vocabulary and controlled for the effects of age and intelligence. We also controlled for the effect of another ability that may be more closely linked to vocabulary acquisition mechanisms: decoding ability. Decoding skill might mediate a relationship between reading volume and a variable like vocabulary size in numerous ways. High levels of decoding skill, certainly a contributor to greater reading volume, might provide relatively complete contexts for figuring out the meaning of words during reading. Thus, reading volume and vocabulary might be linked via their connection to decoding ability: Good decoders read a lot and have the best context available for inferring new words. This potential linkage was accounted for by statistically controlling for decoding ability prior to investigating reading volume. But we found that even after accounting for general intelligence and decoding ability, reading volume contributed significantly and independently to vocabulary knowledge in fourth-, fifth-, and sixth-grade children.

These findings demonstrate that reading volume, although clearly a consequence of developed reading ability, is itself a significant contributor to the development of other aspects of verbal intelligence. Such rich get-richer (and of course their converse, poor-get poorer) effects are becoming of increasing concern in the educational community (Adams, 1990; Chall, 1989) and are playing an increasingly prominent role in theories of individual differences in reading ability and growth (Anderson, et al., 1988; Chall, Jacobs, & Baldwin, 1990; Hayes, 1988; Hayes & Ahrens, 1988; Juel, 1988, 1994; Stanovich 1986, 1989, 1993).

In a study we conducted involving college students, we employed an even more stringent test of whether reading volume is a unique predictor of verbal skill (Stanovich & Cunningham, 1992). In this study we examined many of the same variables as in our study of fourth- to sixth-grade students. However, we decided to stack the deck against reading volume by first removing any contribution of reading ability and general intelligence. By structuring the analyses in this way, we did not mean to imply that reading volume is not a determinant of reading comprehension ability. Indeed, we argue that there *are* grounds for believing that reading volume facilitates growth in comprehension ability. However, we wanted to construct the most conservative analysis possible by deliberately allowing the comprehension measure to steal some variance that is rightfully attributed to the measure of reading volume. The results of our study again attest to the potency of reading volume. We found that reading volume made a significant contribution to multiple measures of vocabulary, general knowledge, spelling, and verbal fluency even after reading comprehension ability and nonverbal ability had been partialed out.

One way of demonstrating the conservative nature of these analyses is illustrated in a longitudinal study that we have conducted (Cipielewski & Stanovich, 1992). We addressed the question of whether reading volume can predict individual differences in *growth* in reading comprehension from third grade to fifth grade. We found that reading volume predicted variance in fifth-grade reading comprehension ability after third-grade reading comprehension scores had been removed. Thus, in removing the contribution of reading comprehension in our adult studies, we are undoubtedly removing some of the variance in variables such as vocabulary and general knowledge that is rightfully attributed to reading volume.

Reading Volume and Declarative Knowledge

In other studies, we have focused even more directly on content knowledge by addressing the issue of "Where Does Knowledge Come From?". Stanovich and Cunningham (1993) examined general ability, reading volume, and exposure to other media sources as determinants of individual differences in content knowledge. This study contained a particularly stringent test of the role of reading volume and individual differences in knowledge acquisition among 268 college students. We administered five different measures of general knowledge to the students. Then we stacked the deck against reading volume once again by statistically entering four measures of general ability before looking at the contribution of reading volume: high school grade-point average, performance on an intelligence test, an SAT-type mathematics test, and an adult reading comprehension test. This set of tasks surely exhausts the variance attributable to any general ability construct; and, as one would expect, we found that general ability accounted for a substantial proportion of variance in the composite measure of general knowledge. Next we entered a composite measure of exposure to television, but it did not account for any additional variance. However, a composite index of reading volume accounted for a substantial 37.1 percent of the variance when entered after the four ability measures and television exposure.

