Running Head: WHOLE CLASS READING

Delivering Phonological and Phonics Training within Whole Class Teaching

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Abstract

Background: Early, intensive phonological awareness and phonics training is widely held to be beneficial for children with poor phonological awareness. However, most studies have delivered this training separately from children's normal whole-class reading lessons.

Aims: We examined whether integrating this training into whole class, mixed ability reading lessons could impact on children with poor phonological awareness, whilst also benefiting normally developing readers.

Sample: Teachers delivered the training within a broad reading program to whole classes of children from Reception to the end of Year 1 (n = 251). A comparison group of children received standard teaching methods (n = 213).

Method: Children's literacy was assessed at the beginning of Reception, and then at the end of each year until one year post-intervention.

Results: The strategy significantly impacted on reading performance for normally developing readers and those with poor phonological awareness, vastly reducing the incidence of reading difficulties from 20% in comparison schools to 5% in intervention schools.

Conclusions: Phonological and phonics training is highly effective for children with poor phonological awareness, even when incorporated into whole class teaching.

Delivering Phonological and Phonics Training within Whole Class Teaching

Early supplementary phonological awareness training is widely held to be beneficial for children at risk of developing reading difficulties, especially when combined with phonics training (linking phonemes to letters in print) (Ehri, Nunes, Willows, Schuster, Yaghoub-Zadeh & Shanahan, 2001). As discussed in Foorman, Breier and Fletcher (2003), the aim of these early interventions is to target the phonological core deficit in poor readers, and it is widely thought that this can best be achieved through additional, intensive phonological training that is delivered on a one-to-one or small group basis.

However, recent studies have shown that supplementary phonological and phonics training can be highly effective even when delivered to large groups or whole classes of children (e.g. Hatcher, Hulme & Snowling, 2004; Fuchs, Fuchs, Thompson, Al Otaiba, Yen, Yang, Braun & O'Connor, 2001; Foorman, Francis, Fletcher, Schatschneider & Mehta, 1998; Leafstedt, Richards & Gerber, 2004). These studies focus mainly on children at risk of developing difficulties, and additional phonological training is thought to be unnecessary for normally developing readers. In fact, Hatcher et al. showed that additional phonological training had no impact on the top two thirds of readers. Although the UK National Reading Panel report (Torgerson, Brooks & Hall, 2006) concluded that systematic phonics training can benefit children at different achievement levels, only four of the fourteen studies included in the meta-analysis were with normally developing readers (Haskell, Foorman, & Swank, 1992; Johnston & Watson, 2004; Leach & Siddall, 1990; Skailand, 1971). All of these studies involved either additional training outside the classroom or relatively small teaching groups (between 10 and 20 children), and all were of short duration (up to 10 weeks). In the current paper, we aim to investigate whether a phonological intervention delivered on an entirely whole class basis, over an extended time-scale, can both reduce the incidence of literacy difficulties and also raise the attainments of normally developing readers.

Clearly, if phonological and phonics training could be incorporated into children's normal whole class teaching, the need for supplementary phonological training would be minimized, creating savings in time and resources and allowing space for alternative activities. Importantly, a whole class phonological intervention could potentially allow a more rigorous analysis of the causes of literacy difficulties and offer new theoretical insights into the nature of the difficulties experienced by lower achieving pupils. For example, if children with poor phonological awareness respond in a qualitatively different way to a whole class intervention, this would indicate that they have different learning requirements to other children, consistent with having a core phonological deficit (Francis, Shaywitz, Stuebing, Shaywitz & Fletcher, 1996) rather than simply falling at the bottom tail of a normal distribution of reading ability (Shaywitz, Escobar, Shaywitz, Fletcher & Makuch, 1992). Subsequently, a whole class intervention could isolate a relatively pure sample of children with a genuine deficit. In addition, although it is generally assumed that lower achieving pupils require a qualitatively different intervention to their peers, it has yet to be demonstrated that this is the case. For example, it is possible that these children require the same intervention but for longer with more opportunities to practise newly acquired skills. In fact, Hindson, Byrne, Fielding-Barnsley, Newman, Hine, & Shankweiler, 2005, found that pre-school children with familial risk of reading difficulties could achieve grade-appropriate levels through pre-school instruction, but they required more sustained training than other children.

The current study investigates whether implementing phonological awareness and phonics training within whole class mixed ability lessons can impact on children at risk of developing reading difficulties as well as raising attainments for normally developing children. Our intervention (hereafter, the Early Reading Research intervention; ERR) is based on a different theoretical model to other interventions, which were derived from research in

developmental and cognitive psychology. The ERR is based on instructional psychology, which focuses on the learning environment rather than individual differences between children and aims to teach the most useful and generalisable skills first, even if developmentally they are acquired after skills that appear to be easier. For example, there is an extensive debate about the order in which children become aware of different sized speech-sound units (e.g. Goswami, 2002; Savage, Blair & Rvachew 2006). However, the developmental progression is not necessarily relevant to the question of how best to teach these skills. Even if children developed awareness of large units, such as rhyme, before they developed awareness of smaller units, such as phonemes, it would not necessarily be optimal to teach children rhyme skills first. In fact, children appear to be able to generalize their knowledge from smaller to larger units, but not vice versa (Brown, 1998; Yeh, 2003), suggesting that learning about phonemes would be most useful. In addition, Vousden, (2007) has compared the number of monosyllabic words in the CELEX database of written and spoken English (Baayen, Piepenbrock, & Gulikers, 1995) that can be read using knowledge of different sized units. She identified over two million words that could be read by knowledge of 339 GPCs (grapheme-phoneme correspondences). In contrast, knowledge of over 2100 onsets and rimes would be required to read approximately the same number of words, significantly increasing the amount of information that would have to be remembered. Thus, regardless of whether children develop an awareness of phonemes first, or rhymes first, there is good evidence that GPCs are the most useful for learning to read.

Instructional psychology draws on the work of Anderson (1990) and Brown (1998) in rational analysis; Carnine and Becker (1982), Carnine, Silbert and Kameenui (1997) and Engelmann and Carnine (1982) in direct instruction and Solity (1991), Solity and Bull (1987) and Wheldall and Carter (1996) in the area of behavioural psychology. This theoretical basis has two major implications. The first is the content of the literacy intervention, in particular

the number of skills taught and the sequences in which they are presented. The second is the assumption that the cause of children's literacy difficulties is located in the way they are taught rather than being the result of a specific deficit.

The core components of successful early reading interventions (phonological awareness and grapheme-phoneme correspondences) were incorporated into a single, short, whole class teaching session that covered all aspects of reading (phonological awareness, phonics, sight reading and reading real books), and could be delivered very frequently. Teaching children crucial skills in short, frequent sessions was a critical component of the ERR intervention. This innovation was based on experimental work by Baddeley (1997) and Seabrook, Brown and Solity (2003). Seabrook et al. examined the impact of varying the spacing between to-be-remembered items. They investigated the spacing effect with lists of words, where the to-be-remembered words were repeated twice, with spacings of between 0 to 8 filler words in between, and found that increasing the spacing between repeated items had a significant impact on recall for participants of all ages, from 5 years to adult. They also examined the impact of this spacing effect on children's reading development in a real classroom context, where teachers taught letter sound correspondences either for 6 minutes a day, or for 2 minutes, 3 times a day. After 2 weeks of teaching, children who received the shorter more distributed sessions made significantly more improvement in phonics. Therefore, distributing teaching into many short sessions may be a critical factor in increasing the impact of whole-class lessons.

