Long-term outcomes of early reading intervention

Keywords: Reading, intervention, phonological awareness, Reading Recovery, long-term

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Dr Hurry has researched the teaching of reading for not only children in the early stages but also as they mature. In the early years, she has explored (with Kathy Sylva) the effectiveness of focussed literacy teaching (a precursor to the National Literacy Strategy). For seven to ten year olds she has looked at the value of the explicit teaching of morphology and comprehension. A common thread running through all this work is the importance of the explicit instruction of central principles. She has also researched the challenges of literacy teaching with disaffected young people, and here, emotional and motivational factors play a much more important role.

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ABSTRACT

This study e explores the long-term effectiveness of two differing models of early intervention for children with reading difficulties, Reading Recovery and a specific phonological training. Approximately 400 children were pre-tested, ninety-five were assigned to Reading Recovery, ninety-seven to Phonological Training and the remainder acted as controls. In the short and medium-term both interventions significantly improved aspects of children's reading, Reading Recovery having a broader and more powerful effect. In the long-term, three and a half years after intervention, there were no significant effects on reading overall, though Reading Recovery had a significant effect for a sub-group of children who were complete non-readers at six years old. Phonological training had a significant effect on spelling. The short and medium-term effects demonstrate that it is possible to substantially reduce children's reading problems. The long-term effects raise doubts about relying on early intervention alone.

Early Reading Intervention: who does it help and for how long?

Increasingly, children with reading difficulties are being offered early intervention, and based on the evidence of its short-term effectiveness (eg. Wasik & Slavin, 1993; Torgesen, 2000; National Reading Panel, 2000), this is to be welcomed. Early intervention is also promoted as a way of preventing 'Matthew effects' (Stanovich, 1986; Chall, 1983) whereby the gap between poor readers and their peers widens as they move through school, because poor readers read less than their peers (Allington, 1984; Biemiller, 1977-78; Clay, 1967; Juel, 1988), which in turn holds back their language development, their general knowledge and even their IQ. It is therefore important to know just how durable are the gains made during early interventions, in order to plan effective later provision, if necessary, for children who have received early intervention. The present paper examines whether or not early reading intervention is indeed effective in the long-term, at the end of primary or elementary schooling. Two programmes are evaluated, both with a proven track record, but with very different approaches, broadly representative of the two dominant contemporary intervention strategies. The first, a phonological intervention closely based on that of Bradley and Bryant (1985), is a successful intervention with a specifically phonological focus. The second, Reading Recovery (Clay, 1985), is one of the most successful early interventions with a broad model of reading (Pinnell, Lyons, DeFord, Bryk & Seltzer, 1994). In this type of intervention, reading for meaning is foregrounded.

Both intervention programmes are underpinned by a view of reading development that would predict sustained gains following early intervention.

Phonological intervention

Decoding is one of the central tasks of reading (Gough, 1996) and current theories

identify phonological processing as fundamental to decoding (Bishop& Snowling, 2004; Harm & Seidenberg, 2004; Jackson & Coltheart, 2001; Stuart, 2002). 'Phase' models of reading development suggest that understanding the alphabetic principle is the critical early hurdle for the child, underpinning further development of fluent reading and reading comprehension (Byrne, 1998; Frith, 1985; Juel, 1991; Ehri, 1991, 1992, 1998, 1999, 2005; Ehri & Wilce, 1985; Stanovich, 1986) and recent interpretations of dual route models of reading also propose that the development of a lexical route relies too on insight into the alphabetic principle (Stuart, 2002). Research has consistently identified deficits in phonological processing as one of the most common causes of literacy difficulties (Frith, 1995; Goswami & Bryant, 1990; Hulme & Snowling, 1992; Jackson & Coltheart, 2001; Stanovich & Siegel, 1994; Rack, Snowling, & Olson, 1992; Siegel, 1989). If mastery of the alphabetic principle is critical to reading development, then children who have responded well to phonological intervention should experience fewer problems as they mature as readers. Theories which address phonological skills describe development in terms of word level skills, such as a 'full alphabetic phase', where the reader is not only able to form alphabetic connections but can also map phonemes and graphemes onto sight words, and a 'consolidated alphabetic phase' where recurring letter patterns become consolidated (Ehri, 1999).

Reading Recovery

Clay (1991) proposes that there is a critical 'acquisition period', corresponding approximately to the first two years of formal schooling (p. 318). During this period, children form a basic network of strategies 'conducive to literacy learning' which include searching, selecting and checking understanding of print. She writes that 'during the reading acquisition

phase the novice reader is not only learning words or letter-sound relationships but is also learning how to use each of the sources of information in texts, how to link these to stored knowledge, and which strategic activities make 'reading' successful' (p. 321). Children who successfully negotiate this stage become relatively independent readers aware of whether or not they understand what they read and able to draw on a range of key strategies to correct their own mistakes. The critical stage implied is one of an explicit orientation towards the reading process, that it is something that should make sense. The importance of specific skills, such as a good grasp of letter-sound correspondences, is recognised, but only as part of a range of strategies being actively employed to draw meaning from print. Thus Clay's view of the early developmental stage of reading is much broader than that of theorists reviewed above who foreground phonological processing. Clay argues that children experiencing problems during this stage run the risk of developing bad habits and a negative approach to reading. In Reading Recovery lessons children are shown how to self-monitor, to check their understandings using all the strategies available to them, to predict and to confirm. In other words they are shown how to develop and make use of meta-cognitive strategies in their reading. According to Clay, this allows them to become self-sustaining independent readers, still requiring adequate classroom instruction, but no longer in need of additional help except in a few cases where there are more deep-seated problems.

An alternative view: the need for ongoing intervention

If the early developmental stages of literacy acquisition are critical in determining later success, then it can justifiably be argued that early intervention to accelerate and improve children's passage through these early developmental stages should produce lasting long-term effects. However, the more weight one gives to other aspects inherent in children

(e.g. their cognitive and linguistic abilities) and the more weight one gives to environmental factors (e.g. the input of home and school) the more likely it is that the effectiveness of targeted early intervention will not be sustained in the long term. If reading development is seen as ongoing, underlying causal factors not addressed by early intervention, such as impoverished literacy experience outside school, inappropriate classroom provision and children's more general learning problems, are likely to re-exert their influence with the passage of time. What is the existing evidence concerning long-term effects of early intervention?

