

# Reading with vocabulary intervention: evaluation of an instruction for children with poor response to reading intervention

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Interventions combining phonically based reading instruction with phonological training are generally effective for children with reading (decoding) difficulties. However, a minority of children respond poorly to such interventions. This study explored the characteristics of children who showed poor response to reading intervention and aimed to improve their literacy and language skills via a new theoretically motivated intervention. Twelve 8-year-old treatment poor responders with severe and persisting reading difficulties participated. A 9-week reading intervention incorporating reading, phonological and vocabulary training was implemented. Before the intervention began the children showed almost no progress over 6 months of regular classroom education, on measures of oral language and literacy. Over the intervention period improvements were made on measures of reading, phonological awareness and language skills, which were maintained 6 months later. Although the intervention was effective, it should be noted that most children remained poor readers and require ongoing remediation.

It is now well established that the most common forms of reading disability are associated with phonological deficits – that is, difficulty with the representation or processing of speech sound information (Vellutino, Fletcher, Snowling & Scanlon, 2004, for review). The most persuasive evidence for this relationship is provided by intervention studies which demonstrate that training in phonological awareness improves not just phonological abilities, but also broader reading skills (e.g. Byrne, Fielding-Barnsley & Ashley, 2000; Lundberg, Frost & Peterson, 1988). Interventions that are particularly successful in enhancing reading ability are those which not only train phoneme awareness, but make explicit its link with reading (e.g. Blachman, Ball, Black & Tangel, 1994; Hatcher, Hulme & Ellis, 1994; Hatcher et al., 2006; Iverson & Tunmer, 1993. See also Bus & Van IJzendoorn, 1999 for a meta-analytic review).

Compared with our understanding of best practice for reading instruction and reading interventions for poor readers (National Reading Panel, 2000), much less is understood about why a significant proportion of children fail to benefit from evidence-based methods of teaching. Torgesen (2000) refers to this as ‘the lingering problem of treatment resisters’. A treatment resister is defined as a child who has failed to respond favourably to an otherwise effective form of reading intervention but there is, as yet, no uniform definition for this group of children (Fuchs & Fuchs, 2006). In a review of five interventions, all of which used a phonologically based approach and common outcome measures, the rate of non-response was calculated as falling between 10% and 46% (Torgesen, 2000). More generally, prevalence estimations will inevitably vary according to a number of factors including sample selection, and focus, length and integrity of the intervention programme (Al Otaiba & Fuchs, 2002; Fuchs & Fuchs, 2002).

There is mounting interest in individual differences in children’s responsiveness to reading interventions. Nelson, Benner and Gonzalez (2003) conducted a meta-analysis in which they calculated the mean effect size of various learner characteristics upon responsiveness to interventions. Seven variables were found to relate to response to intervention, with better skills being related to better response. The average effect sizes (weighted for sample size) were: rapid naming (0.51), problem behaviour (0.46), phonological awareness (0.42), alphabetic principle (0.35), memory (0.31), IQ (0.26) and demographics – namely disability, ethnicity and grade level (0.07 – non-significant). The effects of rapid naming, problem behaviour and phonological awareness were significantly greater than those of the remaining variables. The pattern of results summarised by Nelson et al. (2003) is typified well in a study by Torgesen et al. (1999), which compared the efficacy of two intensive phonologically based reading interventions designed to boost the reading skills of emergent readers with weaknesses in phonological processing. Even following the more successful of the two interventions (Phonological Awareness plus Synthetic Phonics – PASP), 21% of children remained below average on a test of word reading accuracy. Exploring predictors of response to intervention, growth in nonword reading was predicted by rapid naming, behaviour and home environment; growth in word reading was additionally predicted by phonological awareness and phonological memory.

Vellutino et al. (1996) compared groups of poor readers who displayed either very good or very limited growth in reading skills over the course of a reading intervention that incorporated phonological awareness training. Like Torgesen et al. (1999) they found that measures of phonological processing skills (e.g. phoneme segmentation, rapid naming and phonological coding) most reliably distinguished the two groups, with the poor responders displaying significant weaknesses relative to the children who responded well. It is apparent therefore that poor phonological skills and slow naming speed are related to a poorer response to reading intervention.

It is somewhat surprising that oral language skills which extend beyond phonology are omitted from the list of factors affecting responsiveness to intervention, as several distinct lines of inquiry suggest that such skills may be important. First is the acknowledgement that broader oral language skills (e.g. vocabulary and grammar) relate to word reading in typical development, though how their effects are mediated remains poorly understood. Whereas non-phonological oral language consistently correlates with word reading accuracy, this relationship has been found by some to be direct (Catts, Fey, Zhang & Tomblin, 1999; Dickinson, McCabe, Anastasopoulos, Peisner-Feinberg & Poe, 2003; Nation & Snowling, 2004; NICHD Early Child Care Research Network, 2005) and by

others to be indirect (e.g. Muter, Hulme, Snowling & Stevenson, 2004; Storch & Whitehurst, 2002), with a proposed mediating influence of phonological awareness (Metsala & Walley, 1998; NICHD, 2005; Storch & Whitehurst, 2002). There is some evidence that the relationship may be diachronic in nature (e.g. Wagner et al., 1997), and indeed may be moderated by a number of other variables, including the subskill of non-phonological oral language being tested (e.g. Ouellette, 2006), the type of words being read (with a greater influence on exception words than regular or nonwords, e.g. Ricketts, Nation & Bishop, 2007) and phoneme awareness skills (with a stronger influence in children with more proficient phonemic skills, e.g. Dickinson et al., 2003; Muter et al., 2004).

