Running head: Matthew Effects, reading comprehension, and vocabulary

Matthew Effects in young readers: reading comprehension and reading experience aid vocabulary development

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Abstract

We report data from a longitudinal study of the reading development of children who were assessed in the years of their 8th, 11th, 14th, and 16th birthdays. We examine the evidence for Matthew Effects in reading and vocabulary between ages 8 and 11 in groups of children identified with good and poor reading comprehension at 8 years. We also investigate evidence for Matthew Effects in reading and vocabulary between 8 and 16 years, in the larger sample. The poor comprehenders showed reduced growth in vocabulary compared to the good comprehenders, but not in word reading or reading comprehension ability. They also obtained lower scores on measures of out-of-school literacy. Analyses of the whole sample revealed that initial levels of reading experience and reading comprehension predicted vocabulary at ages 11, 14, and 16 after controlling for general ability and vocabulary skills when aged 8. We discuss these findings in relation to the influence of reading on vocabulary development.

Matthew Effects in young readers: reading comprehension and reading experience aid vocabulary development

The Matthew Effect refers to the phenomenon that performance differences between good and poor readers may increase over time (Stanovich, 1986, see also Walberg & Tsai, 1983). One assumption of this hypothesis is that factors other than children's underlying cognitive potential or learning ability before the start of schooling can lead to different rates of reading development. Reading practice is one variable proposed to influence aspects of reading and language development throughout the lifespan. Language comprehension skills may also lead to Matthew Effects because they influence the ability to acquire new information when reading (Kintsch, 1998; Nagy, Herman, & Anderson, 1985). In this paper we examine the existence of Matthew Effects in reading ability and vocabulary knowledge in two ways. First, we compare the growth of word reading, reading comprehension, and vocabulary knowledge in groups of good and poor comprehenders between 8 and 11 years. Second, we investigate whether differences in reading experience or reading comprehension can account for differences in vocabulary growth between 8 and 16 years, in a larger sample of children.

Reading habits and reading development

Differential practice in reading is one factor that might lead to Matthew Effects. Children with poor word reading may fail to understand adequately what they read because their comprehension skills are compromised by their slow or inefficient word decoding skills (Perfetti, 1985). A consequence is that they are likely to be less motivated to read in their leisure time than children with better reading skills. A similar argument can be made for children with specific reading comprehension difficulties: those with poor comprehension despite age-appropriate word reading ability (Cain & Oakhill, 2006). If poor readers engage

in less out-of-school reading, they will get less practice in word reading and comprehension, and the development of these skills may suffer (Stanovich, 1993).

An analysis of reading habits indicates huge differences in the number of words read per year between children who engage in lots or little out-of-school reading. The most avid readers (98 percentile rank) encounter over 4 million words a year; those with average levels of leisure time reading (50 percentile rank) read approximately 600,000 words a year; those who rarely read (10 percentile rank) will encounter about 50,000 words (Anderson, Wilson, & Fielding, 1988). Reading habits are related to reading ability in unselected samples of children (e.g., Cunningham & Stanovich, 1997; Cipielewski & Stanovich, 1992). However, there is no published evidence to date that children with poor reading comprehension (the population of interest in this study) have lower levels of print exposure than their peers (Cain, Oakhill, & Bryant, 2000; Ricketts, Nation, & Bishop, 2007). The absence of differences in reading habits in these samples of good and poor comprehenders may be because the measures used were not sensitive to differences in reading frequency or because differences in reading habits take time to develop. For example, Juel (1988) found that differences between good and poor readers in the frequency of home reading emerged between Grades 1 and 4. In this paper, we examine reading habits in good and poor comprehenders using a range of measures.

Reading ability may influence the quality of the input, as well as the amount of practice. Poorer readers may choose to read less challenging books, ones that do not extend their current word reading or reading comprehension abilities. As a result, poor readers may not only experience reduced growth in their literacy skills in general, they may also have fewer opportunities to learn about different topic areas and to extend language skills that can be developed through books. It is easy to see how reading experience may influence word

reading development, because the printed word is unique to reading. Children who read more will come across a greater number of words and get more practice at decoding words, and have greater opportunities to enhance their knowledge of morphology and spelling than less avid readers. We need to consider differences between print and speech to understand better why reading might additionally enhance reading comprehension and other language skills and knowledge.