This pattern was replicated in each of the five measures of general knowledge we employed, including a homemade instrument we called the Practical Knowledge Test. This task was designed to address the criticism that our other measures of general knowledge were too academic—that they tapped knowledge that was too esoteric or elitist and that was not useful in daily life. We didn't think this was true; many items on these measures were mundane and concrete questions such as "In what part of the body does the infection called pneumonia occur?" Nevertheless, in the Practical Knowledge Test, we made an effort to devise questions that were directly relevant to daily living in a technological society in the late twentieth century; for example, What does the carburetor in an automobile do? If a substance is carcinogenic, it means that it is? After the Federal Reserve Board raises the prime lending rate, the interest that you will be asked to pay on a car loan will generally increase/decrease/ stay the same? What vitamin is highly concentrated in citrus fruits? When a stock exchange is in a "bear market," what is happening? and so forth.

The results indicated that the more avid readers in our study—regardless of their general abilities—knew more about how a carburetor worked, were more likely to know who their United States senators were, more likely to know how many teaspoons are equivalent to one tablespoon, were more likely to know what a stroke was, and what a closed shop in a factory was, etc. One would be hard pressed to deny that at least some of this knowledge is relevant to living in the United States in the late 20th century.

In other questions asked of these same students, we attempted to probe areas that we thought might be characterized by *mis*information. We then attempted to trace the "cognitive anatomy" of this misinformation. One such question concerned the sizes of the world's major religions and was designed to assess awareness of the multicultural nature of the modern world. The question was phrased as follows: "The 1986 *Encyclopedia Britannica* estimates that there are approximately nine hundred million people in the *world* (not just the United States) who identify themselves as Christians. How many people in the world (not just the United States) do you think identify themselves as ?" Space was then provided on the form for the subjects to make estimates of the number of Moslems, Jews, Buddhists, Hindus, etc.

We will focus here on the estimates of Moslem and Jewish people because of our *a priori* hypothesis that availability effects caused by televised coverage of Israel in the U.S. had skewed the perception of this ratio. While our sample's median estimate of the number of Jewish people (20 million) was quite close to the actual figure of 18 million according to the 1990 *Universal Almanac*, the number of estimated Moslems—a mean of 10 million—was startlingly low (817 million is the estimate in the *Universal Almanac*). For each participant in our study, we calculated the ratio of the Moslem to Jewish estimates to see how many students were aware of the fact that the number of Moslems is an order of magnitude larger (the actual estimated ratio is approximately 33:1 according to the *World Almanac;* 45:1 according to the *Universal*

Almanac). The median ratio in our sample was 0.5. That is, 69.3 percent of our sample thought that there were more Jewish people in the world than Moslems.

This level of inaccuracy is startling given that approximately 40 percent of our sample of 268 students were attending one of the most selective public institutions of higher education in the United States (the University of California, Berkeley). We have explored the correlates of this particular misconception in a variety of ways. We looked at the performance on this question as a function of students' level of reading volume and television watching. We observed a clear effect of reading volume on the scores on the question and a significant effect of television viewing, but the effects were in opposite directions! Reading volume was associated with higher scores on the question, but television exposure was associated with lower scores. Scores among the group high in reading volume and low in television exposure were highest, and the lowest scores were achieved by those high in television exposure and low in reading volume. Our analyses confirmed that these relationships were not due to differences in general ability.

Similarly, we have analyzed a variety of other misconceptions in a number of other different domains—including knowledge of World War II, the world's languages, and the components of the federal budget—and all of them replicate the pattern shown for this question. The cognitive anatomy of misinformation appears to be one of too little exposure to print (or reading) and over-reliance on television for information about the world. Although television viewing can have positive associations with knowledge when the viewing is confined to public television, news, and/or documentary material (Hall, Chiarello, & Edmondson, 1996; West & Stanovich, 1991; West et al., 1993), familiarity with the prime time television material that defines mass viewing in North America is most often negatively associated with knowledge acquisition.