Second, there is high comorbidity between reading and language disorders: reading difficulties are frequently observed in children with language impairment (Bishop & Snowling, 2004; Botting, Simkin & Conti-Ramsden, 2006; Nathan, Stackhouse, Goulandris & Snowling, 2004) and complementary studies demonstrate the prevalence of oral language difficulties beyond phonology in children with reading disabilities (Catts et al., 1999; Snowling, Muter & Carroll, 2007). Finally, emerging evidence suggests that measures of non-phonological oral language – namely expressive vocabulary, receptive vocabulary and sentence imitation – predict response to intervention (Al Otaiba & Fuchs, 2006; Vadasy, Sanders & Abbott, 2008; Whiteley, Smith & Connors, 2007). With such findings as a backdrop, the first aim of the present study was to explore non-phonological oral language skills in children who show poor response to reading intervention. Such research is timely given our extensive understanding of effective interventions but the relative neglect of this small but significant population.

To achieve this aim, we selected children who had shown a poor response in a randomised controlled trial of *Reading Intervention* (Hatcher et al., 2006). In this study, 74 children (representing the bottom 8% of the population for reading development) received daily instruction, delivered by a trained teaching assistant (TA) for either 10 (waiting group) or 20 (experimental group) weeks. The intervention, which alternated between individual and small group sessions, entailed training in letter-sound knowledge, phoneme awareness and the linkage of these skills to reading and writing (Hatcher, 2000). Within the first 10 weeks of intervention, the experimental group made a significant gain of 4.58 standard score points on a test of single word reading (population  $M = 100$ ;  $SD = 15$ ), as compared with the waiting group which made a non-significant gain of 0.86 standard score points. Over the entire 20 weeks of intervention, the experimental group made an average increase of 7.07 standard score points, and the waiting group gained 5.76 standard points. However, as the authors noted, the impressive average gains made in reading masked wide variation in the degree of progress made by individuals. In fact, from pre- to post-intervention, 27% of children showed declines in word reading standard scores indicating that their reading progress was not keeping pace with development. These poor responders are the focus of the present investigation.

Led by our findings relating to the language profile of this cohort of children, the second aim of the study was to design and implement a form of reading intervention that targeted reading and phonological skills in the context of a broader language intervention incorporating vocabulary training. This more holistic approach to reading intervention draws upon the theoretical position that vocabulary growth precipitates the development of phoneme awareness. Thus, the lexical restructuring hypothesis (Metsala & Walley, 1998; Walley, 1993) asserts that vocabulary growth forces lexical representations to become increasingly specified and/or segmental, in order that they may remain distinct.

In turn, phonological awareness that is highly segmental (at the level of the phoneme) has been demonstrated to be causally related to reading (Byrne et al., 2000; Hatcher et al., 1994). We predicted that this ‘phonology plus vocabulary’ intervention would enhance the children’s phonological awareness, vocabulary, expressive language and reading abilities.

## Method

A 9-week intervention was implemented for 12 children who had failed to respond to a previous reading intervention. The children were assessed for monitoring purposes in November 2005 (*t*<sub>1</sub>, mean age = 7 years 8 months), a year and a half after completion of the first intervention. They were then assessed before the second intervention in May 2006 (*t*<sub>2</sub>, mean age = 8 years 1 months), immediately following this intervention in July 2006 (*t*<sub>3</sub>, mean age = 8 years 3 months) and 6 months later in January 2007 (*t*<sub>4</sub>, mean age = 8 years 9 months).

### Participants

Children who had demonstrated poor response to the reading intervention described by Hatcher et al. (2006) were identified for further study. The timeline in Figure 1 records the progression of participants through both of the interventions. Twenty children who had shown declines in *BAS II* word reading standard scores as a result of intervention were designated as poor responders at immediate post-testing, of whom 18 were available for maintenance testing 11 months after the intervention had ceased (mean reading standard score = 75.78; *SD* = 11.20). Of these 18 children, 5 had now improved (to attain a minimum standard score of 84) and were removed from the sample, leaving 13 children. A further 7 children, who were initially among the ‘responders’, had a reading standard score of <80 at the point of re-test (range 75–79). These children were added to the sample of poor responders, as their reading scores were far from normalised following the intervention.

Thus, it was the aim to follow up a sample of 20 treatment poor responders, who were deemed to have persisting and severe reading difficulties. After selection of the group,

| School year                   | Hatcher et al. (2006b) |          |           |                          | Present Study                    |                                |                                 |                                   |
|-------------------------------|------------------------|----------|-----------|--------------------------|----------------------------------|--------------------------------|---------------------------------|-----------------------------------|
|                               | Year 1                 |          |           | Year 2                   | Year 3                           |                                |                                 |                                   |
| Testing point                 | Pre-test               | Mid-test | Post-test | Maintenance              | Monitoring <i>t</i> <sub>1</sub> | Pre-test <i>t</i> <sub>2</sub> | Post-test <i>t</i> <sub>3</sub> | Maintenance <i>t</i> <sub>4</sub> |
|                               | December 03            | April 04 | July 04   | June 05                  | November 05                      | May 06                         | July 06                         | January 07                        |
| No. of poor responders        |                        |          | 20        | 18 (of which 5 resolved) | 16                               | 12                             | 12                              | 11                                |
| Additional poor readers (<80) |                        |          |           | 7 low reading            |                                  |                                |                                 |                                   |
| Total sample (this study)     |                        |          |           | 20                       | 16                               | 12                             | 12                              | 11                                |

**Figure 1.** A timeline of the various testing points across the two interventions throughout children’s schooling. *Note:* Year 1 corresponds to children’s second year of formal schooling.