Structure of the Intervention

The intervention consisted of a single, whole class, session covering the teaching of phonological awareness (synthesis and segmentation), phonics, sight vocabulary and reading to and with children. Since experimental studies have shown distributed practice to be more effective than massed practice (Baddeley, 1997; Seabrook et al., 2003), each whole class

session lasted just 12 minutes and was delivered by the children's normal class teacher three times a day. Within these sessions, children practised four skills (phoneme synthesis, phoneme segmentation, phonic skills and sight vocabulary) for 2 minutes each. Since interleaved learning has been shown to prevent forgetting and aid retention (Brown, 1998), teachers mixed new material with older, more familiar material when practising each of these skills. In addition, all skills were taught to high fluency levels (Logan 1988; Raybould & Solity 1982; Solity & Bull 1987) and children were only taught skills that are explicitly used when reading, writing and spelling. For the final 4 minutes of each session, teachers read to children from large books and demonstrated how the skills they had been practising applied to reading. Teachers used a timer with an alarm to ensure they kept to time. Children were not required to complete worksheets or undertake any independent written activities to practise their phonic and sight vocabulary skills. Since all the teaching was conducted on a whole class basis, teachers were shown how to differentiate the various elements of the framework to meet the needs of all children. Thus, teachers spent a few seconds, whilst teaching each skill, focusing on content suitable for different achievement groups, allowing children to progress at different rates through the same material. For example, when learning to read phonically regular words (where each phoneme is represented by a single grapheme) such as CVC (e.g. hat), CVCC (e.g. bend), CCVC (e.g. slip), and CCVCC (e.g. spend), teachers divided classes into higher, middle and lower achieving groups. Teaching started with the higher achievers learning to read CCVCC words where they stated the phoneme represented by each grapheme and then blended the sounds together to state individual words. Middle and lower achievers would also be participating during this time. Although blending five phonemes would be too difficult for middle and lower achievers to do alone, participating alongside the higher achievers meant that this task was modelled for them, reinforcing their knowledge of GPCs. After 40 seconds, teaching switched to the middle

achievers who learned to blend CCVC words. Higher achievers were told to do the task in their heads, and lower achievers continued to participate, again having the task modelled and reinforcing their knowledge of GPCs. Finally, after a further 40 seconds the lower achievers blended three phonemes together in CVC words while the middle and higher achievers did this task in their heads. The lower achievers were involved for the full two minutes of teaching, 40 seconds of which was on an appropriate task. For the remaining 80 seconds of this time, more difficult tasks were modelled. Involving lower achievers in more difficult tasks should help to prepare them for what they will learn next, and allows them to practise appropriate skills, even though they would not be able to read the entire word successfully. Middle and higher achievers, although in receipt of less direct teaching were given time on activities appropriate for their needs. In this way, lower achievers effectively got extra help on material suitable to their attainments in every session. Each component of the intervention is described below.

In addition to the whole class sessions, children were heard reading two to three times a week on an individual basis by a teacher or classroom assistant and their progress in learning phonic skills and sight vocabulary was assessed on a regular basis. For listening to children read, teachers and classroom assistants were trained in an adapted version of the pause, prompt, praise procedure (Wheldall & Glynn, 1988; 1989). When children hesitated over a word, teachers paused for 5 seconds before giving them a suitable prompt. Children were encouraged to decode through applying their phonic and sight vocabulary knowledge to texts rather than relying on picture, or any other non-text related cues.

Components of the Intervention

Phonological Awareness

In order to include all aspects of reading within a single whole class session, we only covered the core components of phonological awareness training. As in Fuchs et al. (2001), Hatcher et al. (2004) and Forman et al. (1998), we taught synthesis and segmentation. Children were taught to synthesize up to five individual phonemes to pronounce a word and segment words into a maximum of five individual phonemes. These were purely phonological tasks and children did not see any words or letters while they were being performed. A wide range of phonically regular words were used, some of which would be unfamiliar to children (e.g., *zen, wilt, stump*) and others with which they would be more familiar. No non-words were used. Synthesis and segmentation were the only phonological skills taught, because they directly parallel tasks used in reading and spelling respectively. For example, when reading, children combine individual phonemes to pronounce a word (synthesis) and when spelling, break words up into individual phonemes (segmentation). Children were not taught any phonological skills that are not used directly and explicitly when reading and spelling (e.g., discrimination, deletion, substitution or transposition of phonemes, as in Hatcher et al., or first-sound isolation, as in Fuchs et al.)

Phonic Skills

Acquiring phonic skills involves mapping phonemes to graphemes. As in other phonics interventions (e.g. the direct code instruction condition from Foorman et al., 1998, and the synthetic phonics condition from Johnston & Watson, 2004), children were initially taught individual letter-sound correspondences so were able to state the phoneme represented by the 26 letters of the alphabet. They were then taught to read phonically regular words followed by letter combinations where two or more letters represent a single sound (e.g., sh, ea) that are blended with other phonemes to enable children to state individual words.

Following the principle of optimal information from rational analysis (Anderson, 1990, applied to reading in Brown, 1998) and Carnine et al.'s (1997) application of Direct Instruction principles to teaching reading, we aimed to teach the optimal number of GPCs (our choice of GPCs was confirmed to be optimal by Solity & Vousden, 2007; Vousden, 2007 using statistical analyses of written text). Children were taught 61 high frequency mappings between graphemes and phonemes (26 letters; 5 vowels modified by 'e', for example the letter 'a' in 'rate'; 30 letter combinations). Children were only taught one GPC (the most frequently occurring phoneme for each grapheme) where multiple mappings exist between phonemes and graphemes (Carnine, et al., 1997; Solity & Vousden, 2007; Vousden, 2007).

Sight Vocabulary

Children were taught to read 100 high frequency words by sight, based on McNally & Murray's (1962) word lists (and determined as the optimal number by Solity, McNab & Vousden, 2007; Solity & Vousden, 2007; Vousden, 2007). These were taught as whole words with no reference to any phonemes within the words, the shape of the word or pictorial representations of the words. Thirty-nine of these high frequency words can also be read through applying phonic skills, when students have acquired knowledge of the necessary GPCs, but were nevertheless initially taught as sight vocabulary. After acquiring the necessary phonic skills these words could then be read through a sight or phonic route.

Reading to Children

Teachers read to and with children on a whole class basis for a minimum of three times a day for 4 minutes, using large books. The teacher read some sections alone, and other sections were read jointly with children. Teachers used this opportunity to show children how to apply their phonological, phonic and sight vocabulary skills to a wide range of texts. Teachers were advised to teach reading through real books rather than through reading

schemes. This is because real books represent the written structures they will encounter as their reading improves and children will see new words in as many different contexts as possible. Increasing the number of contexts in which children see a word is likely to improve retention, since Adelman, Brown and Quesada (2006) demonstrated that the number of contexts in which a word occurs is a better predictor of naming and lexical decision than word frequency. In sum, the ERR intervention aims to provide systematic instruction in phonological awareness and phonics, and at the same time, demonstrate to children how to apply these skills to a wide and diverse range of texts.

Research Questions

In the current paper, we address two main issues. Firstly, we will investigate whether delivering less extensive phonological and phonics training as part of a whole class intervention impacts on the reading development of children with poor phonological skills. If the ERR intervention was not sufficient to teach at-risk children the phonological skills necessary to begin to learn to read, this would cause an interaction reflecting a smaller effect of ERR for children with poor phonological awareness. Secondly, we will investigate whether a whole class intervention can cause a significant reduction in the incidence of reading difficulty, based on the distribution supplied by the British Ability Scales (BAS) Word Reading Test A (Elliott, Murray, & Pearson, 1983). The results of this study will help to judge whether incorporating phonological and phonics training into whole class teaching should be made a priority in the campaign to reduce the incidence of reading difficulties.

