Read Writ
DOI 10.1007/s11145-011-9323-x

Long-term effects of synthetic versus analytic phonics teaching on the reading and spelling ability of 10 year old boys and girls

Rhona S. Johnston · Sarah McGeown · Joyce E. Watson

Abstract A comparison was made of 10-year-old boys and girls who had learnt to read by analytic or synthetic phonics methods as part of their early literacy programmes. The boys taught by the synthetic phonics method had better word reading than the girls in their classes, and their spelling and reading comprehension was as good. In contrast, with analytic phonics teaching, although the boys performed as well as the girls in word reading, they had inferior spelling and reading comprehension. Overall, the group taught by synthetic phonics had better word reading, spelling, and reading comprehension. There was no evidence that the synthetic phonics approach, which early on teaches children to blend letter sounds in order to read unfamiliar words, led to any impairment in the reading of irregular words.

Keywords Synthetic phonics · Analytic phonics · Opaque orthography

The English spelling system has an opaque orthography; although it is an alphabetic system, some spellings have inconsistent grapheme-phoneme connections, e.g., 'aisle'. This inconsistency in English spelling has led to models of adult reading such as the dual route model, where the pathways envisaged for the reading of words with irregular versus regular spelling-sound correspondences are seen as largely independent (Coltheart, Rastle, Perry, Langdon, & Ziegler, 2001). A substantial literature has examined whether individuals take a phonological approach to reading English, determined by whether their responses to irregular words are slower and less accurate than to regular words; it has been found that these effects are shown in both children and adults (e.g., Waters, Seidenberg, & Bruck, 1984). There is some evidence, however, that boys take a more phonological approach to reading than girls.

R. S. Johnston (✉) · S. McGeown · J. E. Watson
Department of Psychology, University of Hull, Hull HU6 7RX, England, UK
e-mail: R.S.Johnston@hull.ac.uk

Published online: 29 May 2011

Baron (1979) found, in a post-hoc analysis of a study of 9–10 year olds, that the boys were slower to read lists of orthographically similar words where words with inconsistent spelling-sound correspondences were included (e.g., *maid, said*) compared to control lists (e.g., *made, said*). In a study of 7 year olds learning to read by a non-phonic method, Thompson (1987) found that boys had inferior reading of exception words (e.g., *great*), their performance on regular words being very similar to that of girls. It is possible, therefore, that a phonic approach to teaching reading would be especially beneficial for boys, who generally do not fare well in international comparisons of reading attainment (e.g., Mullis, Martin, Kennedy, & Foy, 2007), as it would suit their natural approach to word reading. On the other hand, their problems with reading irregular words might be exacerbated by using a phonics approach to reading, as it might increase their errors on these words.

Concerns about the irregularities in English orthography have led to the wide-spread adoption of methods of teaching reading using whole word methods, and the use of phonics approaches with a substantial whole-word element, such as analytic phonics. Indeed, it has been proposed that rigorous early grapheme-phoneme based phonics programmes, such as synthetic phonics ones, cannot be effective in English (Dombey, 2006). The so-called 'reading wars' have led to a number of reviews of the efficacy of whole word versus phonic teaching methods in English speaking countries. Recently, the US National Reading Panel (NRP) concluded that phonic teaching approaches were more effective than whole word approaches (National Institute of Child Health and Development (NICHD), 2000; Ehri, Nunes, Stahl, & Willows, 2001).

This paper is concerned with examining what type of phonics programme is effective in English, and whether one approach is particularly effective for boys. Many countries in Europe use a synthetic phonics approach (e.g., Austria, see Feitelson, 1988), where children learn very early on how to blend letter sounds in order to decode unfamiliar words. However, where phonics is taught in English speaking countries, it generally starts with an analytic phonics approach, where children initially learn to recognise words by sight, that is, it is a mixed methods approach. Alongside this, children learn to recognise letter sounds at the beginning, the end, and then the middle position of printed words. At this point, usually at the end of the first year at school or at the start of the second, they may then be taught how to decode printed words by blending the letter sounds all through the word (usually after hearing how it is pronounced). Johnston and Watson (2004) found in two studies (Experiments 1 and 2) that 5 year old children taught by this analytic phonics method read and spelt less well than those taught by the synthetic phonics method, even when speed of letter learning was equated. In following the children from Experiment 1 through to the age of 11, Johnston and Watson (2005) found that the synthetic phonics taught children gained in word reading ability relative to chronological age year after year. This is in contrast to the NRP finding that in most training studies the gains were lost a few years after the end of the programme (NICHD, 2000). It is also of interest that children from areas of disadvantage performed as well as those from advantaged areas until close to the end of primary schooling, although other UK studies have shown them to fall behind right from the start of schooling (Duncan & Seymour, 2000; Stuart, Dixon, Masterson, & Quinlan, 1998). Finally, it was found that from the end of the third year of school the boys

had better word reading than the girls (Johnston & Watson, 2005), and were still better at the end of the study.

The analytic phonics approach used in Johnston and Watson's (2004) studies was taken from the approach widely used in Scottish schools (Watson, 1998). It is also very similar to the approach that was used until recently in England (*Progression in Phonics*, DfEE, 1999). In the larger of their two studies (Johnston & Watson, 2004, Experiment 1), the children taught by the analytic phonics method switched to the synthetic phonics method as soon as the first post-test was carried out, as the benefits of the synthetic phonics method were clearly evident to the education authority. Therefore, it was unclear from this particular study whether children taught by the analytic phonics method would ultimately perform as well as those taught by a synthetic phonics approach. On the other hand, if the early use of a grapheme to phoneme conversion approach is problematical because of the English spelling system, then it is also possible that the synthetic phonics children would fall behind their analytic phonics counterparts, or at least have specific problems with reading irregularly spelt words (Dombey, 2006). Such a view fits with the dual route model of reading, but not with one route connectionist models (e.g., Seidenberg & McClelland, 1989), which emphasise that even irregular words such as 'yacht' contain information about pronunciation. Although Harm and Seidenberg (2004) have developed a two-pathway connectionist model (the orthographic-phonological-semantic and the orthographic-semantic pathways), irregular words are not said to be processed purely by the latter, more visual orthographic, pathway, as is proposed by the dual route model. As connectionist models propose that a reader may capitalise on the fact that irregular words contain regular elements that will assist pronunciation, it can be hypothesised that the synthetic phonic approach to reading may not lead to so severe an impairment in reading irregular words as that predicted by the dual route model.

A number of cross-national studies have suggested that learning to read in an opaque language such as English has costs for attainment. For example, Wimmer (1995) reported that 7 year old Austrian children who learnt to read in a transparent orthography (German) had better pseudoword reading skills after 1 year at school than 9 year old English children after around 4 years at school, which might suggest quite a penalty for having an opaque orthography. However, Wimmer also pointed out that the two groups also differed according to teaching method, the Austrian group following a rigorous synthetic phonics programme, and the English children learning by an eclectic approach including a whole word 'look say' approach and a phonics programme that used a 'word families' approach (typical of analytic phonics teaching). He suggested that the synthetic phonics teaching approach may have contributed to the better phonological recoding skills of the Austrian children, in addition to the benefits of a consistent orthography, and suggests that it would be interesting to explore how well such an approach would work in an opaque orthography such as English. Although Johnston and Watson (2004) have shown that a rigorous synthetic phonics teaching programme works well in English, there is a need for evidence as to whether children taught this way outperform, in the longer term, children who receive analytic phonics teaching.