**Table 1.** Means (and standard deviations) and ranges of behavioural traits for the group of poor responders ( $N = 11$ ), as assessed by teacher report at  $t1$  using the SDQ.

| Behavioural trait   | Maximum score | Mean (SD)    | Range      |
|---------------------|---------------|--------------|------------|
| Prosocial behaviour | 10            | 6.18 (2.99)  | 1.00–10.00 |
| Hyperactivity       | 10            | 6.36 (2.98)  | 1.00–10.00 |
| Emotional symptoms  | 10            | 2.09 (2.30)  | 0.00–8.00  |
| Conduct problems    | 10            | 1.64 (1.75)  | 0.00–5.00  |
| Peer problems       | 10            | 2.36 (2.91)  | 0.00–9.00  |
| Total difficulties  | 40            | 12.45 (7.71) | 2.00–30.00 |

four were unavailable for testing, leaving 16 children. Before the intervention, one child was excluded from the sample, as she now appeared to fall within the normal range on word reading. Furthermore, two schools withdrew from the project, leaving a final cohort of 12 children who received the intervention. These children had previously participated in *Reading Intervention* during Year 1, when they were aged on average 5 years 9 months. At  $t4$  in the present study (6 months after the second intervention had finished), 11 of the 12 participants were available for maintenance testing; one child had moved school and was not contactable (Figure 1).

Demographically, these children were drawn from backgrounds of relatively low socioeconomic status. Data extracted from the initial intervention project revealed that 7/12 children who participated in the intervention (58%) received free school meals, a widely used index of financial hardship. This rate is considerably above the national average of 18% of primary school children (Nelson & Nicholas, 2006 – Department for Children Schools and Families). All children spoke English as their first and only language. The *Strength and Difficulties Questionnaire (SDQ)* – Goodman, 1997) categorised the group of children as normal on the majority of subscales (prosocial, emotional, conduct and peer problems), and just falling into the borderline category for hyperactivity and total social deviance (see Table 1).

### Assessment battery

Children were seen individually on four occasions at their own school, in a room free from distraction. At  $t1$  children were assessed for monitoring purposes and to investigate their cognitive strengths and difficulties. They were administered an extensive test battery in one session which lasted for approximately 75 minutes. Pre-intervention testing occurred at  $t2$  in a testing session that was approximately 25 minutes long. The post-intervention testing session at  $t3$  lasted on average 40 minutes per child. Children were seen a final time for 20 minutes each in a follow-up testing session ( $t4$ ).

### Literacy

*Letter-sound knowledge (t2, t3).* Children were shown all 26 letters in the English alphabet and asked to identify them by their sound (reliability coefficient .96, taken from Muter et al., 2004).

*Spelling (t1).* Each child was required to spell five trisyllabic words (after Goulandris, 1996). This yielded two scores: a raw score (maximum = 5) and number of phonemes correct (maximum score = 38). (Inter-rater reliability ranged from .92 to .99.)

*Reading.* The *British Abilities Scale II (BAS II) Word Reading Test* (Elliot, Smith & McCulloch, 1997) is a standardised test of single word reading accuracy, and was

administered at all testing points. It has a maximum of 90 items, which are presented in order of increasing difficulty. Testing was discontinued once eight errors had been made in a block of 10 words (age-appropriate reliability coefficient .98).

### *Phonological awareness*

*Phoneme awareness (t1, t2, t3, t4)*. Three subscales from the *Sound Linkage Test of Phonological Awareness* (Hatcher, 2000) provided a measure of ability to manipulate phonemes. Children were first required to blend phonemes, e.g. upon hearing /t/ - /æ/ - /p/, they were to produce 'tap'. Next, they were asked to segment phonemes, for example, break up *pet* into its constituent phonemes - /p/ - /ɛ/ - /t/. Finally, the children were required to delete phonemes from the beginning, middle or end of a word, for example, /g/ from *gone* makes 'on'. Each subscale has two practice items and six test items (maximum score 18). The test was discontinued after eight consecutive errors. (The reliability coefficient for all seven subtests of the Sound Linkage test [Hatcher, 2000] is .94.)

*Nonword repetition (t1)*. The *Children's Test of Nonword Repetition (CNRep)* - Gathercole & Baddeley, 1996) was administered as a test of phonological memory. Children were required to repeat 40 individual nonwords, which ranged from two to five syllables in length, for example *glistow*, *versatrationist* (reliability coefficient .77).

### *Oral language*

*Vocabulary (t1)*. The Vocabulary subtest from the *Wechsler Abbreviated Scale of Intelligence (WASI)* - Wechsler, 1999) was used to provide a measure of verbal ability. In this test, children are required to define a set of words that gradually increase in complexity - from *shirt* to *enthusiastic* (for this age group). Answers are scored on a scale of 0-2, according to their quality (maximum score 56). (Age-appropriate reliability coefficient .86; inter-rater reliability: .97 at t1; .98 at t3.)

*Target vocabulary (t3, t4)*. A vocabulary test was devised to specifically measure performance on target vocabulary words that were taught during the intervention. An individualised selection of 15 taught words was generated for each child. As a baseline control, 15 words that were not taught to any of the children were also randomly selected (see Appendix). The children were asked to define each of these 30 words. The frequency of occurrence of the words (as measured by Kucera-Francis written frequency - MRC Psycholinguistic Database; Wilson, 1987) was controlled for each child across the taught and untaught word lists. Definitions were scored on a 3-point scale in accordance with the general scoring principles for an analogous test (the vocabulary subtest from the *WASI*), and with reference to the prescribed definitions that the children were provided in the intervention. There was a maximum of 30 points for each subset of words (inter-rater reliability .92).

*Grammar (t1, t2, t3)*. The *Action Picture Test (APT)* - Renfrew, 1997) was administered to each child. They were shown 10 pictures and asked a question concerning each one. The questions were designed to elicit use of certain grammatical forms, and responses were scored according to the use of these (maximum score 37). An information score was also calculated, which represented the ability to provide relevant content in answers (maximum score 40). (Inter-rater reliability for both subtests across all three time points ranged from .96 to .99.)

