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An examination of the orthographic and phonological spelling knowledge observed in a sample of independent writing completed by 267 children with specific literacy difficulties

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This paper considers spelling in samples of writing collected in October 2019 (pre COVID-19) from 267 children in the 8–9 age range in 143 mainstream primary schools who were identified by their schools as presenting with the most severe specific literacy difficulties in their age group. They were referred to the Northern Ireland Education Authority Psychology Service for assessment and were formally assessed to provide standardized scores for literacy attainment and cognitive profile. They presented with a cognitive profile which included a standardized score of 90 or above in one or more of the subtests of the Wechsler (2016) Intelligence Scale for Children (WISC). Spelling in independent writing samples was analysed to establish what sources of linguistic knowledge (phonemic, orthographic and morphemic) the children were drawing on to spell words. It was evident from the analysis of these writing samples that children were dependent on phoneme-to-grapheme correspondence when spelling, often selecting letters that did represent the phonemes but it was the wrong selection of letters for phonemes with multiple mappings. The observed pattern of errors indicates that these 267 children had difficulty developing orthographic knowledge resulting in phonologically plausible spelling choices impacting spelling accuracy. The development of orthographic knowledge was limited or had failed to develop for this group of children.

KEYWORDS

orthographic knowledge, orthographic mapping, orthography, phonics, spelling, orthographic processing

1 Introduction

Northern Ireland is one of the four distinct jurisdictions within the United Kingdom (UK), the others being England, Scotland and Wales. In Northern Ireland the primary approach for teaching phonics is a phoneme-to-grapheme correspondence only approach, an alphabetic phonics strategy, with systematic synthetic phonics (SSP) being widely used following the Rose Report (Rose, 2006).

Rose (2006) recommended SSP as the best way for children to learn to read, even though there was no robust research evidence to support this (Bowers, 2020). In SSP teaching must be explicit, structured, and sequential. Children are taught phonemes (smallest units of sound) and graphemes (the letter or letter combinations representing phonemes) and to use these to decode words by identifying and blending each phoneme all through a word to the exclusion of any other strategies. SSP teaches children to segment words into their individual phonemes to spell. Rose (2006) acknowledged the lack of research evidence and chose to consider evidence from practice observed in school inspections. “...and notwithstanding the uncertainties of research, there is much convincing evidence to show from the practice observed that, as generally understood, ‘synthetic’ phonics is the form of systematic phonic work that offers the vast majority of beginners the best route to becoming skilled readers” (p.19, paragraph 47).

By stating that this approach offers “the vast majority” of beginners the best route to becoming skilled readers Rose acknowledged that SSP was not going to meet the needs of all children. Yet it is currently mandated in England to the extent that children who are at risk of falling behind may be offered one-to-one support, but it must be using the same SSP programme (DfE, 2023, Note, 9).

Because SSP has been used for 20 years in England, we have evidence of the longer term impact of exclusively using SSP to teach beginning reading and spelling, as defined by the Department for Education (DfE) in England’s core phonics criteria published in 2010 and updated in 2021. Publishers of phonics programmes must adhere to this criteria to obtain validation by the DfE for use in schools in England which Wyse and Hacking (2024) point out, forces publishers to meet this criteria. They consider the criteria to be problematic, “not any particular synthetic phonics scheme” (p54). Training in SSP was offered to all primary schools in Northern Ireland (NI) by the NI Education Authority from 2008–2012 following the Rose Review (Rose, 2006). The vast majority, but not all schools, availed of this training. In recent years many schools in NI have also availed of the training offered by the DfE validated SSP programme they are using. Phonics programmes available for purchase in NI are those published in England and validated by the DfE, thus impacting classroom practice. The points made in this document may not apply to SSP programmes developed in other countries that differ in content and the strategies used, to the extent that they would not meet the core phonics criteria prescribed by the DfE (2023). This should be taken into account when considering findings from research conducted in other education systems.

