

Developing the practice of educational psychologists through theory and research

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Abstract

Recent research in literacy acquisition has generated detailed programs for teaching phonological awareness. The current paper will address three issues that follow from this research. Firstly, much of the past research has been conducted under conditions that are divorced from the classroom. As a result, it is not known whether the suggested teaching strategies will lead to an increase in children's attainments when integrated into a broad reading curriculum implemented by teachers in mainstream classrooms. Secondly, these phonological interventions have been designed either to prevent the occurrence of reading difficulties or to meet the needs of failing readers. Therefore, it is not known whether the same methods would advantage all children. Thirdly, teaching children to read takes a minimum of two to three academic years. We therefore need to develop a reading curriculum that can provide the progression and differentiation to meet a wide range of needs over several academic years.

We report two studies that have addressed these issues through monitoring the impact of a reading curriculum, implemented by teachers, which integrated children's acquisition of phonological skills with broader aspects of teaching reading over three academic years. The attainments of children at all levels of ability in the experimental group were raised relative to controls, and importantly, these gains were maintained after the intervention was withdrawn. These results demonstrate that phonological awareness training can be successfully integrated into real classroom contexts and that the same methods raised the attainments of normally developing children, as well as those at risk of reading failure.

RECENT PSYCHOLOGICAL research in literacy acquisition has identified the importance of teaching word recognition and phonological awareness skills to beginning readers (Adams, 1990, Ball & Blachman, 1988, 1991; Lundberg, Petersen & Frost, 1988; Perfetti, Beck, Bell & Hughes, 1987; Share & Stanovich, 1995; Wagner & Torgesen, 1987). Although the research has provided considerable knowledge about the relationship between children's cognitive development and learning to read, a critical issue remains the extent to which this research has a positive impact on teachers' everyday classroom practice and ultimately on children's learning outcomes. As a result, a growing area of interest is whether research findings can be incorporated into instructional programs that can be implemented by teachers and

lead to an increase in children's attainments (Blachman, Tangel, Ball, Black & McGraw, 1999; Blachman, Ball, Black & Tangel, 1994; Ehri, Nunes, Willows, Schuster, Yaghoub-Zadeh & Shanahan, 2001; Fuchs, Fuchs, Thompson Al Otaiba, Yen, Yang, Braun & O'Connor, 2001; Hatcher, Hulme & Snowling 2004; Lyon & Moats 1988; National Reading Panel, 2000; Troia, 1999). Thus, previous research in phonological awareness needs to be assessed in terms of whether instructional programs and pupil learning outcomes can be replicated in mainstream classrooms with large numbers of children.

The studies reported in this paper address these issues through teaching phonological skills within a broad-based literacy framework that has been informed by instructional psychology (Solity, 2008). Specifically, the environmental factors (e.g.

curriculum content, classroom organisation, teaching materials and teaching methods) that are thought to be instrumental in enabling children to read, write and spell have been analysed and their impact on children's learning evaluated through a quasi-experimental design.

Improving reading through phonological interventions

Psychological research into teaching reading has generally focussed on teaching phonological awareness and phonological skills (manipulating phonemes in the absence of print): to pre-school children to prevent difficulties occurring (Bradley & Bryant 1983; Lundberg, 1994; Lundberg *et al.*, 1988); to school-aged children to investigate whether difficulties can be overcome (Blachman, Schatschneider, Fletcher, Francis, Clonan, Shaywitz & Shaywitz, 2004; Hatcher, Hulme & Ellis, 1994; Hatcher, Goetz, Hulme, Snowling, Gibbs & Smith 2006; Hatcher, Hulme, Miles, Carroll, Hatcher, Gibbs, Smith, Bowyer-Crane & Snowling, 2006) and to increase the rate at which they learn to read (Castiglioni-Spalten & Ehri, 2003). The key findings that are relevant to the current study are firstly, grapheme-phoneme correspondences (GPCs) are not acquired without direct teaching whereas onset-rimes and larger units can be learned without explicit instruction (Ball & Blachman, 1991; Cunningham, 1990; Lundberg *et al.*, 1988). Secondly, children make better progress in acquiring phonological skills when teaching links phonemes and graphemes (Hatcher *et al.*, 1994; Hatcher & Goetz *et al.*, 2006; Hatcher & Hulme *et al.*, 2006; Shapiro & Solity, 2008). Finally, training in phonological awareness and phonics (mapping phonemes on to graphemes) improves the rate at which children learn to read (see Ehri *et al.*, 2001 for a meta-analysis).

Previous studies have varied in a number of critical areas which make it difficult to draw implications for teaching phonological skills within mainstream settings. In relation to beginning readers, the research has

tended to examine how best to introduce children to GPCs but differed in terms of: the number of GPCs introduced during the training which have ranged from eight (Blachman *et al.*, 1994) to all 26 (Carnine, Silbert & Kameenui, 1997; Lovett, Borden, Deluc, Lacerenza, Benson & Brackstone, 1994); whether letters were written (Carnine *et al.*, 1997; Lovett *et al.*, 1994), wooden or plastic (Williams, 1980; Bryant & Bradley 1985); or whether commercially available schemes were being evaluated (Byrne & Fielding-Barnsley, 1991) or 'home made' programmes which taught skills drawn from a range of sources (Uhry & Shepherd, 1994). The narrow focus on letter-sound correspondences limits the potential relevance of the research to how best to teach more advanced phonic skills.

More generally in terms of research design the majority of intervention have been additional to children's regular classroom programmes rather than in place of them and they have differed in relation to whether:

- there was a treated comparison group and the amount of information provided on the treatment offered to control groups (Hatcher & Goetz *et al.*, 2006; Hatcher & Hulme *et al.*, 2006; Williams, 1980);
- data was provided on treatment fidelity (Fuchs *et al.*, 2001);
- children were excluded from the sample, particularly pupils seen to have special educational needs (Williams, 1980; Hatcher *et al.*, 1994);
- children were taught individually (Silva & Hurry, 1995; Uhry & Shepherd, 1994) or in groups (for example Williams, 1980 taught children in groups of 3-4 whereas Hatcher *et al.*, 2004 taught groups of 15);
- children's progress in reading included normative assessments of reading in addition to assessments of phonological skills (Hatcher *et al.*, 1994; Hatcher *et al.*, 2004; Hatcher & Goetz *et al.*, 2006; Hatcher & Hulme *et al.*, 2006; Yeh, 2003);
- details were provided on all aspects of how children are taught to read, not only

the phonological intervention;

- data was provided on the extent to which gains made during the intervention were maintained after the intervention was withdrawn (Fuchs *et al.*, 2001; Hatcher & Goetz *et al.*, 2006; Hatcher & Hulme *et al.*, 2006).

Finally there was considerable variation in the number of schools and pupils involved in the studies. For example Blachman *et al.* (1994) included 84 children drawn from four schools whereas Becker, Engelmann, Carnine & Rhine (1981) included 5992 children in 20 communities located in 14 states.

Implications for instruction

It is difficult to draw implications for whole class teaching from the research into phonological awareness, as there is little consistency between the studies and very few incorporate teaching methodologies that can be readily transferred to regular classrooms. We argue that there are three main issues that arise from the previous research.