*Speed of processing*. To assess speed of processing, a construct considered indicative of general processing resources (Anderson, 1992), two subtests from the *Wechsler*

*Intelligence Scale for Children (WISC-III – Wechsler, 1992)* were administered. An index score is calculated by summing the scaled scores obtained on each subtest.

*Symbol search (t1)*. In this task, children were required to identify whether or not a target symbol was present among a group of distractors. There was a maximum time of 2 minutes in which to complete as many items as possible (maximum score 45). (Inter-rater reliability .76.)

*Coding (t1)*. This timed test entailed coding of as many symbols as possible in 2 minutes, in accordance with a predetermined visible key (maximum score 65 for 6- and 7-year-olds; 119 for 8-year-olds). (Reliability .70.)

*Behaviour*. At *t2*, each child's class teacher was asked to fill in the *SDQ* (Goodman, 1997) to provide an insight into children's behavioural profiles. Respondents are required to assess the degree to which statements are characteristic of children. The 25-item questionnaire collapses into five subscales: prosocial behaviour, hyperactivity, emotional symptoms, conduct problems and peer problems, with a maximum score of 10 on each subscale. Higher scores on the prosocial subscale are preferable, and the inverse is true of the remaining subscales. Furthermore, scores on the latter four subscales are summed to give a measure of total social deviance (maximum score 40). Scores attained on each subscale are then categorised as either normal, borderline or abnormal.

### *Teaching procedures*

The present intervention, 'Reading with Vocabulary Intervention' (REVI), is a fusion of two established methods of language instruction: *Reading Intervention* (Hatcher et al., 1994, 2006) and the robust vocabulary instruction method devised by Beck, McKeown and Kucan (2002). It was hoped that an intervention combining oral reading linked to phonological training together with vocabulary instruction would prove effective in ameliorating the reading problems of this group of poor responders.

In order to fit in with the constraints of summer term times in schools, REVI was designed as a 9-week intervention. Daily instruction was delivered on a one-to-one basis by trained TAs, and divided into two 15-minute sessions. Session A began with 5 minutes of reading: first the child read an 'easy' book (read with >94% reading accuracy), and then moved onto a book at the instructional level of reading (read with 90–94% reading accuracy). This reading book was used as a springboard for the subsequent 5 minutes of rich vocabulary instruction (Beck et al., 2002), which is described in greater detail below. The final 5 minutes of Session A were spent on a narrative writing task. The children used a sequence of pictures as prompts from which to tell a story. Following some work on the content and accuracy of the language, the TAs selected a small part of the story for the child to write down.

Session B was a modification of *Reading Intervention* (e.g. Hatcher et al., 2006). The first 3 minutes were spent revisiting the target vocabulary taught in the earlier session. This was followed by 5 minutes of phonological awareness training, which involved practising segmenting, blending and deletion of initial, medial and final phonemes. Where possible, the items used in the phoneme awareness activities were semantically linked to that day's target vocabulary word. These words were provided as a guideline and TAs were expected to moderate the difficulty of these phonemic awareness tasks to reflect each child's level of ability. As an example, following vocabulary instruction for the word *repair*, children may have been asked to segment the phonemes in *fix*. Three minutes were then dedicated to teaching of sight words through multi-sensory activities,

such as spelling out the irregular words using different media (e.g. writing on whiteboards, tracing in sand, using magnetic letters) and encountering the words in various written contexts. After this, the TA introduced the child to a new book at the instructional level of reading by first drawing attention to the title and plot, and any unfamiliar words. The child then had an opportunity to link phoneme awareness to letters and to build sight word skills by reading the book with minimal help; a second reading along with the TA encouraged reading fluency (3 minutes). The session finished with a quick recap and reinforcement of the day's target vocabulary and sight words (1 minute). Every fifth day of the intervention was designated as a consolidation day: both sessions were spent revisiting the work covered that week, with a particular emphasis on individual areas of weakness that had emerged.

The intervention programme was funded by the local authority and delivered by TAs who were selected by their schools to participate. The TAs attended two training days at the University of York when they learned how to assess the children's levels of literacy, deliver the intervention and tailor the difficulty of the programme to meet the individual needs of each child. Once the intervention was under way, the TAs received ongoing training in the form of fortnightly tutorials and each TA was observed for a session by a member of the research team as a means of monitoring treatment fidelity.

*Rich vocabulary instruction.* The method of vocabulary instruction was based on the approach of Beck et al. (2002), which advocates the teaching of words that go beyond those that children encounter in their instructional-level reading books. The approach acknowledges that the listening and speaking competence of young children – and by extrapolation here, struggling readers – is in advance of their reading and writing competence. As such, the simplistic vocabulary in the texts that they are able to read is too restrictive to provoke a meaningful development of vocabulary. Rather, a word or a general concept from the instructional reading book was rephrased using a 'sophisticated' (or tier two) word – for example, *change* became *transform*; *very old* became *ancient*. For each reading book that was recommended on the reading intervention programme, two words were generated as candidates for targeted instruction, with reference to the criteria outlined by Beck et al. (2002); namely that tier two words are 'high-frequency words for mature language users . . . that offer students more precise or mature ways of referring to ideas they already know about' (p. 16). Definitions of every word were then prescribed with recourse to *The Compact Oxford English Dictionary* (Thompson, 1996). The words were taught to the children in a rich and multi-contextual manner (e.g. Beck, Perfetti & McKeown, 1982; Beck et al., 2002). Below is a worked example of teaching the word *persist*, based on the book *Kipper's Laces* (Oxford Reading Tree, Oxford University Press), in which the main character, Kipper, is learning to tie his own shoelaces.

