Profiles of children with specific reading comprehension difficulties

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Background. Children with fluent and accurate word reading in the presence of poor text comprehension are impaired on a wide range of reading-related tasks.

Aims. This study investigated the consistency of skill impairment in a sample of poor comprehenders to identify any fundamental skill weakness that (i) might be associated with poor text comprehension, and (ii) might lead to depressed reading development. An additional aim was to determine whether reading comprehension difficulties are associated with more general educational difficulties.

Sample. Twenty-three poor comprehenders and 23 good comprehenders with age-appropriate word reading accuracy were assessed when aged 8 years. Concurrent reading and language performance and reading, educational attainment and reasoning skills 3 years later are reported.

Methods. The following skills were assessed when aged 8 years: word reading, text comprehension, vocabulary, syntax, cognitive ability, working memory, comprehension subskills. Listening comprehension, SAT scores and reasoning scores at 11 years are also reported.

Results. There was no evidence for any fundamental skill weaknesses in the population of poor comprehenders at Time 1. However, poor vocabulary skills led to impaired growth in word reading ability and poor general cognitive ability led to impaired growth in comprehension. Poor comprehenders obtained lower SAT scores than did the good comprehenders at 11 years.

Conclusions. These findings indicate that a single underlying source of poor comprehension is unlikely. Poor comprehenders are at risk of generally poor educational attainment, although weak verbal or cognitive skills appear to affect the reading development of poor comprehenders in different ways.

Text comprehension draws on many different language skills. These include lower-level lexical skills such as word reading efficiency and vocabulary knowledge, sentence-level

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skills such as knowledge of grammatical structure and higher-level text processing skills such as inference generation, comprehension monitoring and working memory capacity (e.g. Carr, Brown, Vavrus, & Evans, 1990; Hannon & Daneman, 2001; Palincsar & Brown, 1984; Perfetti & Hart, 2001; Perfetti, Marron, & Foltz, 1996). Higher-level skills are related to text comprehension because they enable the reader to make the necessary integrative and inferential links to construct a meaning-based representation of the text. Efficient lower-level lexical skills facilitate reading comprehension by enabling more resources to be devoted to higher-level processes.

The relation between these higher- and lower-level skills and text comprehension have been demonstrated in both correlational and longitudinal studies. Concurrent measures of vocabulary, working memory, inference making and comprehension monitoring are related to reading comprehension skills in 7- to 10-year-olds (Cain, Oakhill, & Bryant, 2004). Longitudinal studies have shown that vocabulary and working memory (Seigneuric & Ehrlich, 2005) and word reading, grammatical awareness and vocabulary (Muter, Hulme, Snowling, & Stevenson, 2004) are related to later reading comprehension.

It is not surprising, therefore, that children with reading comprehension difficulties show impairments on a range of language tasks. When word reading ability and written vocabulary knowledge are controlled, poor comprehenders demonstrate deficits on higher-level skills relative to same-age good comprehenders. Impairments have been found on measures of working memory (Yuill, Oakhill, & Parkin, 1989), inference making (Cain & Oakhill, 1999; Cain, Oakhill, Barnes, & Bryant, 2001), narrative production (Cain, 2003; Cain & Oakhill, 1996) and comprehension monitoring (Ehrlich, Remond, & Tardieu, 1999; Oakhill, Hartt, & Samols, 2005). Weaknesses in syntactic knowledge and processing have also been reported (Nation, Clake, Marshall, & Durand, 2004; Stothard & Hulme, 1992). When vocabulary, word reading accuracy and/or non-word reading are allowed to vary, lower-level lexical weaknesses in exception word reading and semantic processing are also apparent (Nation & Snowling, 1998a, 1998b, 1999). Thus, there are many language factors that might be causally related to reading comprehension level and the development of this skill.

Cornoldi, de Beni, and Pazzaglia (1996) urge caution in what we conclude from such correlational studies for the following reasons. First, there are four different ways that a skill can be related to comprehension ability: it may be a prerequisite of reading comprehension, a facilitator, a consequence or simply an incidental correlate. Comparisons between good and poor comprehenders do not distinguish between these alternatives. Second, such comparisons do not establish whether poor comprehenders in general present a particular deficit or whether every poor comprehender presents that deficit. Given the number of skills associated with good reading comprehension, it would be surprising (and discouraging from a remediation point of view) if all the abilities associated with good reading comprehension were deficient in all poor comprehenders, and necessary for good reading comprehension to develop. Skills that are fundamental to reading comprehension should be impaired in the majority of children with specific reading comprehension deficits. However, skills for which deficits can arise as a consequence of poor reading comprehension or are present as an incidental correlate should be preserved in some individuals with poor reading comprehension but weak in others.