The first issue is that experimental interventions are invariably divorced from the classroom and are generally delivered by researchers over relatively short time scales. Blachman *et al.* (1994) commented on the nature of research into the development of children's phoneme awareness:

'The missing link in this research is an intervention study conducted in kindergarten classrooms in the United States, with kindergarten teachers providing the instruction. If educators are going to heed the advice of numerous researchers (see for example Adams 1990; Blachman 1989, 1991; Juel 1988) to provide instruction in phoneme awareness in regular classrooms before children have experienced failure, we need more direct evidence that this model of instruction is effective (p5)'.

Hatcher *et al.* (2004) also noted the lack of evidence demonstrating the impact on children's overall reading of phonological training linked to letters, delivered by class teachers to beginning readers in groups of between 10–15. Troia (1999) reviewed 39 experimental studies that taught phonological awareness skills to children and noted that

only 12 involved classroom-based interventions. The mean intervention period was 11 weeks and the mean number of teaching sessions 32 which do not reflect the type of sustained interventions required by schools to raise attainments over an academic year or more. Ehri *et al.* (2001) present evidence from the National Reading Panel's meta analysis on the ways in which phonemic awareness instruction helps children learn to read and found that of the interventions that they reviewed approximately 75 per cent were delivered by a researcher or person other than the classroom teacher. They also found that interventions were of short duration with the majority (approximately 70 per cent) involving less than 20 hours instruction. The UK National Reading Panel (Torgerson, Brooks & Hall, 2006) reviewed 14 studies that used randomised control trials to investigate effective literacy interventions. The report concluded that systematic phonics training can benefit children at different achievement levels. However, only four studies included in the meta-analysis were with normally developing readers (Haskell, Foorman & Swank, 1992; Johnston & Watson, 2004; Leach & Siddall, 1990; Skailand, 1971) and all 14 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).

The second issue is whether interventions which raise the attainments of children with literacy difficulties have any instructional implications for children who are not experiencing difficulties. This was one of the areas addressed by Hatcher *et al.* (2004) who adapted an intervention which had been shown to be effective in ameliorating reading delay (Hatcher *et al.*, 1994) to investigate whether it could also prevent difficulties and impact on those not at risk of reading failure. Similarly Ehri *et al.* (2001) found that the transfer of phonological awareness training to reading was greatest for beginning readers at risk of reading failure rather than for children making normal progress or older children deemed to be reading disabled.

More generally, the critical issue is whether any interventions, phonological or otherwise, that raise the attainments of the lowest attaining pupils impact on the attainments of other pupils as well. The conventional wisdom is that interventions which meet the needs of specific groups of children will 'hold back' other pupils. In other words there is not a single intervention which is thought to impact on all children.

Finally, previous interventions have varied enormously in the amount of instruction that is provided, and the length of the intervention. Very few studies have examined the long term benefits of an early intervention on the reading development of children, after the intervention had been removed.

Psychology and classroom teaching

When translating experimental research outcomes into effective instructional programs that can be implemented by teachers, theoretical differences and practical tensions emerge between two areas of psychology; developmental/cognitive psychology and instructional psychology. The focus for developmental and cognitive psychologists is an analysis of children's cognitive development and their individual differences which provide the basis for identifying what and how to teach. The debates about the order in which skills develop (Bowey & Francis, 1991; Duncan, Seymour & Hill, 1997; Goswami & Bryant, 1990; Treiman & Zukowski, 1991, 1996;) and which early literacy skills predict later success in reading (Bryant, 1998; Bryant, 2002; Hulme *et al.*, 1998; Hulme, 2002) have been conducted within the areas of developmental and cognitive psychology. The tension emerges when it is inferred that the order in which skills develop automatically translates into an appropriate instructional sequence. This assumption remains largely untested but has given rise to different views about the respective roles of rhymes, onset and rimes and GPCs in teaching reading (Goswami, 1994, 2005; Duncan *et al.*, 1997; Savage & Carless, 2005; Seymour & Evans, 1994).

Instructional psychology, takes as its starting points an analysis of what is to be taught and how best to structure and present knowledge so that the most useful and generalisable skills are taught first, even if developmentally they are acquired after skills that appear to be easier. As a result, within instructional psychology, GPCs are taught before onset-rimes and syllables which, developmentally, appear earlier (Yeh, 2003). 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. Although the theories differ in a number of respects, they all focus on the learning environment rather than the individual differences between children, and they result in teaching strategies based on similar instructional principles. Brown (1998) has applied rational analysis to learning to read and argues that:

'The cognitive abilities of skilled adult readers should have developed in such a way that performance will be statistically optimal with respect to the structure of the English spelling-to-sound mapping system (p121-122).'

A statistically optimal system memorises and makes available items that are most likely to be useful. In the context of reading useful items are those words and phonic structures that occur frequently and whose acquisition enables children to generalise their knowledge to read unknown words accurately and fluently.

For this to occur, the material that children read has to reflect the most frequently occurring structures and characteristics of written English. Carnine *et al.* (1997), Gontijo, Gontijo and Shillcock (2003), Solity and Vousden (2008) and Vousden (2008) report on the frequency and consistency of phonically regular and irregular words in written English. Solity and Vousden discuss how a rational analysis and

direct instruction approach to teaching reading impacts on the selection of sight vocabulary and phonic skills which children are taught. Their analysis of different reading materials (Oxford Reading Tree, Rhyme World), which included adult texts (Kucera & Francis, 1967), indicated that teaching 100 high frequency words enables children to read approximately 50 per cent of any materials they are given. Similarly they identified the 61 most generalizable GPCs which when combined with the 100 most frequently words enable children to read approximately 90 per cent of all the monosyllabic words in the various texts analysed.

Perhaps surprisingly, the identified high frequency words and phonic skills enabled children to read a higher percentage of words in the adult data base than in the materials specially prepared for children. Furthermore, the analysis indicated that there was a limited return on teaching children either additional sight vocabulary or GPCs as this extra information occurs with relatively low frequency in the texts that they will encounter. This has led Solity and Vousden (2008) to suggest that there is an optimal level of sight vocabulary and phonic skills that can usefully be taught to children, beyond which further teaching will have relatively little impact given the extent to which such knowledge will be useful and generalise to the texts children might be expected to read. They have referred to this as the Theory of Optimal Instruction.

Ultimately within instructional psychology, differences in pupils' outcomes are seen to be the consequence of differences in what and how children are taught. These are the pedagogic factors that teachers can influence directly. This contrasts with the more traditional view within developmental and cognitive psychology where different learning outcomes are attributed to a range of factors, for example, differences in children's cognitive development, ability, personality, home background etc.

Current studies

We report two studies that have investigated the impact of the a framework for teaching literacy, known as the Early Reading Research (ERR), to beginning readers over a period of three years. The studies address three broad areas. Firstly, they have investigated whether an experimental framework for teaching literacy implemented by mainstream teachers in classes of approximately 30 pupils during the first three years of formal schooling, Reception (hereafter termed Year R), Year 1 and Year 2, is more effective than either conventional methods of teaching reading or the National Literacy Strategy (the government-led literacy strategy that was implemented in schools throughout the UK in 1998; Department for Education & Employment, 1998). Secondly, the results will determine whether the same methods, can successfully raise the attainments of all children, not only those judged to be at risk of reading failure. Thirdly, the research has investigated whether any gains made during the intervention are maintained after the intervention has been withdrawn.