Johnston and Watson's (2004) studies were primarily concerned with the development of word reading and spelling skills, but the question arises as to what

impact synthetic phonics teaching has on reading comprehension. Stannard (2006) has argued that the Clackmannanshire Study (Johnston & Watson, 2004, Experiment 1) showed that good phonics teaching delivered good word reading but had little impact on reading comprehension. As the analytic phonics groups also carried out the synthetic phonics programme before the end of their first year at school, no comparative data are available on this issue, even though the sample was studied for a further 6 years. However, it was found that the synthetic phonics taught children had reading comprehension skills significantly ahead of what was expected for their chronological age right through to the end of the study, although the gains were smaller than those for word reading and spelling (Johnston & Watson, 2005). According to the Simple View of Reading, boosting decoding or word reading skills may by itself lead to an increase in reading comprehension (Gough & Tunmer, 1986). If the synthetic phonics taught children were found to have superior word reading skills, this raises the issue as to whether they would also have better reading comprehension skills than children taught by the analytic phonics approach.

The aim of this study was to compare the literacy skills of boys and girls from the synthetic phonics taught Clackmannanshire sample (Johnston & Watson, 2004, Experiment 1) at the age of 10 with boys and girls who had learnt by an analytic phonics approach. This study capitalises on the fact that the synthetic phonics group were virtually all non-readers at the start of the study; this meant that they could be matched for time at school and socio-economic background to a group taught by analytic phonics who, if they differed at all in pre-tuition reading skills, could only be at an advantage. Firstly, it was hypothesised that if the synthetic phonics method is unsuited to the irregularities of the English language, then children learning to read by this method would have lower levels of word reading ability compared with the mixed-method analytic phonics approach; alternatively, it was predicted that because even irregular words contain some letter sounds that give a guide to pronunciation, those taught by the synthetic phonics method would have better word reading skills. It was also hypothesised that if the irregularities in English spelling are problematical for a synthetic phonics approach, then reading exception and strange words would be particularly problematical for boys, for whom there is evidence that they take a more phonological approach to reading. If so, they might have more difficulty in reading irregular words than boys taught by a mixed-method analytic phonics approach, whereas girls might be less affected by teaching method. Finally, it was hypothesised that whichever group had an advantage in word reading would also have better reading comprehension skills.

Study 1: comparison of synthetic phonics and analytic phonics taught children on word reading, spelling and reading comprehension

Method

Participants

Data from the Clackmannanshire Study, which was carried out in Scotland, were compared with data from schools in England. It was not possible to collect

comparative data in Scotland as the influence of the study there was such that many schools had adopted early sounding and blending, and this was directly confirmed in responses to questionnaires by teachers from outside the region.

Starting with the Primary 6 data collected in Clackmannanshire in Scotland when the children were 10 years old (Johnston & Watson, 2005), a subset of the original synthetic phonics sample ($n = 190$) was matched on time at school and socioeconomic background with a sample ($n = 203$) from a city in England taught by *Progression in Phonics* (Department for Education and Employment (DfEE), 1999), a mixed method approach that includes analytic phonics. Very few of the children in this Clackmannanshire subsample could read or spell at the start of schooling in August 1997; only five children gained a reading score, and only two gained a spelling score. This was because in Scotland at that time, literacy skills (i.e., letter sounds and word reading) were not taught in Nursery schools.

The synthetic phonics children were tested in March of their sixth year at school, but the analytic phonics sample was tested in June of their sixth year, or November of their seventh year, to equate for time at school (in the latter area, children attended school for between one and three terms in their first year of school, whereas in Scotland all of the children attended school for three terms in their first year). A term is on average around 64 school days. Whilst time at school was equated across groups, the children in the analytic phonics sample were on average 3 months younger; this difference was dealt with by comparing literacy skills using age-standardised scores. The samples were also matched on socioeconomic status and were categorised as moderately advantaged, moderately disadvantaged, disadvantaged and greatly disadvantaged using Clackmannanshire Council's Index of Disadvantage (synthetic phonics sample) and the Department for Education and Skills (DfES) Panda system (analytic phonics sample).

The schools for the analytic phonics sample were matched to the schools in Clackmannanshire. Although there were no data available on the performance of this sample before reading tuition started in primary school, literacy skills could scarcely be lower than those of the synthetic phonics sample. The schools were matched on SES as follows. In the Synthetic Phonics (SP) condition, seven schools were involved, contributing 11 classes to the sample. In the Analytic Phonics (AP) condition, there were eight schools, contributing one class each to the sample. In order to effect a match on SES, the two samples were stratified by bands of SES; whole classes were selected, and all pupils were included. This led to the following match: very low SES (SP, $n = 34$; AP, $n = 29$), low SES (SP $n = 33$; AP $n = 28$), moderately low SES (SP $n = 20$ AP $n = 38$), and medium to moderately high SES (SP $n = 103$, AP $n = 108$). The greater numbers for moderately low SES AP taught children did not skew the mean scores on the WRAT downwards for the analytic phonics sample, as these 38 children had a mean WRAT of 99.68, whereas the means for the medium to moderately high SES classes were lower in all except one case (95.79, 97.78, 99.15, and 101.17). School inspections carried out around the time of testing show that all of the English schools were considered satisfactory; this assessment takes into account performance on tests carried out in all schools in England for English and Math.

The analytic phonics sample was composed of 46.6% from moderately to severely disadvantaged areas and 53.4% from moderately advantaged areas.

The synthetic phonics sample was composed of 45.6% from moderate to severely disadvantaged areas and 54.4% from moderately advantaged areas. In terms of percentage of free schools meals, the resulting groups were well matched. For the advantaged groups, the figures were 14.5 and 14.2% for the synthetic phonics and analytic phonics samples, respectively. For the disadvantaged groups, the figures were 41.6 and 45.25% for the synthetic phonics and analytic phonics samples, respectively.