In another study, Stanovich, West, & Harrison (1995) examined a much older population in order to investigate the extent to which age-related growth in knowledge can be accounted for by differences in reading volume. Although much research effort has been expended on describing cumulative growth in crystallized intelligence (e.g., acquired knowledge such as vocabulary and general information), we know little about the experiences that relate to knowledge growth in older individuals. For example, educational experience (years in school) is a predictor of intellectual functioning in older individuals (e.g., Schwartzman, Gold, Andres, Arbuckle, & Chaikelson, 1987). It is assumed that education (which is received early in life) in part determines the extent and quality of many intellectual activities later in life. And it is presumably this intellectual activity as one ages that is so crucial to the preservation of cognitive capacities. Thus, while considerable development of cognitive skills and abilities can result from formal educational experiences, it is the lifetime use of these skills that is assumed to have the beneficial effect.

In this study, Stanovich, et al. (1995) examined the performance of college students and senior citizens on general knowledge, vocabulary, working memory, syllogistic reasoning, and several measures of reading volume. The older individuals outperformed the college students on the measures of general knowledge and vocabulary, but did significantly less well than the college subjects on the working memory and syllogistic reasoning tasks. This dissociation between fluid intelligence (all-purpose general problem-solving capacity) and crystallized intelligence (general knowledge and vocabulary) is a standard finding in the literature (Baltes, 1987; Horn & Hofer, 1992; Salthouse, 1988). However, a series of analyses indicated that when measures of reading volume were used as control variables, the positive relationships between age and vocabulary and age and declarative knowledge were eliminated (in contrast, the negative relationships between age and fluid abilities were largely unchanged). Thus, the results of this study are consistent with the conjecture that—in the domain of verbal abilities—reading a lot can even help to compensate for the normally deleterious effects of aging! (See also, Smith, 1996.)

How Do We Become Avid Readers?

Moving back again to the other end of the age spectrum, we switch focus to the question: Given that lifelong reading habits are such strong predictors of verbal cognitive growth, what is it that predicts these habits? We've been looking at reading volume as a predictor of reading comprehension and cognitive ability, but what predicts reading volume or avid reading?

It is generally agreed that comprehension ability and reading volume are in a reciprocal relationship. In an attempt to tease apart this reciprocal relationship, we explored the linkages between children's first-grade reading and cognitive abilities and eleventh-grade outcomes in a unique ten-year longitudinal study (Cunningham and Stanovich, 1997). Most of our earlier studies involved assessing contemporaneous relations, but in this study, we examined the performance of a sample of students who had been tested as first graders (see Stanovich, Cunningham, and Feeman, 1984). About one half of these students were available ten years later for testing as eleventh graders. At this time, we administered a set of reading comprehension, cognitive ability, vocabulary, and general knowledge tasks, as well as several measures of reading volume. Additionally, some standardized test scores from the intervening period were available. We were therefore able to examine what variables in the first grade predicted these cognitive outcomes in the eleventh grade. We interpreted the reading volume measures administered in the eleventh grade as cumulative indicators of variance in reading volume that had taken place many years earlier. Thus, we viewed the measures as in some sense retrospective indicators tapping the cumulative experiences and habits of the students some distance in time before actual assessment. As a result, we were able to examine how far this retrospective feature could be stretched.

We addressed the question of whether the *speed* of initial reading acquisition in the first grade could predict later tendencies to engage in reading activities even after differences in general cognitive abilities were controlled, as some models of Matthew effects in educational achievement would predict (Chall, Jacobs, & Baldwin, 1990; Juel, 1994; Stanovich, 1986). We statistically removed the contribution of eleventh-grade reading comprehension ability, in order to remove the direct association between reading volume and current reading ability. Then we examined the contribution of three standardized measures of first grade reading ability (decoding, word recognition, and comprehension) and observed that all three measures predicted eleventh-grade reading volume even after eleventh-grade reading comprehension ability had been partialed out! In contrast, we observed that first grade intelligence measures do *not* uniquely predict eleventh-grade reading volume in the same way. Thus, this study showed us that an early start in reading is important in predicting a lifetime of literacy experience—and this is true *regardless* of the level of reading comprehension ability that the individual eventually attains.