The studies have three distinctive features that will potentially contribute to a narrowing of the divide between theory, research and practice. Firstly, the experimental framework for teaching literacy is derived from instructional psychology and so is based on an analysis of what children are to be taught rather than being based on theories of how children learn to read or children's cognitive development. Secondly, it integrates phonological awareness training into a broad reading curriculum that reflects the range of skills that beginning readers are typically expected to acquire. Thirdly, the study offers an ecologically valid intervention (Troia, 1999). It will be implemented by teachers on a whole class basis and will take place over three academic years which is a more realistic time scale for teaching children to read than those typically associated with the majority of phonological training programmes. The experimental framework for teaching reading therefore

provides the necessary progression to meet children's needs over time and develops children's phonological and broader literacy skills beyond the inevitable constraints of shorter programmes. These studies represent one of the few attempts in the UK to conduct experimental research in mainstream schools on the impact of different methods of teaching reading.

Method

Studies 1 and 2 report quasi-experimental, two year interventions with a one year follow-up. Study 1 involved a longitudinal analysis that compared the progress of children taught through the ERR framework for teaching literacy with those taught through pre-NLS conventional teaching methods. Study 2 involved longitudinal and cross-sectional analyses that compared the progress of children taught through the ERR framework with those taught through the NLS and a combination of pre-NLS conventional teaching and the NLS.

Teaching frameworks

The ERR framework for teaching literacy. Children were taught on a whole class basis through three daily sessions of 15 minutes. Within each 15 minute session children were taught synthesis, segmentation, phonic and sight vocabulary skills for two minutes each. This period of eight minute skills teaching was followed by four minutes of reading with children in Study 1 and seven minutes of reading with children in Study 2 where pupils were shown how to apply their skills to 'real books' rather than texts drawn from a reading scheme. The only phonological skills taught (manipulating phonemes in the absence of print) were synthesis (a key skill underpinning progress in reading where children combine individual phonemes to pronounce words) and segmentation (a key skill underpinning spelling where children break words up into individual phonemes). Phonic skills (relating graphemes and phonemes) were taught at the 'small-unit level' and initially taught pupils to map

phonemes to graphemes where each phoneme is represented by a single letter (the sequence is VC, CVC, CVCC, CCVC, CCVCC and CVCe, e.g. in, pot, bend, slip, stamp, cape, respectively). This was followed by teaching 30 core letter combinations (where single phonemes are represented by two or more letters, e.g. sh, ai, ea, etc) and 34 prefixes and suffixes. Children were taught to read 100 high frequency words at a sight level. Thirty nine of these words were phonically regular and so could be decoded phonically when the appropriate skills have been taught. The benefit of teaching phonically regular, high frequency words, at a sight level is that it enables children to read a wide range of texts independently before they might otherwise have been able to do so, had they only been able to decode these words phonically. Children were taught to decode unknown high frequency words through a phonic route once they have been taught the necessary phonic skills.

The framework highlights the advantages of teaching children to read through 'real books' rather than reading schemes. Thus, the framework represents an approach to teaching reading and spelling which brings together two previously irreconcilable philosophies: real books and phonics. For example, the Literacy Task Force (1997) commented, *'There have been few more vigorous educational controversies in the last decade than the one over how reading should be taught. Opposing sides in a vigorous national debate took to the barricades with banners proclaiming their loyalty to "phonics" or "real books (p16)'*". The ERR differs from other approaches to teaching phonics, both past and present, in the way children are taught and shown how to apply skills to a wide and diverse range of texts. Children will be less likely to apply and generalise their phonic skills if they are given a limited diet of books drawn from a reading scheme.

The other components of the framework involve: reading high quality stories to, and with, children; listening to children read individually on a regular basis; teaching

spelling daily for five minutes through a strategy based on children’s segmentation skills; daily writing which emerges from the material children are reading; teaching new vocabulary; regular assessments and providing children with feedback on their progress.

Pre-NLS conventional teaching methods. Pre-NLS conventional teaching methods were used in all comparison schools in Study 1 until the introduction of the NLS in all schools (experimental and comparison) during the post-intervention year of the study. Study 2 began after the introduction of the NLS in September 1998. The performance of the experimental groups was compared to three different comparison groups. Comparison group 1 (CG1 – see Table 1) were taught through the NLS from the start. However, comparison groups 2 and 3 (CG2 and CG3) were taught through a combination of pre-NLS conventional teaching and the NLS. Further information on the different comparison groups can be found in a later section describing the research design.

Under pre-NLS methods, children were taught in a single hour-long lesson per day that included whole-class, small group and individual work. In addition, comparison

group teachers taught a slightly broader, range of skills than ERR teachers. During Year R, 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,

Year of study	ERR1 (2 Schools)	ERR2 (10 Schools)	ERR3 (2 Schools)	CG1 (2 Schools)
1 Term 1 (Sept–December)	ERR School Year R	NLS School Year R	NLS School Year R	NLS School Year R
1 Term 2 (January–March)	ERR School Year R	NLS School Year R	NLS School Year R	NLS School Year R
1 Term 3 (April–July)	ERR School Year R	ERR School Year R	NLS School Year R	NLS School Year R
2 Terms 1, 2, & 3	ERR School Year 1	ERR School Year 1	ERR School Year 1	NLS School Year 1
3 Terms 1, 2, & 3	ERR School Year 2	ERR School Year 2	ERR School Year 2	NLS School Year 2
4 Terms 1, 2, & 3	NLS School Year 3	NLS School Year 3	NLS School Year 3	NLS School Year 3

Table 1: Summary of the teaching methods used in each ERR Group and Comparison Group 1 during Study 2

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. After learning single GPCs children were taught initial (e.g. *bl, br, st*) and final blends (e.g. *nd, ll, 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. Although core skills such as phonics and sight vocabulary were introduced to the whole class, teachers provided 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).

National literacy strategy. All schools were taught according to the NLS in the post-intervention years of Study 1, and Study 2. In addition, comparison group 1 in Study 2 (CG1, see Table 1) implemented the NLS throughout the study. Full details of the NLS for Key Stages 1 and 2 can be found in DfEE (1998) which offers a term by term, week by week programme for schools to follow.

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.

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, but who received conventional teaching methods (see Shapiro & Solity, 2008 for more details).

In study 1, the research was conducted over a three-year period as children progressed from the beginning of Year R (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 Year R 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 Year R and Year 1 were maintained. From the beginning of Year 2, both groups of children were taught according to the NLS.

Study 2 was conducted over a four year period as children progressed from Year R to the end of Year 3. The ERR intervention took place in Years R, 1 and 2 but was withdrawn in Year 3 so that it was possible to investigate whether any gains made during Years R-2 were maintained. From the beginning of Year 3, the experimental group and CG1 were both taught according to the NLS. Sixteen schools were invited to participate in Study 2, all from the same geographical area within a government action zone, indicating that the schools were in areas of high social disadvantage and that children were not meeting the expected standards for their age. The head teachers from these schools opted to implement either the ERR intervention, or the NLS.

The way the action zone was managed gave schools the opportunity to opt into the ERR intervention at three different points over a 12 months period. Thus, two schools implemented the ERR intervention from the beginning of Year R (group ERR1, see Table 1) for three full academic years, ten schools implemented the ERR intervention from the beginning of the summer term in Year R (ERR2) for two full academic years and one term and two further schools implemented the ERR intervention from the beginning of Year 1 (ERR3) for two complete academic years. Thus, by the beginning of Year 1, 14 schools were implementing the ERR intervention. The progress of these children, who comprised the experimental group, was compared to children in the remaining two schools who followed the NLS for three full academic years throughout Years R, 1 and 2 (CG1).