Long-term effects of early intervention

Bus and van Ijzendoorn (1999) in a meta-analysis of studies measuring the effects of phonological intervention found large short-term effects on phonological awareness (effect size (es) = 1.04) and medium effects on reading (es = .70). This is consistent with a large body of evidence of the effectiveness of explicit phonics instruction but this evidence does not address the durability of early gains (Hurry, 2004; National Reading Panel, 2000). In the eight studies reported by Bus and van Ijzendoorn (1999) which examined long-term effects (maximum 29 months) these were much weaker. After an average of about a year and a half, there were no significant effects on reading (es = .16) but small but significant effects on spelling (es = .25) and reading comprehension of (es = .26).

Byrne, Fielding-Barnsley and Ashley (2000) did find significant long-term effects for their preschool phonological training. Six years after children had received the 12 week intervention (30 minutes per week) they did significantly better than controls on both word and non-word reading. Although the long-term effect of such a limited intervention is impressive, effect sizes were small (ranging from .33 to .39) and Byrne, Fielding-Barnsley

and Ashley conclude that 'children who are slow to grasp ideas early in reading development…are liable to remain slow to acquire other principles' (p. 666) and may continue to need support. Overall, the evidence suggests that early, time limited phonological intervention alone may not be enough to ensure long-term reading success.

Reading Recovery is one of the most fully evaluated broadly based early interventions, and several studies have examined its effectiveness a year or two post intervention. In the most methodologically rigorous study, Pinnell and colleagues (Pinnell et al., 1994) found a substantial immediate effect of Reading Recovery, and Reading Recovery children were still performing significantly better than controls eight months after intervention but there was a reduction in the effect compared with immediate post-test. DeFord, Pinnell, Lyons and Young (1988) followed up two cohorts of Reading Recovery and comparison children to the end of 3rd Grade. After two years the Reading Recovery children had maintained their gains in terms of months of reading age advantage; however, this advantage ceased to be statistically significant and the intervention effect diminished. The lack of significant long-term effects of Reading Recovery in Ohio is confirmed in the report of the Battelle study group to the Ohio Department of Education (1995) which concludes that short-term reading gains are not maintained in Grades 3 and 4.

In Australia and New Zealand, four studies have examined the medium/long-term effects of Reading Recovery. One found only very small differences between Reading Recovery children and a comparison group one year after intervention (Glynn, Crooks, Bethune, Ballard & Smith, 1989). Center, Wheldall, Freeman, Outhred and McNaughton, (1995) present a mixed picture one year post intervention, with Reading Recovery children significantly ahead of their controls on Book Level (a measure using graded texts) but not on the range of other measures used (words in context, text comprehension and metalinguistic

processes. Two further Australian studies of Reading Recovery (Rowe, 1989; Wade & Moore, 1997) report more powerful long-term effects, with advantages persisting for Reading Recovery children to the end of years 5 and 6. However, Wade and Moore followed up only children who had successfully completed the programme. Such comparisons tell us little about the overall long-term effectiveness of Reading Recovery because they fail to follow up children who participated in the programme but were not successful on it.

In summary, the international evidence of longer term effects of Reading Recovery, with one exception (Rowe, 1989), does not support the hypothesis that Reading Recovery can alter children's 'learning curve' beyond the period of intervention, though gains made during the intervention tend to be maintained (Shanahan & Barr,1995). Similarly, for the other major broad based intervention, Success for All, Venezky (1998) reports that after the early primary grades SFA students begin to fall behind the national average until by the end of grade five they are almost 2.4 years behind.

The evidence base for long-term effects of early intervention is small, particularly for children with early reading difficulties and for the UK. The present study adds to the existing evidence and explores interactions between two models of intervention (Reading Recovery and Phonological Training) and children's initial reading levels to inform us about the fit between child and intervention.

Methods

Research design

Both children receiving Reading Recovery (provided by their schools) and children receiving Phonological Training (provided by the research team) were compared with similar (control) children receiving their school's standard provision.

As shown in Figure 1, children were pre-tested on a battery of reading tests in September/October 1992, before the start of intervention (pre-test). Short-term gains were assessed in June/July 1993 after the interventions were completed (post-test 1). Medium-term gains were assessed one year later, in May/July (post-test 2). Long-term effects were assessed in September/December 1996, when children were in Year 6 (final year of primary school, post-test 3).

Figure 1 around here

Sampling

Schools. At the start of the study in 1992, all 24 English schools which had chosen to provide Reading Recovery with a trained teacher were initially included in the evaluation. During the intervention year, two schools which had to abandon Reading Recovery were dropped from the study, leaving 22 self-selected Reading Recovery schools. For each Reading Recovery school, the LEA primary schools advisor identified two schools with similar intake, which were then randomly assigned to be 'Control' (18) or 'Phonological Training' (23) Schools

Children. In each of these 63 schools, the six poorest Year 2 readers in the age range six to six years six months (approximately the bottom 20% of readers) were selected on the basis of their performance on the Diagnostic Survey (Clay, 1985). In the 22 Reading Recovery schools, the poorest scorers among selected children (usually the bottom four) were offered intervention, the remainder being assigned to a within-school control condition. In each of the 23 Phonological Training schools, the six poorest readers were randomly assigned

to Phonological Training (n=4) or to within-school control condition (n=2). In the remaining 18 Control schools, all the selected children became part of the control group.

On the basis of these groups, four comparisons are reported:

1. Reading Recovery children with their within-school Controls, a quasi-experiment.
2. Reading Recovery children with between-school Controls (children in Control and Phonological Training schools), a quasi-experiment.
3. Phonological children with their within-school Controls), a randomised controlled trial.
4. Phonological children with between-school' Controls in Control schools, a quasi-experiment. (Control children in Reading Recovery schools were not included in this Phonological between-school control group as Reading Recovery schools explicitly share the principles of Reading Recovery with classroom teachers, thus compromising their 'control' status).

Table 1 shows numbers of children in each group at the four measurement points. Boys were overrepresented at 61% of the sample (class average = 52% boys); 42% of the sample were receiving free school meals (class average 32%, national average 16%); 16% (class average 17%) spoke English as a second language. The groups were well matched on these demographic factors, with no significant differences.

Table 1 around here

Measures

Pre-test and post-test 1. Children were assessed on standardised reading tests, tests sensitive to the skills addressed by Reading Recovery and tests sensitive to the focus of Phonological Training:

1) The British Ability Scale (BAS) Word Reading test (Elliot, Murray & Pearson, 1984).