1. The TA contextualises the word for its role in the story: 'In the story, Kipper had to keep trying to tie his shoelaces until he had learned how to do it himself. He had to *persist*'.
2. The child repeats the word to help secure a phonological representation: 'Say the new word with me, *persist*'.
3. The TA provides the child with a prescribed definition of the word: 'If you *persist*, you go on doing something even if it is difficult'.
4. The TA uses the word in alternative contexts: for example, 'Yesterday I was doing some difficult work and I had to *persist* with it until I got it all right'.



5. The child is encouraged to use the word in additional new contexts: 'Tell me about a time that you have had to *persist* with something'.
6. The child repeats the word to reinforce its phonological representation: 'Say our target word, *persist*'.

## Results

### *Characteristics of children who show poor response to intervention*

Table 2 presents the means and standard deviations obtained by the group on the various measures that were administered during the monitoring stage of the study ( $t1$ ). It is clear that this group of children show significant difficulties in most areas. Literacy levels and phonological awareness skills were seriously impaired, as would be anticipated. In addition the children also displayed significant weaknesses in their non-phonological oral language skills: their expressive vocabulary scaled score fell below the average range (approximately 5th centile) and their raw scores on the APT information and grammar subtests approximated the performance of a typical child aged 5 years 6 months. Speed of processing (a measure of general cognitive resources) fell on the borderline of average with a mean index score of 85. By way of contrast, results from the preceding study (Hatcher et al., 2006) showed that children who responded well to *Reading Intervention* had normally developed receptive vocabulary abilities, as measured by the *British Picture Vocabulary Scale II* (BPVS II – Dunn, Dunn, Whetton & Burley, 1997): mean standard score = 95.38 (10.51); range = 69–119.

This exploratory analysis of the poor responders' strengths and weaknesses provided the rationale for an intervention that addressed not only literacy and phonological awareness, but also non-phonological aspects of oral language.

### *Efficacy of the intervention*

Table 3 shows the performance of the poor responders on measures of reading, phonological and language skills at  $t2$ ,  $t3$  and  $t4$ . Paired samples  $t$ -tests were run to assess the significance of gains between  $t2$  and  $t3$ , as a result of the intervention. As shown in Table 3, there were statistically significant gains in word reading, letter–sound

**Table 2.** Means (and standard deviations) for the group of poor responders ( $N = 12$ ) on a variety of cognitive and linguistic measures, at  $t1$ .

| Test                                    | Maximum score | Mean (SD)     | Range        |
|---|---------------|---------------|--------------|
| BAS-II word reading (raw)               | 90            | 11.08 (7.42)  | 2.00–25.00   |
| BAS-II word reading (standard)          | –             | 76.17 (7.67)  | 62.00–88.00  |
| Spelling (raw)                          | 5             | 0.00 (0.00)   | 0            |
| Phoneme awareness total (raw)           | 18            | 6.50 (3.43)   | 0.00–11.00   |
| Nonword repetition (standard)           | –             | 85.42 (20.78) | 54.00–112.00 |
| Phonetic spelling (raw)                 | 38            | 19.83 (5.84)  | 11.00–31.00  |
| WASI vocabulary (scaled)                | –             | 5.58 (2.71)   | 1.00–9.00    |
| APT information (raw)                   | 40            | 31.21 (4.56)  | 21.50–35.00  |
| APT grammar (raw)                       | 37            | 24.79 (5.14)  | 15.00–31.00  |
| WISC-III symbol search (scaled)         | –             | 6.50 (4.66)   | 1.00–13.00   |
| WISC-III coding (scaled)                | –             | 8.33 (3.20)   | 1.00–14.00   |
| WISC-III speed of processing (standard) | –             | 85.33 (14.61) | 60.00–104.00 |

**Table 3.** Means (and standard deviations) and ranges of scores for the group of poor responders on a variety of linguistic measures at *t*2, *t*3 and *t*4; and outcome of paired samples *t*-tests and effect sizes over the intervention period (*t*2–*t*3).

| Test                              | Max. score | <i>t</i> 2 mean (SD) | Range       | <i>t</i> 3 mean (SD) | Range       | <i>t</i> (11)        | Effect sizes ( <i>t</i> 2– <i>t</i> 3) | <i>t</i> 4 mean (SD) | Range        |
|-----------------------------------|------------|----------------------|-------------|----------------------|-------------|----------------------|--|----------------------|--------------|
| BAS-II word reading               | 90         | 15.42 (10.51)        | 1.00–35.00  | 20.17 (11.26)        | 5.00–37.00  | 4.75 <sup>****</sup> | 0.44                                   | 25.00 (15.72)        | 6.00–52.00   |
| BAS-II word reading <sup>SS</sup> | –          | 75.17 (10.28)        | 55.00–93.00 | 77.92 (9.41)         | 63.00–94.00 | 2.72 <sup>**</sup>   | 0.28                                   | 76.27 (12.35)        | 59.00–101.00 |
| Letter–sound knowledge            | 26         | 24.33 (1.83)         | 21.00–26.00 | 25.75 (0.45)         | 25.00–26.00 | 2.49 <sup>*</sup>    | 1.07                                   | –                    | –            |
| Phoneme awareness total           | 18         | 6.50 (3.48)          | 1.00–11.00  | 9.58 (4.19)          | 2.00–17.00  | 3.99 <sup>**</sup>   | 0.80                                   | 10.64 (3.88)         | 3.00–17.00   |
| Phoneme blending                  | 6          | 4.17 (1.99)          | 1.00–6.00   | 4.75 (1.60)          | 1.00–6.00   | 1.74                 | 0.32                                   | 4.55 (1.57)          | 1.00–6.00    |
| Phoneme segmentation              | 6          | 1.50 (1.45)          | 0.00–4.00   | 3.00 (2.00)          | 1.00–6.00   | 3.32 <sup>**</sup>   | 0.86                                   | 3.64 (1.80)          | 1.00–6.00    |
| Phoneme deletion                  | 6          | 0.83 (1.03)          | 0.00–3.00   | 1.83 (1.85)          | 0.00–5.00   | 2.17                 | 0.67                                   | 2.45 (1.81)          | 0.00–6.00    |
| APT information                   | 40         | 31.08 (4.02)         | 25.00–39.00 | 35.25 (2.59)         | 30.50–39.00 | 4.81 <sup>****</sup> | 1.23                                   | –                    | –            |
| APT grammar                       | 37         | 24.08 (3.26)         | 19.00–31.00 | 26.33 (2.71)         | 23.00–30.00 | 2.75 <sup>*</sup>    | 0.75                                   | –                    | –            |

Note: Raw scores are reported for all tests with the exception of one standard score, indicated by SS.