Teaching methods

Both groups of children had learnt to read by a phonic method early on in their schooling, and ultimately covered the same ground. However, these phonic methods differed in important respects. The children in England (mixed-method analytic phonics group) had learnt to read by the National Literacy Strategy programme *Progression in Phonics* (DfEE, 1999), which provides considerable detail on how the programme should be delivered. It is designed for use with children in the first 3 years of school. Children are initially taught phonological awareness, that is, they are trained to hear rhymes and phonemes in spoken words. Following this, they are taught letter sounds at the beginning of words, then at the end, and then in the middle. This stage is usually reached at the end of the first year of school. After this point, children see printed words, hear them spoken, and then sound and blend them. This phonics programme closely resembles what is done in traditional analytic phonics programmes (Harris & Smith, 1976; Johnston & Watson, 2007, Chap. 1), the only difference being that the *Progression in Phonics* (PiPs) children are also taught to segment spoken words for spelling. The children proceed to learning to read and spell words with consonant digraphs, (e.g., *thin*), initial and final consonant blends (e.g., *swim*, *tent*), vowel digraphs (e.g., *coat*), and split digraphs (e.g., *cake*). At this stage, children may work with words with similar rime spellings. Throughout, children are encouraged to guess unfamiliar words from context, and so sounding and blending is not the primary approach to identifying unfamiliar words. High frequency words in general, and irregular words in particular, were taught by sight without phonic analysis. In the city in which the study was carried out, literacy consultants were trained and paid for by the central government, to give in-service teaching in the method and to monitor the satisfactory teaching of this programme, and for literacy throughout the primary school years. Observations by the authors in classes throughout the city showed that the programme was uniformly being observed.

There has been some confusion about what constitutes a synthetic phonics programme. For example, Brooks (2003) has argued that PiPs should be categorised as a synthetic phonics programme, on the grounds that it contains some sounding and blending. This is a statement that needs some consideration, as it underlines the fact that there are subtle but important differences between different types of phonics programmes. Firstly, in synthetic phonics programmes, sounding and blending is introduced at the beginning of reading tuition, whereas in PiPs it is introduced towards the end of the first year at school, or even later. Thus children spend most of their first year at school reading words largely by sight; even when

introduced, sounding and blending is not the predominant approach to learning to recognise words, as children are taught to guess unknown words from context. Secondly, in PiPs children are told how the words are pronounced before sounding and blending them, which means that they do not have to synthesise the sounds in order to pronounce the words; studying the letter sounds in *known* words is a core feature of the analytic phonics approach. Interestingly, in 2002, Brooks correctly described the synthetic phonics method as being where the child sounds and blends the letters in *unknown* printed words, in order to discover how to pronounce them, so he has changed his position on this issue.

The children in the Clackmannanshire sub-sample learnt to read by the synthetic phonics approach in their first year of school, and also learnt how to segment spoken words for spelling (Johnston & Watson, 2004, Experiment 1). In synthetic phonics programmes, at the start of reading tuition children learn a few letter sounds, e.g., 's', 'a', 't', 'p' (see Johnston & Watson, 2007) and then see whole words made up from those letters, e.g., *tap*, *pat*, and *sat*. They are not told what these words are, however, but have to sound and blend the letter-sound sequences to read the words independently. They are also not taught to guess unfamiliar words from context. The class synthetic phonics programmes in Clackmannanshire were closely monitored for the 16 weeks of the experimental programme by the region's Senior Quality Assurance Officer. The programme was handed out on a weekly basis in order to keep up the momentum; the quality assurance officer frequently monitored the class teaching of the programme. Some teachers were unhappy with the method, particularly expressing concern about the speed of learning, but the quality assurance officer ensured that they complied with the method. The Clackmannanshire teachers were therefore less familiar with the programme they implemented than the teachers in England, having had only half a day in-service training before the study commenced, whereas in England, the government scheme *Progression in Phonics,* had been in place for several years. Therefore, given the lack of experience of the teachers in Clackmannanshire, one might predict a less efficacious implementation of the method, and therefore poorer results. For the second year of school, the teachers in the region were given an outline of the phonics to teach, covering more complex digraphs, syllables, and morphemes, but this teaching was not closely monitored.

The two phonics programmes ultimately covered the same ground in the teaching of orthographic patterns. However, the phonics programme in Clackmannanshire was largely completed by the end of the second year of school, whereas England's *Progression in Phonics* (DfEE, 1999) programme was largely completed by the end of the third year of school.

There was considerable similarity in the rest of the reading curriculum, both schemes fostering the ability to read for information and for pleasure (in Scotland, Scottish Executive Education Department (SEED), 2000; in England, DfEE, 1998). In Scotland, according to the 5–14 Guidelines (SEED), by Primary 6 children should reach Level C in literacy attainment. When reading for information, they should be able to read a variety of texts, and in discussion and writing show that they understand the main and supporting ideas, and draw conclusions from the text where appropriate. They should also be able to find and use information from a

range of sources. Similarly, in England (DfEE, 1998) a progression is outlined such that children by the end of Year 5 (i.e., sixth year at school) should be able to read information passages and identify the main points of the text, summarise a sentence or paragraph by identifying the most important elements and rewording them in a limited number of words, and read and evaluate a range of instructional text in terms of their purposes, organisation, layout, clarity and usefulness. Both schemes also develop children's reading for enjoyment, fostering their awareness of genre and of the ideas and the techniques used by authors.

The children in Clackmannanshire had undertaken a much more accelerated reading and spelling programme than had hitherto been the case, and Primary 2 teachers were faced with classes that were very much further advanced than they had been used to. Although the intervention had ended, advice was given on further aspects of phonics for reading and spelling that should be covered. The teachers also spent time on developing the children's reading comprehension skills. The teachers were additionally encouraged to spend some time on developing thinking skills. In order to assist the teachers with this, they were offered a programme lasting for one half hour session per week. For example, using the stimulus of a picture, the teacher would ask open-ended questions and invite oral responses. The children would also be introduced to the idea of defining, classifying and comparing; later on they would also cover ambiguity, inference, and comparison. Towards the end of Primary 2 the children would be encouraged to answer questions with questions, using paragraphs of printed text as stimuli. These sessions continued in Primary 3, where children were introduced to discussing in pairs concepts such as being brave, the meaning of precious, or being poor, again using text as the stimuli. By the end of the year, they would be matching paragraphs to relevant cartoon frames, as well as continuing to develop their discussion skills. These half-hour per week programmes were not separately monitored by the authors, nor were any outcomes assessed. Feedback suggested that this area of work was not popular with the teachers.

Materials

The following tests were used with the children at the age of 10. Word reading was tested using the WRAT Reading Test (Wilkinson, 1993). This test was adopted in the 6th year of the Clackmannanshire study as so many children had reached ceiling on the British Ability Scales Word Reading Test (Elliott et al., 1977), which has an upper reading age of 14 years and 5 months. The BAS test contains both regular and irregular words. In the sixth year, both the BAS and WRAT tests were administered; the results were very comparable when children at ceiling on the BAS were excluded. Reading comprehension was tested using the Group Reading Test (Macmillan Unit, 2000a); this is a cloze procedure test, but for 10 year olds it has been found to correlate well with the Neale Analysis of Reading ability (Neale, 1989), a test of passage comprehension ($r = 0.76$ on a sample of 54 10 year old children; McGeown, unpublished results). The GRT II test manual also shows that the Group Reading Test has very good reliability and validity (K-R 21 is .88 for Form C and .84 for Form D). See manual guidelines for the GRT II for further details of reliability and validity (Macmillan Unit, 2000b). Spelling was tested using

the Schonell Spelling Test (Schonell & Schonell, 1952), and vocabulary knowledge was assessed by the English Picture Vocabulary Test (Brimer & Dunn, 1984).