2) Neale Analysis of Reading (Neale) (1988).

3) Book Level. This entails establishing which of a series of texts, graded from one to twenty-six according to the Reading Recovery levels, children can read with 90% accuracy or above. Level 1 texts are the simplest caption books suitable for children with very limited reading skills. Level 26 equates to a reading age of between 8 and 9 years (Glynn, Crooks, Bethune, Ballard & Smith, 1989, p. 11). At post-test 1, book Level correlated 0.85 with both BAS Word Reading and the Neale.

4) The Diagnostic Survey (Clay, 1985) which includes: Letter Identification, Concepts about Print, a word test, Written Vocabulary and Dictation. Raw scores from each subtest were transformed to z scores and summed. At first post-test, summed z-scores correlated significantly with the BAS Word Reading test ($r = .78$), the Neale ($r = .76$) and with Book Level ($r = .80$).

5) The Oddities Test (Kirtley, Bryant, Maclean & Bradley, 1989), which measures awareness of rhyme and of initial and final phonemes. Bryant, MacLean, Bradley and Crossland (1990) report a Spearman-Brown reliability coefficient of 0.78 in their sample of sixty-four children aged five years seven months; in the present study, internal consistency of the Oddities Test was .83 (Cronbach's alpha). However, scores on the Oddities Test were only modestly correlated with the Dictation task at first post-test (Spearman's rho = .44) and with the Nonword Reading test at second post-test (Spearman's rho = .46), suggesting that these tests measure different sub-skills.

An overall measure of reading and spelling was calculated by summing z scores for the Diagnostic Survey, Book Level, BAS Word Reading and the Neale and transforming again into a z score.

Background information was also collected on age, sex, IQ (BAS Short Form, Elliot, Murray & Pearson, 1984), whether the children spoke English as a first or additional language and free-school meals status

Post test 2. Children were re-assessed on the standardised reading tests (BAS Word Reading, Neale), and on the Oddities Test, but not on the Diagnostic Survey or Book Level, which were no longer appropriate for the age group. Children were also assessed on a standardized spelling test (BAS Spelling test, Elliott, Murray & Pearson, 1983) and on the Graded Non-word Reading test (Snowling, Stothard & McLean, 1996), which measures children's phonological decoding ability.

An overall measure of reading and spelling was calculated by summing the z scores for BAS Word Reading, the Neale, and BAS Spelling and transforming again into a z score.

Information was again collected on free-school meals status.

Post-test 3. At the final follow-up children were assessed on:

1) The NFER-Nelson Group Reading Test 6-12, (NFER-Nelson, 1985), a standardised test of reading comprehension at the sentence level, using cloze procedures

2) The Parallel Spelling Test (Young, 1983).

An overall measure of reading and spelling was calculated by summing the z scores for reading and spelling and transforming again into a z score.

Information was again collected on free-school meals status.

Procedures

All participating children were pre-tested by a member of the research team trained

over several days to administer the tests, including pilot sessions. At each of the three post-tests, members of the research team tested the children 'blind', i.e. without knowing to which group children belonged.

Interventions

Reading Recovery. All Reading Recovery teachers were fully trained in Reading Recovery by an accredited trainer. The intervention, which includes reading of graded texts, word-level phonics work and writing, was delivered in standard form. The rigorous training, support and monitoring of the Reading Recovery programme results in high programme fidelity (Hurry, 1996). Children are withdrawn from class for individual tuition daily for half an hour, until they reach the average reading band for their class when they are 'discontinued' (for full programme details, see Clay, 1993). In the present study children received on average 21 weeks intervention, with an average of 77 sessions. Eighty-nine percent of the children made sufficient progress to be 'discontinued'. All children receiving Reading Recovery were included in the analyses reported below, irrespective of their discontinued status.

Phonological Training. Following Bradley and Bryant (1985), this involved sound awareness training plus word building with plastic letters. The training focused initially on alliteration and rhyme but also included work on boundary sounds and vowels and digraphs in response to the child's progress. Children also matched sounds with plastic letters and constructed words. Each child was given forty, ten-minute, individual sessions, spread over seven months.

The five teachers who delivered the Phonological Training were all highly experienced primary teachers, but, unlike the Reading Recovery teachers, they were part of

the research team and did not share details of the intervention with classroom teachers. They were given a one-day training session in the required techniques by Kirtley and MacLean, researchers who had taught the phonological programme in the original Bryant and Bradley studies (Bryant & Bradley, 1985; Bradley & Bryant, 1985; Kirtley et al., 1989), together with a training manual, and one week's practice delivering the programme to non-participating children. Problems encountered were discussed with Kirtley and MacLean, who also gave feedback. Further training sessions were held monthly for the duration of the intervention period. Programme fidelity was monitored by the senior research officer who observed each member of the team teaching and listened to audio tapes of five sessions. The researchers recorded the content of every lesson, for every child, to facilitate monitoring. At the end of the intervention, the performances of children by phonological tutor were compared. Regression analysis (controlling for pre-test scores on the Diagnostic Survey and the BAS Word Reading Test) established that there were no significant differences on any of the first post-test measures which were due to the tutor delivering the Phonological Training.

Provision for the Control Group. Children in both within and between school control groups received the standard provision available in their school. As weak readers, they often received extra, specialized with help with reading, on average 21 minutes weekly. Classroom teachers of all participating children in the intervention year were asked to complete a questionnaire describing their practice (closely based on one devised by Ireson, Joscelyne, & Blatchford, 1994). One hundred and ten of the 127 teachers involved returned the questionnaire (86% response rate). There were no statistically significant differences between teachers from the different types of school (Reading Recovery (RR), Phonological Training (Ph) and Control (C)) on the basis of average years teaching experience or the frequency with

which they used most types of reading activities in class (for fuller details see Sylva and Hurry, 1995).

Results

Children's reading and spelling at the beginning of the study

At pre-test in 1992, many of the original cohort of children could barely read, but, as shown in overall reading/spelling z scores in Table 2, the children selected for intervention were doing slightly worse than the control groups - significantly so in both Reading Recovery comparisons and in the between-schools Phonological Training comparison. This can be clearly observed by looking at the overall reading/spelling score (Table 2). Both intervention groups have minus scores i.e. are below the mean for the entire sample.