Print and speech are essentially different modes of communication that share a common linguistic foundation. However, as Chafe and Danielewicz (1987) point out: "There can be no doubt that people write differently from the way they speak" (p. 83). Written language makes use of vocabulary that may not be familiar to children from their everyday spoken interactions. It tends to be richer and more varied than spoken language in terms of the vocabulary used (Cunningham & Stanovich, 1998). One simple reason for this is that writers draft and revise texts before readers see them. In addition, conversational language contains more instances of colloquialisms: we tend to use *kid* rather than *child*, *bike* rather than *bicycle*, and fillers such as 'you know' (Chafe & Danielewicz, 1987; Redeker, 1984). Verbal ability measures are highly dependent on vocabulary and might, therefore, also be enhanced through reading. Knowledge growth in general may be related to literacy habits because reading affords learning opportunities (Stanovich, 1991; Stanovich, West, & Harrison, 1995). In contrast to these ideas, Carver (1994) suggested that there will little opportunity for vocabulary learning through leisure time reading because the choice of materials will include few unknown words. However, many vocabulary items have different meanings or nuances depending on the context and such knowledge can be acquired even when reading familiar words.

Reading experience may influence the development of reading comprehension directly through comprehension practice. Reading generally involves comprehending extended passages of language. When reading newspapers, magazines, short stories and novels the reader has to integrate information over several sentences, paragraphs, or pages and keep track of multiple protagonists. In this way, reading involves the practice of key comprehension skills such as inference and integration. The same is generally not true for conversational use of speech. Reading experience may also have an indirect influence on reading comprehension through gains in vocabulary knowledge. Reading comprehension and vocabulary knowledge are correlated (Carroll, 1993). Clearly, knowledge of key word meanings is essential to understand the meaning of a text. Therefore, any gains in vocabulary knowledge through reading practice may enhance reading comprehension performance.

Reading comprehension and crucial comprehension skills such as inference may themselves facilitate the development of vocabulary knowledge, resulting in reciprocal relations between comprehension and vocabulary (Stanovich, 1986). Inference from context is significantly correlated with the ability to understand text and is also considered a means of vocabulary learning and extension (Cain, 2007; Daneman, 1988; Nagy & Scott, 2000). Children with poor reading comprehension have poorer inference making skills than their peers, and are also poorer at inferring the meaning of novel words from supportive contexts (Cain, Oakhill, & Lemmon, 2004; Cain, Oakhill, & Elbro, 2003). Thus, children with poor reading comprehension may fail to develop their vocabulary knowledge at the same rate as better comprehending peers, because they lack the means to learn new words through independent reading. Indeed, independent leisure-time reading is predictive of vocabulary growth during middle childhood (Nagy et al., 1985). Thus, increased vocabulary growth

might be the result of good early comprehension skills as well as a contributor to comprehension ability.

A large body of work by Stanovich and colleagues supports the relation between reading habits and language and literacy development. Reading habits explain growth in reading comprehension between Grades 3 and 5 (Cipielewski & Stanovich, 1992) and Grades 1 and 11 (Cunningham & Stanovich, 1997). In these studies, early reading comprehension ability was statistically controlled. Other studies have demonstrated growth in a range of verbal skills, such as spelling, decoding ability, and vocabulary after controlling for initial performance in that skill (e.g., Echols, West, Stanovich, & Zehr, 1996). Reading experience may even compensate for modest levels of cognitive ability (Stanovich, 1993).

However, as Stanovich points out, it is also important to determine whether an experiential factor such as reading experience can predict growth in a skill or knowledge base over and above general learning ability (often assessed by general intelligence). When controlling for nonverbal IQ, Cunningham and Stanovich (1997) found that reading experience did *not* explain growth in reading comprehension. This was a particularly strong test of their argument and, in addition, their sample was small, reducing the power of the study and the potential to find effects. We use a nonverbal IQ control in the analyses reported in this paper to examine whether reading habits and/or reading comprehension have any specific effects on skill development.

Evidence for Matthew Effects

Stanovich's work has focused on the role of reading experience as a driving mechanism for growth. What about studies that have specifically investigated the evidence for Matthew Effects themselves? In general, Matthew Effects are elusive (Scarborough, 2005). Bast and Reitsma (1998) found increasing individual differences in some aspects of

reading in a group of children followed from Kindergarten to Grade 3. For word recognition skills, the gap between the poorer and better readers during the course of the study increased. In contrast, differences in reading comprehension did not emerge. A study by Shaywitz and colleagues failed to find any evidence for Matthew Effects in a composite measure of reading (subtests for single word reading, pseudoword reading, and passage comprehension) between Grades 1 to 6. They did, however, find that children with initially higher scores on a measure of IQ made greater gains on this measure during the course of the study (Shaywitz et al., 1995).