Results

Vocabulary knowledge

In order to assess whether the two samples were matched on verbal ability, an analysis was made of vocabulary knowledge using the English Picture Vocabulary Test (Brimer & Dunn, 1984) (see Table 1 for means and standard deviations). A three-way analysis of variance was carried out, with type of teaching (analytic versus synthetic phonics), level of disadvantage (disadvantaged versus advantaged), and sex (boys versus girls) as the between subjects factors. There was no main effect of type of teaching, $F(1, 385) = 1.80$, $p > .05$, ($M = 91.2$, $SD = 12.0$ for synthetic phonics, $M = 89.4$, $SD = 11.3$ for analytic phonics). However, there was a main effect of sex, $F(1, 385) = 10.10$, $p < .002$, $\eta_p^2 = 0.03$, with males gaining higher scores than females ($M = 91.9$, $SD = 11.6$ for boys, $M = 88.2$, $SD = 11.5$ for girls). There was also a main effect of disadvantage, $F(1, 385) = 12.40$, $p < .001$, $\eta_p^2 = 0.03$, with children from advantaged areas performing better ($M = 92.1$, $SD = 11.0$ for advantaged areas, $M = 88.1$, $SD = 12.1$ for disadvantaged areas). There were no significant interactions between any of these factors, $F < 1$ in all cases except for type of teaching and sex, $F(1, 385) = 1.53$, $p > .05$. Thus it is clear that this test was sensitive to the indices of disadvantage used, and that the samples were well matched on this variable.

Word reading

A three-way analysis of variance was carried out, with type of teaching (analytic versus synthetic phonics), level of disadvantage (disadvantaged versus advantaged), and sex (boys versus girls) as the between subjects factors (see Table 1 for means and standard deviations). There was no main effect of level of disadvantage, $F(1, 385) = 2.37$, $p > .05$ ($M = 104.0$, $SD = 13.9$ for advantaged areas, $M = 101.9$, $SD = 15.3$ for disadvantaged areas). The main effect of sex just failed to reach significance, $F(1, 385) = 3.54$, $p = .061$, ($M = 104.1$, $SD = 15.1$ for boys, $M = 101.5$, $SD = 13.9$ for girls). There was a main effect of type of teaching, $F(1, 385) = 46.95$, $p < .001$, $\eta_p^2 = .11$, performance being better in the synthetic phonics group ($M = 108.2$, $SD = 13.9$ for synthetic phonics, $M = 98.1$, $SD = 13.6$ for analytic phonics). There were no interactions between levels of disadvantage and sex, $F(1, 385) < 1$, and levels of disadvantage and type of teaching, $F(1, 385) < 1$. However, there was a two-way interaction between sex and type of teaching, $F(1, 385) = 4.29$, $p < 0$ .04, $\eta_p^2 = .01$. Newman Keuls tests showed that, regardless of sex, the synthetic phonics group read better than analytic phonics group ($p < .01$ in both cases). Synthetic phonics boys read better than the girls in their classes ($p < .01$), whereas there was no sex difference with analytic phonics. There was no three-way interaction between sex, levels of disadvantage, and type of teaching, $F(1, 385) < 1$.

Table 1 Study 1: mean standardised scores on vocabulary knowledge, word reading, reading comprehension and spelling, comparing teaching method, boys versus girls, and advantage versus disadvantage

	N	Age	Vocabulary knowledge	Word reading	Reading comp	Spelling
Analytic phonics						
Advantaged						
Boys	64	10.49 (0.34)	92.20 (10.83)	97.84 (12.66)	95.73 (12.59)	97.12 (14.83)
Girls	44	10.49 (0.32)	89.57 (11.79)	99.25 (11.56)	101.50 (12.18)	101.27 (14.36)
Disadvantaged						
Boys	45	10.43 (0.35)	88.24 (11.91)	98.16 (15.96)	91.44 (13.79)	91.46 (15.70)
Girls	50	10.51 (0.35)	86.34 (10.52)	97.28 (14.27)	93.78 (11.75)	95.00 (15.99)
Synthetic phonics						
Advantaged						
Boys	53	10.72 (0.28)	95.17 (10.48)	112.72 (14.24)	102.51 (12.10)	108.34 (12.95)
Girls	50	10.72 (0.29)	90.78 (10.44)	106.14 (11.63)	100.16 (9.32)	104.93 (10.53)
Disadvantaged						
Boys	53	10.78 (0.31)	91.30 (12.56)	108.19 (12.39)	99.66 (13.40)	103.14 (11.79)
Girls	34	10.69 (0.31)	85.38 (13.30)	103.74 (16.84)	96.09 (10.55)	100.42 (11.76)

Reading comprehension

A three-way analysis of variance was carried out, with type of teaching (analytic versus synthetic phonics), level of disadvantage (disadvantaged versus advantaged), and sex (boys versus girls) as the between subjects factors (see Table 1 for means and standard deviations). There was a main effect of levels of disadvantage, $F(1, 385) = 14.59$, $p < .001$, $\eta_p^2 = .04$. The children in advantaged areas performed better ($M = 99.8$, $SD = 11.9$ for advantaged areas, $M = 95.4$, $SD = 12.9$ for disadvantaged areas). There was no main effect of sex, $F(1, 385) < 1$, ($M = 97.5$, $SD = 13.5$ for boys, $M = 97.9$, $SD = 11.4$ for girls), but there was a main effect of the type of teaching, $F(1, 385) = 10.37$, $p < .001$, $\eta_p^2 = .03$, performance being better with synthetic phonics ($M = 100.0$, $SD = 11.7$ for synthetic phonics, $M = 95.7$, $SD = 13.0$ for analytic phonics). Type of teaching interacted with sex, $F(1, 385) = 8.01$, $p < .005$, $\eta_p^2 = .02$. Newman Keuls tests showed that girls comprehended equally well regardless of teaching method, but that boys did better if taught by synthetic phonics; it was also the case that boys taught by analytic phonics had poorer reading comprehension than girls ($p < .01$). There was no sex difference with synthetic phonics teaching, but with analytic phonics teaching girls had better reading comprehension ($p < .05$). There was no interaction between levels of disadvantage and sex, $F(1, 385) < 1$, and no interaction between levels of disadvantage and type of teaching, $F(1, 385) = 1$ .06, $p > .05$. There was no three-way interaction between levels of disadvantage, sex and type of teaching, $F(1, 385) < 1$.