Table 2 around here

Children's reading and spelling over the follow-up period, descriptive statistics

Table 3 around here

Table 3 shows the progress children in the various groups made during the intervention. Since the intervention children had slightly poorer literacy skills levels than controls at pre-test, intervention effects are calculated with account taken of initial reading ability as measured by the Diagnostic Survey and BAS Word Reading test. These variables are always entered first into fixed order regression analyses, followed by child's experimental group status in the second block of the regression analysis. Response variables are the range of reading/spelling outcomes, transformed where necessary to reduce skewness, and all the response variables satisfy the assumptions for regression. The Beta coefficients and effect

sizes (es) are reported for all the regression analysis. The es reported here is Cohen's d (Cohen, 1988), i.e. the mean of the experimental group minus the mean of the control group, divided by the standard deviation of the groups. Effect sizes help to interpret magnitude of an experimental effect. According to Cohen's classificatory scheme (Cohen, 1988), es of .2 – .5 are small, of .5 – .8 are medium and greater than .8 are large. The results reported here do not use multi-level modeling as the sample size in each school is insufficient to identify anything but very large school-level effects; a previous report of multi-level modeling analysis (Sylva & Hurry, 1995) found between-school variation to be very small after controlling for pre-test.

Children's reading and spelling at first (short-term) follow-up

Reading Recovery. At first post-test on completion of intervention, Reading Recovery children had made substantially more progress than both their within and between school controls on all the measures of reading and spelling and on the overall measure. The es on these measures were found to be medium to large (.63 to .87, Table 4). They had an approximately eight month reading age advantage over controls. Even without controlling for their significantly poorer scores at pre-test, the Reading Recovery group had significantly higher mean scores across all reading and spelling measures than their between-school controls and on the diagnostic survey and book level for the within-school comparison. However, Reading Recovery children were only significantly better than the between- (not the within-) school controls on the Phonological Awareness measure.

Table 4 around here

Phonological Training. The short-term effects of Phonological Training were much

more specific than those of Reading Recovery, and not as secure. Phonological Training children were only consistently ahead of their controls on phonological awareness, and the effect size was small in the within-school comparison (Table 5). In the between-school comparison, the Phonological children also performed significantly better than controls on the Diagnostic Survey, which contains measures sensitive to phonological skills and spelling, but there was no significant effect on reading, nor on the overall measure.

Table 5 around here

Children's reading and spelling at second (medium-term) post-test

Reading Recovery. As shown in Table 6, one year after children had graduated from Reading Recovery, they were still significantly ahead of their between-school controls in reading (both word and prose reading, es = .41 and .42 respectively) and to a lesser extent in spelling (es = .32) and on the overall reading/spelling measure (es = .39). However, these es of between .32 and .42 are small. The gap between the Reading Recovery and the control children had narrowed. Also, Reading Recovery only predicted statistically significantly higher scores on Non-word reading and not on the Oddities test, the other measure of phonological skill.

Reading Recovery children were no longer reading and spelling significantly better than their within-school controls, possibly because the control children in Reading Recovery schools had benefited from the presence of Reading Recovery in their school.

Table 6 around here

Phonological Training. As shown in Table 7, in the between-school comparison, children who had received Phonological Training one year previously had now made significantly more progress overall, in reading (both word and prose) and spelling, as well as phonological skills, but the overall reading/spelling es was small (.24). There were no significant differences between the Phonological children and their within-school controls even on the Oddities test which directly assesses the intervention focus (Table 7).

Table 7 around here

Children's reading and spelling at third (long-term) post-test

When the children were tested in the autumn of 1996 their average age was ten years and three months. In the fixed-order regression analyses carried out at this point it was necessary to enter free school meals status into the regression, alongside initial reading, as this was now a significant predictor of reading/spelling progress. Both reading and spelling response variables were transformed to reduce skewness. Once initial reading skills and free school meals status had been entered in the analysis, neither of the interventions predicted significantly raised reading scores (Table 8). Although both intervention groups were somewhat ahead of their between-school controls, the sizes of the intervention effects were negligible or small (.15 for Reading Recovery and .21 for Phonological Training), and not statistically significant. The between-school effects represent a reading age advantage of around three months. Reading Recovery did not predict better spelling progress. However, in the between-school comparison, where intervention children had shown substantially greater phonological skills than control children in the first two post-tests, there was a significant effect of Phonological Training on spelling (es = .27), Also, Phonological Training was

significantly associated with better progress in the between-school but not the within-school comparison of the overall measure of reading/spelling (es = .25). Reading Recovery did not predict a significant effect in either comparison.

Table 8 around here

Overall, on average, these children who had made a poor start in their reading at six were quite noticeably behind national norms on both the reading and spelling tests at 10. Their average chronological age was ten years three months but their average reading and spelling ages were eight years six months and eight years nine months respectively. This was in part due to the fact that many of them attended schools in socially disadvantaged areas, where the average reading age for children in their classes at ten years old was six months below national norms (Hurry & Sylva, 1998). However, it would appear that, in the long-term, neither of the interventions had allowed the children to overcome their poor start with reading.

Initial reading skills and responsiveness to intervention

Children were dichotomized into two groups on the basis of their performance at pre-test: non-readers (scoring less than 3 on the word reading test, 0 on the prose reading test and 0 or 1 on Book Level), and those with some word reading skills. Just under a half were non-readers at six. A Matthew effect was evident even in this truncated sample, with the initial non-readers making significantly less progress than those with some word reading at six years old ($B = .24$, $p < .05$ on the combined reading/spelling measure at final long-term post-test). This might suggest that the poorest readers, who were roughly the bottom 10% of readers in

their class, may be less responsive to intervention.

Tables 9 & 10 around here

Tables 9 and 10 show that this was not the case for either intervention and that Reading Recovery was actually more powerful for non-readers. In the short-term in the Reading Recovery comparisons, es for non-readers were at least twice those for children with some word reading at six years old. The interaction effect between reading status at pre-test and Reading Recovery was significant on overall reading/spelling in the between-schools comparison ($B = .55$, $p < .01$). In the medium-term, one year post intervention, the effect of Reading Recovery for children with some word reading at six was reduced, with small and insignificant es of .11 and .07. However, for those who started as complete non-readers medium es of .54 and .59 were still evident in both within- and between- conditions. Again the interaction effect between initial reading status and Reading Recovery was significant in the between-school comparison ($B = .46$, $p < .05$).