Some studies have investigated the presence of Matthew Effects in discrete groups of good and poor readers. One such study conducted by Scarborough and Parker (2003) investigated the presence of Matthew Effects in children with learning disabilities. They followed the progress of 57 children from 8 to 14 years of age. There was little evidence of an increase in differences between groups of good and poor readers across time. A large-scale longitudinal by Catts and colleagues also failed to find widening differences between groups in reading and reading-related measures between Kindergarten and Grade 4 (Catts, Hogan, & Fey, 2003). However, Juel (1988) did find evidence for Matthew Effects in some aspects of literacy. Good readers made greater gains on measures of writing composition and listening comprehension than poorer readers between Grades 1 and 4. The two groups' word recognition and reading comprehension development did not show the same divergence.

This review indicates that Matthew Effects are not found in every study nor for every measure used in a particular study. Scarborough and Parker (2003) suggest that the detection of Matthew Effects may depend on the age group being studied. For example, this widening of performance between groups might be a short-lived phenomenon in the early school years and the academic consequences of initial reading levels may not be cumulative across the

years. Matthew Effects might also be dependent on other properties of the skill being studied. Vocabulary is an example of what Paris calls an unconstrained skill (Paris, 2005). Constrained skills, such as letter-sound knowledge are learned quickly and all of the elements in the set are learned eventually. An unconstrained skill, such as vocabulary, has a much longer developmental trajectory than a constrained skill with no specific endpoint. We continue to learn vocabulary throughout our lives, because there are always new words to be learned. The same is true for reading comprehension (Paris, 2005). For this reason, there may be greater opportunities for Matthew Effects to arise for vocabulary and reading comprehension than for word reading.

In general, Matthew Effects have been investigated in children with poor word reading (e.g. Juel, 1988; Scarborough & Parker, 2003), in largely unselected samples (Bast & Reitsma, 1988), or have involved assessment of reading with a composite measure (Shaywitz, et al, 1995). Using these approaches, poor reading comprehension cannot be disentangled from poor word reading ability, which will compromise the study of Matthew Effects in reading comprehension. In this paper, we report data from a longitudinal investigation of reading comprehension development in which we have separate assessments of word reading and reading comprehension. We also studied a group of children in our sample who had unexpectedly poor reading comprehension in relation to their chronological age and word reading ability.

First, we present analyses to examine the evidence for Matthew Effects in the good and poor comprehenders in relation to the development of their word reading, reading comprehension, and vocabulary. Our focus in this paper is to understand better the reasons for any Matthew Effects. With this objective in mind, we examine two variables that might drive differences in this aspect of development: reading experience and comprehension skills.

Attrition of our initial sample of good and poor comprehenders led to reduced power at later time points in the study, so we investigate the influence of reading experience and comprehension skill on vocabulary development in our complete dataset.

Method

Participants. One hundred and two children aged 7 to 8 years were recruited for a longitudinal investigation of reading development. The mean age of the sample at the start of the study was 7 years and 7 months (*SD* = 3.28; range 86-98 months). In this paper, we report data from the children in the following UK school year groups: Year 3, when they were 7 to 8-years-old; Year 6, when they were 10 to 11-years-old (N = 83); Year 9, when they were 13 to 14-years-old (N=52); and Year 11, when they were 15 to 16-years-old (N=40). The population was relatively unselected, except that children who were extremely good or extremely poor readers were excluded from the sample. The very poor readers were excluded from the study because it was envisaged that they might have problems with some of the tasks; the very good readers were excluded because we expected that their reading ability would be beyond the scale of the Neale Analysis of Reading Ability – Revised (NARA: Neale, 1989), the test used to measure word reading accuracy and reading comprehension at the start of the study, by the age of 11. The teachers were asked to screen out all children who did not speak English as their first language, and/or who had any known behavioural, emotional, or learning difficulties.

At the first time point, when the children were in the year of their 8th birthday, we also identified one group of good comprehenders and one of poor comprehenders on the basis of their word reading and reading comprehension scores (these measures are described below). The aim was to identify poor comprehenders who did not have a word reading deficit. To do this, we used a different technique to one adopted in our previous research (e.g., Cain,

Oakhill, & Lemmon, 2005; Oakhill, 1982). We plotted the z-scores for word reading accuracy and reading comprehension and created two 'buffer zones' of .5 of a z-score. Using this method, we selected 21 good comprehenders whose word reading accuracy z-score was 0 or above and whose reading comprehension z-score was .5 or above that of the whole sample. We selected 21 poor comprehenders whose word reading accuracy was 0 or above and who had reading comprehension z-scores that were at least .5 below the whole sample. The characteristics of the entire sample are presented in Table 1. The characteristics of the populations of good and poor comprehenders are reported in the Results section (see Table 4).