Method

Design

We used a quasi-experimental design to investigate the impact of the ERR intervention, compared to conventional classroom teaching. The intervention replaced the entire content and organization of the reading curriculum within experimental schools. The attainments of

children attending experimental schools were compared with a comparison group made up of children attending similar schools (see section below on matching ERR and comparison schools), but who received conventional teaching methods (see section on teaching procedures for details). The research was conducted over a three-year period as children progressed from the beginning of Reception (the first year of formal schooling in the UK; mean age four years, eight months) to the end of Year 2 (the third year of school in the UK; mean age seven years, four months). The intervention took place in Reception and Year 1 (i.e. for the first two years of school) but was withdrawn in Year 2 so that it was possible to investigate whether any gains made during Reception and Year 1 were maintained. From the beginning of Year 2, both groups of children were taught according to the National Literacy Strategy (NLS) (the government-led literacy strategy that was implemented in schools throughout the UK in 1998; Department for Education & Employment, 1998).

The first assessments were conducted when children entered Reception (mean age 4 years, 8 months). These initial assessments represent children's baseline literacy level, at the point at which they begin formal schooling (hereafter termed baseline assessments). Follow-up assessments were conducted at the end of each school year during the intervention (Reception: mean age 5 years, 4 months; Year 1: mean age 6 years, 4 months) and for one year post-intervention (Year 2: mean age 7 years, 2 months). At each time point, all children registered in the year group were tested, unless absent.

Assessment Measures

The assessment measures were designed to examine children's learning of phonological skills, grapheme-phoneme correspondences, word reading and prose reading. Measures of mathematical skill were also included as an independent measure of educational achievement. The assessment measures used were: NFER-Nelson New Reading Analysis (Vincent & de la Mare, 1985), British Ability Scales (BAS) word reading test A (Elliott et al., 1983; hereafter

known as BAS score) plus additional tests of reading-related skills. The current paper will present analyses using BAS raw scores only. However, all literacy measures are presented in Table 2a in the Results section, with effect sizes (*d*, Cohen, 1988). Three measures were gained from the NFER-Nelson test, which contains six graded prose passages. Firstly, NFER words (NFERW), the total number of words read correctly before the assessment ended. Secondly, NFER accuracy (NFERA), gained by subtracting number of errors made on each prose from 16, then summing the resulting score. Thirdly, NFER comprehension (NFERC), the total number of questions answered correctly. The BAS is a single word reading test and scores on this test reflect the number of words read correctly. Two measures were gained from the BAS, a raw score and a reading age.

The other reading related skills measured were letter sound knowledge, synthesis, segmentation and rhyme. Letter-sound knowledge and rhyme were particularly important tests in the initial assessment session because it may be possible to measure children's performance on these tasks before they have developed an awareness of smaller units, and before they have started to read entire words. For example, Carroll, Snowling, Hulme, and Stevenson (2003) found that rime awareness developed earlier than phoneme awareness. In addition, Foy and Mann (2006) recently examined the reciprocal relationship between letter sound knowledge and phoneme awareness, and found that knowledge of letter sounds can help children develop explicit awareness of phonemes. Thus, even if children are performing close to floor on reading and phoneme awareness tasks, we may be able to measure their performance in rhyme and letter sound tasks, and this performance will provide a good indication of their literacy level at the beginning of the study. Our rhyme assessment was based on Bradley and Bryant's (1983) oddity task and we measured children's ability to identify the 'odd one out' from four aurally presented words. The target phoneme was placed in the initial, middle or final phoneme position. Our letter-knowledge task measured

children's ability to produce the correct sound for each of the 26 letters of the alphabet, presented as letters written in large font. The phonological measures (synthesis, segmentation, rhyme; see Table 2b) were used to investigate the impact of the ERR on children at different levels of phonological awareness. Other measures were also taken that assessed children's progress on specific skills taught within the intervention (e.g. reading phonologically regular words and sight vocabulary reading). These additional measures are reported elsewhere (Solity & Shapiro, 2007).

In addition, tests of mathematical ability were conducted. These provided a measure of children's performance on skills that were not taught within the ERR framework and provided a further check that the schools were matched for teacher effectiveness (see section on matching ERR and comparison). The tests were: counting to 20, counting groups of lines, writing numbers, constructing groups (drawing a specified number of lines), addition, subtraction and mixed addition and subtraction. The mathematical scores are presented in Table 1b in the Results section.

The assessments were all conducted on a one-to-one basis in a quiet corner of the classroom. The research assistants who collected the data were experienced in conducting standardized reading assessments with young children but were naïve to the purpose of the study.

Participants

Teachers and pupils from 12 schools participated in the research (details of how schools were selected are described in the following section). Most pupils attending these schools came from families living on low incomes and prior to the study, pupils from these schools achieved literacy levels below the national average. At the beginning of the study, 464 children were present across all 12 schools. Of these children, 251 were in ERR schools and 213 in comparison schools. By the end of Year 1 (the end of the intervention), 16

children had left the ERR schools and 14 children had left the comparison schools, leaving 434 children remaining in the study. By the end of Year 2 (one year post-intervention), a further 47 children had left the ERR schools and 56 had left the comparison schools leaving 331 children remaining in the study. Children who joined the schools after the baseline assessments had been conducted were not included in the following analyses.

Our study required intervention schools to completely replace their normal literacy teaching for two academic years with a highly prescriptive intervention. Not only were the curriculum content and teaching methodology altered, the structure of every school day had to be adapted so that the ERR framework could be delivered through three 12 minute sessions. We found that the extent of the intervention meant that random assignment was not acceptable to the teachers, and we therefore allowed head teachers to opt in (see section on assigning schools to groups, below). Although non-random assignment was listed as a serious shortcoming of many interventions reviewed by Troia (1999), he did recognise that the studies that used the most rigorous experimental designs were generally those with the lowest ecological validity. He went on to suggest that, "The educational community must be prepared to accept compromises and innovations in experimental methodology and alternative investigative paradigms so that ecologically valid treatments are available for field use" (p. 50). Nevertheless, as Troia discussed, it is important to ensure that school effects are minimised when random assignment is not possible, and we have outlined the precautions taken to minimise school effects in one of the following sections.

Procedure for Assigning Schools to Groups

Head teachers from all schools within a Local Education Authority (a local government body responsible for providing education for pupils of school age in a particular area of the UK; hereafter termed LEA) were invited to attend a meeting, together with either the literacy coordinator or one Reception teacher, to discuss options for improving standards

in early literacy. Most of the options that were discussed involved internal re-organisation such as changing the distribution of resources, re-arranging the timing of literacy activities or improving communication between members of staff. In addition, we were invited to give a brief presentation at this meeting, outlining our reading intervention as an alternative option available to the schools.

Out of the 500 schools within the LEA, head teachers from only 25 schools agreed to attend the meeting. Clearly, these schools were comparable in that the head teachers recognised the need to improve standards in early literacy and were willing to consider making changes to the way literacy was taught in their school. Of these 25 schools, 6 agreed to implement the ERR intervention, and all remaining schools (19) agreed to participate as a comparison group.

Precautions for Minimizing the Influence of School Effects

Long-term intervention with post-intervention follow up. We believed that a two-year intervention would help to overcome the potential limitations of not using randomised samples. Since teachers implemented a methodology over two years, this would have become their accepted way of teaching, rather than being a short-term novelty. Therefore, it would be less likely that pupils' learning outcomes would be influenced by teacher enthusiasm and motivation. We also included a post-intervention year, and measures of mathematical ability in order to measure any school effects, over and above the effects of the intervention.