Spelling

A three-way analysis of variance was carried out, with type of teaching (analytic versus synthetic phonics), level of disadvantage (disadvantaged versus advantaged), and sex (boys versus girls) as the between subjects factors (see Table 1 for means and standard deviations). There was a main effect of levels of disadvantage, $F(1, 385) = 14.93$, $p < .001$, $\eta_p^2 = .04$ ($M = 102.8$, $SD = 14.0$ for advantaged areas, $M = 97.5$, $SD = 14.70$ for disadvantaged areas). There was also a main effect of type of teaching, $F(1, 385) = 32.58$, $p < .001$, $\eta_p^2 = .08$, with better spelling in the synthetic phonics group ($M = 104.6$, $SD = 12.0$ for synthetic phonics, $M = 96.4$, $SD = 15.6$ for analytic phonics). There was no main effect of sex, $F(1, 385) < 1$, ($M = 100.2$, $SD = 15.1$ for boys, $M = 100.4$, $SD = 13.8$ for girls), but sex interacted with type of teaching, $F(1, 385) = 6.09$, $p < .02$, $\eta_p^2 = .02$. Newman Keuls tests showed that both boys ($p < .01$) and girls ($p < .05$) spelt better with synthetic than analytic phonics teaching. Girls spelt better than boys with analytic phonics ($p < .05$), but there was a non-significant trend towards boys spelling better than girls with synthetic phonics teaching. There were no interactions between level of disadvantage and sex, $F(1, 385) < 1$, level of disadvantage and type of teaching, $F(1, 385) < 1$, or level of disadvantage, type of teaching, and sex, $F(1, 385) < 1$.

Study 2: comparison of regular and irregular word reading in analytic versus synthetic phonics classes

Although the word reading test used in Study 1 was composed of both regular and irregular words, it is possible that the gains found for word reading with synthetic phonics teaching were due to an enhanced ability to read only the regular words. Study 2 was designed to examine the reading of regular and irregular words.

Method

Participants

Sixty-four children from two classes, one taught by analytic phonics and one taught by synthetic phonics, took part in this study. The analytic phonics taught class was one of the classes included in Study 1; there were 33 (20 male) children ($M = 10;6$, $SD = .40$) in this class. The school was in a moderately high SES area; in 2005, 85% of the pupils met the required standard in English, where the average for the region was 73%. The synthetic phonics taught class was taken from a school matched on socioeconomic status to the analytic phonics class. The children were not in the original experimental study (Johnston and Watson, 2004, Experiment 1), having started school a year later. There were 31 (14 male) children in this class ($M = 10; 8$, $SD = .28$).

Materials

Word reading, reading comprehension and vocabulary knowledge were tested using the same tests as in Study 1.

Regularity test

High and low frequency regular (e.g., back, ramp), strange (e.g., eight, ache) and exception words (e.g., bear, bald) were presented individually on a computer in a quasi-random order. In total there were 95 words (5 practice words and 15 examples of each word type). All children were tested individually and were instructed to pronounce each word as accurately and quickly as possible.

Results

Word reading, reading comprehension, and vocabulary knowledge

Two way analyses of variance, with two between-subjects factors, teaching programme and sex, were carried out. The synthetic phonics taught children had better word reading than the analytic phonics group; $F(1, 67) = 5.96$, $p < .02$, $\eta_p^2 = .08$, and there were no sex differences, $F(1, 67) = 1.09$, $p > .05$. They also had better reading comprehension, $F(1, 66) = 16.22$, $p < .001$, $\eta_p^2 = .20$, with no sex differences being found, $F(1, 66) = 2.34$, $p > .05$. Finally, they also had better vocabulary knowledge; $F(1, 62) = 14.75$, $p < .001$, $\eta_p^2 = .21$, with no sex differences being found, $F(1, 62) < 1$.

Regularity task

A 2 × 3 × 2 × 2 (frequency × regularity × teaching programme × sex) analysis of variance was carried out on the accuracy data, see Table 2 for means and standard deviations. There was a main effect of frequency, $F(1, 60) = 146.91$, $p < .001$, $\eta_p^2 = .71$, with high frequency words being read better than low frequency words. In addition, there was a main effect of teaching programme, $F(1, 60) = 4.91$, $p < .03$, $\eta_p^2 = .076$, favouring the synthetic phonics group. There was also a main effect of regularity, $F(2, 120) = 111.81$, $p < .001$, $\eta_p^2 = .65$, but there was an interaction between frequency and regularity, $F(2, 120) = 120.92$, $p < .001$, $\eta_p^2 = .67$; Newman Keuls tests showed that there was no regularity effect for high frequency words, but for low frequency items, regular words were read better than exception and strange words, and exception words were read better than strange words ($p < .01$ in all cases). There was an interaction between teaching programme and frequency, $F(1, 60) = 7.14$, $p < .01$, $\eta_p^2 = .11$; Newman Keuls tests showed that the synthetic phonics group read low frequency words better than the analytic phonics group ($p < .01$). There was no interaction between teaching programme and regularity, $F(2, 120) = 1.93$, $p > .05$. There was no sex difference, $F(1, 60) > 1$, and there were no interactions with sex: regularity by sex, $F(2, 120) = 1.51$, $p > .05$, frequency by sex, $F(1, 60) = 1.56$, $p > .05$, frequency by regularity by sex,

Table 2 Study 2: mean word reading, reading comprehension and vocabulary standardised scores; mean accuracy (out of 15) of reading high and low frequency regular, strange and exception words (standard deviations in *brackets*)

	Word reading	Reading comprehension	Vocabulary knowledge	High frequency regular	High frequency exception	High frequency strange	Low frequency regular	Low frequency exception	Low frequency strange
Synthetic phonics									
Boys	104.43 (14.08)	105.79 (14.15)	102.14 (12.94)	15.00 (0.00)	14.64 (0.75)	14.57 (0.51)	14.71 (0.61)	11.50 (1.79)	9.86 (3.59)
Girls	109.12 (11.37)	109.12 (9.70)	97.71 (13.32)	14.88 (0.33)	14.47 (0.80)	14.59 (1.00)	14.65 (0.79)	12.12 (2.29)	10.94 (3.67)
Analytic phonics									
Boys	97.44 (14.27)	92.60 (11.27)	89.35 (8.96)	14.80 (0.52)	14.45 (0.83)	14.55 (0.69)	14.05 (1.61)	9.95 (2.80)	7.60 (3.79)
Girls	99.73 (15.04)	98.36 (13.86)	86.67 (12.35)	14.85 (0.38)	14.46 (0.88)	14.38 (0.96)	13.85 (1.63)	10.69 (3.50)	8.85 (4.36)

$F(2, 120) = 2.53$, $p > .05$. Finally, there was no interaction between frequency, regularity and teaching programme, $F(2, 120) = 2.89$, $p > .05$, or between frequency, regularity, teaching programme and sex, $F(2, 120) > 1$. An analysis of covariance controlling for the differences in overall word reading and ability and vocabulary knowledge between the groups removed the main effect of teaching programme, $F(1, 54) = 1.63$, $p > .05$, and the interaction between teaching programme and frequency was no longer significant, $F(1, 54) = 1.97$, $p > .05$.