When SSP was first introduced by Rose (2006) the early improvements in reading were to be expected because the whole language approach to teaching reading, which preceded SSP, did not include a systematic approach to phonics teaching. From 2016 onward the extent of the difficulties experienced by up to 25% of children became increasingly evident. SSP focuses on the phoneme level of phonological awareness and the link to letters that represent phonemes. SSP does not address the onset and rime level, syllable level and whole word level of the sounds we can hear in spoken language, and the links to the orthographic patterns that represent these larger units of sound.

Teaching to develop children’s phonological processing ability: the ability to identify, store, retrieve, and manipulate the sounds in spoken language, has been successful in remediating the

phonological deficit and establishing phonological skills: the skills of segmenting, manipulating and deleting phonemes. Many children do, however, have problems with blending due to the working memory demands of the task. These phonological processing skills underpin phonics learning and support the formation of phoneme-to-grapheme links. However, phonological skills at phoneme level do not aid the decision making needed to select the correct letters when spelling words that include phonemes with multiple mappings (phonemes that can be spelled different ways). This requires orthographic knowledge of what the word looks like (McMurray, 2020). Orthographic knowledge is knowledge of spelling patterns that represent larger units of sound: those consisting of more than one phoneme, such as onsets, rimes, syllables, and whole words, and are recognized or recalled as orthographic units without the need to encode phoneme-by-phoneme. Orthographic knowledge is also identifiable in parts of words that cannot be identified by sound: for example, double letters or silent letters. Teaching phoneme-to-grapheme correspondence only, can result in difficulties with sight word recognition, reading fluency and spelling accuracy for a significant minority of children as identified by DfE statistics. SSP has impacted the development of reading skills in England and areas in the wider UK where the method has been used. However, DfE statistics on phonics and reading show that up to 25% of children at the end of Key Stage 1 (Year 2, 6–7-year-olds) and at the end of Key Stage 2 (Year 6, 10–11 year olds) continue to fail to meet expected standards.

The DfE statistics from 2016–2023 make clear the size of the minority Rose recognized would not make adequate progress with SSP. Koutsouris et al. (2021) drawing on the DfE (2016) statistics found that 20% of children entering Key Stage 2 in England (7–8-year-olds) were delayed or non-start readers.

In 2019, prior to the pandemic, 9% of Key Stage 1 children in England (Year 2, 6–7-year-olds) did not meet the standard set for phonics, and 25% failed to meet the standards set for reading at the end of Year 2. This means that slightly over 16% of the total number of children at the end of Key Stage 1 in England still failed to meet the standards set for reading, even though this 16% had demonstrated sufficient knowledge of phonics to pass the phonics test. This 16% despite having met the expected standard set for phonics were not able to meet the standards set for reading. Working at the expected standard includes fluency, comprehension, reading most common exception words and most common suffixes (Standards and Testing Agency, 2018).

These statistics provide evidence that systematic synthetic phonics (SSP) alone, is insufficient for reading success for this group. Furthermore, in 2019, 27% of 10–11-year-old children did not meet the standards set for reading by the end of Key Stage 2 (DfE, 2019b statistics). Post-covid, the DfE statistics published in October 2023 found that 11% of children failed to meet the expected standard in phonics at the end of Key Stage 1 and 32% of children failed to meet the standard set for reading. The DfE statistics published in October 2024 found that 11% of children failed to meet the expected standard in phonics at the end of Key Stage 1. The percentage of children who failed to meet the standard set for reading at the end of Key Stage 1 is not available as these assessments became non-statutory from 2023/2024 onward (DfE, 2024a). However, in the Key Stage 2 statistics published in October

2024, 26% of children failed to meet the standard set for reading (DfE, 2024b).

According to the Education Policy Institute [EPI] (2024) report, since the introduction of the DfE (2019a) Phonics Screening Check (PSC) there is no evidence of improved Key Stage 1 (end of Year 2 England) or Key Stage 2 (end of year 6 England) reading results, and no evidence that the PSC narrowed the attainment gap at the end of Year 2 (children 6–7 years of age) or the end of Year 6 (children 10–11 years of age). In addition to this the EPI report concludes that neither national data from the International Reading Panel Study (PIRLS, 2021), previous research using the NPD (National Pupil Database), or the new analysis in the EPI report, find a discernible positive impact of the Phonics Screening Check on the reading levels of primary aged children in England.