Matching ERR and comparison schools. Since we only required 6 comparison schools out of the 19 schools who agreed to participate, we were able to closely match them on many critical factors, such as geographical proximity, socio-economic status of the intake group and previous test results. Importantly, the comparison and ERR schools were matched on the percentage of pupils eligible for free school meals (22.96% of children in ERR schools received free school meals, compared with 24.39% in comparison schools) and on the

percentage of children achieving Level 4 (the UK government-defined expected level) in their Key Stage 2 (KS2) test results, taken by 11 year olds, the summer immediately before the study began (37.16% of children in ERR schools achieved level 4, compared with 41.83% in comparison schools). As an additional broad check of comparability, we compared KS2 results once the intervention had been in place for one year. Both groups of schools showed an overall improvement in standards, reflecting a nationwide drive to improve literacy levels immediately prior to the introduction of the NLS (Department for Education & Employment, 1998). Nevertheless, the two groups were still equivalent. If anything, ERR schools remained slightly behind (46.67% achieved level 4 in ERR schools, compared with 51.17% in comparison schools). Together, these data indicate that the ERR and comparison schools were well matched on school effectiveness and the social economic status of their intakes.

Teaching Procedures

ERR Strategy

Implementation of the intervention. Teachers in both year groups were trained to implement the reading framework through a combination of five half-day plenary sessions and regular follow-up visits to schools (approximately four a term between September and June), by two educational psychologists who were members of the research team. Children in the experimental schools were given 36 minutes of direct instruction through three 12-minute teaching sessions every day, as described in the introduction.

Treatment fidelity. Teachers were observed approximately four times per term (12 times a year) by the two educational psychologists to ensure that the framework was being delivered appropriately. Record sheets were completed during each observation which documented whether: each element in the framework was being implemented; the core instructional principles were being applied; each element was being taught by the specified methods and children were being heard reading and having their progress assessed on a

weekly basis. Teachers were given feedback following each observation and general issues that applied to all teachers were addressed at the next training session.

All the elements in the framework were implemented during every observation. However, variation existed, as with all teaching, in the quality and frequency of teaching. The school visitors kept qualitative records, which documented the key teaching points, and fed these back to teachers during the observations. The key teaching points were: increase pace of sessions; increase children's fluency; ensure that tasks are interleaved; use whole class or differentiated group responses rather than individual responses and make explicit links between skills taught and how they are used when reading texts. Teachers' records indicated that every child was heard reading at least twice a week and every child's progress in learning sight vocabulary and phonic skills was assessed once a week.

Comparison Strategy

The staff and governing bodies from the comparison schools agreed to arrange for teachers to have regular meetings with a member of the research team so that they could provide full details of how they were teaching reading. We anticipated that the staff at the comparison schools, knowing that they were part of a research project where the outcomes of their teaching were to be compared to an experimental group, would be motivated to ensure that children were taught as effectively as possible.

One member of the research team regularly visited the comparison schools throughout the duration of the study. Interviews were conducted with the reception and Year 1 teachers twice every term and all aspects of how they were teaching reading were discussed. It was hypothesized that merely visiting schools on a regular basis to enquire how reading was taught might have been as effective as the experimental intervention. Medwell, Wray, Poulson and Fox (1998) found that effective teachers found time to reflect on their practice. As a result, providing regular opportunities for teachers to discuss how they were teaching

reading may in itself have been sufficient to impact on children's progress. In addition, comparison teachers' weekly records of what and how they taught were inspected. This made it possible to identify the teaching methods being used in the comparison schools and to assess their similarity to those being implemented in the experimental schools.

The crucial difference between ERR and comparison teaching methods was in the structure of the reading lessons. Comparison children were taught in one hour-long lesson per day that included whole-class, small group and individual work, whereas ERR children received three short reading lessons per day, conducted entirely on a whole-class basis. In addition, comparison group teachers taught a slightly broader, range of skills than ERR teachers. During Reception, comparison children were taught the same letter sound correspondences as ERR children. However, the comparison children were also taught to isolate individual sounds at the beginning, middle and end of words. In contrast, ERR children were only taught how to segment and synthesise entire words. Comparison children were introduced to new sounds on a weekly basis which were presented in alphabetical order. This contrasts with the ERR training, where the order of new sounds was determined by their frequency in written English and new sounds were only introduced once the majority of children were fluent in all previously taught sounds.

Rhyming words and word families were taught to the comparison group, although without specific reference to onset and rime whereas the ERR children were not taught any rhyming words. Common words found in the reading scheme used and in children's writing were taught as sight vocabulary to comparison children and were similar to those used in the ERR intervention. Comparison teachers followed one of three reading schemes (The Oxford Reading Tree, The Ginn Reading 360 Series or One, Two, Three and Away). Stories were read regularly with much use made of large books and an emphasis on reading for enjoyment. Children were encouraged to use picture clues when reading and to give the initial sound of

an unknown word. In Year 1, children continued to learn phonic skills and were introduced to initial (e.g., *bl, br, st*) and final blends (e.g. *nd, lt, mp*). Key vocabulary related to the children's topic work was also introduced on a weekly basis. Teachers continued to read stories to the whole class using large books. In year 1, teachers continued to teach core skills such as phonics and sight vocabulary to the whole class. However, teachers began to provide more individualised training for children according to their level of reading. Thus, within the hour spent on reading each day, a large proportion of the time would be spent with the children divided into groups, working on different skills according to their level of reading. The methods for teaching reading were similar to those described in the work of Wragg, Wragg, Haynes and Chamberlin (1998).

Treatment Comparability

Within the ERR, 24 minutes a day were spent in teaching skills and a minimum of 12 minutes on reading with children. Thus, ERR teachers spent 36 minutes a day on reading related activities. Comparison school teachers devoted a morning session of approximately one hour a day to literacy activities, and this was conducted partially as a whole class, and partially in smaller groups and one-to-one with the class teacher or an assistant. Thus, the comparison schools spent a little longer on literacy activities than the ERR group, and spent more time providing individual attention for children experiencing difficulties. The comparison strategy included the same components (phonological awareness, phonics, sight vocabulary and reading to children) but the methods used to teach these components differed. The key differences were that comparison teachers taught phonological awareness by isolating individual sounds in words, whereas ERR teachers taught synthesis and segmentation. Comparison teachers also taught more letter combinations, a larger sight vocabulary and presented skills in different sequences. For example, the ERR schools taught GPCs according to their frequency of occurrence in written English (Carnine, et al., 1997),

teaching the most frequently occurring GPCs first, whereas the comparison schools generally introduced GPCs alphabetically. In addition, comparison teachers taught each component only once a day during the hour spent on literacy activities, using a combination of whole class, small group and one-to-one teaching. In contrast, ERR teachers taught each component three times a day within each 12-minute whole class session.