As only two schools comprised CG1 two further comparison groups were formed to further evaluate the impact of the ERR intervention through a series of cross-sectional analyses. At the end of the first year of the intervention when the experimental group was coming to the end of Year R, pupils attending the same 14 schools who were coming to the end of Year 2 (Comparison Group 2, CG2; $n = 742$; age = 7 years of

age) and Year 3 (Comparison Group 3, CG3, $n = 746$; chronological age = 8 years of age) were also assessed. This allowed us to compare the progress of the ERR pupils when they reached the end of Year 2 (following at least two years of intervention) and Year 3 (one year post-intervention) with same-age pupils from the same schools, who had been taught through a mixture of conventional teaching methods and the NLS (CG2 and CG3). Thus, CG2 who were at the end of Year 2 had been taught through pre-NLS conventional teaching in Years R-1 and through the NLS in Year 2. CG3 were at the end of Year 3 and had been taught through pre-NLS conventional teaching in Year R-2 and through the NLS in Year 3.

Assessment measures. In study 1 and study 2, baseline assessments were conducted just before the ERR intervention was implemented (September Year R, mean age 4 years, 8 months, in study 1; either September, April, or July Year R in Study 2). Follow-up assessments were conducted at the end of each school year (in July) during the intervention (Year R and Year 1 for study 1; Year R, Year 1 and Year 2 for study 2) and for one year post-intervention (Year 2 for study 1; Year 3 for study 2).

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). The current paper will present analyses using BAS scores only. Non-standardised tests of reading related skills were also taken in study 1 and these were used to divide children into literacy groups at the end of Year R (see Table 2 for a list of these measures). In study 1, additional tests of mathematical ability were conducted to confirm that the schools were matched for teacher effectiveness (see Shapiro & Solity, 2008). 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 standardised reading

	Measure	Comparison			ERR			d
		M	SD	n	M	SD	n	
Year R	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	37.8	23.28	143	51.04	19.65	188	0.59

Table 2: Means, SDs and effect sizes for ERR and comparison children's performance on the BAS between end Year R and end Year 2 in Study 1

assessments with young children but were naïve to the purpose of the study.

Participants. In Study 1, teachers and pupils from 12 schools participated in the research. Schools were selected following a meeting to which head teachers together with either the literacy coordinator or one Reception teacher 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. The purpose of the meeting was 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.

Head teachers and their colleagues from approximately 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. See Shapiro & Solity, 2008, for further details on how schools were selected. 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.

In Study 2, teachers and pupils from 16 schools participated in the research, and 14 of these schools opted to implement the ERR intervention. 92 children (from 2 schools) started the ERR intervention in September, the beginning of Year R (ERR1), 543 children (from 10 schools) started the intervention in April, middle of Year R (ERR2), 90 children (from 2 schools) started the intervention in July, the end of Year R (ERR3). There were 81 children in the two schools that opted to implement the NLS (CG1). Children who joined the schools after the baseline assessments had been conducted were not included in the following analyses.

There were 742 Year 2 children in the ERR schools in 1999, and 94 Year 2 children in the 2 comparison schools. There were 746 Year 3 children in the ERR schools in 1999, and 105 Year 3 children in the comparison schools.

Results

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. Almost all children in both study 1 and study 2 scored at floor on the reading tests in September, Year R (e.g. 96 per cent scored 0 on the BAS in Study 1), so these data were not analysed. The square root of BAS score was taken for all the following analyses. Below, we report an analysis of the impact of ERR for children at different levels of achievement in Study 1. We then report longitudinal and cross-sectional comparisons of ERR and comparison children in Study 2.

Study 1

Although reading scores were at floor at the beginning of Year R, we were able to confirm that there were no significant differences between the two groups on the few tests in which children scored above floor: rhyme, letter-sound knowledge and mathematical skills. In addition, 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 (see Shapiro & Solity, 2008 for full details).

As reported in Shapiro and Solity (2008), ERR children significantly outperformed comparison children during the intervention, and for one year post-intervention (see Table 2 for mean BAS scores and effect sizes at each year). Here, we investigate whether the impact of the ERR intervention was con-

sistent for children at all levels of achievement. Children were divided into three achievement groups at the end of year R, separately for ERR and comparison schools. We used a cumulative z score for each child, taken from all literacy measures at end Year R (see Table 3 for raw scores on all measures). 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). We then investigated the interaction between achievement group and ERR. As expected, BAS scores were significantly higher for ERR children than comparison children (significant co-efficient of ERR in Table 4) and significantly higher for higher achievement groups (significant co-efficient of achievement group in Table 4). However, the increase in BAS score with achievement group was the same for ERR and comparison groups (non-significant co-efficients of ERR \times achievement group), indicating that children at all levels of achievement benefited equally from the ERR intervention. This pattern is shown clearly in Figure 1: children in all 3 achievement groups attending ERR schools consistently outperform their counterparts in comparison schools. In fact, the advantage for ERR children is so dramatic that the ERR lower achievers have caught up with the comparison middle achievers by the end of year R. As discussed in Shapiro and Solity (2008), the ERR intervention led to a reduction in the number of children falling into the bottom 10 BAS centiles from 20 per cent in comparison schools to 5 per cent in ERR schools by the end of year 2. In addition, only 1 per cent ERR children fell into the bottom 5 BAS centiles, compared with 14 per cent comparison children.

Study 2

As shown in Table 5, scores for the three ERR groups (ERR1, 2 and 3) were clearly much higher than the comparison group (CG1). Thus, in Study 2, we have replicated the dramatic effect of the ERR intervention

	Comparison		Comparison		Comparison		ERR		ERR		ERR	
	Low		Mid		High		Low		Mid		High	
Measure	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
NFERw	0.90	1.45	5.91	7.14	23.09	30.17	4.51	6.60	19.57	48.29	57.23	75.20
NFERc	0.00	0.00	0.19	0.52	0.53	0.90	0.27	0.61	0.67	1.36	1.53	1.73
SV1	1.43	1.55	4.86	3.69	9.16	3.63	5.99	5.20	9.74	5.48	13.85	3.20
SV2	0.00	0.00	0.90	7.11	7.64	18.74	2.34	6.73	11.12	22.04	35.54	31.14
BAS	0.03	0.18	2.36	3.49	8.27	8.96	1.83	2.93	6.31	8.82	15.12	13.32
LS	4.05	5.76	7.83	7.06	17.24	7.08	11.67	7.42	16.10	8.01	22.98	4.46
PHRG	0.03	0.18	0.29	1.41	1.61	3.64	0.63	1.82	2.74	5.18	8.75	6.71
SYN	0.88	1.69	2.07	2.67	5.04	4.45	3.66	4.27	6.37	5.00	10.59	3.96
SEG	2.00	2.62	3.86	3.62	8.64	4.10	4.83	4.28	7.10	4.64	11.49	3.68
Rhyme	5.33	3.25	6.01	3.39	7.61	3.01	4.73	3.75	5.56	3.51	7.07	3.36
SPG	1.26	2.09	2.96	2.94	6.71	3.86	2.49	2.52	4.81	4.17	9.65	4.30

Table 3: Literacy performance for all ERR and comparison achievement groups at end Year R in Study 1. *Note.* NFERw = the total number of words read correctly in the NFER passage reading test. NFERc = the total number of NFER comprehension questions answered correctly. SV1 = Sight Vocabulary Test 1, high frequency words, number of words read correctly. SV2 = Sight Vocabulary Test, medium frequency words. BAS = BAS words read correctly. LS = letter sound knowledge (number of letter sounds read correctly). PHRG = Phonologically regular word test, number read correctly. SYN = Synthesis test (e.g. "c-a-t" makes ___?). SEG = Segmentation test (e.g. sound out "cat"). Rhyme = Rhyme Oddity task. SPG = oral spelling task

observed in Study 1, in a larger study of different UK schools. In the first section below, we report a longitudinal comparison of children receiving the ERR intervention (ERR1, 2 and 3) and children receiving the NLS (CG1) between Year R and Year 3. In the second section, we report a cross-

sectional comparison of Year 2 and Year 3 children tested during the intervention (ERR1, 2 and 3 and CG1) with previous cohorts of Year 2 and Year 3 children from the same schools, tested before the intervention was implemented.