Year 3 and Year 6 Assessments

Children completed a range of experimental and standardised assessments. Only those relevant to the current study are described.

Reading ability. The children completed the Neale Analysis of Reading Ability: Revised (NARA: Neale, 1989) at each time point. The NARA provides measures of word reading accuracy (word recognition in context) and reading comprehension (assessed by ability to answer a series of questions about each passage). The age equivalent scores for the entire sample at both assessment points are reported in Table 1. Children completed Form 1, for which test-retest reliability for this age range is between .82-.86 for word reading accuracy, and between .93-.95 for reading comprehension. Raw scores were used in all analyses.

Vocabulary knowledge. Children completed two assessments of vocabulary knowledge. The Gates-MacGinitie Vocabulary subtest (MacGinitie, MacGinitie, Maria, & Dreyer, 2000) was used to measure sight vocabulary. Children completed Levels 2 (in Year 3) and 5/6 (in Year 6) Form K. The test requires the child either to select one of four words to go with a picture (in the test suitable for 7-8 year-olds) or to select a synonym of a given

word from one of four options (10-11 year-olds). Thus, it measures the ability to recognize and retrieve the meanings of written words out of context. The total number correct (maximum = 45) for each assessment point is reported in Table 1. Cronbach's alpha for this age range is between .90 and .95. We assessed receptive vocabulary using an individually-administered test, the *British Picture Vocabulary Scales* (BPVS: Dunn, Dunn, Whetton, & Pintillie, 1992). The standardized scores are reported in Table 1. Raw scores were used in all analyses. The reported reliability (median of Cronbach's alpha over year groups) is .93.

Cognitive ability. Non-verbal cognitive ability was assessed using two subtests of the Wechsler Intelligence Scale for Children – Third UK Edition (WISC-III: Wechsler, 1992), the *Block Design* and *Object Assembly.* The total possible score for each test differed. Therefore, the percentage of the total possible score obtained was calculated and the mean percentage score was used in the analyses below, to give equal weighting to both components of each assessment. Cronbach's alpha (average across this age range reported in the manual) is .84 for Block Design and .68 for Object Assembly.

TABLE 1 AROUND HERE

Reading habits. Children were interviewed about their reading behaviour in school Years 3 and 6. The questions included the frequency of visits to the local library, reading to their parents, being read to by their parents, talking about books with their parents, and reading on their own. Points for frequency were awarded as follows: every day = 5 points; most days each week = 4 points; more than once a week = 3 points; once a week = 2 points; less than once a week = 1 point; never = 0 points. Responses to these questions were used to form a composite score. Parents were sent a questionnaire, which included the same

questions. In addition, they were asked to count the number of children's books in the home. Children and parents were also asked to estimate the number of hours of television viewing on weekdays and weekends. Children found this estimation hard, but the responses from parents were used to create an estimate of the total hours of television viewing each week. Eighty-three parents returned the questionnaire at the first assessment point and 54 at the second assessment point and (rarely) some questions were left blank. Clearly, socially desirable responding is an issue with a reading habits questionnaire. For the analyses below, we report: the scores from the children's interview questionnaire (for which we have data for the complete sample): *M*s = 10.57 and 8.06, *SD*s = 5.10 and 3.59, for Times One and Two respectively, and the objective measure of the home literacy environment provided by parents: the total number of books in the house, *M*s = 85.19 and 82.85, *SD*s = 60.04 and 53.98. Cronbach's alpha for the reading questions was.72. We also report the parental estimate of the hours of television viewing per week as a measure of divergent validity: *M*s = 16.11 and 18.75, *SD*s = 9.60 and 7.87.

Year 9 and Year 11 Assessments

All assessments were administered to the children in small groups, outside of the classroom.