In the long-term, on the combined reading/spelling score, Reading Recovery was still more effective for the initial non-readers, though not quite significantly so, even in the between-schools comparison ($p = .07$, es = .34) and the interaction between initial reading status and intervention also just failed to reach statistical significance ($p = .07$). Separating the combined measure, for reading alone in the between-school comparison having received Reading Recovery did still had a significant effect on the bottom 10% of readers ($p < .05$, es = .39) and the interaction between initial reading status and intervention was significant ($p < .05$), but not for spelling.

No significant interaction effects were found between the Phonological intervention

and initial reading level. It would appear that Phonological Training is equally effective for all children with reading difficulties, whether or not they can read any words when first offered the intervention, though there is a non-significant tendency for it to be more effective for the slightly better readers.

Discussion

We report here on the effect of two early interventions on reading progress over four years, of children who were in the bottom 20% of readers in their class at six years old. In the short-term, both interventions worked. Consistent with other research, in both within- and between- school comparisons Reading Recovery was found to be a powerful method of improving children's reading and spelling over a broad spectrum, doubling reading children's progress (Pinnell et al., 1994; Shanahan & Barr, 1995; Wasik & Slavin, 1993). However, Reading Recovery did not have a consistent effect on children's phonological awareness. The Phonological Training on the contrary was effective at improving phonological awareness in both within- and between- school comparisons, consistent with research on phonological intervention (Bryant & Bradley, 1985; Bus & van Ijzendoorn, 1999; Hurry, 2004; National Reading Panel, 2000), but had little short-term impact on children's reading. This tendency for phonological intervention not to generalise to word-reading and comprehension in the short-term has been observed by others (Bus & van Ijzendoorn, 1999; National Reading Panel, 2000).

Based on the large impact that Reading Recovery had on children's reading during the intervention, when they made about twice as much progress as controls, a Matthew effect would predict that the gap between Reading Recovery and control children should have widened further with the passage of time. The better readers should have been reading more

books, building their vocabulary and world knowledge and feeling better about reading. However, three-and-half years on, for most of the comparisons made, children who had received Reading Recovery were no longer significantly ahead of their peers. Only those Reading Recovery children who were non-readers at six (the bottom 10% in their class) had made significantly more progress than similar between-school controls by the time they were 10 years old, and only in reading, not spelling.

Despite the fact that, overall, those who were better readers at six made significantly greater progress over the follow-up period than initial non-readers, it was the weakest readers who benefited most from Reading Recovery. For the children who were not reading at all at six years old, Reading Recovery was more effective at every follow-up point than for slightly better readers. However, even this group of Reading Recovery children did not increase their lead over their controls; they fell back slightly. Immediately on completing the intervention programme, Reading Recovery children who started as non-readers had an average reading age of six years, three months on the BAS word reading test, compared with an average of five years, five months for their between-school controls. Three years and four months on, the Reading Recovery children had made (roughly) one year and 11 months progress, compared to two years and three months of the between-school control group. For those who were slightly better readers at six, the children who had received Reading Recovery had made (roughly) three years, five months progress in their reading over the course of the four years, two months of the study Their between-school controls had made three years, seven months progress. Clay's (1991) proposition that children can be taught reading strategies early on which will protect them from later reading problems receives only limited support and only for the weakest readers.

Phonological Training did not improve reading immediately post-intervention and in

fact, the between-school control group had a significantly higher mean on the overall reading measure at first follow-up than the intervention group. However, one year and three years later, the Phonological group was doing significantly better on the overall reading/spelling measure than their between- school controls. The sustained effect of the Phonological Training in this comparison is consistent with the theory that phonological awareness is an essential early building block for decoding, which is itself a critical component of reading. This is all the more impressive since children only received 40 ten-minute sessions in Phonological Training, as compared to an average of 77 thirty-minute sessions for those on the Reading Recovery programme.

The delay in the impact of Phonological Training on reading is surprising, but a similar effect is reported by Bond and Dykstra (1967, 1997). In their comparisons of a range of methods of teaching initial reading they found that whole word techniques produced the largest immediate results, but that phonics programmes outstripped basal programmes in Grades 2 and 3. In our study, the only reading measure that showed a significant effect from the Phonological Training in the short-term was the Diagnostic Survey. This was largely due to the superior performance of the phonological group on Writing Vocabulary, a measure of spelling appropriate for young children, and on the Dictation task. Frith (1985) has argued that children first use phonic strategies to spell, and that their reading is initially heavily reliant on whole-word recognition. She suggests that as children's understanding of the link between the alphabet and sounds in words develops through spelling it subsequently helps them in their reading. This offers an explanation for our finding that Phonological Training had a significant long-term effect on spelling rather than reading and is consistent with other studies which have found larger effects on spelling than reading (Bradley & Bryant, 1985; Lundberg, Frost & Petersen, 1988; Byrne, Fielding-Barnsley & Ashley, 2000). The act of

word construction in spelling would seem to be a natural medium to practise and develop phonological skills.

The fact that intervention effects which went beyond phonological awareness were not evident in the within-school Phonological Training comparison must temper the confidence with which these results can be interpreted. This within-school comparison was the strongest design of all as it was a randomised controlled trial, with children being randomly assigned within their schools to intervention or control conditions. Immediately post-intervention there was a much more substantial difference in phonological awareness between Phonological Training children and between-school controls than within-school controls. It is plausible that the control children in the Phonological schools were exposed to some elements of the Phonological Training in their classes, undermining the within-school experiment. However, class-teachers were not supposed to be introduced to the intervention. The research team who delivered the training were explicitly told not to show class-teachers their methods and class-teachers reported that having the intervention in their school had not changed their teaching methods.