Fixed effects	Co-efficient	Z score	Random effects	Variance	S.E.	Log-likelihood
ERR	1.11	3.30**	Year	3.87	.16	-2369.90
Achievement group	1.75	16.03**	Child	0.00	0.00	
ERR x Achievement group	.018	0.12 ns	School	0.00	0.00	

Table 4: Regression model with fixed effects (achievement group, ERR) and multi-level random effects (year, child, school), for ERR and comparison achievement groups in Study 1. *Note.* **p < .001, *p < .05, ns non-significant

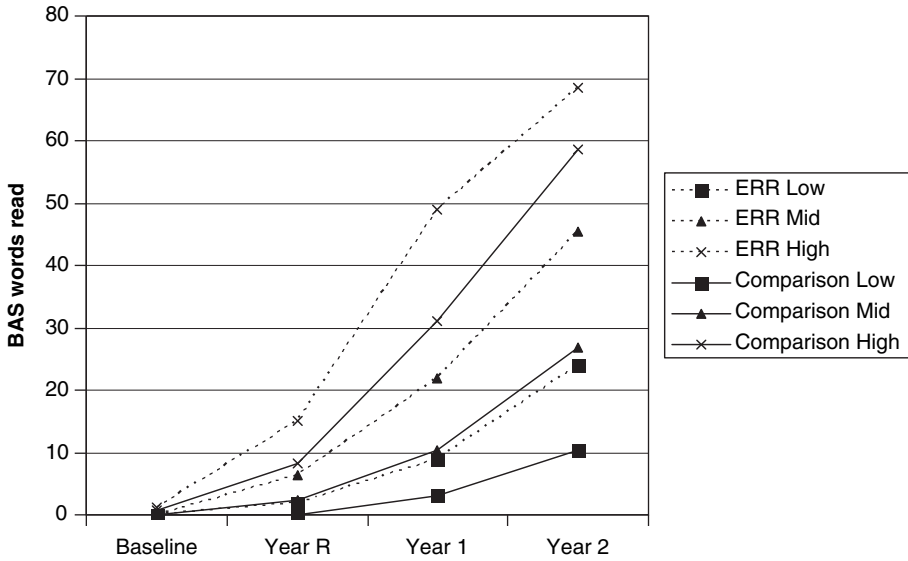


Figure 1: BAS scores for ERR and Comparison children at three levels of achievement over time

Longitudinal comparison of ERR and CG1

Table 5 and Figure 2 show the reading performance for the three ERR groups and the CG1 Group between Year R and Year 3. Although the ERR1 and CG1 children were assessed in September Year R, immediately prior to the intervention, reading scores were at floor so we therefore report mean BAS scores in July Year R for these children. ERR2 children began the intervention in April Year R, and mean BAS scores at this time point are reported. ERR3 began the intervention in September Year 1 and mean BAS scores prior to this, in July Year R, are reported. Table 5 and Figure 2 indicate that

all three ERR groups were consistently ahead of the CG1 Group from Year 1 onwards.

In order to check that the ERR and comparison groups were equivalent in their literacy potential at Year R, we compared ERR1 and ERR3 with CG1 (all these groups were assessed at the same time point; July Year R). We found no significant difference in BAS scores between ERR1 and CG1 or between ERR3 and CG1 at the end of Year R (see models 1 and 2 in Table 6). Therefore the CG1 and ERR groups were likely to be well matched on their literacy potential at the beginning of the study. In addition, we found no differences between the three intervention

	ERR1			ERR2			ERR3			CG1		
	M	SD	n	M	SD	n	M	SD	n	M	SD	n
Year R	7.98	10.46	90	3.00	6.03	542	7.74	12.20	90	5.16	7.78	80
Year 1	37.19	19.39	89	35.05	17.99	454	37.19	19.39	75	17.82	17.20	65
Year 2	51.95	19.94	82	49.63	21.14	419	51.11	21.45	72	38.85	23.32	61
Year 3	60.12	21.18	69	59.45	20.97	360	61.56	20.16	61	51.54	22.08	52

Table 5: Means and SDs for BAS scores for the longitudinal sample from Study 2, during the intervention

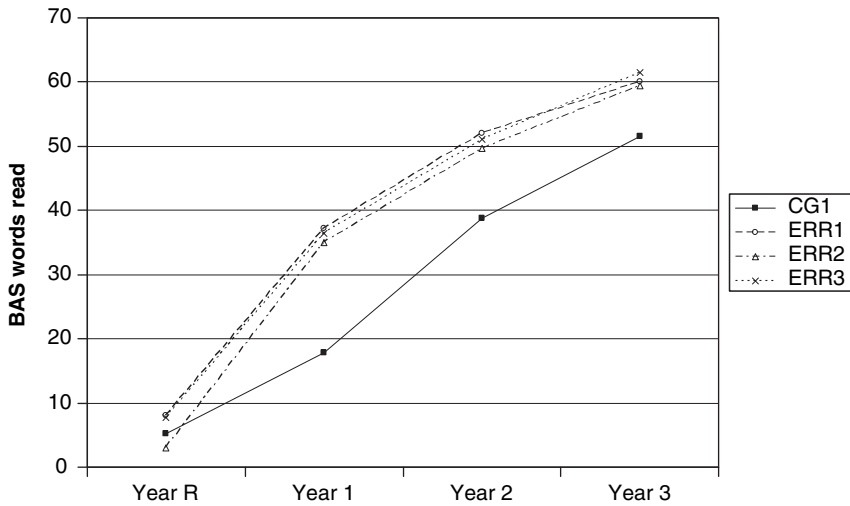


Figure 2: BAS scores for CG1 and ERR children between Year R and Year 3

groups (ERR1, 2 and 3) in their response to the intervention (see Model 3, Table 6). However, Model 4 shows that the advantage for ERR children over CG1 children is significant over years 1, 2 and 3 indicating a significant advantage of the ERR intervention over the NLS.