Reading ability. Two subtests of the Edinburgh Reading Test (Educational Assessment Unit, 1999) were completed to measure reading comprehension. One subtest (with 16 items) assessed the ability to extract information from short texts without detailed reading, e.g. skimming ability. The other subtest was designed to assess the ability to draw inferences from text, e.g. reading comprehension ability. Children read three short passages and after each one they were given a multiple-choice completion with the instruction that 'each item should be completed to reproduce the sense of the passage', for the item: 'This passage describes ..' the choices were: a kidnapping; police raiding a house; a man's escape

from attackers; a murder. There were six items to complete for each passage. The sum total scores were used to create a comprehension score: *M* = 25.46 (*SD*= 3.75) for Year 9 and *M* = 26.68 (*SD*= 3.72) for Year 11. The reported test-retest reliabilities of these components are .86 (skimming) and .73 (comprehension).

Children completed a pseudohomophone detection task at each time point. In Year 9 (the third assessment point), the task required children to choose one of three nonsense that sounded like a real word, e.g., 'fone, phote, toaf'[i]. Five practice items with feedback were followed by 52 trials: *M* = 40.89 (*SD* = 7.22). Cronbach's alpha for this test was .87. The total number of correct trials was the score used in the analyses. In Year 11 (the fourth and final assessment point) a checklist format was used. Children were required to identify the pseudowords that sounded like real words. One practice item was followed by a checklist of 100 items, 46 of which were judged to sound like real words in British English by the two authors[ii]. Cronbach's alpha for the items that sounded like real words was .69. The mean number of correct words that were marked (hits) was 21.93 (SD=4.57). The mean number of incorrect words that were falsely marked (false alarms) was 3.19 (SD=3.92). The scores used in the analyses were calculated to take response bias into account: [P(hits) – P(false alarms)] / 1-P(false alarms).

Vocabulary knowledge. Knowledge of word meanings was assessed with a subtest from the Edinburgh Reading Test. Each item comprised a sentence, in which a word was printed in bold type, e.g. 'What **advantage** can you possibly gain from keeping goldfish?' followed by five words, e.g. 'ability, benefit, experience, income, promotion'. The task was to underline the word that 'means most nearly the same' as the word in bold type. There were 24 items: *M* = 15.71 (*SD*= 4.82) for Year 9 and *M* = 18.58 (*SD*= 4.03) for Year 11. The raw scores were used in the analysis. The reliability reported in the manual is .91.

Print exposure. In School Years 9 and 11, children completed an Author Recognition Test (e.g. Stanovich & West, 1989) developed for this study. The list consisted of 40 names: 20 real authors and 20 foils. The real authors in the list comprised 'popular authors' for each age group, who were not part of the literacy curriculum. The foils were checked on the internet by the researchers to make sure that they were not real authors. For each measure, the total number of foils that were checked was subtracted from the total number of real authors (hits – false alarms). For children in Year 9, the mean values were: hits = 6.09, foils = 1.73, with a total score mean of 4.36 (*SD*=2.90, range = -1 to 11). For children in school Year 11, the mean values were: hits = 8.48, foils = 1.75, with a total score mean of 6.72 (*SD* = 3.02, range = -1 to 13). Cronbach's alpha was .69.

When children were in school Year 11, an additional assessment of reading habits was obtained with a questionnaire designed to assess reading habits outside of school. The frequency and time spent (where applicable) on the following behaviours was rated: use of the local library, reading for pleasure, television viewing and internet use. Children were also asked to estimate the number of books read in the previous 12 months, the number of magazines purchased each month, and were asked questions about favourite book genres and television programmes. Children rated the frequency of each behaviour on a scale. Not all children completed all responses. Cronbach's alpha for the questions about reading was .78. For the purposes of this analysis, a composite measure of reading was calculated from responses to three questions: frequency of library visits, the frequency of reading for pleasure, and the number of books read in the previous 12 months. Frequency of television viewing was investigated separately in the analyses to provide a measure of divergent validity. Internet use and magazine reading did not correlate significantly with any measures, so are not reported in the analyses reported below.

Results

The results are reported in the following sections: 1) relations between the reading ability and vocabulary knowledge variables across time; 2) analyses to examine Matthew Effects in the good and poor comprehender groups; 3) relations between reading habits and reading ability; and 4) analyses to examine the role of reading experience in growth in vocabulary across time.

1. Reading and vocabulary: Relations across time

The measures of word reading (word reading accuracy for School Years 3 and 6 and pseudohomophone reading for Year 9), reading comprehension, and sight vocabulary were, in general, correlated across time points and always correlated with the successive measure. These values are reported in Table 2. Receptive vocabulary was measured in School Years 3 and 6 only and performance was significantly correlated across time, $r(83) = .59$, $p < .0001$. Thus, early ability was related to later ability in general, but the relations across time were often moderate.