Cornoldi et al. (1996) explored these issues in a sample of 11-year-old Italian schoolchildren who had weak reading comprehension skills in the presence of good decoding skills and normal intelligence. Different patterns of strength and weaknes
were evident across a range of measures important for text comprehension and not all poor comprehenders experienced impairments in all of the skills. There may be subtypes of poor comprehender with different fundamental weaknesses, however Cornoldi et al.’s sample was too small to detect such groups.

One potential fundamental weakness is verbal ability, which is strongly correlated with reading comprehension (Carroll, 1993). Yet, as Nation, Clark, and Snowling (2002) point out, there have been few investigations of underlying verbal and non-verbal ability in children with reading comprehension deficits. Stothard and Hulme (1996) found depressed Verbal IQ (VIQ) relative to Performance IQ (PIQ; pro-rated from the WISC) in a population of 7- to 8-year-old poor comprehenders. In contrast, Nation et al. found depressed levels of both verbal and non-verbal ability in poor comprehenders aged 8 to 9 years old, although the non-verbal deficit was only marginally significant for poor comprehenders with normal range general ability scores. Surprisingly, the poor comprehenders with high and low general ability scores obtained comparable word reading and reading comprehension scores, even though the two groups differed significantly on verbal ability. These results indicate that it is important to examine further the relation between verbal ability and reading comprehension. If verbal ability is causally related to reading comprehension, one would expect the low-ability group to show a more severe comprehension deficit than their peers.

**Purpose of the study**

There are three central issues that arise from the work of Cornoldi, Nation and their colleagues addressed in this paper as follows.

**Variations in language and cognitive skills in children with poor reading comprehension**

Cornoldi and colleagues found varying patterns of skill strength and weakness in their poor comprehenders between the ages of 11 and 13 years. In the UK, research has focused on comprehension impairments in younger children aged between 8 and 11 years and, to date, these investigations have focused on single component skills of reading comprehension (e.g. Cain et al., 2001; Oakhill et al., 2005; Stothard & Hulme, 1996). We know little about the consistency of impairments in this age range. As noted earlier, differences between the selection procedures used in different studies might lead to the presence of deficits in some studies and not others. We present profiles of poor comprehenders across a range of language and cognitive skills to identify whether there are consistent deficits associated with poor reading comprehension in this age group, which would inform both the remediation of poor comprehension and our theoretical understanding of reading comprehension.

**Relations between verbal and vocabulary ability and literacy development in children with poor reading comprehension**

Nation et al. did not find an association between general cognitive skills and the severity of the comprehension deficit presented by poor comprehenders. We investigated an additional hypothesis that cognitive and verbal skills act as facilitators of reading development, by looking at progress in reading over time. If general cognitive ability is associated with poor reading comprehension, poor comprehenders should experience non-verbal as well as verbal processing deficits. We explored the association between verbal, quantitative and spatial reasoning skills and comprehension ability 3 years after
initial selection when our sample was aged 11 years, to investigate the specificity of the
relation between reasoning skills and comprehension level.

**Persistence and educational implications of a comprehension impairment**

Cornoldi et al. found that 7 of the original 12 poor comprehenders demonstrated
comprehension deficits 2 years later, whilst the other 5 participants were no longer at
risk. This statistic is very encouraging, suggesting that around 40% of those with a
comprehension problem at 11 years do not have a persistent severe deficit. We looked at
the persistence of a comprehension deficit between 8 and 11 years. We also compared
the good and poor comprehenders’ achievement performance in three key curriculum
areas, English, mathematics and science when they were aged 11 years, to determine
whether early problems with reading comprehension are associated with later
scholastic difficulties, and the specificity of any problems.

**Method**

**Participants**

The participants were taken from a group of 102 children (63 girls, 39 boys), first assessed
at 7 to 8 years of age in a longitudinal study. The children were drawn from 17 classrooms
in six schools serving middle- and lower-middle-class catchment areas. Word reading
accuracy and reading comprehension were assessed with the Neale analysis of reading
ability – revised British edition (Neale, 1989). Two groups of children, good and poor
comprehenders, were selected according to the following criteria. Children with Neale
word reading accuracy scores that were more than 6 months below or more than 12
months above their chronological age were excluded. The good comprehenders had
Neale reading comprehension scores that were at or above that predicted by their word
reading accuracy scores. The poor comprehender group were the remaining children
who had a discrepancy of 12 months or greater between their chronological age and their
reading comprehension age, and also between their word reading accuracy and
comprehension age. The participants therefore all had age-appropriate word reading skill
and either good or poor comprehension. At Time 1, each group comprised 23 children
(good comprehenders: 13 girls, 10 boys; poor comprehenders: 15 girls, 8 boys).