Conclusion

The present study finds that children who are poor readers after the first year in school will tend to fall further behind as they move through school, with reading and spelling ages on average one and a half to two years behind their chronological age in the last year of primary school. Sadly, early intervention of either a broad or phonics-based nature, even though effective at the time of delivery, does not appear to inoculate children from later problems. The partial long-term success of Phonological Training supports the proposition that early phonological skills are critical but it only explains around 1% of the variance on the

reading/spelling measure when the children were 10 years old. Even in the short-term, Bus and van Ijzendoorn (1999) report that phonological awareness training only accounts for about 12% of the variance in reading skills. It could be argued that another form of phonics intervention would have been more effective. McGuinness (2004), for example, argues that the teaching of rimes which is a part of Phonological Training, is ineffective, and that it is best to teach from sound to letter using the 40+ phonemes of English and their main spellings. However, even the studies of phonics training reviewed by the National Reading Panel (2000) leave a lot of variance unexplained. The long-term success of Reading Recovery for the weakest readers supports Clay's proposition of the critical nature of the early stages of reading acquisition for this group, but again, most of the variance remains unexplained. Hatcher and colleagues (Hatcher, Hulme & Ellis, 1994; Hatcher, Hulme & Snowling, 2004) suggest that combining the elements of a phonics programme with the broader focus of Reading Recovery produces enhanced results and perhaps such a programme would have sustained effects. However, our study suggests that children who find reading difficult at six have problems in developing and making use of strategies in reading that may persist. This may be due to child-related factors or to the home or school environment. Early intervention helps by explicitly teaching some of the early skills such as phonological awareness and the techniques of self-monitoring appropriate to the level of reading. Further progress is likely to be impeded by the underlying difficulties responsible for the children's early problems. In terms of cognitive skills, research clearly demonstrates the continuing nature of reading development, involving blending and segmenting, orthographic strategies and higher order comprehension skills (e.g. Frith, 1985; Oka & Paris, 1986; Palinscar & Brown, 1984; Byrne et al., 2000). The areas of concern in reading for ten-year-olds are different from those of six-year-olds. Venezky's (1998) review of the evidence on Success for All concludes that it also

becomes less effective by grade five. He remarks that it is better designed and more intensive in the lower grades, giving too little attention to higher-level reading and thinking skills further up the school. There has been an impressive body of work on the importance of explicitly teaching phonological skills to beginning readers and our own results tend to confirm the value of this element of instruction, but there is a tendency to disregard the continuing nature of reading development beyond the first stages of decoding.

Other non-cognitive factors are likely to have an impact on children's reading progress: their enjoyment of reading, their teachers' expectations or skill, encouragement at home or from their peers. For example, it has been consistently reported that teachers tend to restrict poorer readers' choice in the reading curriculum (e.g. Ofsted, 2004). Student choice has a strong effect on reading engagement, comprehension and achievement (Guthrie & Humenick, 2004). Although early interventions may impact on children's reading skill, teachers may still expect too little, the home environment may fail to nurture the child's learning, the social context may remain unaffected by intervention which solely targets the child.

The findings reported here do not support the proposition that early and effective cognitive intervention is sufficient to prevent later reading problems. Rather, the evidence presented here is consistent with Shanahan and Barr's (1995) proposition that cognitive support must be ongoing. Also, cognitive instruction does not address social and affective issues which may exert a continuing influence.

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Figure 1. Timetable of the Research

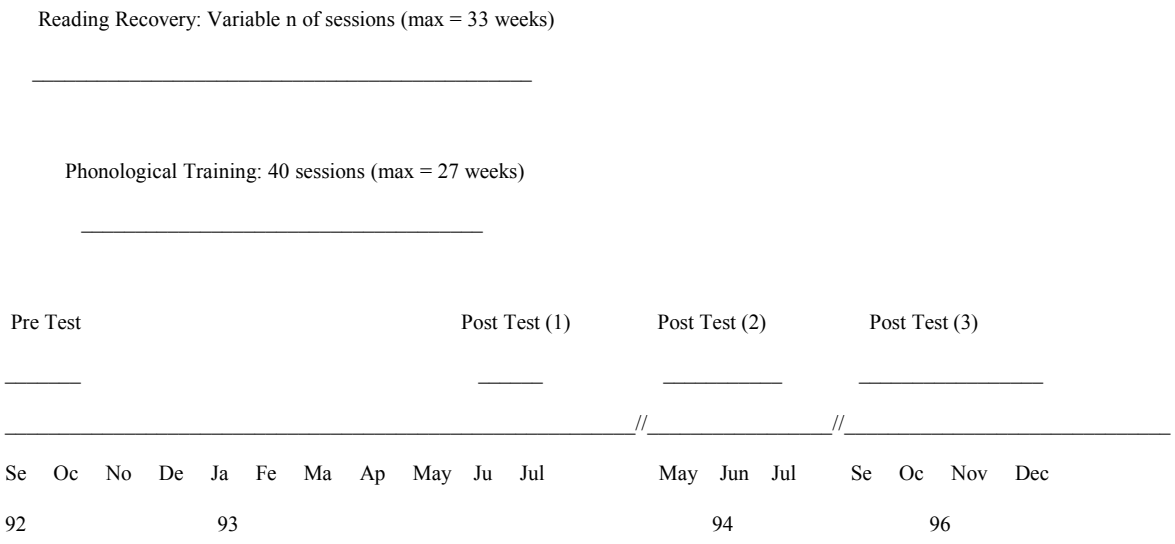

Table 1. Children tested at each measurement point

	RR	RR within-school control	Ph	Ph within-school control	Control schools
Pre-test (Sept/Oct 1992)	95	41	96	46	111
Post-test (1) (June/July 1993)	89	40	92	43	109
Post-test (2) (May/July 1994)	92	36	88	43	107
Post-test (3) (Sept/Dec 1996)	89	35	81	38	99

Table 2. Pre-intervention reading skills, Autumn 1992

Experimental Groups (Mean chronological age = 6yrs 3mnths)	Mean Raw Scores (sd)						
	(BAS) Word Reading[1]	(Neale) Prose Reading	Book Level	Diagnostic Survey	Overall reading/ spelling	(Oddities Test) Phonological Awareness	IQ
Reading Recovery							
Intervention children	2 (4) reading age, below 5yrs	0 (1) reading age, below 5yrs	1 (1)	-0.3 (.8)	-0.32 (.5)	2 (3)	92 (13)
Within-school controls	4 (4) reading age 5yrs 3m	2 (3) reading age, below 5yrs	2 (2)	0.4 (.9)	0.10 (.8)	4 (4)	96 (12)
Between-school controls	6 (8) reading age 5yrs 6m	2 (3) reading age, below 5yrs	2 (3)	0.2 (1.1)	0.26 (1.2)	3 (3)	96 (13)
Phonological Training							
Intervention children	3.5 (5) reading age 5yrs 1m	1 (3) reading age, below 5yrs	1 (2)	-0.2 (.9)	-0.17 (.9)	3 (3)	93 (13)
Within-school controls	4.5 (7) reading age 5yrs 4m	1.5 (3) reading age, below 5yrs	1 (2)	0 (1)	0.01 (1.0)	3 (3)	94 (14)