TABLE 2 ABOUT HERE

TABLE 3 ABOUT HERE

2. Reading and vocabulary: Tests for Matthew Effects

Table 3 summarises the performance of the good and poor comprehenders' word reading, reading comprehension, and vocabulary scores across time. There were complete data for 17 poor comprehenders and 14 good comprehenders. We adopted Scarborough and Parker's (2003) technique and conducted a series of mixed ANOVAs in which group (good comprehender vs poor comprehender) was a between-subjects factor and time (Year 3 and

Year 6) was a within-subjects factor. In separate analyses, word reading, reading comprehension, sight and receptive vocabulary were dependent variables.

There was no evidence for Matthew Effects in the analyses with word reading and reading comprehension as dependent variables. For word reading, there was a main effect of time: $F(1,29) = 624.98$, $p < .001$, $\eta_p^2 = .96$, because performance improved with age. The effect of group ($F<2.5$) and the interaction ($F<1.0$) did not reach significance, both ps $> .10$. In the analysis of reading comprehension scores, there were main effects of time: $F(1,29) = 177.96$, $p < .001$, $\eta_p^2 = .86$, and group: $F(1,29) = 85.20$, $p < .001$, $\eta_p^2 = .75$, but no interaction, $F < 1.0$.

There was, however, evidence for Matthew Effects in the analyses of the two vocabulary measures. In the analysis of sight vocabulary there were main effects of group: $F(1,29) = 7.43$, $p < .015$, $\eta_p^2 = .21$ and time: $F(1,29) = 43.83$, $p < .001$, $\eta_p^2 = .60$, and a significant interaction between these variables: $F(1,29) = 7.67$, $p < .01$, $\eta_p^2 = .21$. The same pattern was found for receptive vocabulary: time, $F(1,29) = 245.57$, $p < .001$, $\eta_p^2 = .89$, group: $F(1,29) = 7.16$, $p < .015$, $\eta_p^2 = .20$, and the interaction between the two: 4.76, $p < .05$, $\eta_p^2 = .14$. The interactions are depicted in Figure 1. Note that the sight vocabulary measure at Time Two was more difficult and children obtained lower scores in general. However, the difference between groups was larger at the second time point.

Because of the small sample size and absence of significant interactions in the analyses of word reading and reading comprehension, post-hoc power analyses using G*Power3 (Faul, Erdfelder, Lang, & Buchner, 2007) were calculated to assess the likelihood of making a Type II error (failing to reject the null hypothesis when it is false). The criterion for an acceptable level of power to avoid this error is $\beta = .80$. The actual β calculated to

detect a medium effect size (f = .25) was .77, which indicates that the study was very slightly underpowered.

INSERT FIGURE 1 AROUND HERE

3. Relations between reading habits and reading ability

Table 4 reports the zero-order correlations between the measures of reading habits and print exposure (ART) at each time point. Of note, are the following significant relations. The interview measures of reading experience were significantly correlated when children were aged 8 and 11 (r = .26), 8 and 16 (r = .34), 11 and 16 (r = .35). These correlations are only moderate, indicating that reading habits are subject to change over time. Support for this comes from the finding that the correlations between the interview measure at 8 years and the ART at 14 and 16 did not reach conventional levels of significance (ps = .068 and .062). However, responses to the interview at 11 years were significantly correlated with ART at 14 (r = .38) and 16 years (r = .46). Television viewing habits were correlated across time points and at 8 and 11 years were negatively correlated with measures of reading experience, demonstrating divergent validity.

For the sample as a whole, indicators of reading habits were positively correlated with reading comprehension and vocabulary knowledge at each time point. Television viewing tended to be negatively correlated with reading and vocabulary measures, although the correlations were not generally significant. Word reading ability at Times 1 and 2 and pseudoword reading at Times 3 and 4 were not so strongly related to reading habits. These findings are summarised in Table 4.