**Additional assessments: Time 1**

A number of reading and reading-related skills were measured using standardized
assessments and our own experimental measures. A brief description of each test is
given below (further details can be obtained from the first author).

**Vocabulary knowledge**

Two assessments of vocabulary knowledge were taken. Sight vocabulary was assessed
using the Gates-MacGinitie Test (MacGinitie & MacGinitie, 1989), which is group
administered. Children were given the Level 2 test (Form K), in which they had to select
one of out four words to go with an accompanying picture. The total number correct was
calculated. Receptive vocabulary was assessed using the British Picture Vocabulary Scales
(BPV; Dunn, Dunn, Whetten, & Pintillie, 1982). Standardized scores were calculated.

**Memory**

Two assessments of working memory were completed. One was a listening span task in
which children were required to provide a single word completion for a sentence
spoken by the experimenter (processing component) and remember that word for later recall (storage component). The other assessment was Yuill et al.'s (1989) digit reading task. Children read out loud groups of three digits (processing) and remembered the final digit for later recall (storage). Children completed three trials of two, three and four groups of sentences or digits for each task.

Knowledge of syntax

The Test for Reception of Grammar (TROG; Bishop, 1983) was used to measure children's knowledge of syntax. Blocks L, N, O, Q, R, S and T were administered, because pilot work demonstrated that children in this age group were not at ceiling on these blocks. The total number of items correct was calculated.

General intellectual ability

Estimates of verbal and non-verbal intelligence were made using the WISC-III (UK edition; Wechsler, 1992). Children completed two subtests from the verbal scale - vocabulary and similarities - and two from the performance scale - block design and object assembly. The mean standard scores are reported.

Specific comprehension subskills

Three comprehension subskills were assessed: comprehension monitoring; inference and integration skill; and knowledge about story structure. In the comprehension monitoring task, children read stories, some of which contained pairs of inconsistent statements. Their task was to underline ‘any bits that did not make sense together’. The sum of correctly identified inconsistencies and correctly identified consistent stories was calculated. Integration and inference making skill was assessed using Oakhill's (1982) integration task, which assesses the ability to make constructive inferences between two sentences in three-line texts. The score used was the total number of integrated statements and literal statements that were accepted. Two tasks assessed knowledge of story structure. The first was a story anagram task (Stein & Glenn, 1982) in which children put together stories that had been cut up into their six constituent sentences and randomized. Concordance scores (between target and actual sentence order) were computed. Understanding of the purpose of story titles (the sorts of information about characters, locations and events that titles contain) was assessed by a structured interview (Cain, 1996).

Outcome assessments

The outcome measures were taken when the children were aged 10 to 11 years. Seventeen of the original good comprehenders and 19 of the poor comprehenders were available for re-retesting on the Neale analysis of reading ability - revised British edition. We had access to the raw scores obtained by 16 good comprehenders and 17 poor comprehenders on their Key Stage 2 Standard Assessment Tests (SATs) in English, mathematics and science. These tests are taken by all English schoolchildren during the May in the year that they turn 11 years and assess how well children have progressed in the core curriculum subjects. We also assessed the listening comprehension skills of 16 children in each group. Children were read the six stories of the Neale Analysis of Reading Ability, Form 2. After each story they provided written answers to the set of questions. The schools provided us with the standardized scores on the three assessments of reasoning that make up the Cognitive Abilities Tests - second edition (Thorndike, Hagen, & France, 1986): verbal (17 poor comprehenders, 15 good
comprehenders); and quantitative and non-verbal reasoning (17 poor comprehenders, 16 good comprehenders). These assessments were administered in the autumn term of the year that the children turned 11 years.

Results

Reliability of our experimental measures was assessed using Cronbach’s alpha over items. In most cases, the reliability coefficient was acceptable (.60 to .80). However, the measure of inference and integration produced an alpha level of .48 (over all 24 items). For all significant group comparisons, Cohen’s d was calculated as a measure of effect size. A value of .2 is regarded as a small effect, .5 is medium and .8 and above is large (Cohen, 1988).