1.1 Current issues

Zarić et al. (2021) research provides evidence that even when phoneme-to-grapheme correspondence is one-to-one, it is insufficient for the development of orthographic knowledge for reading fluency and spelling. This research was conducted in German, a transparent orthography. Orthographic knowledge refers to spelling patterns stored in memory that are recognized on sight without having to decode or encode phoneme-by-phoneme. Orthographic mapping refers to the linkage between these larger units of sound and their orthographic patterns (onsets, rimes, syllables and words). Kilpatrick (2020), a proponent of phoneme-to-grapheme correspondence as the route to orthographic mapping acknowledges that “*letter-sound knowledge and phonemic awareness are not enough- perhaps they are enough for phonic decoding- but not for efficiently remembering words during real world reading*,” (p.13). He theorizes that “proficiency” of letter-sound and phonemic knowledge explain orthographic mapping. This theory, however, fails to provide insight into cases where reading and spelling can develop at a normal rate, if the child can develop mappings between groups of letters that represent groups of sounds without being able to identify the individual phonemes within these groups. Stothard et al. (1996) reported the case of LF who was unable to establish phoneme-to-grapheme correspondences and could not read non-words, yet she learned to read and spell at a normal rate. LF learned to read by developing mappings between orthography and larger units of sound. She recognized groups of letters that represented groups of sounds without being able to identify the individual phonemes within these groups. This case demonstrates the importance of teaching orthographic mappings.

Phonemic and letter-sound proficiency as described by Kilpatrick (2020) provides an account of alphabetic mapping (phoneme-to-grapheme links) but not an adequate account of orthographic mapping. This phonemic proficiency theory fails to take account of multiple mappings in English and the orthographic choices that must be made. “For example, the “o” sound can be spelled seven different ways as in, go, know, though, note, toe, boat, sew. Remembering the auditory sequence of letter names as an aid to remembering the visual sequence of letters is a strategy that is needed to learn these spellings. It is not possible to spell these words based on identifying the phonemes only.

This raises the issue of the importance of letter names. In the USA letter names are taught in advance of letter sounds and before formal schooling. Whereas in “*England, children are taught to label letters by their sounds. . . before they learn the letter names*” (Treiman and Wolter, 2020, p.48). It is not until Year 1 in England, when children are 5–6 years of age, that the statutory curriculum requires that the names of the letters of the alphabet are taught. The DfE acknowledge that “*Knowing letter names is necessary to distinguish between alternative spellings of the same sound*” (DfE, 2014). However, for the first year at school children (4–5 years of age) are learning to associate letters with their sound, not letter names. This is confusing for young children when encountering words with the same letter and different sound. It is important that teachers can refer to letter names, from the beginning, so that they can discuss the sound made by the letters with multiple mappings, e.g., “c” at the beginning of cat and at the beginning of circle. Treiman and Wolter (2020) highlight the benefits for 4–5-year-old children, of knowing letter names when attempting to spell words, and as a prerequisite to learning letter sounds. It is important that children are taught the names of the letters of the alphabet in advance of teaching phoneme-to-grapheme correspondences because knowing the letter names helps with the spelling of words containing phonemes with multiple mappings (Treiman and Wolter, 2020).

1.2 The development of orthographic knowledge

Alphabetic mapping refers to the linkage between phonemes and graphemes. Alphabetic knowledge refers to the letters of the alphabet and the phonemes they represent that are stored in memory. English has approximately 44 phonemes and only 26 letters. This means that phoneme-to-grapheme correspondence is not straightforward and is further challenged by multiple mappings. For this reason, orthographic knowledge is required to know if a spelling “looks right.” A representation of the word, or key word parts, must already be in memory to know if the correct letters have been chosen from the range of letter(s) that can represent phonemes that have multiple mappings, for example, because not “becos,” said not “sed.”