This is a stunning finding because it means that students who get off to a fast start in reading are more likely to read more over the years, and, furthermore, this very act of reading can help children compensate for modest levels of cognitive ability by building their vocabulary and general knowledge. In other words, ability is not the only variable that counts in the development of intellectual functioning. Those who read a lot will enhance their verbal intelligence; that is, reading will make them smarter.

The Reciprocal Effects of Reading Volume

We can begin to sketch a view of the reciprocal influences of early reading acquisition and reading volume as determinants of later reading comprehension and other cognitive abilities. Early success at reading acquisition is one of the keys that unlocks a lifetime of reading habits. The subsequent *exercise* of this habit serves to further develop reading comprehension ability in an interlocking positive feedback logic (Juel, Griffith, & Gough, 1986; Juel, 1988; Snow, Barnes, Chandler, Goodman, & Hemphill, 1991; Stanovich, 1986, 1993). Although it is difficult to tease apart, we have attempted to trace the increasing divergence in children's reading ability, as well as other cognitive outcomes, by examining both sides of the important role of reciprocal causation. Our longitudinal study has permitted us to observe these effects, whereby children who get out of the gate quickly—who crack the spelling-to-sound code early on—appear to enter into a positive feedback loop. One of the benefits of these reciprocating effects may be a level of participation in literacy activities that leads to a lifetime habit of reading and thus sets the stage for future opportunities—opportunities not enjoyed by children who enter into this feedback loop more slowly.

A positive dimension of our research is that all of our studies have demonstrated that reading yields significant dividends for everyone—not just for the "smart kids" or the more able readers. Even the child with limited reading and comprehension skills will build vocabulary and cognitive structures through reading.

We can thus elicit two crucial messages from our research findings. First, it is difficult to overstate the importance of getting children off to an early successful start in reading. We must ensure that students' decoding and word recognition abilities are progressing solidly. Those who read well are likely to read more, thus setting an upward spiral into motion.

Second, we should provide all children, regardless of their achievement levels, with as many reading experiences as possible. Indeed, this becomes doubly imperative for precisely those children whose verbal abilities are most in need of bolstering, for it is the very act of reading that can build those capacities. An encouraging message for teachers of low-achieving students is implicit here. We often despair of changing our students' abilities, but there is at least one partially malleable habit that will itself develop abilities—reading!

References

Adams, M. J. (1990). *Beginning to read: Thinking and learning about print*. Cambridge, MA: MIT Press.

Allington, R. L. (1977). If they don't read much, how they ever gonna get good? *Journal of Reading*, *21*, 57–61.

Allington, R. L. (1983). The reading instruction provided readers of differing reading abilities. *The Elementary School Journal*, *83*, 548–559.

Allington, R. L. (1984). Content coverage and contextual reading in reading groups. *Journal of Reading Behavior*, *16*, 85–96.

Anderson, R. C., Wilson, P. T., & Fielding, L. G. (1988). Growth in reading and how children spend their time outside of school. *Reading Research Quarterly*, *23*, 285–303.

Baltes, P. B. (1987).Theoretical propositions of life-span developmental psychology: On the dynamics between growth and decline. *Developmental Psychology*, *23*, 611–626.

Berger, K. W. (1977). *The most common 100,000 words used in conversations*. Kent, Ohio: Herald Publishing House.

Biemiller, A. (1977–1978). Relationships between oral reading rates for letters, words, and simple text in the development of reading achievement. *Reading Research Quarterly*, *13*, 223–253.

Brown, G. D. (1984). A frequency count of 190,000 words in the London-Lund Corpus of English Conversation. *Behavior Research Methods, Instruments, & Computers*, *16*, 502–532.