Skills that differentiate good and poor comprehenders at Time 1

A series of t tests was performed on the Time 1 measures comparing good and poor comprehenders. The mean scores and results of the t tests are shown in Table 1. The two groups differed on many comprehension-related skills that have differentiated similarly selected groups in previous work; namely, verbal working memory, the ability to structure stories, knowledge about the purpose of story titles, inference and integration and comprehension monitoring (Cain, 1996, 2003; Cain et al., 2004; Cain, Oakhill, & Lemmon, 2004; Oakhill et al., 2005; Oakhill, 1982). The two groups did not differ on the digit working memory measure (in contrast to Yuill et al., 1989). There was little evidence of more generalized language and verbal impairments. The groups did not obtain significantly different scores on the measure of syntactic knowledge, TROG (in contrast to Stothard & Hulme, 1992), but the good comprehenders obtained significantly higher scores on the measure of receptive vocabulary, BPVS. The two groups obtained comparable scores on the performance ability measure of the WISC-III although the good comprehenders demonstrated marginally higher verbal ability scores.1

Variations in language and cognitive skills in children with poor reading comprehension

Table 2 shows the distribution of scores obtained by the poor comprehenders at Time 1. The scores used were the standardized scores for the BPVS, PIQ and VIQ assessments, for which the hypothesized mean is 100 with a standard deviation of 15. For the remaining assessments, z scores for the entire sample in our study (N = 102) were used to indicate skill strength or weakness. A composite memory score was calculated from the mean z scores of the two memory measures and a composite comprehension score was calculated from the mean of the four comprehension assessments. The two vocabulary assessments were explored separately because the Gates-MacGinitie measure involves word reading skill, whereas the BPVS is a measure of receptive vocabulary. The group is divided into those who exhibited a deficit (score below the mean) or an advantage (above the mean) on each measure.

The majority of the poor comprehenders performed below the sample mean on all measures with the exception of the two vocabulary measures (Gates-MacGinitie, BPVS)

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1 This marginal difference should be treated with caution because of the number of comparisons made.
Profiles of poor comprehenders

Table 1. Time 1 descriptive statistics for good comprehenders, poor comprehenders and the total sample

<table>
<thead>
<tr>
<th>Measure</th>
<th>Total sample (N = 102)</th>
<th>Poor comprehenders (N = 23)</th>
<th>Good comprehenders (N = 23)</th>
<th>t(44)</th>
<th>Effect size Cohen's d</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chronological age</td>
<td>7.07 (3.28)</td>
<td>7.07 (2.88)</td>
<td>7.07 (3.44)</td>
<td>0.51</td>
<td></td>
</tr>
<tr>
<td>Neale reading accuracy</td>
<td>7.10 (6.27)</td>
<td>7.10 (4.58)</td>
<td>7.10 (5.30)</td>
<td>0.29</td>
<td></td>
</tr>
<tr>
<td>Neale reading comprehension</td>
<td>7.04 (11.19)</td>
<td>6.05 (9.22)</td>
<td>8.04 (6.64)</td>
<td>9.51***</td>
<td>2.74</td>
</tr>
<tr>
<td>BPVS</td>
<td>102.99 (9.50)</td>
<td>98.57 (11.69)</td>
<td>106.30 (6.36)</td>
<td>2.79**</td>
<td>0.82</td>
</tr>
<tr>
<td>Gates-MacGinitie</td>
<td>34.30 (4.63)</td>
<td>34.26 (4.22)</td>
<td>35.74 (4.75)</td>
<td>0.36</td>
<td></td>
</tr>
<tr>
<td>VIQ</td>
<td>10.42 (2.18)</td>
<td>9.56 (1.80)</td>
<td>10.67 (1.99)</td>
<td>1.98(*)</td>
<td>0.58</td>
</tr>
<tr>
<td>PIQ</td>
<td>10.45 (2.47)</td>
<td>9.85 (3.03)</td>
<td>11.15 (2.32)</td>
<td>1.64</td>
<td></td>
</tr>
<tr>
<td>TROG</td>
<td>21.61 (2.67)</td>
<td>20.96 (2.27)</td>
<td>22.17 (2.94)</td>
<td>1.55</td>
<td></td>
</tr>
<tr>
<td>WM verbal</td>
<td>11.30 (3.05)</td>
<td>10.30 (2.73)</td>
<td>12.57 (3.51)</td>
<td>2.43*</td>
<td>0.72</td>
</tr>
<tr>
<td>WM digit</td>
<td>10.68 (3.05)</td>
<td>10.35 (2.82)</td>
<td>10.83 (3.27)</td>
<td>0.53</td>
<td></td>
</tr>
<tr>
<td>Story anagram</td>
<td>.80 (.16)</td>
<td>.74 (.15)**</td>
<td>.84 (.17)</td>
<td>2.06*</td>
<td>.62</td>
</tr>
<tr>
<td>Story titles</td>
<td>2.93 (1.15)</td>
<td>2.23 (1.08)</td>
<td>3.65 (1.77)</td>
<td>5.11***</td>
<td>1.51</td>
</tr>
<tr>
<td>Monitoring</td>
<td>14.54 (3.10)</td>
<td>12.74 (3.32)</td>
<td>16.17 (2.25)</td>
<td>4.11***</td>
<td>1.21</td>
</tr>
<tr>
<td>Inference and integration</td>
<td>14.84 (3.75)</td>
<td>13.60 (3.91)</td>
<td>16.00 (3.38)</td>
<td>2.22*</td>
<td>.66</td>
</tr>
</tbody>
</table>