Results

We collected data from 464 children (251 ERR, 213 comparison) at baseline and 323 of these children were present at all four time points. The current paper reports analyses of BAS scores, but the pattern of results was consistent across a range of measures (presented in Table 2a). We used a square-root transformation to fit the scores to a normal distribution. Firstly, we examined the two groups to check that they were matched in terms of their baseline scores on tests of rhyme and letter sound knowledge (scores were at floor for other measures, see next section for details). Secondly, we assessed the impact of the ERR intervention on children's reading development. Since we collected longitudinal data from children who were clustered within schools, it was necessary to account for three levels of random effect: those caused by differences between time-points, differences between individual children and differences between schools. We therefore built multilevel models to examine the impact of the ERR intervention, over and above the random effects of time, child and school. The STATA program, gllamm, (Rabe-Hesketh, Skrondal & Pickles, 2002) allowed us to fit three level (year, child, school) random intercept regression models, accounting for missing data through maximum likelihood estimation. These models allow us to measure the interaction between ERR and time, in order to assess whether ERR had a significant impact on the growth of reading scores. Initially, we modelled overall improvement in reading scores, for ERR and comparison children over three time points from end Reception to end Year 2. However, this model could not include baseline reading

performance, which was at floor. Therefore, we also fitted a series of year-by-year regression models that factored in the influence of a child's literacy scores in one year on their reading performance in the following year. In addition, we compared the impact of the ERR intervention on the reading development of children at different levels of phonological awareness. Since the ERR intervention taught fewer skills than other interventions, it was important to assess whether this was sufficient for children with poor phonological awareness. Finally, we assessed whether the ERR whole class intervention significantly reduced the incidence of reading difficulty, as measured by the BAS (Elliott et al., 1983).

Are the ERR and Comparison Children Equivalent at baseline?

As described in the Method, the ERR and comparison schools were matched closely in terms of Key Stage 2 Standard Assessment Test results from previous years and the proportion of children eligible for free school meals. However, we also inspected the baseline scores for the two groups to ensure that they were matched. Four hundred and sixty four children (251 ERR, 213 comparison) were tested at the beginning of Reception on measures of pre-reading skills (e.g. phonological awareness, letter sound knowledge) and standardised reading tests (BAS, NFER). However, almost all children scored at floor for the reading and phonological awareness tests (e.g. 96% scored 0 on the BAS) so reading performance could not be compared. The measures with the fewest children at floor were rhyme and letter-sound knowledge (see Table 1a). Since these skills are considered to be good early predictors of later reading ability (Goswami, 1999; Adams, 1990), they should provide a good indication as to whether the two groups of children started with equivalent pre-literacy skills. Non-parametric analyses (Mann-Whitney tests of 2 independent samples) on these measures revealed no significant differences between the ERR and comparison groups. The children performed much better on our measures of mathematical skill and we found no significant differences in performance on writing numbers and counting. As a further check that the

groups were equivalent, we also measured mathematical skills at the end of Reception and the end of Year 1 (see Table 1b). These measures indicate that the groups were well matched on mathematical skill at the end of Reception. However, there was a slight advantage for ERR children on computation at Year 1. There are various possible reasons for this advantage. Firstly, the ERR children's improved reading may have had a knock-on effect on their ability to read and solve equations. Secondly, an increase in teacher and pupil confidence caused by improvements in reading may have affected their confidence in subjects not covered by the intervention. Finally, teachers in the ERR schools may have been generally more effective. Nevertheless, it is important to note that the ERR advantage for computation was small compared to the advantage on reading measures (see next section), and was not apparent for the mathematics measures taken at the end of Reception.

Together, these findings indicate that the two groups were equivalent at the beginning of the study. However, the large numbers of children performing at floor for the literacy measures should lead us to be cautious about assuming that the two groups began with equivalent literacy skills. To take into account a potential difference between the groups, we also conducted a series of regression models that factor in the influence of a child's literacy scores in one year on their reading performance in the following year (see section on Year-by-year Regressions below).

Overall Impact of ERR

Longitudinal Analysis

Tables 2a and 2b indicate that overall literacy performance was higher for ERR than comparison children, between the end of Reception and the end of Year 2. Gllamm was used to fit a three level model (time, child, school) to explore the interaction between ERR and time (3 levels: Reception, Year 1, Year 2) on reading performance (√BAS score). Baseline scores were not included in this analysis since reading performance was at floor (note that

baseline rhyming performance and letter sound knowledge were included in the models in the next section). A significant interaction between ERR and time would indicate that the intervention was successful, and that children in the ERR group improved faster between the end of Reception and the end of Year 2. As shown in Table 3, the co-efficient of the main effect of time indicated that scores increased significantly by 1.21 (√BAS units) each year for the comparison group, i.e. reading scores increase with time, as expected. The significant co-efficient of the interaction between ERR and time indicated that the difference in slope for the two groups was 0.40. Thus, the ERR intervention caused a significant increase in growth of reading scores. In fact, scores for the ERR group increased by 0.40 faster than scores for the comparison group (equivalent to 33% faster) indicating a dramatic effect of the ERR intervention.

Year-by-year Regressions

We also fitted year-by-year regression models to measure the effect of ERR when reading skill at the previous time point had been factored in. As discussed earlier, reading performance was at floor at baseline so rhyme and letter sound knowledge were used as baseline predictors. We fitted three models: reading at the end of Reception, with ERR, baseline-rhyme and baseline-letter-knowledge as predictors; reading at end Year 1 with end Reception reading level and ERR as predictors; end Year 2 reading with end Year 1 reading and ERR as predictors.

As shown in Table 4, previous literacy was a significant predictor of BAS score in all models. Importantly, ERR was a significant predictor of reading for both the baseline to Reception and Reception to Year 1 regressions, even when literacy skill at the previous time point was included. However, for the Year 1 to Year 2 regression, ERR was no longer a significant predictor of Year 2 reading. This result was expected since the ERR intervention was removed at the end of Year 1 and both groups were taught according to the NLS

(Department for Education & Employment, 1998) over this period. ERR children were well ahead of comparison children by the end of Year 1, and it was this advantage, rather than the school they were attending (ERR vs. comparison), that predicted their performance at end Year 2. This result increases our confidence that it was the presence of the ERR intervention that boosted the attainments of the ERR children, rather than other factors specific to the schools they were attending.

Effect Sizes

We calculated the size of the main effect of ERR on each measure. According to values suggested by Cohen (1988), an effect size of 0.20 was considered small, 0.50 was considered moderate and 0.80 and above was considered large. However, it is important to bear in mind that a whole class intervention delivered by teachers just learning a technique for the first time will result in generally smaller effect sizes. In fact, Hurry, Nunes, Bryant, Pretzlik, Parker, Curno and Midgley (2005) considered a moderate effect size (0.5) to be impressive for this type of study. After one year of intervention (end of Reception), all effect sizes for the reading measures were small to moderate and by the end of Year 1, all effect sizes were moderate or large apart from NFERC (0.41). These effect sizes decreased slightly at the end of Year 2, one year after the ERR intervention had been removed. See Table 2a for effect sizes for all literacy measures. Note that effect sizes were also moderate to large for the synthesis and segmentation measures at the end of Reception (see Table 2b), but the comparison group actually performed slightly better on the rhyme measure. This may be because the comparison children received some training in rhyme awareness, whereas rhyme was not taught at all within the ERR intervention.

Impact of ERR on Children at Different Levels of Phonological Awareness

We took three measures of children's phonological awareness at the end of Reception (synthesis, segmentation and rhyme; see Table 2b). This time point was chosen because the

distribution of scores allowed differences between children to be observed clearly (very few children were performing at floor and very few were performing at ceiling). Models 1 - 3 (Table 5) investigated the interaction between phonological awareness and ERR. BAS score increased significantly with each unit increase in phonological score (significant co-efficients of synthesis, segmentation and rhyme), consistent with a strong relationship between phonological skills and reading (e.g. Bradley and Bryant, 1983; Wagner & Torgesen, 1987). However, the increase in BAS score with phonological score was the same for ERR and comparison groups (non-significant co-efficients of ERR x synthesis, segmentation and rhyme), indicating that children at all levels of phonological skill benefited equally from the ERR intervention.