Carroll, J. B., Davies, P., & Richman, B. (1971). *Word frequency book.* Boston: Houghton Mifflin.

Chall, J. S. (1983). *Stages of reading development*. New York: McGraw-Hill.

Chall. J. S. (1989) Learning to read: The great debate twenty years later. A response to "Debunking the great phonics myth." *Phi Delta Kappan*, *71*, 521–538.

Chall, J. S., Jacobs, V., & Baldwin, L. (1990). *The reading crisis: Why poor children fall behind*. Cambridge, MA: Harvard University Press.

Cipielewski, J., & Stanovich, K. E. (1992). Predicting growth in reading ability from children's exposure to print. *Journal of Experimental Child Psychology*, *54*, 74–89.

Cunningham, A. E., & Stanovich, K. E. (1990). Assessing print exposure and orthographic processing skill in children: A quick measure of reading experience. *Journal of Educational Psychology*, *82*, 733–740.

Cunningham, A. E., & Stanovich, K. E. (1991).Tracking the unique effects of print exposure in children: Associations with vocabulary, general knowledge, and spelling. *Journal of Educational Psychology*, *83*, 264–274.

Cunningham, A. E., & Stanovich, K. E. (1997). Early reading acquisition and its relation to reading experience and ability 10 years later. *Developmental Psychology*, *33*(6), 934–945.

Echols, L. D., West, R. F. Stanovich, K. E., & Zehr, K. S. (1996). Using children's literacy activities to predict growth in verbal cognitive skills: A longitudinal investigation. *Journal of Educational Psychology*, *88*, 296–304.

Francis, W. N., & Kucera, H. (1982). *Frequency analysis of English usage*: *Lexicon and grammar*. Boston: Houghton Mifflin.

Gambrell, L. B., Wilson, R. M., & Gantt, W. N. (1981). Classroom observations of task-attending behaviors of good and poor readers. *Journal of Educational Research*, *74*, 400–404.

Guthrie, J.T., Schafer, W. D. & Hutchinson, S. R. (1991). Relation document literacy and prose literacy to occupational and societal characteristics of young black and white adults. *Reading Research Quarterly*, *26*, 30–48.

Hayes, D. P. (1988). Speaking and writing: Distinct patterns of word choice. *Journal of Memory and Language*, *27*, 572–585.

Hayes, D. P. & Ahrens, M. (1988). Vocabulary simplification for children: A special case of 'motherese.' *Journal of Child Language*, *15*, 395–410.

Hall, V. C., Chiarello, K., & Edmondson, B. (1996). Deciding where knowledge comes from depends on where you look. *Journal of Educational Psychology, 88*, 305–313.

Horn, J. L., & Hofer, S. (1992). Major abilities and development in the adult period. In R. J. Sternberg & C.A. Berg (Eds.), *Intellectual development* (pp. 44–99). Cambridge: Cambridge University Press.

Juel, C. (1988). Learning to read and write: A longitudinal study of fifty-four children from first through fourth grade. *Journal of Educational Psychology*, *80*, 437–447.

Juel, C. (1994). *Learning to read and write in one elementary school*. New York: Springer-Verlag.

Juel, C., Griffith, P. L., & Gough, P. B. (1986). Acquisition of literacy: A longitudinal study of children in first and second grade. *Journal of Educational Psychology*, *78*, 243–255.

Kaestle, C. F. (1991). *Literacy in the United States*. New Haven, CT.: Yale Press.

Miller, G. A., & Gildea, P. M. (1987). How children learn words. *Scientific American*, *257*(3),94–99.

Nagy, W. E., & Anderson, R. C. (1984). How many words are there in printed school English? *Reading Research Quarterly*, *19*, 304–330.

Nagy, W. E., Herman, P. A. (1987). Breadth and depth of vocabulary knowledge: Implications for acquisition and instruction. In M. G. McKeown & M. E. Curtis (Eds.), *The nature of vocabulary acquisition* (pp. 19–35). Hillsdale, NJ: Erlbaum.