*One poor comprehender absent.
*p < .05, **p < .01, ***p < .001, (*)p = .064.

Key for labels used in tables:
Chronological age, Neale word reading accuracy, Neale comprehension scores all given as years, months (months).
BPVS = British Picture Vocabulary Scales, standardized scores.
Gates-MacGinitie = Gates-MacGinitie Sight Vocabulary Test, maximum score = 45.
VIQ = mean standard scores from verbal scale of WISC-III.
PIQ = mean standard scores from performance scale of WISC-III.
TROG = Bishop's Test of Reception of Grammar, maximum score = 28.
WM verbal = verbal working memory task and WM digit = digit working memory task, maximum score = 27.
Story anagram = story structure task, concordance scores.
Story titles = story titles task, maximum score = 4.
Monitoring = a comprehension monitoring task, maximum score = 24.
Inference and integration = inference making task, maximum score = 16.

For the working memory measures, 9 of the 23 children obtained below mean scores on both measures, and 12 of the 23 poor comprehenders obtained below mean scores on three or four of the comprehension subskills. Despite obtaining significantly lower mean BPVS scores than good comprehenders in the group comparisons, the majority of poor comprehenders did not present a receptive vocabulary deficit in relation to age-appropriate performance. In contrast, although the poor comprehenders’ mean VIQ score was only marginally lower than that obtained by the good comprehenders, the majority of this group obtained VIQ scores that were below the mean for their age.
Table 2. Number of poor comprehenders with scores above or below the sample mean on Time 1 measures

<table>
<thead>
<tr>
<th>Measure</th>
<th>Deficit of at least</th>
<th>Score between 0 and −1 SD</th>
<th>Score between 0 and +1 SD</th>
<th>Advantage of at least</th>
</tr>
</thead>
<tbody>
<tr>
<td>BPVS</td>
<td>3</td>
<td>7</td>
<td>13</td>
<td>0</td>
</tr>
<tr>
<td>Gates-MacGinitie</td>
<td>2</td>
<td>9</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>VIQ</td>
<td>4</td>
<td>11</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>PIQ</td>
<td>7</td>
<td>3</td>
<td>8</td>
<td>5</td>
</tr>
<tr>
<td>TROG</td>
<td>3</td>
<td>11</td>
<td>8</td>
<td>1</td>
</tr>
<tr>
<td>Memory composite</td>
<td>2</td>
<td>13</td>
<td>8</td>
<td>0</td>
</tr>
<tr>
<td>Comprehension composite</td>
<td>3</td>
<td>16</td>
<td>4</td>
<td>0</td>
</tr>
</tbody>
</table>

Relations between verbal and vocabulary ability and literacy development in children with poor reading comprehension

There was no evidence for the specific verbal ability deficit found by Stothard and Hulme (1996). Poor comprehenders obtained mean PIQ standard scores that were comparable to their VIQ scores (scores in Table 1): t(22) < 1. Variations within the sample of 23 poor comprehenders were evident. Seven children obtained VIQ scores below the mean and PIQ scores above the mean, whereas only two presented the opposite pattern. Eight children were poor on both measures and six obtained scores higher than the mean on both.

To determine whether variations in cognitive ability or vocabulary skills were associated with different profiles of literacy performance, we classified the poor comprehenders on the basis of their general cognitive ability (mean of the standard scores from the four subtests of WISC-III) and their receptive vocabulary knowledge (BPVS standardized scores). Thirteen children obtained an average score from the IQ subtests above the population mean of 10 (M = 11.08, SD = 0.88) and 10 children obtained below the population mean (M = 7.93, SD = 1.02). These were the high and low cognitive ability groups, respectively. Thirteen poor comprehenders obtained a BPVS standardized score above the population mean of 100 (M = 107.16, SD = 4.16) and 10 obtained a score below mean scores (M = 87.40, SD = 1.41). These were the high and low vocabulary groups, respectively.