Cross-sectional comparison of ERR and CG1 children, with children attending the same schools prior to the intervention

As shown in Table 7a, children who had been in receipt of the ERR intervention for three years and had reached the end of Year 2 and then one year later when they reached the

Model	Fixed effects	Co-efficient	Z score	Random effects	Variance	S.E.	Log-likelihood
1. ERR1 vs. CG1 before intervention	ERR	0.32	0.93 ns	Child School	1.73 0.08	0.19 0.11	-290.09
2. ERR3 vs. CG1 before intervention	ERR	0.18	0.63 ns	Child School	2.32 0.03	0.26 0.07	-313.70
3. Comparison of ERR groups during intervention	ERR1 vs. ERR2	-0.17	-0.64 ns	Year Child School	1.32 1.79	0.06 0.12	
	ERR1 vs. ERR3	0.02	0.06 ns		0.07 0.05		
4. ERR1, 2 & 3 vs. CG1 during intervention	ERR	1.13	3.76**	Year Child School	1.52 1.82 0.12	0.06 0.13 0.06	-3531.02

Table 6: Study 2 Regression models with fixed effect (ERR) and multi-level random effects (year, child, school) for ERR and comparison groups in Study 2

	Before intervention			During/after intervention		
	M	SD	n	M	SD	n
Year 2	40.00	21.84	740	50.15	21.00	573
Year 3	52.55	21.95	746	59.81	20.87	490

Table 7a: Means and SDs for children’s BAS performance, from ERR schools, before and during the intervention in Study 2

	Before intervention			During/after intervention		
	M	SD	n	M	SD	n
Year 2	40.56	23.01	94	38.85	23.32	61
Year 3	50.45	21.12	105	51.54	22.08	52

Table 7b: Means and SDs for children’s BAS performance, from comparison schools, before and during the intervention in Study 2

end of Year 3 (and been in receipt of the NLS for one year post-intervention), outperformed previous cohorts of Year 2 and 3 children (CG2 and CG3 respectively) who attended the same schools but before the ERR intervention was implemented.

In contrast, Table 7b shows that CG1 (who had received the NLS teaching throughout their formal schooling) when they reached the end of Year 2 and 3 did not outperform previous cohorts of Year 2 and 3 children at the same schools who had received conventional, pre-NLS teaching prior to the introduction of the NLS, which they then received for one year only. Thus, comparing the different cohorts of comparison children allows us to judge whether receiving NLS teaching for all 3 years of school (for Year 2 children) or all 4 years of school (for Year 3 children) is more effective than 2 or 3 years of conventional teaching plus just one year of NLS teaching (see Table 1 for a summary of the teaching methods received by each group during the study).

There is little difference between CG1 and the two earlier cohorts of Year 2 and 3 children attending the comparison schools, indicating that CG1 had not gained any significant benefit from receiving NLS teaching throughout their schooling (this difference is shown to be non-significant, see Models 1 and 2 in Table 8). In contrast, children who received the ERR intervention significantly outperformed previous cohorts of children from the same schools (see Models 3 and 4 in Table 8).

General discussion

In recent years, a considerable amount of research has been undertaken into the acquisition and impact of phonological awareness on children’s reading. This research has tended to focus on teaching phonological and phonic skills to children with reading difficulties or at risk of failing to learn to read. Instructional programs are generally implemented by researchers rather than teachers, with small groups of children or on a one-to-one basis. However, a key issue is whether it is possible for mainstream classroom teachers to implement teaching programs through whole class teaching, which increase the reading standards of all children, with a diverse range of needs and not just those with difficulties or at risk of failing. The current studies have therefore, addressed three areas which have rarely been considered by psychologists working in the field of education. We investigated whether firstly, a classroom based framework for teaching literacy during two academic years was more effective than conventional methods of teaching reading; secondly, whether the same methods, can successfully raise the attainments of all children, not only those judged to be at risk of reading failure; and finally, whether any gains that children make during the intervention were maintained one year after it had been withdrawn.

Has the ERR framework for teaching raised reading attainments?

The ERR has demonstrated that a theoretically driven, research-based, teaching pro-

Model	Fixed effects	Co-efficient	Z score	Random effects	Variance	S.E.	Log-likelihood
1. CG1 Year 2 vs. CG2 from comparison schools	NLS	-0.28	-0.85 ns	Child School	3.85 0.70	0.44 0.56	-326.41
2. CG1 Year 3 vs. CG3 from comparison schools	NLS	0.05	0.20 ns	Child School	2.61 0.00	0.29 0.00	-298.02
3. ERR Year 2 vs. CG2 from ERR schools	ERR	.80	8.26**	Child School	3.02 0.11	0.12 0.05	-2598.74
4. ERR Year 3 vs. CG3 from ERR schools	ERR	0.50	5.33**	Child School	2.60 0.06	0.11 0.04	-2352.42

Table 8: Regression models with fixed effect (ERR or NLS) and multi-level random effects (child, school) for ERR and comparison groups before and during the intervention in Study 2. Note: ** $p < .001$, * $p < .05$, ns, non-significant

gram, implemented by regular teachers through whole class instruction in classes with up to 40 pupils, impacted significantly on children's attainments in reading. Overall, the ERR group outperformed the comparison groups on all measures while the intervention was in place during Year R and Year 1 in Study 1 and in Years 1 and 2 in Study 2 and for one year after the intervention had been removed. However, the aim of the research was to investigate not just whether reading attainments could be increased but also whether whole class teaching improved the reading attainments of children of all ability levels.

Did the ERR framework raise the attainments of children at all levels of ability?

The second area addressed by the research was whether reading standards could be raised for children of all abilities through whole class teaching. We therefore examined the performance of higher and lower achievers within the ERR and comparison groups. We found no interaction between ERR and achievement group, demonstrating that the ERR had the same impact on

children at all levels of achievement. In fact, the impact of ERR was so great that the ERR lowest achievers had caught up with the comparison middle achievers by the end of Year R. Importantly, the ERR highest achievers were performing to levels well above the highest achievers in comparison schools. Thus, any fears that higher achieving pupils would be held back by whole-class teaching certainly have not been realised in this study.

How can a whole-class intervention impact on all children?

Overall, it is clear that the intervention had a dramatic impact on reading performance, confirming that a phonological awareness and phonics strategy can be highly effective when incorporated into whole-class reading sessions, delivered by children's regular teachers. Crucially, we found no evidence that children starting at different levels of literacy responded differently to ERR. Although children beginning at higher levels of literacy improved faster and read better, the benefit of the ERR intervention was equal for all three groups. In addition, children with all levels of phonological

awareness benefited to the same extent from the ERR intervention. These findings suggest that the vast majority of children would benefit equally from improved whole-class methods, without the need for additional one-to-one or small group help. We believe there are two key explanations for the dramatic effect of ERR. Firstly, the ERR intervention was much more focussed than previous interventions (e.g. Fuchs *et al.*, 2001; Hatcher *et al.*, 2004). We taught fewer core skills, and a minimum number of letter-sounds and sight vocabulary words. This 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). We will compare the core skills taught through the ERR intervention, with those taught in other interventions in the next section.

Secondly, teachers were trained to differentiate between achievement-groups during each whole class session. Thus, lower achieving readers were effectively getting individual, attainment-specific help within every whole-class session, delivered three times a day for twelve minutes in Study 1 and fifteen minutes in Study 2. Combining all components of the ERR framework into a single whole-class session allowed us to deliver each component much more frequently than was possible in other interventions that used small group teaching, or taught different skills in different sessions (e.g. Hatcher *et al.*, 2004; Fuchs *et al.*, 2001).

Like the ERR intervention, Hatcher *et al.*'s interventions replaced all standard teaching of reading. They provided Year R and Year 1 children with a whole-class reading programme, that 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 replace all standard teaching of reading. In fact, the most intensive of Fuchs *et al.*'s interventions, "Ladders + PALS", only accounted for 20–25 per cent 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. In contrast, 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 in Study 1 and 7 minutes of reading to children in Study 2. The success of the ERR intervention indicates that phonological awareness and phonics training can be incorporated into a single whole-class reading session, allowing training to be delivered very frequently and structured to provide content suitable for different ability groups.