INSERT TABLE 4 AROUND HERE

For the smaller sample of good and poor comprehenders, not all of the questionnaires returned by parents were complete, but we have data for between 15-17 children in each group on these measures and full data (for all 21 children in each group) on the children's questionnaire. A comparison of the two groups' reading habits at Time One revealed that, in general, the good comprehenders obtained higher scores on the home literacy measures. The good comprehenders reported engaging in literacy activities in the home more frequently than did the poor comprehenders: *M*s = 14.42 and 8.33, *SD*s = 4.05 and 4.86; $t(40) = 4.41$, $p < .001$, and the effect size was large: $d = 1.36$. Although the parents' responses to these questions did not differ (*M*s = 16.18 and 15.41), the parents of good comprehenders reported a higher number of children's books in the home than did the parents of poor comprehenders: *M*s = 102.76 and 58.23, *SD*s = 63.43 and 38.14; $t(40) = 2.35$, $p < .05$, $d = .85$. There was not a significant difference between the groups in the hours of television watching per week: *M*s = 14.56 and 16.06, *SD*s = 5.89 and 7.08, for the good and poor comprehender groups respectively; $t(40) < 1.0$.

4. Predicting growth in vocabulary from print exposure and reading comprehension

To investigate the relations between reading experience and growth in vocabulary knowledge, a series of fixed-order hierarchical multiple regressions were conducted. These analyses were conducted on data from the entire dataset, which included the data from the good and poor comprehenders reported in the previous analyses. The purpose was to determine whether reading experience could explain individual differences in vocabulary growth, over and above cognitive ability. We do not report analyses to investigate growth in

word reading or reading comprehension, because there was no evidence for Matthew Effects in the analyses with good and poor comprehenders.

INSERT TABLE 5 AROUND HERE

Separate analyses were used to predict growth between 8 and 11, 8 and 14, and 8 and 16 years with sight vocabulary as the criterion variable. In each analysis cognitive ability at 8 years was entered in the first step, followed by sight vocabulary. At the third and final step the score obtained on the children's reading questionnaire was entered in one analysis, and the score obtained on the reading comprehension assessment in the other analysis. An additional pair of analyses to explore growth in receptive vocabulary between 8 and 11 years was conducted. All predictor variables were the measures taken at Time One, when the children were aged 8. These analyses are summarised in Table 5. They show that reading experience explained growth in all measures of vocabulary over and above general cognitive ability and the earlier measure of vocabulary. In addition, reading comprehension explained growth in vocabulary after initial levels of cognitive ability and vocabulary had been statistically controlled[iii].

Additional analyses investigated whether the variance explained by reading experience and reading comprehension was shared or independent. These demonstrated that in the short-term (Year 3 to Year 6), reading experience explained significant additional variance in later sight vocabulary (4.6%) and receptive vocabulary (9.6%) scores after controlling for reading comprehension. In the longer-term, reading experience did not make a unique contribution to the prediction of vocabulary scores.

Discussion

We examined evidence for Matthew Effects in word reading, reading comprehension and vocabulary in young readers. Children with specific reading comprehension difficulties showed slower rates of vocabulary growth than same-age peers with good reading comprehension. Differences between the two groups' word reading and reading comprehension skills did not increase across time. The two groups differed in their reading habits. Further analyses with the whole sample indicated that both reading habits and reading comprehension contributed to vocabulary growth over and above general cognitive ability. These results are discussed in relation to theories of vocabulary and reading comprehension development.

We did not find any evidence for Matthew Effects in word reading or reading comprehension. Other studies have also failed to find divergence in the development of these skills in samples of good and poor readers (Scarborough & Parker, 2003). We also found that word reading ability and proxy measures of this skill (pseudohomophone tasks) were, in general, not related to reading habits. We interpret these findings in the context of Paris's discussion of constrained and unconstrained skills and the time course of their development. The children in our study had acquired reasonable levels of word reading at the outset: they were in the year of their 8th birthday and had received at least 3 years of formal instruction at school. None were diagnosed with reading difficulties. These children may therefore have already acquired sufficient rudimentary decoding ability to read unfamiliar regular words. Their word reading abilities, in conjunction with learning from context, may have proved sufficient to support the development of their irregular word reading.

Vocabulary and reading comprehension are unconstrained skills that continue to develop across the lifespan. Indeed, we found evidence for differential growth in vocabulary

that may, in part, be aided by the greater opportunities for growth and, therefore, divergence in scores. In contrast, the reading comprehension difference between the groups remained constant. One possibility is that the measures of reading comprehension used, which were short texts from standardised tests, were not sufficiently demanding to detect the comprehension skills that might be developed and enhanced by reading experience over time.