Discussion

It was found in Study 1 that, after 6 years at school, children taught by the synthetic phonics approach read words, spelt words and had reading comprehension skills significantly in advance of those taught by the analytic phonics method. This shows that despite English being an opaque orthography, children are not impaired when taught by an approach to reading that is common in transparent orthographies. However, interactions were found between teaching methods and sex. Boys benefited the most from synthetic phonics teaching, as they had word reading scores better than those of the girls in their classes, and had equivalent spelling and reading comprehension (in the latter case, contrary to the findings of international surveys e.g., Mullis et al., 2007). However, the analytic phonics taught boys had the typically observed pattern of inferior performance compared with the girls in their classes in all except word reading. Interestingly, the synthetic and analytic phonics taught girls had equivalent reading comprehension scores, although the former group had better word reading (and spelling) skill. Although children from areas of disadvantage had lower levels of reading comprehension and spelling than those from advantaged areas, it was found that word reading ability was not affected by differences in socio-economic background. In Study 2, the synthetic phonics taught group showed no impairment in reading irregular words compared with the analytic phonics taught sample, and boys did not make significantly more errors on irregular words than girls.

The analytic phonics group in Study1 did not have low levels of word reading ability, mean performance on the WRAT being 98.1, despite the fact that 46.6% of the sample came from areas of moderate to severe socio-economic disadvantage. The significant group difference in word reading ability reflects the fact that the synthetic phonics group had a mean score of 108.2 on the WRAT. There is no indication, therefore, that the analytic phonics children were selected from schools having inadequate teaching standards. Furthermore, the groups were well matched in verbal ability, and had a similar SES profile. The evidence rather supports the view that synthetic phonics teaching led to above average levels of word reading ability; the effect size comparing the two group, using Cohen's d, was quite large at 0.73.

In the Clackmannanshire Study (Johnston & Watson, 2004, Experiment 1), at the age of 5 the synthetic and analytic phonics groups were well matched at pre-test on literacy measures, but as the former group came from a much lower SES background lower levels of attainment would be expected (Duncan & Seymour,

2000; Stuart et al., 1998). At the end of the 16 week programme, however, the synthetic phonics group's word reading was 7 months ahead of that of analytic phonics taught children, who were reading appropriately for their chronological age (the effect size between the two groups being 0.91). Subsequently, the total sample of synthetic phonics taught children (including those initially taught by the analytic phonics method) showed increasing gains for word reading over age, ending up reading 3.6 years ahead of chronological age at the age of 11 (Johnston & Watson, 2005). For the girls, the effect size for word reading age versus chronological age was 1.12 at the end of the second year of school, and 1.36 at the end of the seventh year of school; the boys were on a steeper trajectory, the effect sizes being 1.24 and 1.71, respectively, reflecting the fact that from the third year of school their word reading was significantly better than that of the girls.

The increasing gains in word reading ability for the synthetic phonics group needs to be viewed in the light of evidence that, in general, gains with phonics programmes diminish over time. Ehri et al.'s (2001) meta-analysis showed that treatment gains for phonics over non-phonics programmes declined from a moderate effect size of 0.51 at immediate post-test to a small effect size of 0.27 at follow up. However, a study by Torgesen et al. (1999) showed increasing gains over time with synthetic phonics teaching. Groups of children at risk of reading failure were taught by a synthetic phonics approach and compared with those taught by embedded phonics (which more closely resembles analytic phonics). In kindergarten, the latter group actually started out ahead of the synthetic phonics group, showing an effect size of −0.61. However, at the end of the first grade, when the synthetic phonics group had started to sound and blend with letters, there was an effect size of 0.36 favouring the synthetic phonics group; after second grade this had risen to 0.45. Thus the synthetic phonics taught groups in both Torgesen et al. (1999) and Johnston and Watson's (2004, 2005) studies atypically showed an upward trajectory of gains in word reading ability across time. As to the present study, it would have been beneficial to have had an analytic phonics comparison group that was also assessed when it started school, but the higher levels of reading ability found for the synthetic phonics group do fit with the existing literature.

The advantage found for children learning to read English using the synthetic phonics method in Johnston and Watson's (2004) study led to the method being advocated for use in all schools in England (Rose Review, 2006), and a government programme was provided for schools to use (*Letters and Sounds*, DfES, 2007). However, a meta-analysis, funded by England's Department for Education and Skills (DfES), claimed that there was no clear outcome as to whether synthetic or analytic phonics was the most effective method (Torgerson, Brooks, & Hall, 2006), which may seem surprising in the context of the research by Torgesen et al. (1999) and Johnston and Watson (2004). There are various reasons for this null result. One of the three studies included in the meta-analysis was an unpublished study of kindergarten children, where the children were inappropriately trained on complex vowels, such as *tape* and *rode* (Skailand, 1971); these sorts of words are not suitable for early sounding and blending. An advantage was found for the analytic phonics group on the trained items, but not on the untrained words. However, the data on the reading of the *trained* words were used in the meta-analysis, whereas the National

Reading Panel only analysed examined performance on untrained items. Torgesen et al.'s (1999) study was also included. This showed in the long term that the synthetic phonic method was more effective than embedded phonics but Torgerson et al. (2006) used data from a few months into this two and a half year study, when the embedded phonics group was briefly ahead in reading. This was because the synthetic phonics group was mostly learning phoneme awareness at this stage rather than phonics. The third study included was Johnston and Watson's (2004) Experiment 2, and this also showed that synthetic phonics teaching led to much better reading skills than the analytic phonics method.

Stannard (2006) and Wyse and Styles (2007) have argued that synthetic phonics teaching is not as effective in developing reading comprehension as PiPs, although they present no data to support this belief. However, there is no evidence that systematic phonics tuition retards reading comprehension. Ehri et al.'s (2001) meta-analysis found that children taught by a systematic phonics method made gains in text comprehension as well as decoding, word reading, and spelling. As analytic and synthetic phonics methods are both systematic, one might predict at the very least that the two methods would produce equivalent results. However, in the present study it was found that synthetic phonics teaching led to the boys showing significantly better reading comprehension compared with those taught by an analytic phonics approach. This raises questions as to whether this advantage was caused by the higher levels of word reading skill shown by the synthetic phonics boys. According to the Simple View of Reading (Gough & Tunmer, 1986), word reading and oral language comprehension ability together give a good prediction of reading comprehension skills. Furthermore, Vellutino, Tunmer, Jaccard and Chen (2007), using structural modelling, have shown that word recognition ability does play a significant role in reading comprehension for children aged around 7–8 years. This suggests a direction of causation for the early years of the Clackmannanshire Study, with the accelerated development of word reading leading to reading comprehension being significantly above what was expected for age. However, whereas word reading ability had an upward trajectory, reading comprehension showed the reverse pattern. In Primary 2, the gain for reading comprehension over age was 7 months, but by Primary 7 it was 3.5 months, a difference which was statistically significant (Johnston & Watson, 2005). Interestingly, Vellutino et al. (2007) found that for children aged around 11–12 years, word reading did not play such a large role in reading comprehension, and listening (i.e., oral language) comprehension was found to play a more significant role. An increasing reliance on oral language skills is likely to be disadvantageous for children from areas of deprivation, as their general language skills may not be as well developed as those for children from more advantaged areas. This may also be disadvantageous for boys, who generally do less well in verbal tests than girls (Hyde & Linn, 1988). However, if boys can boost their reading comprehension by having very good word reading ability, this may explain why the synthetic phonics taught boys were as good as the girls in reading comprehension. With analytic phonics teaching, the boys had equivalent word reading skills to the girls, but were behind them in reading comprehension; boys may need higher level of word reading ability to achieve the same level of reading comprehension as girls. It is interesting that the girls' reading

comprehension was as good as that of the synthetic phonics taught girls, despite having inferior word reading skills; this may indicate that they were better able to use general language skills to support their reading comprehension. Indeed, the programme *Progression in Phonics* (DfEE, 1999) encouraged the strategy of guessing unknown words from context and the girls may have been better able to do this, whereas the boys may have needed to be able to read the individual words more accurately in order to get meaning from text.