The high- and low-ability (cognitive and vocabulary) groups did not differ in their reading comprehension and word reading levels at Time 1 (all ts < 1.4, all ps > .15), but general cognitive and vocabulary skills at age 8 years affected the progress made in reading between 8 and 11 years. Poor comprehenders with low cognitive ability at Time 1 made significantly less progress in reading comprehension than those with high cognitive ability. The means (and standard deviations) for the low cognitive (N = 9) and high cognitive (N = 10) groups were 17.0 (10.2) and 27.6 months (5.9), respectively, t(17) = 2.81, p < .015, d = 1.27. These groups made comparable progress in word reading development: 46.9 (14.7) and 46.9 months (15.7), respectively, t(17) < 1. In contrast, the comparisons between the high (N = 10) and low (N = 9) vocabulary groups revealed a significant difference in the progress made in word reading accuracy. In order, the means (and standard deviations) were 53.7 (10.2) and 39.3 (15.9), t(17) = 2.37, p = .030, d = 1.08. These two groups did not differ significantly in the progress made in reading comprehension development, obtaining means of 24.5 (8.9) and 20.4 (10.5) months, respectively, t(17) < 1. The comparisons are based on a small
sample size, so caution must be taken when interpreting these results. However, where comparisons were significant, substantial effects were apparent.

**Persistence of a comprehension impairment**

The children classified as good and poor comprehenders at Time 1 differed significantly in their reading comprehension level three years later (M1 = 124.8 and 98.4 months, SDs = 13.7 and 12.4), t(34) = 6.08, p < .001, d = 2.02. The two groups also differed in their scores on the listening comprehension measure (M1 = 24.5 and 20.3, SDs = 4.7 and 4.4), t(30) = 2.62, p < .05, d = .93. Surprisingly, there was not a significant difference in word reading level (M1 = 145.4 and 140.2 months, SDs = 10.6 and 15.0), t(34) = 1.20, p = .24. Poor comprehenders, in general, maintain their reading comprehension deficit, but poor comprehension at 8 years does not necessarily lead to depressed word reading development.

At 11 years of age, a large proportion of our sample obtained word reading accuracy scores that were more than 12 months above their chronological age. (Possible reasons for this are explored in the Discussion). Children whose reading comprehension scores were below their chronological age at outcome were classified as poor comprehenders. One child classified as a poor comprehender at Time 1 obtained an age-appropriate comprehension score at outcome. In the original good comprehender population, four children obtained reading comprehension scores below both their chronological age and the sample mean at outcome. Thus, although the impairments and advantages remained fairly consistent, there were exceptions.

**Educational implications of a comprehension impairment**

The good comprehenders obtained significantly higher scores than the poor comprehenders on all SAT measures. The mean raw scores for the two groups in order are as follows: English, M1 = 66.3 and 60.3, SDs = 7.4 and 8.0, t(31) = 2.23, p < .05, d = .78; maths, M1 = 78.7 and 63.7, SDs = 10.2 and 17.5, t(31) = 3.57, p < .01, d = 1.05; science, M1 = 61.6 and 51.9, SDs = 7.1 and 8.4, t(31) = 3.57, p < .01, d = 1.25. Cohen's d indicates medium-large effects, but it should be noted that the raw scores correspond to an average attainment of Level 4 (age appropriate) for both groups for all subject areas.

The standardized scores obtained on the three different assessments of reasoning ability revealed age-appropriate performance in verbal, non-verbal and quantitative skills for both good and poor comprehenders: CAT verbal, M1 = 109.7 and 100.8, SDs = 7.1 and 7.4; quantitative, M1 = 106.4 and 102.2, SDs = 7.8 and 9.5; non-verbal, M1 = 108.7 and 103.7, SDs = 9.9 and 9.3. However, there was a significant difference between the good and poor comprehenders on the measure of verbal reasoning, t(30) = 3.43, p < .01, d = 1.23. Comparisons on the other two measures were not significant, both ts < 1.5, both ps > .14.