Impact of ERR on the Incidence of Reading Difficulty

Comparing the distribution of BAS T-scores for the ERR and comparison groups against the BAS norms provides a basis for judging whether the ERR intervention led to a reduction in the incidence of reading difficulties, typically thought to be approximately 20% of the UK school population (Department for Education and Science, 1978; Department for Education, 1994). We calculated T-scores and centiles for each child according to the BAS norms (Elliott et al., 1983). Figures 1a and 1b show the distribution of T-scores for the Comparison and ERR children at the end of Year 2, compared to the BAS norms (Elliott et al., 1983). Figure 1a indicates a negatively skewed distribution for comparison children; whereas Figure 1b indicates a positively skewed distribution for ERR children. By the end of Year 2, 29/143 (20%) comparison children and only 9/188 (5%) ERR children fell into the bottom 10 BAS centiles, x^2 (1, n = 331) = 19.78, p < .001. In addition, only 2 (1%) ERR children fell into the bottom 5 BAS centiles, compared with 20 (14%) comparison children, x^2 (1, n = 331) = 23.79, p < .001. Even when assessed against BAS norms, which includes data from more advantaged areas, ERR has caused a reduction in reading difficulty, from

10% to 5%, $x^2 = 3.90$, $p < .048$ and a reduction in serious reading difficulties from 5% to 1%, $x^2 = 6.42$, $p < .011$.

Discussion

The ERR intervention incorporated phonological and phonics training into a single whole class session that covered all aspects of reading. We investigated the success of the ERR intervention by comparing the reading development of children receiving the intervention with those attending comparison schools. Firstly, we found that children attending ERR schools improved in their reading performance faster than children in comparison schools, and that children at different levels of phonological awareness appeared to benefit equally from the intervention. Secondly, we found that the proportion of children classified as having reading difficulties by the end of Year 2 was significantly less within ERR schools than within comparison schools. In addition, the proportion of children experiencing reading difficulties was reduced in relation to the BAS norms (Elliott et al., 1983) representing expected reading attainments across the UK population.

Why was the Training so Effective in a Whole Class Context?

We believe there are three key explanations for why the training was effective in a whole class context: firstly, our method of differentiating between different achievement groups, secondly, the frequency of delivery and finally, the highly focused nature of the training.

Differentiation

Teachers were trained to differentiate between achievement-groups during each whole class session. The children were classified into achievement groups, as is normal practice, and the teacher would spend a few seconds of the time spent on each skill focusing on each group of children, e.g. the lowest achieving readers would be given extra practice on earlier learned words or letter sounds, and the highest achieving readers would be given an

opportunity to progress to new words or letter sounds. Thus, lower achieving readers were provided with attainment-specific help within every whole class session. However, as we described in the section on teaching procedures above, they were also engaged for the entire session, even when more advanced skills were being taught. Although the lower achievers would not have been able to successfully produce all the sounds or words that were covered in the session, they would have the next step modelled for them, and therefore be aware of the skills they would attain in the near future. In this way, it was possible to meet the individual needs of children at different levels of attainment without the need for one to one tuition.

Frequency of Delivery

Combining all components of the ERR framework into a single whole class session allowed us to deliver each component much more frequently than would have been possible if the training were delivered as an additional intervention. For example, Hatcher et al. provided Reception and Year 1 children with a whole class reading programme, which was supplemented by one of three types of additional phonological awareness training: rhyme only, phoneme only and rhyme plus phoneme. The additional phonological awareness component of Hatcher et al.'s intervention was delivered to groups of 10- 15 children for 10 minutes three times a week. In contrast, since the ERR intervention included phonological awareness within every whole class session, children received 4 minutes of phonological awareness training three times a day (i.e. 15 times a week).

Unlike the ERR and Hatcher et al.'s intervention, Fuchs et al. did not intervene in all aspects of reading teaching. In fact, the most intensive of Fuchs et al.'s interventions, "Ladders + PALS", only accounted for 20- 25% of the time teachers spent on reading/ language arts, and these components were delivered much less frequently than ERR. Fuchs et al.'s phonological training (Ladders) was delivered on a whole class basis, but the maximum

time spent on Ladders was three 15-minute sessions per week whereas under the ERR intervention, children received 4 minutes of phonological training 15 times a week. In Fuchs et al.'s phonics training (PALS), children worked in pairs and this was only delivered three times per week for about 20 minutes. In contrast, the ERR whole class session, delivered 15 times per week, included 2 minutes of phonics training plus 4 minutes of reading to and with children. Thus, incorporating phonological awareness and phonics training into a single whole class reading session allowed training to be delivered very frequently (see Seabrook, Brown & Solity, 2005, for an experimental investigation of frequent vs. massed practice).

Focused Training

The ERR intervention was much more focused than other, similar interventions (e.g. Fuchs et al., 2001; Hatcher et al., 2004). We taught fewer core skills, and a minimum number of letter-combinations and sight vocabulary words. This may have simplified the process of learning to read for lower achieving pupils, whilst allowing higher achieving pupils to quickly grasp the essential skills necessary to begin to read independently (Share, 1995).

Since the ERR intervention incorporated all literacy teaching within whole class sessions, it is not possible to separate the impact of different aspects of our intervention. Nevertheless, we can compare these components of our intervention with those from two other key studies, Hatcher et al. and Fuchs et al. and isolate the key differences.

The ERR intervention taught two phonological skills: synthesis (blending individual phonemes to pronounce words) and segmentation (breaking words into individual phonemes). The phonics programme progressed from individual grapheme-phoneme correspondences, to reading phonically regular words (individual phonemes are represented by a single grapheme and blended to pronounce a word) to reading words with letter combinations (phonemes are represented by two or more letters). Graphemes were presented

as written letters (for individual grapheme-phoneme correspondences) or in the context of single written words, or embedded within written continuous prose.

As in the ERR intervention, Hatcher et al.'s phoneme training programmes also taught synthesis and segmentation, but included other skills not covered within the ERR (e.g. discrimination, deletion, substitution and transposition of phonemes). Similarly, Hatcher et al's reading programme covered essentially the same phonic skills as the ERR intervention but differed in the following ways: firstly, Hatcher et al. taught additional skills (concepts about print, letter names); secondly, they taught children to use different strategies for reading phonically regular words (isolating initial, medial and final phonemes; learning initial and final blends); thirdly, they used a variety of materials (plastic and magnetic letters); fourthly, the skill sequences for teaching phonic skills were different; fifthly, they used graded texts rather than the real books used in the ERR intervention and finally, they allowed teachers to select teaching goals and teaching activities.

Like ERR, Fuchs et al.'s phonological awareness programme (Ladders) was delivered to whole classes of children and included activities that promoted synthesis and segmentation. However, like Hatcher et al., they also included additional activities, not taught within the ERR intervention. In particular, word and syllable awareness, rhyming, first sound isolation and onset-rhyme level blending. In the phonics component of Fuchs et al.'s intervention (PALS), children were given a brief teacher-led demonstration and then worked in pairs on letter identification and word identification tasks, including sight words, regular words and simple sentences. This component essentially covered the skills taught in the phonics and reading to and with children sections of the ERR session, but was delivered in a very different format. Fuchs et al.'s phonics component was delivered in a 20 minute session with pairs of children working together, whereas the equivalent components of ERR were incorporated within a short teacher-delivered whole class session. Nevertheless, note that

under the ERR intervention, a teacher or teaching assistant listened to each child reading two or three times a week (as we described in the teaching procedures section of the Method).