The gain that boys experienced in word reading when learning to read by a synthetic phonics approach may have a neural substrate underlying it. Burman, Bitan, and Booth (2008) found, in a study of 9–15 year old children, that boys' processing of printed words was associated with the activation of areas of the brain concerned with visual processing, and spoken words were processed in areas concerned with auditory and phonological processing. That is, their pattern of activation was modality specific, which may imply a lack of integration of visual and phonological information. Girls' performance, on the other hand, was correlated with activation in supramodal areas of the brain during the reading and spelling tasks. Boys did also show activation in these areas, but at a lower level, and it was not associated with task performance. Burman et al. (2008) concluded that language processing was more abstract in girls and more sensory in boys. Synthetic phonics teaching may aid boys in learning to integrate visual and phonological information, thus bringing up their spelling levels to those of girls, and also boosting their word recognition skills. Mixed methods/analytic phonics approaches may not be so effective at overcoming boys' problems in making these links.

This fits with Ehri's (2005) conclusion that in English the route to skilled sight word reading is paved with phonology, good readers developing a sight word recognition of words that is well-underpinned by phonological information in memory. As word reading involves the integration of visual and phonological information even in an opaque orthography, synthetic phonics may be more effective because early on it develops the integration of information from these two modalities, and this may be particularly beneficial for boys. The analytic phonics approach, having an early sight word element and late teaching of sounding and blending, may lead to some children reading largely by a form of sight word reading underpinned only by superficial connections between print and sounds. However, there is a view, stemming from the dual route model of reading, that there are two separate processes in reading, sight word and phonically based decoding (Stuart et al., 2008). This idea overlooks the fact that once a child has sounded and blended a word a few times, it will be able to store it in memory and access it without pre-lexical segmentation (Reitsma, 1983). If children taught by synthetic phonics did not develop sight word reading, they would become stuck in the full alphabetic phase outlined by Ehri, making a lot of regularisation errors when reading irregular words. However, the synthetic phonics group in Study 2 showed no impairment in reading irregular words compared with the analytic phonics group; in fact, with low frequency words there was a clear trend towards superior reading of exception and strange words (they were from around 11 to 16% better on these items). This is compatible with the connectionist view that even strange words contain some regular elements that can be accessed by using phonological information. Thus it is

likely that children taught by the synthetic phonics approach form connections between the regularly spelled elements and sounds in memory for irregular words; indeed, the synthetic phonics taught children in the present study were taught to read such items in this way.

It is interesting that synthetic phonics was found to be very effective, given that English has an opaque orthography. Certainly, the boost that synthetic phonics teaching gave to word reading skills in this study suggests that reading development need not be as slow in English as has been suggested (e.g., Seymour, Aro, & Erskine, 2003). Indeed, the advantage found for Austrian children in cross-linguistic studies (e.g., Landerl, 2000; Wimmer & Goswami, 1994) may in part be accounted for by differences in teaching methods between Britain and Austria, as Wimmer (1995) has suggested. Another factor to consider is that the children in the studies were often tested on the reading of polysyllabic nonwords, which might have been advantageous for the German speaking children, as it is a more polysyllabic language. The English and Austrian school systems do differ in a number of ways, not least of which is the age of commencing school. Therefore, it is of interest that a comparison of children learning to read in countries with similar educational systems, that is, England versus Wales (the language in the latter country having a transparent orthography), found that the Welsh children did indeed read better when aged 5–7 than children in England, but interestingly there were no differences at the age of 10 (Hanley, Masterson, Spencer & Evans, 2004; Spencer & Hanley, 2003).

This present study makes an important contribution to documenting the long-term effects of synthetic phonics teaching. Maintaining the gain in word reading for age would have been noteworthy, but in fact it increased over time, leading to a high level of attainment at the age of 10. This study has confirmed that the synthetic phonics approach is effective in English, even though it is an opaque orthography, and that boys do very much better with this method than the analytic phonics approach. It is suggested that boys may be slower to develop the integration between visual and phonological information that underpins word reading due to sex differences in brain activation when carrying out reading tasks. The early teaching of synthetic phonics may be more effective in developing these interconnections for boys in particular, whereas a method like analytic phonics, which begins with sight words and has a late introduction of sounding and blending, may not foster this integration so well.

Acknowledgments The authors would like to thank the pupils and teachers who took part in this study. They would also like to gratefully acknowledge funding from the Scottish Executive Education Department and the University of Hull; however, the views expressed here are not necessarily those of these bodies.

References

Baron, J. (1979). Orthographic and word-specific mechanisms in children's reading of words. *Child Development, 50*, 60–72.

Brimer, M. A., & Dunn, L. M. (1984). *English picture vocabulary test*. Awre, England: Educational Evaluation Enterprises.

Brooks, G. (2002). Phonemic awareness is a key factor in learning to be literate: How best should it be taught. In M. Cook (Ed.), *Perspectives on the teaching and learning of phonics*. Royston, England: UKRA.

Brooks, G. (2003). *Sound sense: The phonics element of the National Literacy Strategy. A report to the Department for Education and Skills.* Retrieved from http://www.standards.dfes.gov.uk/pdf/literacy/gbrooks_phonics.pdf.

Burman, D. D., Bitan, T., & Booth, J. R. (2008). Sex differences in neural processing of language among children. *Neuropsychologia, 46*, 1349–1362.

Coltheart, M., Rastle, K., Perry, C., Langdon, R., & Ziegler, J. (2001). DRC: A dual route cascaded model of visual word recognition and reading aloud. *Psychological Review, 108*, 204–256.

DfEE. (1998). *The national literacy strategy framework for teaching*. London, England: DfEE.

DfEE. (1999). *Progression in phonics.* London, England: DfEE. Retrieved from www.standards.dfes.gov.uk/primary/publications/literacy/63309/.

DfES. (2007). *Letters and sounds.* London, England: DfES. http://www.standards.dfes.gov.uk/local/clld/las.html.

Dombey, H. (2006). Phonics and English orthography. In M. Lewis & S. Ellis (Eds.), *Phonics: Practice, research and policy* (pp. 95–104). London, England: Paul Chapman Publishing.

Duncan, L. G., & Seymour, P. H. K. (2000). Socio-economic differences in foundation level literacy. *British Journal of Psychology, 91*, 145–166.