Correlational analyses revealed that verbal reasoning was significantly related to SAT performance: maths, r = .54, p < .01; science, r = .60, p < .001; English, r = .63, p < .001. It was also significantly correlated with both concurrent comprehension, r = .64, p < .001, and comprehension three years earlier, r = .67, p < .001 (N = 29). One factor that might underpin the relations between verbal reasoning and these other

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2 An alternative method by which we calculated the z scores for comprehension scores of the entire sample and compared children who obtained comprehension scores above and below the mean gave the same results.
measures is verbal working memory, a skill that is associated with good comprehension 
(e.g. Cain, Oakhill, & Bryant, 2004). There was little evidence for that. When working 
memory scores were partialled out, there were significant correlations between Time 3 
verbal reasoning and comprehension \((r = .54)\), SATs English \((r = .55)\) and science 
\((r = .43)\), all \(ps < .025\), although the correlation between verbal reasoning and SAT 
maths no longer reached significance, \(r = .27, p = .16\).

**Discussion**

In this paper, we addressed three issues related to poor reading comprehension: 
(i) Variations in language and cognitive skills in children with poor reading 
comprehension - are there consistent language and cognitive skill deficits associated 
with poor reading comprehension skills at 8 years of age? (ii) Relations between verbal 
and vocabulary ability and literacy development in children with poor reading 
comprehension - does poor verbal ability or vocabulary knowledge result in a more 
severe comprehension impairment at 8 years or affect the progress made in reading 
between 8 and 11 years? (iii) Persistence and educational implications of a 
comprehension impairment - how does poor comprehension when aged 8 impact 
upon later reading performance and educational attainment? We discuss the findings 
relating to each, in turn, and consider the educational and theoretical implications of 
this work.

Children with reading comprehension problems presented deficits on a range of 
literacy assessments associated with the meaning-based aspects of reading. Of interest to 
both theoretical models of reading development and educational practitioners was the 
substantial heterogeneity within this population. The effect sizes for the significant 
group comparisons indicated medium-large effects, but we did not find consistent 
deficits associated with poor reading comprehension. This work extends previous 
studies by demonstrating profile differences across a range of literacy tasks. Although 
poor comprehenders in general may suffer from weak monitoring skills or inferior 
inference making ability, some poor comprehenders demonstrate average or even good 
performance on these tasks relative to peers. The low reliability of the inference 
measure means that that result should be treated with caution. However, this measure 
has previously demonstrated reliable group differences between good and poor 
comprehenders (e.g. Oakhill, 1982).

There were no significant differences between good and poor comprehenders' 
knowledge of the meanings of single written words or grammatical structures. However, 
the performance of some poor comprehenders on these measures was greater than one 
standard deviation below the group mean. Although this analysis was not designed to 
address causality, we can speculate that some children in our sample might have 
experienced problems in their processing of text because of weak word- or sentence-
level skills, whilst others may have been limited by weak higher order processing skills. 
Unfortunately, the sample size does not provide sufficient power to test such 
hypotheses; further work with a much larger sample is required.

The results of our profiling concur with those obtained by Cornoldi et al. (1996) in 
that no clear fundamental weakness was apparent. Instead, this work indicates that 
group comparisons may obscure crucial weaknesses in the individual. For the 
practitioner, these findings highlight the need to tailor intervention programmes to the 
specific weaknesses presented by each child. For the theorist, they indicate that reading 
comprehension level can be determined by many different language and cognitive
Our understanding of comprehension development may be better advanced by investigation of the interaction between different language and cognitive abilities, rather than a focus on lower- or higher-level reading-related skills.

There was no evidence that poor comprehenders with low cognitive or vocabulary skills were more severely impaired on concurrent measures of language and literacy than their more able peers. Thus, cognitive and verbal skills do not appear to be prerequisites for the attainment of age-appropriate reading comprehension in the early stages of reading. However, initial levels of cognitive ability were related to growth in their reading comprehension and initial levels of receptive vocabulary were related to growth in word reading indicating that cognitive ability and vocabulary skills act as facilitators of comprehension and word reading, respectively. Although the sample size was small, the effect sizes of these differences were substantial. Thus, this finding warrants further investigation with a larger sample.

The relation between cognitive ability and growth in reading comprehension might have arisen if the cognitive ability scores reflected general information processing and reasoning capacity. These skills could, in turn, underpin growth in text processing skill. There was no evidence that the good and poor comprehenders differed in reasoning skill in general, when aged 11; a significant and sizable group difference was only found on the measure of verbal reasoning. Thus, it may be that poor comprehenders have an impairment with processing complex information in the verbal domain, but not a general reasoning impairment. One source of these difficulties in text processing and verbal reasoning might be the well-documented working memory deficits experienced by poor comprehenders. However, the significant relation between comprehension skill and verbal reasoning was apparent even when verbal working memory skills were partialled out. Processing capacity is clearly not the sole determinant of this relation. A detailed analysis of the processing skills and abilities that determine verbal reasoning should inform the relation between these measures.