<sup>\*</sup>Significant at *p* < .05.

<sup>\*\*</sup>Significant at *p* < .01.

<sup>\*\*\*\*</sup>Significant at *p* < .001.

**Table 4.** Case analysis of the gains made on the word reading subtest from the BAS II during the intervention period (*t2*–*t3*).

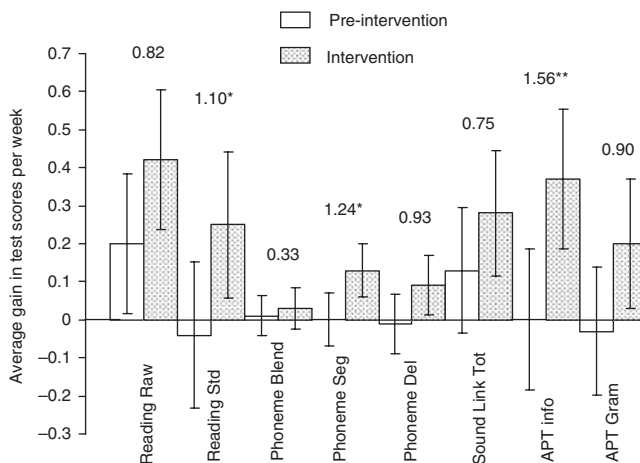
| Participant | Raw scores |           |      | Standard scores |           |      |
|-------------|------------|-----------|------|-----------------|-----------|------|
|             | <i>t2</i>  | <i>t3</i> | Gain | <i>t2</i>       | <i>t3</i> | Gain |
| 8           | 16         | 16        | 0    | 81              | 77        | –4   |
| 2           | 7          | 10        | 3    | 71              | 71        | 0    |
| 4           | 35         | 35        | 0    | 85              | 85        | 0    |
| 1           | 16         | 21        | 5    | 71              | 72        | 1    |
| 3           | 29         | 35        | 6    | 93              | 94        | 1    |
| 9           | 9          | 14        | 5    | 74              | 76        | 2    |
| 12          | 5          | 6         | 1    | 63              | 65        | 2    |
| 6           | 14         | 19        | 5    | 75              | 80        | 5    |
| 10          | 28         | 37        | 9    | 86              | 91        | 5    |
| 11          | 8          | 16        | 8    | 75              | 81        | 6    |
| 7           | 17         | 28        | 11   | 73              | 80        | 7    |
| 5           | 1          | 5         | 4    | 55              | 63        | 8    |

knowledge, phoneme segmentation, APT information and grammar, with effect sizes on raw scores ranging from 0.44 to 1.23. (Effect sizes are expressed in terms of Cohen's *d*, where the difference in means across the pre-intervention and post-intervention testing points was divided by the pooled standard deviations.) In one case (letter knowledge) the effect size needs to be interpreted with caution, given the limited variability and the ceiling effect in the *t3* scores. Gains made in phoneme awareness showed no fall back between *t3* and *t4*, and reading raw score increased significantly in the maintenance period ( $t(10) = 2.93, p < .05$ ).

A case analysis of gains made in reading over the course of the intervention is recorded in Table 4. The cases are ordered according to increasing gains made on word reading standard scores. Two cases showed no absolute improvement in reading, and thereafter, gains in standard scores ranged from 1 to 8.

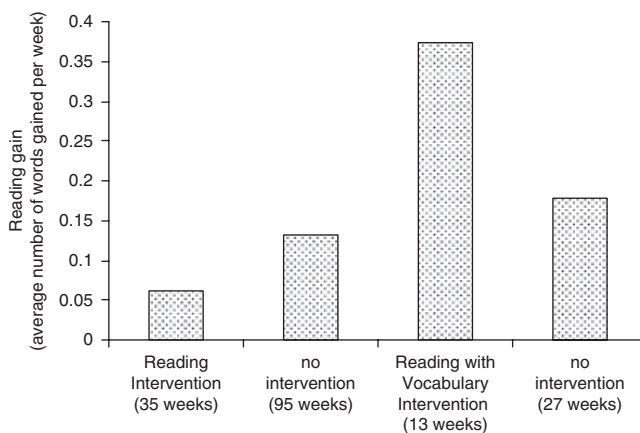
The efficacy of the vocabulary component of the intervention was assessed by contrasting children's ability to define a set of words they had been taught with a set that they had not. At *t3* the children were better at defining words that they had been taught ( $t3, M = 12.75, SD = 3.47$ ), as compared with words they had not been taught ( $t3, M = 3.17, SD = 2.92$ ). This difference was significant,  $t(11) = 10.18, p < .001$  and represented a very large effect (Cohen's  $d = 2.99$ ). Gains in taught vocabulary were maintained at *t4* ( $t4, M = 12.55, SD = 4.72$ ). Between *t3* and *t4* there was a significant gain in children's ability to define untaught vocabulary items ( $t4, M = 6.55, SD = 3.96; t(10) = 3.93, p < .01$ ).