Were the phonological and phonics components of the ERR intervention sufficient to impact on children with poor literacy skills?

As we discussed in the Introduction, the phonological awareness and phonics components of the ERR intervention were much less extensive than those used in previous successful interventions (e.g. Fuchs *et al.*, 2001; Hatcher *et al.*, 2004; Hatcher & Goetz *et al.*, 2006; Hatcher & Hulme *et al.*, 2006). Nevertheless, we found that our phonological awareness and phonics programmes impacted on the attainments of all children, so that no additional teaching in these areas

was required. 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 have described in Shapiro & Solity, 2008).

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. The success of the ERR intervention for children at all levels of literacy suggests that some of the skills taught within Hatcher *et al.* and Fuchs *et al.*'s interventions were unnecessary, and may even have been inappropriate for some children. We claim that phonics and phonological training that focuses on a minimal number of core skills is more appropriate for both low and high achieving readers.

As discussed in Shapiro and Solity (2008), we cannot make a direct comparison between our study and other interventions. Nevertheless, the high scores achieved by ERR children in our studies indicate that the whole class approach can have dramatic effects. In fact,

our lower achieving ERR children made improvements in reading that were at least as impressive as other, more intensive interventions (e.g. see Hatcher *et al.*, 2004). Hatcher *et al.* suggest that effects for their at-risk group would have been even greater had the intervention been more intensive and individualised, “Arguably, if the same amount of phoneme training were to be presented over a shorter period of time, and to smaller groups of children...or to individuals, the effects would be larger.” (p. 355). They would predict that the ERR intervention would not be appropriate for at-risk children, since the ERR intervention was delivered on a whole-class basis and missed out many of the key skills included in Hatcher *et al.*’s additional phoneme training programme. However, we have found that a less intensive intervention was equally effective across the three literacy groups, and for children with all levels of phonological awareness.

Our findings suggest that very frequent whole-class sessions, systematically covering only the most essential phonological and phonics skills can lead to greater gains than a more extensive strategy conducted less frequently (see Seabrook *et al.*, 2005 for an experimental investigation of the distributed practice effect). This challenges the notion that different instructional strategies are necessary for children starting school with different levels of literacy. Instead, if we focus on the central components of the reading process, it is possible to leave out many features of other instructional programmes, and provide training that is suitable for children at all achievement levels.

Can a whole-class intervention reduce the incidence of reading difficulties?

The ERR intervention achieved a dramatic reduction in reading difficulties through entirely whole-class teaching methods. Whereas 20 per cent of comparison children fell into the bottom 10 BAS centiles at the end of Year 2 in Study 1, this figure was reduced to just 5 per cent of the ERR children. Strikingly, only 1 per cent of ERR

children fell into the bottom 5 BAS centiles, compared with 13 per cent of the comparison children. Although we should be cautious about making a direct comparison with studies conducted with different measures of reading and different populations of children, our findings do appear to compare favourably with an estimated reduction from 17.5 per cent (Shaywitz, Fletcher & Shaywitz, 1995) to 2–6 per cent (Torgesen, 2000) following intensive early interventions in the US (see also Foorman *et al.*, 2003).

It is possible that children who still experience difficulties following the ERR intervention would respond to intensive one-to-one training (Torgesen *et al.*, 1999; Vellutino *et al.*, 1996). However, it is more likely that our poorest readers represent the same difficult-to-remediate children following one-to-one methods (Vellutino *et al.*, Torgesen, 2000). Whereas Foorman *et al.* (2003) and Hatcher *et al.* (2004) argue that reading difficulties must be prevented by early identification and individualised training, we suggest that this extra training would be unnecessary for the vast majority of children, if whole-class methods were improved.

Since differences in children’s speed of learning are inevitable, the aim for researchers and practitioners should be to create a learning environment that allows all children to acquire the basic skills necessary to develop their own knowledge base. As discussed by Share (1995), the aim of reading instruction is to impart basic letter-sound knowledge and phonic skills so that children can use this as a framework to build on as they effectively teach themselves to read. If we can ensure that all children cross the threshold into independent reading, we can avoid the downward spiral experienced by children who fail to acquire basic reading skills within the first few years of school (Gough & Juel, 1991; Foorman *et al.*, 1997; Francis *et al.*, 1996; Stanovich, 1986). Our findings suggest that the most cost-effective way to achieve this would be to focus research on improving whole-class teaching. These studies can then provide the groundwork for targeted research

into individualised strategies for the few children who fail to develop independence in reading through whole-class methods.

Were gains made during the intervention maintained after the intervention was withdrawn?

An important measure of the effectiveness of the intervention was whether children's gains in reading performance could be maintained after the intervention was withdrawn. During the interventions in Studies 1 and 2 the ERR and comparison groups were taught to read through different methods. However, after the interventions were withdrawn both groups were taught in the same way because all the schools implemented the curriculum developed for the NLS. Our results clearly show that the ERR intervention was effective in boosting reading performance, and that these gains were maintained for at least one year after the intervention had been removed. Further work is in progress to examine the impact of the ERR for longer interventions, and with longer post-intervention follow ups (Solity and Shapiro, 2008).

Drawing conclusions from the research

Two types of conclusions can be drawn from classroom-based research of the type reported in this article. Type 1 conclusions are possible when the intervention offered to the experimental and control groups differs in only one area enabling conclusions to be made about the precise nature of the intervention. Type 2 conclusions are possible when interventions differ in a number of respects but where one intervention is shown to be more effective than the other.

Type 2 conclusions can be drawn from the research reported in this article. The studies demonstrated that the ERR intervention was more effective than the NLS and the pre-NLS conventional teaching that was being implemented in the comparison group. However, it is less clear which elements within the literacy framework developed for the intervention had a specific impact on

children's attainments and progress. Nevertheless, some tentative, broader, conclusions can be drawn based on comparing the outcomes of this study with previous research.

Earlier we compared the impact of the ERR intervention with the whole class intervention of Hatcher *et al.* (2004) which teaches a broader range of phonological and phonic skills but also includes those taught through the ERR literacy framework. Whereas the ERR impacted on higher and lower achievers, Hatcher *et al.*'s additional phonological intervention only impacted on lower achievers.

The crucial difference between the two interventions is that the ERR taught a small number of core skills, that directly parallel the way those skills are applied to reading and writing. Children were taught through short, frequent, differentiated, whole-class sessions, providing content appropriate for children of different levels of attainment. The differing impact of the two interventions on normally developing readers suggests that some of the skills taught through Hatcher *et al.* were not appropriate for all children. Although the additional phoneme training impacted on the phoneme manipulation skills of normally developing readers; such gains were not reflected in word reading. These findings suggest that systematically covering only the most essential phonological and phonics skills can lead to greater gains than a more extensive strategy conducted less frequently (see Seabrook *et al.*, 2005 for an experimental investigation of the distributed practice effect).

Despite the limitations in studies which lead to Type 2 rather than Type 1 conclusions, large-scale, classroom-based experiments, are critical in demonstrating that theoretically driven interventions can be implemented by teachers and lead to significant and permanent gains in children's learning. Without such evidence, it is difficult to justify asking teachers to consider adapting their classroom practice. At the very least, Type 2 conclusions indicate what is possible, in terms of learning outcomes,

within regular classrooms. This potentially provides a marker and baseline for evaluating the impact of other whole-class interventions implemented by teachers, particularly when common measures are taken.