1 Reading ages are very approximate as many children scored nothing on this test at this time.

Between-school controls	6 (8) reading age 5yrs 6m	2 (3) reading age, below 5yrs	2 (3)	0.35 (1.1)	0.34 (1.3)	3 (3)	96 (13)
Total	4 (6) reading age 5yrs 3m	1 (3) reading age, below 5yrs	1.5 (2)	0 (1)	0 (1)	3 (3)	94 (13)

Table 3a-3c. Descriptive statistics at each of the three follow-ups

Table 3a First (short-term) follow-up (Summer 1993) (mean chronological age = 7yrs)

Experimental Group	(BAS) Word Reading		(Neale) Prose Reading	Diagnostic Survey	Overall reading/ spelling
	Raw score	Reading age	Raw score		
Reading Recovery					
Intervention children	19.4 (10.5)	6yrs 4m	11.3 (6.6)	0.45 (.62)	0.39 (.74)
Within-school controls	15.7 (12.4)	6yrs 1m	10.7 (9.7)	0.00 (1.07)	0.05 (1.01)
Between-school controls	15.8 (14.1)	6yrs 1m	9.2 (7.9)	-0.12 (1.13)	-0.06 (1.08)
Phonological Training					
Intervention children	13.0 (11.8)	5yrs 11m	7.2 (8.5)	-0.27 (1.13)	-0.31 (.98)
Within-school controls	14.5 (12.5)	6yrs 0m	8.1 (7.5)	-0.07 (1.00)	-0.15 (1.01)
Between-school controls	16.4 (14.7)	6yrs 1m	9.7 (8.1)	-0.12 (1.03)	0 (1.06)

Table 3.b Second (medium-term) follow-up (Summer 1994) (mean chronological age = 8yrs)

Experimental Group	(BAS) Word Reading		(Neale) Prose Reading	(BAS) Spelling	Overall reading/ spelling
	Raw score	Reading age	Raw score		
Reading Recovery					
Intervention children	33.4 (17.0)	6yrs 11m	19.5 (11.3)	17.8 (7.0)	0.04 (.84)
Within-school controls	34.1 (19.4)	7yrs 0m	20.1 (14.8)	18.9 (9.0)	0.10 (1.05)
Between-school controls	32.5 (19.2)	6yrs 11m	18.9 (13.2)	18.2 (9.2)	0.04 (1.02)
Phonological Training					
Intervention children	30.0 (19.4)	6yrs 10m	17.1 (13.3)	17.1 (9.2)	-0.10 (1.02)
Within-school controls	32.3 (17.9)	6yrs 11m	18.8 (12.7)	18.0 (8.2)	0.02 (1.00)
Between-school controls	32.6 (19.8)	6yrs 11m	19.0 (13.5)	18.2 (9.6)	0.04 (1.00)

Table 3.c Third (long-term) follow-up (Autumn 1996) (mean chronological age = 10yrs 3m)

	Reading		Spelling		
	Raw score	Reading age	Raw score	Spelling age	
Reading Recovery					
Intervention children	30.5 (9.1)	8yrs 4m	12.7 (6.5)	8yrs 7m	-0.08 (.87)
Within-school controls	31.8 (8.1)	8yrs 7m	14.8 (9.0)	8yrs 11m	0.13 (.01)
Between-school controls	31.4 (9.7)	8yrs 8m	14.5 (8.4)	8yrs 10m	0.09 (1.01)
Phonological Training					
Intervention children	29.8 (10.2)	8yrs 3m	13.8 (9.7)	8yrs 8m	-0.05 (1.06)
Within-school controls	31.9 (9.7)	8yrs 7m	14.8 (6.9)	8yrs 9m	0.13 (.95)
Between-school controls	31.2 (9.7)	8yrs 7m	14.4 (8.9)	8yrs 9m	0.07 (1.04)

Table 4. The effect of Reading Recovery on reading, spelling and phonological skills at first (short-term) follow-up (Summer 1993).

The results of a regression analysis controlling for initial scores on the Diagnostic Survey and BAS Word Reading.

Measures	Reading Recovery Comparison [2]			
	Within-school (sample size = 72 v 40)		Between-school (89 v 153)	
	B	Effect size	B	Effect size
(BAS) Word Reading	1.2	0.81 ***	1.4	0.84 ***
(Neale) Prose Reading	0.79	0.63 **	1.4	0.85 ***
Book level	5.2	0.78 ***	7.2	0.96 ***
Diagnostic Survey	0.75	0.87 ***	0.94	0.99 ***
(Oddities Test) Phonological Awareness	0.74	0.14	1.3	0.26 *
Overall Read/Spell	0.68	0.77***	0.88	0.88***

* $p < 0.05$ ** $p < 0.01$ *** $p < 0.001$

2 The Reading Recovery children in five schools were excluded from the within-school analyses as there were no control children available in these schools.

Table 5. The effect of the Phonological Training on reading, spelling and phonological skills at first (short-term) follow-up (Summer 1993).

The results of a regression analysis controlling for initial scores on the Diagnostic Survey and BAS Word Reading

Measures	Phonological Training Comparison			
	Within-school (92 v 43)		Between-school[3] (92 v 109)	
	B	Effect size	B	Effect size
(BAS) Word Reading	0.12	0.08	0.30	0.16
(Neale) Prose Reading	1.1	0.13	0.9	0.09
Book level	0	0	0	0
Diagnostic Survey	0.1	0.10	0.3	0.30 **
(Oddities Test) Phonological Awareness	1.7	0.34 *	3.6	0.72 ***
Overall Read/Spell	0.08	0.08	0.18	0.16

* $p < 0.05$ ** $p < 0.01$ *** $p < 0.001$

3 Control children from Reading Recovery schools were not included in the between-school analysis because of the ambiguity of their status (see Methods section). Therefore, numbers in the control group differ between RR and PhT throughout all analyses.

Table 6. The effect of Reading Recovery on reading, spelling and phonological skills at second (medium-term) follow-up (Summer 1994).

The results of a regression analysis controlling for initial scores on the Diagnostic Survey and the BAS Word Reading test.

Measures	Reading Recovery Comparison			
	Within-school[4] (68 v 34)		Between-school (91 v 150)	
	B	Effect size	B	Effect size
(BAS)Word Reading [5]	5.1	0.25	7.6	0.41 ***
(Neale) Prose Reading	3.2	0.26	5.3	0.42 ***
(BAS) Spelling	1.3	0.18	2.7	0.32 **
(Oddities) Phono. Awareness	0.3	0.01	0.1	0.03
Nonword Reading	2.6	0.29	3.2	0.38 **
Overall Read/Spell	0.23	0.25	0.37	0.39***

* $p < 0.05$ ** $p < 0.01$ *** $p < 0.001$

4 The Reading Recovery children in five schools were excluded from the within-school analyses as there were no control children available in these schools.