The crucial difference between ERR and the Hatcher et al. and Fuchs et al. interventions is that ERR taught a small number of core skills, which directly parallel the way those skills are applied to reading and writing. It is possible that the lower achieving pupils attending ERR schools may have benefited even more, had they been trained on the additional skills taught within Hatcher et al. and Fuchs et al.'s interventions. However, even without additional training, ERR children were achieving BAS scores that were very much higher than those of comparison children, and higher than BAS norms (Elliott et al., 1983). In addition, the BAS scores achieved by lower achieving ERR children were comparable to those achieved by similar children receiving Hatcher et al.'s reading with phoneme intervention (also measured using the BAS word reading test A scores, Elliott et al., 1983). Furthermore, the ERR intervention impacted on all achievement groups in contrast to Hatcher, et al. who found that their most effective phonological intervention only impacted on lower achieving pupils. Although it is not possible to make direct comparisons with other intervention studies, the high reading scores achieved by the ERR children, indicate that incorporating phonological and phonics training into a whole class intervention can be highly effective, and more intensive interventions may not necessarily be advantageous for all lower achieving pupils. Nevertheless, further research would be needed to investigate this issue. Specifically, we would need to compare the reading development of children receiving the ERR whole class intervention, with children receiving the whole class intervention, plus training on the additional skills included in interventions such as those of Hatcher et al. and Fuchs et al.

Implications for Theoretical Accounts of Reading Difficulties

As discussed in the Introduction, reading difficulties are commonly described in terms of a phonological deficit (e.g. Foorman et al., 2003). However, our findings are more consistent with the hypothesis that children with phonological difficulties fall into the lower tail of a normal distribution of reading ability (supporting Shaywitz et al., 1992). We observed a wide range of scores on phonological awareness, and found a strong relationship between these scores and reading performance. However, we could find no evidence that children with poor phonological awareness responded in a qualitatively different way to the ERR intervention. Nevertheless, it is possible that the very poorest readers in the ERR group did suffer from a genuine phonological deficit, but because they represented such a small proportion of our sample, we did not have the power to detect a difference in their response to our intervention. Further research into this significantly reduced population of lower achievers would permit a more theoretically coherent exploration of the nature of literacy difficulties and the impact of different phonological interventions in addressing those difficulties. Our findings suggest that past studies in this area may have included an excessive number of lower achievers who are at the lower end of the continuum of reading ability rather than having a distinct phonological deficit. If such children were excluded from future samples we would be able to examine the extent to which phonological interventions based on different theoretical models meet children's needs. For example, within instructional psychology, a relatively small number of highly useful phonological skills are taught that directly mirror tasks undertaken when reading, writing or spelling. In contrast the majority of phonological interventions derived from cognitive psychology teach a broader range of skills, which are less explicitly linked to literacy tasks. Comparing the responses of a relatively homogeneous population of lower achieving pupils to such interventions would have clear implications for our understanding of how children learn to read and the difficulties they may encounter.

Implications for Practice

The results from this study suggest that delivering short, frequent whole-class sessions that include focused phonological and phonics training can have a significant impact on the reading development of children with poor phonological skills, and thus reduce the proportion of children experiencing reading difficulties. In the current study, we were only able to compare our intervention with standard teaching in comparison schools. Clearly, more intensive interventions may have an even greater benefit on lower achieving pupils. However, future research would need to directly compare a whole class intervention that includes phonological and phonics training with the same intervention plus additional intensive training in order to judge how many children would benefit from a more intensive programme.

Nevertheless, the results of this study do indicate that phonological and phonics training can be successfully incorporated into whole class teaching, and since this strategy has a relatively low impact on educational resources, incorporating good quality phonological and phonics training within children's normal whole class lessons should certainly be made a priority in the campaign to reduce the incidence of reading difficulties.

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Table 1a

Baseline performance for ERR and comparison children on literacy and mathematics measures

	Comparison				ERR				
Measure	*M*	*SD*	*n*	% at floor	*M*	*SD*	*n*	% at floor	*d*
LS (/26)	1.84	4.40	213	70	1.88	4.40	251	65	0.01
Rhyme (/10)	2.27	3.20	213	51	2.05	3.19	251	61	-0.07
Counting	9.22	4.78	213	3	9.4303	4.43	251	3	0.05
Writing	3.68	4.50	213	39	3.60	4.26	251	39	-0.02

Note. LS = letter sound knowledge (number of letter sounds read correctly), Counting = average score across 3 tests: the highest number correctly counted to out loud (up to 20); counting groups of lines; writing groups of lines, given number. Writing = numbers written correctly (from aural presentation).

Table 1b

Mathematical ability for ERR and comparison groups from Reception to end Year 1

		Comparison			ERR			
	Measure	*M*	*SD*	*n*	*M*	*SD*	*n*	*d*
Reception	Counting	14.03	3.39	198	14.60	2.78	234	0.18
Reception	Writing	10.57	4.62	198	11.07	4.10	233	0.12
Reception	Computation	2.48	3.11	198	2.55	3.38	233	0.02
Year 1	Computation	4.98	2.62	165	5.93	2.74	202	0.35

Note. Computation = average score on 2 tests: written addition test, written subtraction test (plus extra test in Year 1, a mixture of addition and subtraction).

Table 2a

Literacy for ERR and comparison children between end Reception and end Year 2

		Comparison			ERR			
	Measure	*M*	*SD*	*n*	*M*	*SD*	*n*	*d*
Reception	BAS	3.77	6.67	198	8.01	10.99	235	0.45
Year 1	BAS	16.97	16.99	165	29.13	20.23	202	0.62
Year 2	BAS	37.80	23.28	143	51.04	19.65	188	0.59
Reception	NFERW	10.52	20.69	198	28.07	57.10	235	0.39
Year 1	NFERW	75.33	104.12	165	140.74	135.23	202	0.52
Year 2	NFERW	194.97	157.76	143	265.66	152.86	188	0.45
Year 1	NFERA	12.55	16.22	165	23.80	19.87	202	0.59
Year 2	NFERA	32.77	23.85	143	43.13	22.39	188	0.44
Reception	NFERC	0.25	0.65	198	0.85	1.44	235	0.50
Year 1	NFERC	2.16	3.41	165	3.76	4.18	202	0.41
Year 2	NFERC	6.29	6.24	143	8.43	6.20	188	0.34

Table 2b

Phonological awareness for ERR and comparison children at end Reception

	Comparison			ERR			
Measure	*M*	*SD*	*n*	*M*	*SD*	*n*	*d*
Rhyme (/10)	6.37	3.34	197	5.83	3.64	235	-0.15
Segmentation (/30)	4.98	4.50	197	7.94	5.02	235	0.59
Synthesis (/20)	2.76	3.64	197	7.02	5.25	235	0.84

Table 3

Regression Model with Fixed Effects (ERR, Time) and Multi-level Random Effects (Year, Child, School), Dependent Variable = √BAS Score

Fixed effects	Co-efficient	Z score	Random effects	Variance	S.E.	Log-likelihood
Time	1.21	24.35**	Year	.80	0.04	-1781
ERR x time	.40	6.05**	Child	0.97	0.09	
			School	0.03	0.02	

Note. ** p < .001, *p < .05, *ns* non-significant

Table 4

Year-by-year Regression models with BAS score at Reception, 1 and 2 as outcomes and with ERR and the previous year's rhyme and letter-sound knowledge or BAS score as predictors