The relation found between vocabulary and word reading development is very interesting. Vocabulary is associated with good text comprehension, but there is evidence for a relation with word reading as well. For example, Haghtvet (2003) found strong correlations between vocabulary knowledge and word decoding skill in poor readers. One possibility for the relation between semantic knowledge and the development of accurate word reading is the mechanism specified in some connectionist models of word reading. Harm and Seidenberg (2004) suggest that whereas the meanings of unfamiliar words are accessed only after decoding, a stronger direct link from the written to the semantic representation exists for familiar words. Another possibility is that the initial levels of receptive vocabulary skill reflected home literacy environment (e.g. Foy & Mann, 2003), which might go on to influence out-of-school reading and practise in word reading and therefore growth in this skill. Alternatively, phonological memory may underpin the relation - it is related to acquisition of receptive vocabulary (Gathercole, Hitch, Service, & Martin, 1997) and also word reading development (Passenger, Stuart, & Terrell, 2000). Further longitudinal work is required to disentangle these relations.

The majority of the good and poor comprehender groups maintained their status across the three years. However, the poor comprehenders did not fall behind in their word reading skills. Children with poor comprehension may engage in less out-of-school reading because they derive less enjoyment from the activity that children with good text comprehension skills, or they may choose to read less demanding literature and therefore encounter fewer new words in print each year. If so, one would predict that their word
reading skills would not develop in line with those of their peers. The absence of word reading deficits in our poor comprehender sample when aged 11 was surprising and warrants consideration. This finding might be a consequence of the criteria used to select the good and poor comprehenders for this analysis. Children who obtained word reading ages that were more than 6 months below their chronological age were excluded, to ensure that the poor comprehenders were not weak readers, in general. The majority of our sample was reading above their chronological age at 11 years, as measured on our standardized assessment. These children may have had the fundamental skills necessary to make good progress in reading such that their word reading skills were not at risk. We would predict limited growth for children who had weaker word reading skills at outset.

Children with poor comprehension at 7 to 8 years had a poorer educational outcome than their peers, in contrast to Nation et al’s (2002) finding that only the low-ability poor comprehenders were poorer on maths (assessed concurrently). It should be noted that the poor comprehenders were not underperforming for their age, obtaining an average score that corresponds to Level 4, yet their scores were significantly below those of their skilled peers and the effect sizes were substantial.

One explanation for the link between reading comprehension and performance on the curriculum-based maths and science tests might lie in the processing skills that underpin performance on these measures. Reading comprehension and working memory capacity are correlated (Cain et al., 2004), and working memory capacity is related to performance on the national curriculum assessments taken at 7 years (Gathercole & Pickering, 2000). However, although working memory skills may have affected performance on these tasks, some of our poor comprehenders did not experience a working memory deficit. Thus, other factors must have accounted for their poorer performance.

Relative to good comprehenders, the poor comprehenders obtained lower scores on measures of English, mathematics and science when aged 11 years, yet their reasoning skills were not impaired relative to their age. The poor comprehenders obtained verbal reasoning scores below those obtained by the good comprehenders and the correlations between verbal reasoning and performance on the SATs indicates a surprisingly strong association. These relations were based on a very small sample size and should be treated cautiously. However, we recommend that further analysis of the teaching and assessment of maths and science is carried out to assess how reliant they are on verbal reasoning skills. As it stands, these findings suggest that children with poor verbal reasoning skills may be impaired across the wider curriculum.

This study raises many interesting questions about reading comprehension impairments for both the theorist and practitioner. We did not identify any concurrent skill deficits that were consistently associated with poor comprehension: within the population of poor comprehenders, there was considerable difference in the range of skill strengths and weaknesses. However, poor comprehenders with weak vocabulary skills and poor cognitive ability were vulnerable to impaired growth in word reading and reading comprehension, respectively. Furthermore, poor comprehenders performed more poorly than their peers in areas of the educational curriculum other than English.

We conclude that the determination of reading comprehension skill is considerably more complex than the result of a simple relation with cognitive level, verbal ability or reasoning skills, although these factors clearly play a role. When comprehension problems are identified, careful analysis of other language and cognitive skills must inform remediation. Intervention studies will not only aid the education of the poor comprehender in the classroom, but they will also inform our understanding of the skills that contribute to comprehension problems.
References