5 Word reading was transformed using a square root transformation to improve the normality of the distribution.

Table 7. The effect of the Phonological Training on reading, spelling and phonological skills at second (medium-term) follow-up (Summer 1994).

The results of a regression analysis controlling for initial scores on the Diagnostic Survey and the BAS Word Reading test

Measures	Phonological Training Comparison			
	Within-school (88 v 43)		Between-school (87 v 107)	
	B	Effect size	B	Effect size
(BAS) Word Reading	2.5	0.13	5.2	0.27 **
(Neale) Prose Reading	1.3	0.10	2.9	0.22 *
(BAS) Spelling	1.4	0.16	2.5	0.27 *
(Oddities) Phono. Awareness	0.1	0.02	2.4	0.49 ***
Nonword Reading	1.5	0.18	2.8	0.33 **
Overall Read/Spell	0.13	0.13	0.27	0.24*

* $p < 0.05$ ** $p < 0.01$ *** $p < 0.001$

Table 8. The effects of Reading Recovery and Phonological Training on reading and spelling skills at the third (long-term) follow-up, Autumn 1996

Controlling for initial reading attainment

Experimental Groups	Results of a regression analysis, controlling for pre-test score on the word reading test and the Diagnostic Survey					
	Reading/comprehension[6]		Spelling[7]		Overall Read/Spell	
	B	Effect size	B	Effect size	B	Effect size
Reading Recovery						
Within-school comparison	10.8	0.17	0.04	0.04	0.02	0.03
Between-school comparison	11.6	0.15	0.12	0.11	0.12	0.12
Phonological Training						
Within-school comparison	26	0.03	0.08	0.07	0.10	0.09
Between-school comparison	16.6	0.21	0.34	0.27*	0.27	0.26*

* $p < 0.05$

6 In all subsequent regression analyses, the cube of raw scores on the reading test were squared to reduce skewness.

7 In all subsequent regression analyses, square root transformation was used on the raw scores on the spelling test.

Table 9. The differing effect of the two interventions on reading and spelling by children's reading level at pre-test.

Descriptive statistics for between-schools comparison.

Experimental Groups	Raw score, mean (sd) Reading /Spelling age					
	Baseline Reading	Short-term Reading	Medium-term		Long-term	
			Reading	Spelling	Reading	Spelling
SUB SAMPLE: STARTING TO READ AT SIX YEARS OLD						
Reading Recovery						
Intervention children	5.2 (4.4)	22.9 (11.1)	37.7 (15.0)	20.0 (5.9)	33 (6)	14 (6)
	5yrs 5m	6yrs 6m	7yrs 2m	7yrs 4m	8yrs 8m	8yrs 10m
Between-school controls	9.2 (8.5)	21.9 (14.3)	41.0 (17.3)	22.5 (8.3)	35 (7)	17 (9)
	5yrs 10m	6yrs 5m	7yrs 3m	7yrs 7m	9yrs 3m	9yrs 5m
Phonological Training						
Intervention children	7.6 (5.9)	21.6 (11.7)	41.9 (17.7)	22.8 (8.7)	37 (5)	19 (8)
	5yrs 9m	6yrs 5m	7yrs 4m	7yrs 7m	9yrs 4m	9yrs 7m

Between-school controls	9.6 (9.0)	22.7 (14.7)	44.2 (16.0)	22.6 (8.2)	36 (7)	18 (9)
	5yrs 8m	6yrs 6m	7yrs 4.5m	7yrs 7m	9yrs 4m	9yrs 6m
SUB SAMPLE:NON-READERS AT SIX YEARS OLD						
Reading Recovery						
Intervention children	.4 (.6)	17.2 (9.6)	30.6 (18.0)	16.4 (7.4)	28 (10)	11 (7)
	Below 5yrs	6yrs 3m	6yrs 10m	7yrs 1m	8yrs 2m	8yrs 4m
Between-school controls	.6 (.8)	6.5 (7.2)	19.8 (14.5)	11.7 (6.4)	25 (10)	10 (6)
	Below 5yrs	5yrs 5m	6yrs 5m	6yrs 9m	7yrs 8m	8yrs 0m
Phonological Training						
Intervention children	.4 (.7)	6.7 (6.9)	19.6 (14.4)	13.2 (7.8)	25 (10)	10 (8)
	Below 5yrs	5yrs 6m	6yrs 5m	6yrs 9m	7yrs 7m	8yrs 2m
Between-school controls	.6 (.8)	6.3 (7.4)	18.4 (13.4)	11.1 (6.0)	24 (9)	9 (5)
	Below 5yrs	5yrs 5m	6yrs 4m	6yrs 8m	7yrs 6m	7yrs 11m)

Table 10. The differing effect of the two interventions on overall reading/spelling by children's reading level at pre-test.

Results of regression analyses, controlling for free school meals status and for initial scores on the Diagnostic Survey and BAS Word Reading.

	RR Comparison				Ph T Comparison			
	Within-schools		Between-schools		Within-schools		Between-schools	
	B	Effect size	B	Effect size	B	Effect size	B	Effect size
Short-term follow-up								
Some word reading	0.3	0.34	0.52	0.56***	0.16	0.16	0.12	0.13
Non Readers	0.95	1.15***	1.1	1.22***	-0.01	0.01	0.17	0.25
Interaction between reading level at pre-test & intervention	0.53		0.55**		-0.17		-0.03	
Medium-term follow-up								
Some word reading	0.09	0.11	0.07	0.07	0.32	0.34	0.4	0.42*
Non Readers	0.43	0.54	0.48	0.59***	-0.05	-0.06	0.19	0.26
Interaction between reading level at pre-test & intervention	0.44		0.46*		-0.33		-0.16	
Long-term follow-up								
Some word reading	-0.09	-0.06	-0.07	0.1	0.24	0.37	0.22	0.3
Non Readers	0.15	0.19	0.3	0.34 (	0.07	0.07	0.32	0.38*

		p < 0.07)		
Interaction between reading level at pre-test &	0.24	0.36	-0.26	-0.004
intervention		(p < 0.07)		

* p < 0.05 ** p < 0.01 *** p < 0.001