Orthographic processing is how you identify and form orthographic units, commit them to memory and retrieve them. It is the cognitive process that enables the detection of letter patterns representing a whole word, patterns within words (onset and rime), syllables, and rules and regularities in print, by attending to each letter whilst also noting letter sequences in parallel as units, thus enabling these orthographic units to be stored in memory. This learning can be acquired implicitly from reading experience. However, children with poor orthographic processing require orthographic mappings to be explicitly taught. McMurray (2004, 2020) provides evidence that spelling is the vehicle that can provide the level of systematic teaching needed.

Mather (2024) notes that orthographic processing facilitates the recall of letters and their sounds, letter combinations and whole words contributing to the development “*of a robust sight word vocabulary and accurate spelling*” (p.22). Good readers who are good spellers are children who have good orthographic processing

ability and can, therefore, detect patterns in print and learn about spelling rules and regularities implicitly from their reading experience, without being taught these rules (McMurray, 2020). Lennox and Siegel (1994) identified three groups of young readers: “good readers/good spellers,” “good readers/poor spellers,” “poor readers/poor spellers.” They found that children with normal spelling abilities (i.e., “good readers and good spellers”) develop visual skills and the use of analogy implicitly from exposure to print “in tandem” with phonological skills. However, Lennox and Siegel found that those children who were “poor spellers but good readers,” were able to use phonological skills in their spelling but had difficulty choosing the correct orthographic representation of a word from the phonologically accurate alternatives. They considered that this difficulty was due to deficits in visual memory and lack of awareness of orthographic patterns. The result of neglecting to teach phonics explicitly at orthographic levels allows the “good readers/good spellers” group, who can develop orthographic knowledge implicitly from their reading experience, to advance well beyond their peers (McMurray, 2020). For orthographic knowledge to develop the child must be able to map blended units of sound at onset and rime, syllable and whole word level, to the orthographic patterns that represent them, in addition to, and not instead of, establishing phoneme-to-grapheme correspondence (PGC). However, it is stated in explanatory Note 1 of the DfE (2023) 16 essential core criteria for validation of phonics programmes, that “*The focus should be on phonemes [footnote 2], and not on “consonant clusters” (/s/ + /p/ + /l/not/spl/) or “onset and rime” (/c/ + /a/ + /t/not c-at, m-at, b-at)*”.

The ability to recognize patterns in print that consist of more than one phoneme is an essential strategy for children with working memory difficulties and/or orthographic processing difficulties (Mather and Jaffe, 2021; McMurray, 2020). The needs of children who fail to make progress when phonics is taught at phoneme-to-grapheme level only, without the inclusion of phonics at the orthographic levels of onset and rime, syllable and whole word, cannot be addressed by the SSP method being repeated for small groups or on a one-to-one basis as recommended by the DfE (2023). According to Adams (1990), children 4–5 years of age should be taught phoneme-to-grapheme correspondences first, but not all phonemes, as the long vowel sounds are difficult for many young children to hear and discriminate. Adams (1990) advises that onset and rimes are important for stabilization of the vowel sounds which she describes as notoriously difficult to learn in isolation. Their pronunciation is more stable within rime patterns. McMurray (2022) advises that when consonant phonemes have been established, teaching should move quickly to establish recognition of initial consonant orthographic patterns also known as onsets, i.e., consonant blends such as cl, bl, fl, gl, sl, and consonant clusters such as spl. These orthographic patterns are recognized on sight as orthographic units that occur at the beginning of many words. This is not an additional memory load but a step in developing effective decoding that does not place unnecessary demands on working memory. Children with orthographic processing difficulties when taught using SSP develop phonemic awareness because this is what they have been taught to focus on. Because they are insensitive to orthographic patterns they cannot acquire orthographic knowledge implicitly and become dependent