Implications for educational psychologists

The research reported in this article has a number of theoretical and practical implications for educational psychologists (EPs). The first concerns the most appropriate theoretical basis for deriving a curriculum to teach all children. In the past, psychological approaches to teaching have been based on an analysis of children's cognitive development, with a particular focus on their acquisition of phonological skills. This has led to programs such as Sound Foundations (Byrne & Fielding-Barnsley, 1991), Sound Linkage (Hatcher, 2000), the Phonological Assessment Battery (Frederickson, Frith & Reason, 1997) or Phonological Awareness Training (Wilson & Frederickson, 1995) that enable teachers to assess and teach phonological skills. However, it cannot be assumed that psychological interventions based on an analysis of children's cognitive development that have been reported in past research, and have been shown to impact on children with difficulties or children at risk of reading failure, can also benefit other children. There is some evidence to suggest that phonological interventions do not appear to help children who are not experiencing difficulties (Ehri *et al.*, 2001; Hatcher *et al.*, 2004) and so do not automatically translate into the most effective instructional programs for raising the attainments of all children. If this is so such interventions may have limited applicability in mainstream schools.

The theoretical underpinnings of the ERR are rational analysis, direct instruction and behavioural psychology which focus on the environmental factors that best facilitate children's learning. The curriculum content of the framework for teaching reading developed within the ERR emerged from an analysis of the literature children are taught to read (Carnine *et al.* 1997), through organ-

ising the curriculum in such a way that children are taught a relatively small number of highly generalizable skills and through developing teaching strategies which incorporate core instructional principles of teaching and learning. It is not regarded as necessary to make reference to children's cognitive development or the individual differences between them.

Thus, the outcomes from the research reported in this article suggest that EPs should refocus their attention when determining the needs of pupils perceived to be experiencing difficulties. Instead of an analysis of their cognitive development and how they differ from normally developing peers, we should move towards an analysis of the core instructional factors that influence pupils' attainments such as the curriculum, teaching methodology and assessment frameworks.

A second implication concerns the relationship between phonological training and other aspects of teaching literacy. The ERR has embedded phonological training within a broad framework for teaching literacy which goes beyond the relatively narrow parameters of many phonological interventions. As a result, with appropriate differentiation, teachers are able to meet a diverse range of needs within a single 15-minute teaching session. Whilst it is recognised that phonological interventions are most effective when linked to print (Bryant & Bradley 1985; Hatcher *et al.*, 1994), it may well be the case that to have a greater impact on the learning of all children they have to be linked to a wider literacy curriculum (Shapiro & Solity, 2008). This is not to detract from the merits of many existing phonological interventions but to question their wider applicability if they only benefit a relatively small percentage of beginning readers.

A third and related implication concerns the most suitable texts for teaching reading. It is widely accepted that failing readers need structured, phonically regular texts to support their acquisition of phonological

and phonic skills. It is assumed that is provided through the use of reading schemes. However, research undertaken by Solity, McNab & Vousden (2008) and Solity & Vousden (2008) indicates that this is not necessarily the case. The analyses that they report suggest that high frequency words and a small, core number of grapheme-phoneme correspondences (GPCs) occur as frequently in children's real books as reading schemes. Furthermore, these high frequency words and GPCs actually occur more often in adult literature than children's reading schemes as well. Given that recent reports (Ofsted, 2004; Progress in International Reading Literacy Study, 2001; Twist, Schagen & Hodgson, 2007) have drawn attention to the experiences of lower achieving pupils when being taught to read and the disheartening effects of remaining on a reading scheme for extended periods, the use of real books to teach such pupils could have a positive and motivating impact in sustaining pupils' interest in reading. As a result EPs may have to shift their focus when working with children seen to experience literacy difficulties to the texts that are used to teach reading as well as the broader literacy curriculum.

A fourth implication of the impact of the ERR on higher and lower achievers concerns the widely held belief within the educational community that the same teaching strategies cannot work for all children. It is typically assumed that children with different attainments need to be taught in different ways and that if the attainments of the lowest achievers are increased through whole class teaching then the higher achievers will be disadvantaged. Our data indicates that far from holding children back, the intervention provided through the ERR has enabled higher achieving pupils to attain to higher levels than might be expected without the intervention.

Equally, it is thought that lower achieving pupils can only have their needs met through either small group or one-to-one teaching, which is common practice within the field of special education. This is reflected in all the

programs recommended by the Department for Education and Skills (DfES, 2003) for teaching children with reading difficulties. However, within the ERR, individual pupil needs are met, not through withdrawing them in the accepted and traditional manner, but through showing teachers how to organise whole class teaching and differentiate the curriculum when teaching synthesis, segmentation, phonic and sight vocabulary skills. Children of all ability levels were given short, direct and specific opportunities to practice these skills and apply them explicitly to a wide range of high quality texts. This is particularly relevant at a time when there are initiatives to promote inclusion of children with difficulties in mainstream classrooms. Interventions that require small group teaching or the withdrawal of children with difficulties effectively undermine the inclusion agenda.

As a result, EPs may need to address how literacy is being taught to all the children within a class and consider the merits of differentiated whole class teaching as a way of improving the attainments of pupils perceived to experience difficulties rather than recommending that they are taught in a small group or on a one-to-one basis. More generally this will involve EPs in questioning the validity of the three wave strategy to meeting the needs of the lowest achieving pupils. Evidence from the Primary Review (Tymms & Merrell, 2007) suggests this would be timely: there has been no clear evidence of an increase in literacy standards over the last decade despite the presence of the NLS, numerous intervention specifically targeting lower achieving pupils and the significant financial resources invested in raising literacy attainments. One reason for the lack of success of the three wave model is the assumption that small group or one-to-one teaching is the appropriate response to pupils failing rather than better differentiated whole class teaching. On the basis of the research reported here, an alternative explanation for pupils failing to make progress lies in an inappropriate curriculum where they are taught skills that will not impact directly on their

reading. If this is the case there is no reason to think that being taught these skills on an individual basis will be any more successful than when presented to the whole class, if they are not the correct skills in the first instance.

The ultimate benefits of EPs focussing on whole class teaching are two fold. The first is that they would be seen to be applying psychology more broadly, to meet the needs of all children, not only those experiencing difficulties. Such a move would potentially take them away from being experts in special education to being applied psychologist with skills, knowledge and expertise in the teaching and learning process. The second benefit is that the reported research indicates that with the right intervention, the attainments of all pupils improve, not only those of the lower achievers. Thus the incentive for teachers to examine how all children are taught literacy is the knowledge that all their pupils will benefit. This represents a highly cost-efficient alternative to intensive small group and one-to-one teaching.

Conclusion

The study reported in this article has demonstrated that a theoretically driven curriculum based on what children have to learn and how to teach can have a dramatic impact on children's attainments. In particular it has

demonstrated that a phonological intervention can be taught alongside an optimal number of core sight vocabulary and phonic skills on a whole class basis and lead to a dramatic reduction in the percentage of children perceived to have literacy difficulties. The research has significant implications for EPs in relation to the models of psychology that inform their assessments of pupils perceived to have difficulties, the use of real books to teach reading and the role of whole class teaching to increase the attainments of lower attaining pupils. From a practical point of view, the ERR framework represents a cost-effective approach to teaching; the gains have been achieved through teaching children on a whole class basis which involves less time and less money than would be required to teach through withdrawal groups or individual teaching. Finally, the research has significant implications for the way that EPs develop their practice in the future as applied psychologists.

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