An interesting finding was that reading experience and reading comprehension predicted later performance on a measure of receptive vocabulary, in addition to the effects found for sight vocabulary. However, there was no evidence for Matthew Effects in reading comprehension. Neither was there any strong evidence for reciprocity in the relations between reading comprehension and vocabulary. Early sight vocabulary scores did not predict later reading comprehension scores; early receptive vocabulary did, however, explain variance in reading comprehension 3 years later. A subsequent examination of the receptive vocabulary test indicated that many of words appear in written but not spoken language corpora (Leech, Rayson, & Wilson, 2001). It may be that measures of receptive vocabulary are sensitive to words that are acquired from print, rather than conversation, for populations of readers.

The proportion of variance in vocabulary knowledge explained by reading experience and also our other variables is comparable to that reported in other studies, (e.g. Echols et al., 1996). Our analyses differ from those of Stanovich and colleagues in that we used measures of initial reading habits rather than reading habits at the final time of testing. A measure of reading habits at the final test point will indicate the accumulation of experience over the period of development. Analyses using our final time point measures of reading habits produced the same pattern of results for sight vocabulary (although reading experience did not make a significant contribution to the prediction of receptive vocabulary). Our study adds

to the literature by demonstrating that *early* reading habits benefit vocabulary growth. However, we found only moderate correlations between the different measures of reading habits across the study, indicating that reading habits can and do change. We conclude that an early enjoyment of books should be nurtured, but can be further developed in the early years of schooling.

The relation between early comprehension skills and vocabulary growth is supported by other research that suggests that good comprehension skills aid learning (Kintsch, 1998; Nagy et al., 1985; Nagy & Scott, 2000). Future work with young readers should extend beyond vocabulary knowledge to examine whether reading habits influence other types of knowledge acquisition. Another factor that might influence learning from text is memory (Daneman, 1988). We did not explore the contribution of memory in the current analyses. However, memory capacity and vocabulary learning from print are related in populations of children and adults (Cain et al., 2004; Daneman & Green, 1986). Thus, comprehension skill per se may not be the driving force behind knowledge growth, rather related skills such as inference and memory. Future work is needed to explore these ideas further.

An important point to note is that our analyses controlled for early cognitive ability, as recommended by Stanovich and Cunningham (1993). These findings indicate that the influence of reading habits and reading comprehension on vocabulary development do not occur simply because they all tap general learning ability or cognitive efficiency. Rather, both reading habits and reading comprehension appear to have specific and direct effects on vocabulary growth.

There are limitations associated with the design of our study that restrict the extent to which these results can be generalised. One limitation is the power of the study: our samples were small and not all good and poor comprehenders were available for testing at later time

points, thus restricting the range of permissible analyses. Despite the limited power compared to some other research in this area, we found clear evidence of Matthew Effects on some measures. Further, our power analyses indicated that the sample size was sufficient to detect medium effect sizes, so the failure to detect Matthew Effects for word reading and reading comprehension are not obviously attributable to reduced power. A second limitation was the use of subjective measures of reading experience in Times 1 and 2. Although our measures of reading experience had good reliability (assessed by Cronbach's alpha), the children's questionnaire data are subject to response bias if children wish to appear well read (Cunningham & Stanovich, 1990; Stanovich & West, 1989). However, this measure was significantly correlated with the objective count of books in the home demonstrating convergent validity and divergent validity was apparent in the relations found with television viewing. These data suggest that the additional information obtained from individual interviews was valid.

In conclusion, we found evidence for Matthew Effects in vocabulary growth that were related to reading habits and reading comprehension skill between the ages of 8 and 16. These findings support the proposal that leisure time reading provides opportunities for vocabulary learning and that reading comprehension skills may support vocabulary development. Importantly, our findings demonstrate the importance of fostering early reading habits and a motivation to read in young readers and provide additional information about a means for vocabulary growth.

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Table 1
Characteristics of entire sample at Time One and Time Two: Means (standard deviations) and range

	Time One School Year 3 8 years (N=102)	Time Two School Year 6 11 years (N=83)
NARA word reading accuracy *(age equivalent)*	7 years, 10 months 6.27 (77-108)	11 years, 8 months 14.65 (98-154)
NARA reading comprehension *(age equivalent)*	7 years, 2 months 11.19 (63-119)	9 years, 3 months 17.51 (77-154)
Gates-MacGinitie sight vocabulary *(max = 45)*	34.30 4.63 (26-42)	27.98 7.13 (10-43)
British Picture Vocabulary Scale (standardised scores)	103.00 9.50 (71-128)	115.04 13.00 (94-157)
Cognitive ability (WISC-III) *(sum of percent correct for Block Design and Picture Completion)*	46.62 12.69 (16-69)	65.12 12.17 (25-93)