Ehri, L. (2005). Development of sight word reading: Phases and findings. In M. J. Snowling & C. Hulme (Eds.), *The science of reading: A handbook* (pp. 135–154). Blackwell: Oxford.

Ehri, L., Nunes, S., Stahl, S., & Willows, D. (2001). Systematic phonics instruction helps students learn to read: Evidence from the National Reading Panel's meta-analysis. *Review of Educational Research, 71*, 393–447.

Elliott, C. D., Murray, D. J., & Pearson, L. S. (1977). *The British abilities scales*. Windsor, England: NFER Nelson.

Feitelson, D. (1988). *Facts and fads in beginning reading: A cross-language perspective*. Norwood, NJ: Ablex.

Gough, P. B., & Tunmer, W. E. (1986). Decoding, reading and reading disability. *Remedial Special Education, 7*, 6–10.

Hanley, J. R., Masterson, J., Spencer, L. H., & Evans, D. (2004). How long do the advantages of learning a transparent orthography last? An investigation of the reading skills and incidence of dyslexia in Welsh children at the age of 10. *Quarterly Journal of Experimental Psychology, 37*, 1393–1410.

Harm, M. W., & Seidenberg, M. S. (2004). Computing the meanings of words in reading: Cooperative division of labor between visual and phonological processes. *Psychological Review, 111*, 662–720.

Harris, L. A., & Smith, C. B. (1976) *Reading instruction: Diagnostic teaching in the classroom* (2nd ed., p. 181). London, England: Holt, Rinehart and Winston.

Hyde, J. S., & Linn, M. C. (1988). Gender differences in verbal ability: A meta-analysis. *Psychological Bulletin, 104*(1), 53–69.

Johnston, R. S., & Watson, J. (2004). Accelerating the development of reading, spelling and phonemic awareness. *Reading and Writing: An Interdisciplinary Journal, 17*, 327–357.

Johnston, R. S., & Watson, J. (2005). *The effects of synthetic phonics teaching on reading and spelling attainment, a seven year longitudinal study.* Ediburgh, Scotland: Scottish Executive Education Department. Retrieved from http://www.scotland.gov.uk/library5/education/sptrs-00.asp.

Johnston, R. S., & Watson, J. (2007). *Teaching synthetic phonics*. Exeter, England: Learning Matters.

Landerl, K. (2000). Influences of orthographic consistency and reading instruction on the development of nonword reading skills. *European Journal of Psychology of Education, 15*, 239–257.

Macmillan Unit. (2000a). *The group reading test II*. Windsor, England: NFER-Nelson.

Macmillan Unit. (2000b). *Group reading test II teacher's guide*. Windsor, England: NFER Nelson.

Mullis, V. S., Martin, M. O., Kennedy, A. M., & Foy, P. (2007). IEA's progress in international reading literacy study in primary school in 40 countries. Chestnut Hill, MA: TIMSS and PIRLS International Study Center, Boston College. http://timss.bc.edu/pirls2006/intl_rpt.html.

National Institute of Child Health and Human Development (NICHD). (2000). Report of the national reading panel: Teaching children to read. Washington, DC: NICDH. Retrieved from http://www.nichd.nih.gov/publications/nrp/smallbook.cfm.

Neale, M. D. (1989). *The neale analysis of reading ability—revised British edition*. Windsor, England: NFER-Nelson.

Reitsma, P. (1983). Printed word learning in beginning readers. *Journal of Experimental Child Psychology, 36*, 321–339.

Rose, J. (2006). *Independent review of the early teaching of reading*. Retrieved from http://www.standards.dfes.goc.uk/rosereview/report.pdf.

Schonell, F. J., & Schonell, F. E. (1952). *Diagnostic and attainment testing* (2nd ed.). Edinburgh, Scotland: Oliver and Boyd.

Scottish Executive Education Department (SEED). (2000). *5 to 14 Guidelines*. Retrieved from http://www.ltscotland.org.uk/5to14/guidelines/.

Seidenberg, M. S., & McClelland, J. L. (1989). A distributed, developmental model of visual word recognition and naming. *Psychological Review, 96*, 523–568.

Seymour, P. H. K., Aro, M., & Erskine, J. M. (2003). Foundation literacy acquisition in European orthographies. *British Journal of Psychology, 94*, 143–174.

Skailand, D. B. (1971, February). *A year comparison of four language units in teaching beginning reading*. New York: Paper presented at annual meetings of the American educational research Association.

Spencer, L. H., & Hanley, J. R. (2003). Effects of orthographic transparency on reading and phoneme awareness in children learning to read in Wales. *British Journal of Psychology, 94*, 1–28.

Stannard, J. (2006). Keeping Phonics in Perspective. In M. Lewis & S. Ellis (Eds.), *Phonics. Practice, research, policy* (pp. 120–121). London, England: Paul Chapman Publishing.

Stuart, M., Dixon, M., Masterson, J., & Quinlan, P. (1998). Learning to read at home and at school. *British Journal of Educational Psychology, 68*, 3–14.

Stuart, M., Stainthorp, R., & Snowling, M. (2008). Literacy as a complex activity: deconstructing the simple view of reading. *Literacy, 42*, 59–66.

Thompson, G. B. (1987). Three studies of predicted gender differences in processes of word reading. *Journal of Educational Research, 80*, 212–219.

Torgerson, C. J., Brooks, G., & Hall, J. (2006). *A systematic review of the research literature and use of phonics in the teaching of reading and spelling*. DfES research reports(RR711). Retrieved from http://www.dcsf.gov.uk/research/programmeofresearch/projectinformation.cfm?projectid=14389&resultspage=1.

Torgesen, J. K., Wagner, R. K., Rose, E., Lindamood, P., Conway, T., & Garvan, C. (1999). Preventing reading failure in children with phonological processing disabilities: group and individual responses to instruction. *Journal of Educational Psychology, 91*, 579–593.

Vellutino, F. R., Tunmer, W. E., Jaccard, J. J., & Chen, R. (2007). Components of reading ability: Multivariate evidence for a convergent skills model of reading development. *Scientific Studies of Reading, 11*, 3–32.

Waters, G. S., Seidenberg, M. S., & Bruck, M. (1984). Childrens' and adults' use of spelling-sound information in three reading tasks. *Memory and Cognition, 12*, 293–305.

Watson, J. E. (1998). *An investigation of the effects of phonics teaching on children's progress in reading and spelling*. Doctoral Dissertation. University of St Andrews, St Andrews, Scotland.

Wilkinson, G. (1993). *Wide range achievement test—3rd edition (WRAT-3)* (3rd ed.). Wilmington, Delaware: Wide Range.

Wimmer, H. (1995). From the perspective of a more regular orthography. *Issues in Education, 1*, 101–104.

Wimmer, H., & Goswami, U. (1994). The influence of orthographic consistency on reading development—Word recognition in English and German children. *Cognition, 51*, 91–103.

Wyse, D., & Styles, M. (2007). Synthetic phonics and the teaching of reading: The debate surrounding England's Rose report. *Literacy, 41*, 35–42.