Nagy, W. E., Herman, P. A. & Anderson, R. C. (1985). Learning words from context. *Reading Research Quarterly*, *20*, 233–253.

Olson, D. R. (1986). Intelligence and literacy: The relationships between intelligence and the technologies of representation and communication. In R. J. Sternberg & R. K. Wagner (Eds.), *Practical intelligence* (pp. 338–360). Cambridge: Cambridge University Press.

Salthouse, T. A. (1988). Resource-reduction interpretations of cognitive aging. *Developmental Review*, *8*, 238–272.

Schwartzman, A., Gold, D., Andres, D., Arbuckle, T., & Chaikelson, J. (1987). Stability of intelligence: A 40-year follow-up. *Canadian Journal of Psychology*, *41*, 244–256.

Smith, F. (1989). Overselling literacy. *Phi Delta Kappan*, *70*(5), 354.

Smith, M. C. (1996). Differences in adults' reading practices and literacy proficiencies. *Reading Research Quarterly*, *31*, 196–219.

Snow, C. E., Barnes, W. S., Chandler, J., Goodman, L., & Hemphill, L. (1991). *Unfulfilled expectations: Home and school influences on literacy*. Cambridge, MA: Harvard University Press.

Stanovich, K. E. (1986). Matthew effects in reading: Some consequences of individual differences in the acquisition of literacy. *Reading Research Quarterly*, *21*, 36–407.

Stanovich, K. E. (1989). Has the learning disabilities field lost its intelligence? *Journal of Learning Disabilities*, *22*, 487–492.

Stanovich K. E. (1993). Does reading make you smarter? Literacy and the development of verbal intelligence. In H. Reese (Ed.), *Advances of child development and behavior*, *24*, 133–180. San Diego, CA: Academic Press.

Stanovich, K. E., & Cunningham, A. E. (1992). Studying the consequences of literacy within a literate society: The cognitive correlates of print exposure. *Memory & Cognition*, *20*, 51–68.

Stanovich, K. E., & Cunningham, A. E. (1993). Where does knowledge come from? Specific associations between print exposure and information acquisition. *Journal of Educational Psychology*, *85*, 211–229.

Stanovich, K. E., Cunningham, A. E., & Feeman, D. J. (1984). Intelligence, cognitive skills, and early reading progress. *Reading Research Quarterly*, *19*, 278–303.

Stanovich, K. E., & West, R. F. (1989). Exposure to print and orthographic processing. *Reading Research Quarterly*, *24*, 402–433.

Stanovich, K. E., & West, R. F., & Harrison, M. (1995). Knowledge growth and maintenance across the life span: The role of print exposure. *Developmental Psychology*, *31*, 811–826.

Sternberg, R. J. (1985). *Beyond IQ: A triarchic theory of human intelligence*. Cambridge: Cambridge University Press.

Sternberg, R. J. (1987). Most vocabulary is learned from context. In M. G. McKeown & M. E. Curtis (Eds.), *The nature of vocabulary acquisition* (pp. 89–105). Hillsdale, NJ: Erlbaum Associates.

Sticht, T. (1979). Applications of the audread model to reading evaluation and instruction. In L. B. Resnick & P. Weaver (Eds.), *Theory and practice of early reading* (pp. 209–226). Hillsdale, NJ: Erlbaum Associates.

Walberg, H. J., & Tsai, S. (1983). Matthew effects in education. *American Educational Research Journal*, *20*, 359–373.

West, R. F., & Stanovich, K. E. (1991).The incidental acquisition of information from reading. *Psychological Science*, *2*, 32–330.

West, R. F., Stanovich, K. E., & Mitchell, H. R. (1993). Reading in the real world and its correlates. *Reading Research Quarterly*, *28*, 34–50.

Zill, N., & Winglee, W. (1990). *Who reads literature?* Cabin John, MD: Seven Locks Press.