In the absence of an untreated control group, it was important to compare the gains made during the intervention period (9 weeks) against the progress made throughout a pre-intervention baseline control period<sup>1</sup> (6 months). Figure 2 shows a comparison of the mean progress made per week on each measure during the pre-intervention and the intervention periods, with 95% within-subject confidence intervals (Loftus & Masson, 1994). It can be seen that children failed to make any significant progress on the measures during the pre-intervention baseline period in contrast to the significant progress made during the intervention period in reading standard score, phoneme segmentation and APT information.



**Figure 2.** A comparison of the mean progress made per week on each measure over the control and intervention periods, with effect sizes (and 95% within-subject confidence intervals; Loftus & Masson, 1994).

Note: \*significant at  $p < .05$ ; \*\*significant at  $p < .01$  (paired sample  $t$ -tests).



**Figure 3.** Average number of words learned per week over the intervention and no-intervention periods, as measured by gains in raw scores on the Word Reading subtest of the *BAS II* ( $N = 12$ ).

One measure of the effectiveness of the intervention is the number of standard score points in reading gained per hour (McGuinness, McGuinness & McGuinness, 1996). During the initial period of intervention (Hatcher et al., 2006) the present group made a negligible gain of, on average, 0.02 standard score points per hour of intervention. In contrast, these same children gained on average 0.13 standard score points per hour of the REVI programme. The children's average rate of progress in reading (calculated as the increase in raw score per week) throughout their involvement in the research projects is shown in Figure 3. The average number of words learned per week during REVI is almost three times greater than the corresponding rates of learning during the periods immediately before and immediately after the intervention.

## Discussion

The present study explored the characteristics of a sample of children who had previously demonstrated poor response to *Reading Intervention*. The initial cognitive profiling of the children informed the design of a new intervention to target reading, phonological and language skills, which was delivered by trained TAs over a 9-week period to individual children. The intervention was found to facilitate the development of these children's language and literacy skills, although given the absence of a control group, conclusions about efficacy must remain tentative.

Consistent with what is already known about the causes of reading difficulties, the poor responders in the present study displayed significant weaknesses in phoneme awareness skills (Hatcher & Hulme, 1999; Nelson et al., 2003; Vellutino et al., 1996). Importantly, however, their difficulties extended to non-phonological language skills including vocabulary, grammar and expressive language. This finding stands in contrast to that of Vellutino et al. (1996) who showed that tests of semantic and syntactic skills were inconsistent in their ability to discriminate between children who did and did not respond well to intervention. However, these authors also observed that such deficits are less likely to be present in the middle to upper-class population from which their sample of poor readers was drawn (cf. Al Otaiba & Fuchs, 2006).

In light of the children's broader oral language difficulties, and building on the theoretical hypothesis that vocabulary growth precipitates the development of phoneme awareness (Gibbs, 2004; Metsala & Walley, 1998; Walley, 1993), an intervention was designed to integrate training in vocabulary and expressive language skills with training in reading and phonology (REVI). Over 9 weeks of the REVI programme, children made significant gains in word reading, letter-sound knowledge, phoneme awareness, grammar, expressive language and knowledge of taught vocabulary. A brief follow-up test showed that the gains made in reading, phoneme awareness and vocabulary were maintained 6 months later.

Concerning the gains made over the intervention, letter-sound knowledge was brought to near-perfect across the sample. The significant gains made in phoneme awareness were carried by improvements in phoneme segmentation. The progression on the phoneme awareness tasks mirrors typical development (moving from blending to segmentation then deletion – see Yopp, 1988); the majority of children therefore seemed ready to improve at this intermediate stage of phonemic awareness. Progress in spoken language was observed in both the content and grammar of children's utterances, which was likely to have been encouraged by the attention paid to expressive language during the narrative writing task and the vocabulary instruction. Moreover, the large effect size observed for the gains in vocabulary is pleasing given that it is accepted that learning new word meanings is a difficult and lengthy process (Beck et al., 1982; Beck & McKeown, 2007).

A case analysis of the gains made in word reading showed that nine of the twelve children increased their standard scores over the duration of the intervention. Only one child (8%) showed a decline in standard scores. On average, the reading gains made by the poor responders in this study were equivalent to 0.13 standard score points in reading per hour of the REVI programme. According to a review by Torgesen et al. (2001) this gain places the intervention at the lower end of efficacy (where the average is around 0.20 standard score points gained per hour). Nevertheless, despite REVI being half as long in duration, the observed gains are comparable to those shown in the intervention of Lovett,

Borden, Lacerenza, Benson and Brackstone (1994), which trained the word identification skills of 7- to 13-year-old children with severe literacy difficulties. In fact, of the studies summarised by Torgesen et al. (2001), REVI provided the shortest amount of instruction. Thus, it is reasonable to suggest that a version of REVI which is longer in duration may produce more striking effects.

By way of caution, attention must be drawn to the fact that most children's reading was still below average by the end of the intervention, as shown by their mean standard score in single word reading of 78. It is important to be mindful of a number of other limitations of this study. First, its small scale may restrict the extent to which these results can be generalised. However, elsewhere it is acknowledged that research with populations of treatment poor responders is difficult to implement because both 'sample size and design will depend on their response to previous tiers of instruction and cannot be reliably predicted' (Denton, Fletcher, Anthony & Francis, 2006, p. 465). The unpredictable and highly selective nature of such groups also makes for difficulty in discerning the most appropriate control group. This aside, the use of participants as their own historical control in the present study is not sufficient enough to make strong claims regarding the efficacy of the intervention, and is a shortfall which must be avoided in future work with such samples. Notwithstanding these limitations, we believe that this study makes an important contribution towards unpacking the nature of poor responders to reading intervention and chronicles a novel approach to addressing their wider difficulties, which paves the way for future research. Specifically, despite being grounded in theory which predicts a causal chain from vocabulary growth, through phoneme awareness to reading (Metsala & Walley, 1998; Walley, 1993), the current methodology was unable to disentangle the nature of these relationships.