Model (outcome)	Fixed effects (predictors)	Co-efficient	Z score	Random effects	Variance	S.E.	Log-likelihood
1. (BAS score at Reception)	Baseline rhyme	0.16	4.04**	Child	0.28	0.02	-345
	Baseline letter sound	.40	8.25**	School	0.01	0.01	
	ERR	.26	3.57**				
2. (BAS score at Year 1)	Reception BAS	1.84	21.66**	Child	0.84	0.06	-500
	ERR	.36	2.27*	School	0.06	0.03	
3. (BAS score at Year 2)	Year 1 BAS	1.12	28.05**	Child	1.00	0.08	-468
	ERR	.02	0.10*ns*	School	0.04	0.04	

Note. ** p < .001, *p < .05, *ns* non-significant

Table 5

Regression Models with Fixed Effects (ERR, Phonological Awareness) and Multi-level Random Effects (Year, Child, School), Dependent Variable = √BAS Score

Model	Fixed effects	Co-efficient	Z score	Random effects	Variance	S.E.	Log-likelihood
1.	Synthesis	0.91	7.44**	Year	2.68	0.11	-2165
	ERR x Synthesis	-0.06	-0.44*ns*	Child	<0.01	<0.01	
				School	0.04	0.03	
2.	Segmentation	0.88	10.03**	Year	2.59	0.11	-2144
	ERR x Segmentation	-0.03	-0.28*ns*	Child	<0.01	<0.01	
				School	0.03	0.02	
3.	Rhyme	0.69	4.35**	Year	2.78	0.14	-2225
	ERR x Rhyme	-0.10	-0.48*ns*	Child	0.23	0.10	
				School	0.05	0.03	

Note. ** p < .001, *p < .05, *ns* non-significant

Figure Captions

Figure 1. Distribution of BAS T-scores for comparison children (*n* = 143, figure 1a) and ERR children (*n* = 188, Figure 1b) at the end of Year 2, compared to BAS norms (Elliott et al., 1983).

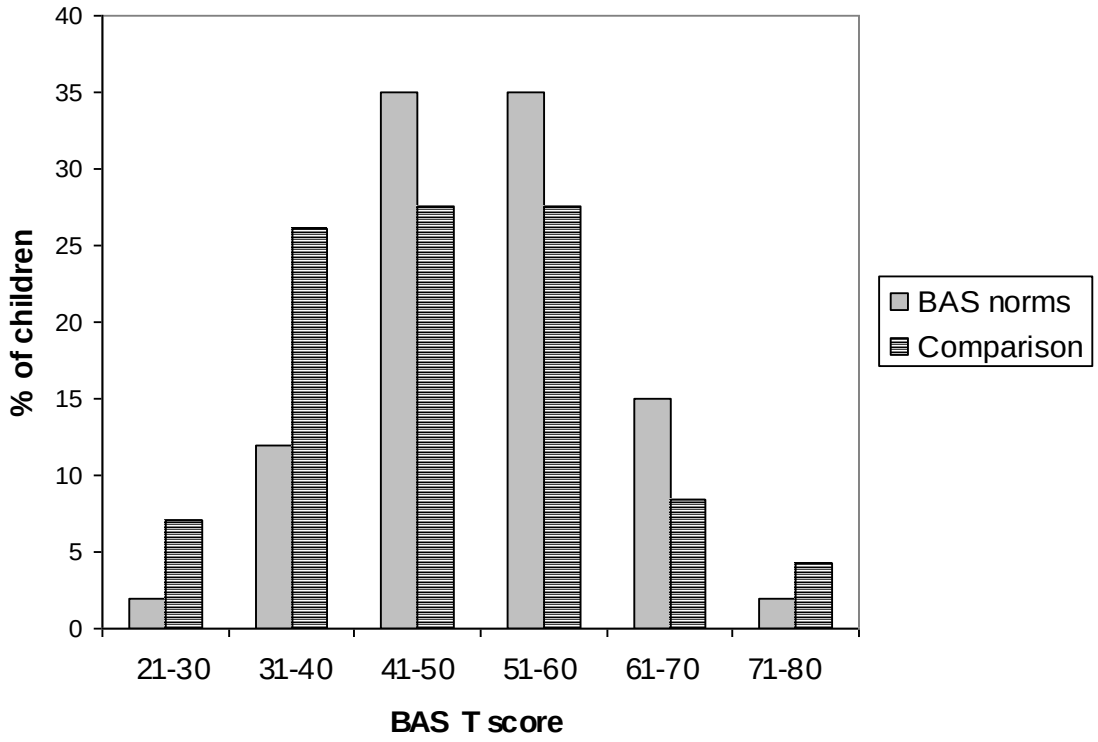
40
35
30
25
20
15
10
5
0
% of children
21-30
31-40
41-50
51-60
61-70
71-80
BAS T score
BAS norms
Comparison

Figure 1a

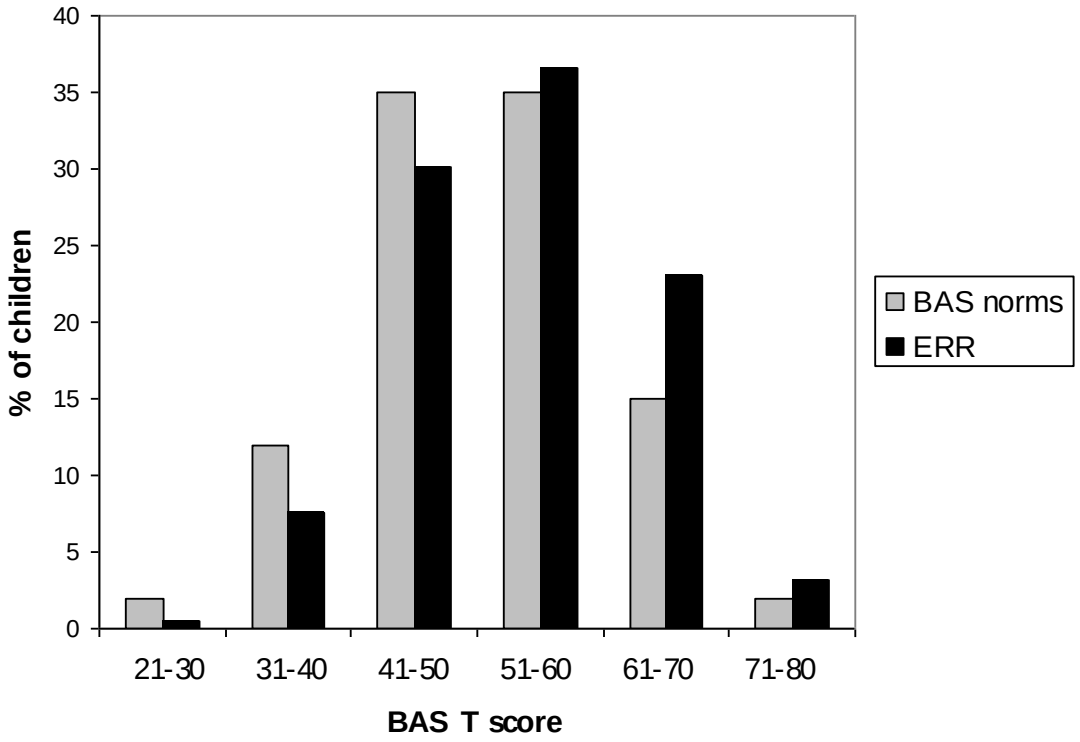
40
35
30
25
20
15
10
5
0
% of children
21-30
31-40
41-50
51-60
61-70
71-80
BAS T score
BAS norms
ERR

Figure 1b