Together the findings of this research highlight the role of non-phonological oral language difficulties in the aetiology of reading problems and suggest that interventions for such children should incorporate work on these oral language skills. Indeed it could be argued from the current findings that the view that responsiveness to reading intervention is determined by the severity of initial phonological deficits is narrow. Rather, the results are in line with the 'dual deficit' intimated by Whiteley et al. (2007) – that the children who are least likely to benefit from phonologically based interventions are those with deficits in both letter knowledge and expressive vocabulary. Future research should explore the hypothesis that children with deficits in both phonological and non-phonological oral language are more likely to be unresponsive to reading intervention than are children with a single deficit (Al Otaiba & Fuchs, 2002) and further, as Vellutino et al. (1996) hinted, that this sort of dual deficit is more likely to typify children of lower socioeconomic status, such as the children studied herein.

In conclusion, an intervention that incorporated training in reading, phonological awareness and vocabulary improved the reading skills of a group of 8-year-old children who had already failed to respond to a demonstrably effective form of reading intervention (Hatcher et al., 2006). This study joins previous research (Hatcher et al., 2006; Vadasy, Jenkins & Pool, 2000) in demonstrating that, with suitable training and support, interventions can be delivered by non-professional tutors, which represents a potentially cost-effective approach to remediation. The new intervention significantly improved the foundation skills for literacy, namely phoneme awareness, vocabulary and expressive language. Its effect on reading was also statistically significant, though most of the children remained below average for their age. The present findings provide a springboard for future investigations of response to treatment. If weaknesses in non-

phonological aspects of oral language are confirmed as reliable predictors of poor responsiveness – and more especially if phonological–non-phonological dual deficit in oral language is predictive of poor responsiveness – then it may be appropriate to use the principles embodied in the REVI programme as a first and early intervention for children at risk of reading difficulties.

### Note

1. Qualitative data were returned for 11 of the 12 children regarding additional support that they received in school over this control period. The support can be categorised as follows: individual work with a Special Educational Needs Co-ordinator ( $N = 2$ ); small group work with a TA that was literacy-based ( $N = 4$ ), speech-based ( $N = 1$ ) or unspecified ( $N = 1$ ); individual maths instruction with a TA ( $N = 1$ ); numeracy and literacy support ( $N = 1$ ); no additional support ( $N = 1$ ). For the remainder of the time between the first and second interventions (essentially the maintenance period in the initial study), it was not possible to ascertain what level of additional support these children were receiving.

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## Appendix

**Table A1.** Items used to test children’s knowledge (at *t*<sub>2</sub>) of words they had not been taught during the vocabulary instruction.

| Untaught vocabulary test items |             |
|--------------------------------|-------------|
| Valuable                       | Nuisance    |
| Transform                      | Inattentive |
| Seek                           | Gloomy      |
| Scolding                       | Eager       |
| Relic                          | Deceiving   |
| Quest                          | Captured    |
| Preparation                    | Animated    |
| Participating                  |             |

**Table A2.** Items comprising individualised tests of children's knowledge (at *t2*) of words they had been taught during the vocabulary instruction, and the frequency with which these items occurred across all the individualised tests.

| Taught vocabulary test items |           |             |           |             |           |
|------------------------------|-----------|-------------|-----------|-------------|-----------|
| Word                         | Frequency | Word        | Frequency | Word        | Frequency |
| Adventure                    | 6         | Entertain   | 4         | Perplexed   | 3         |
| Alternative                  | 2         | Errand      | 2         | Possessions | 7         |
| Ancient                      | 1         | Evidence    | 1         | Predict     | 1         |
| Announce                     | 1         | Exhausted   | 1         | Prey        | 1         |
| Anxious                      | 1         | Expedition  | 1         | Protect     | 3         |
| Apologise                    | 1         | Explored    | 7         | Proud       | 4         |
| Approve                      | 4         | Failed      | 2         | Record      | 2         |
| Assemble                     | 3         | Fine        | 1         | Refused     | 2         |
| Astonished                   | 2         | Forget      | 1         | Removal     | 1         |
| Blustery                     | 4         | Frustrated  | 1         | Remove      | 1         |
| Celebrate                    | 5         | Furious     | 2         | Repair      | 1         |
| Challenge                    | 1         | Grateful    | 1         | Rescue      | 4         |
| Confused                     | 6         | Hazardous   | 1         | Retaliate   | 1         |
| Confiscate                   | 1         | Hungry      | 1         | Rotten      | 2         |
| Consider                     | 1         | Ignore      | 1         | Ruined      | 1         |
| Considerate                  | 1         | Imagination | 2         | Scrumptious | 1         |
| Constructing                 | 1         | Imitate     | 1         | Select      | 1         |
| Culprit                      | 1         | Impressive  | 3         | Suitable    | 1         |
| Decorate                     | 2         | Include     | 2         | Suspicious  | 2         |
| Defend                       | 2         | Inquisitive | 1         | Sway        | 1         |
| Delighted                    | 4         | Interest    | 1         | Sympathy    | 2         |
| Determined                   | 1         | Mechanic    | 1         | Terrified   | 5         |
| Devour                       | 1         | Miniature   | 1         | Transported | 2         |
| Din                          | 1         | Mischievous | 3         | Troubles    | 1         |
| Disastrous                   | 2         | Mistake     | 2         | Urgent      | 1         |
| Discover                     | 2         | Mysterious  | 1         | Vanished    | 1         |
| Disguise                     | 5         | Observed    | 1         | Variety     | 1         |
| Dislike                      | 2         | Occupied    | 1         | Visitors    | 1         |
| Distracted                   | 1         | Offend      | 2         | Warning     | 2         |
| Emergency                    | 4         | Opposite    | 1         | Wrecked     | 1         |

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