on decoding phoneme-by-phoneme. Alphabetic mapping is an important first step in the learning process (Ehri, 2020; Mather and Jaffe, 2021; McMurray, 2022), however, due to the complexity of English orthography, and the range of multiple mappings from grapheme-to-phoneme and phoneme-to-grapheme, decoding words for reading and encoding words for spelling involves choices that are dependent on orthographic knowledge being in place. Daffern and Critten (2019) found that the only evidence of orthographic knowledge for low achieving spellers was a small bank of high frequency words. It is, therefore, important to consider if this is the case for the 267 children in this study. In the National Curriculum programmes of study for England the DfE (2013) advises that children “*should also be able to make phonically plausible attempts to spell words they have not yet learnt*”(p.16). However, Treiman et al. (2019) found that phonological plausibility is not a good indicator of later success in spelling. They found that the best predictor of later spelling was orthographic correctness which significantly outperformed phonological plausibility. This was based on a UK sample of children in the reception year (mean age 5 years 1 month at baseline) and their later spelling performance in Year 2 (mean age 7 years 3 months). Treiman et al. (2019) concluded that, “*These findings fit with other evidence that even young children can attend to and remember visual orthographic features of words (Cassar and Treiman, 1997; Martinet et al., 2004; Wright and Ehri, 2007)*,” (p.92).

Treiman et al.’s (2019) findings provide evidence of the orthographic processing ability of young children and the positive impact on spelling accuracy. McMurray (2004, 2020) advises that if children know the correct phonemes in a word and they select letters that do represent the phoneme, but it is the wrong choice of letters for words they have encountered when reading (phonological plausibility), then this is a warning signal that the child is unable to acquire orthographic knowledge implicitly from their reading experience (McMurray, 2020). She contends that failing to recognize these orthographic processing difficulties at 5–6 years of age results in spelling difficulties becoming entrenched if intervention, through learning to spell, is not implemented at this early age. Her research found that an integrated approach to teaching spelling to develop phonic, orthographic and morphemic knowledge in parallel from 5–8 years of age, resulted in success for all children with the average post intervention standardized spelling score being 113, almost one standard deviation above the mean ($p < 0.0001$, Effect size 1.19). This programme included a structured approach to teaching patterns and sequences consistent in sound and spelling (onset and rime) and the associated morphemic knowledge for words in the patterns, alongside the teaching of high frequency words and words with a curriculum focus (McMurray, 2004, 2020).

As the difficulties with over-reliance on phoneme-to-grapheme correspondence have become clear, key researchers have emphasized the importance of phonics teaching extending beyond phoneme-to-grapheme correspondence to develop knowledge of orthographic units for automatic sight word reading, reading fluency and spelling (Ehri, 2020, 2024; Mather and Jaffe, 2021). Evidence of good orthographic processing ability is demonstrated by very young children who can learn to read words by sight without having to decode every word

phoneme-by-phoneme (sound by sound), and by a young child's ability to recognize and recall irregular words that have to be learned as single units, for example, the, are, our, were. Miles and Ehri (2019) and Deheane (2009) contend that familiar words are read as single units with each letter processed in parallel rather than sequentially. This is something that children with poor orthographic processing have particular difficulty with.

The significance of orthographic processing difficulties has been highlighted in the meta-analysis conducted by Georgiou et al. (2021). They examined 68 studies published between January 1990 and December 2019, to examine if individuals with dyslexia (DYS) have an orthographic knowledge deficit when compared to their chronological-age (CA)- and reading-level (RL)-matched controls. A random-effects model analysis revealed a large effect size (Cohen's $d = 1.17$) for the CA-DYS comparison and a small effect size (Cohen's $d = 0.18$) for the RL-DYS comparison. They concluded that children with dyslexic-type difficulties have a deficit in orthographic knowledge that is as large as the deficits in phonological skills and rapid naming and that this should be assessed, and consideration given to including activities to develop orthographic knowledge in intervention programmes. It is important to establish whether the 267 children in this study have spelling errors that are consistent with Georgiou's claim about the significance of the orthographic deficit. Difficulties in acquiring orthographic skills are now included in the new Delphi definition of dyslexia and the criteria for assessment (Holden et al., 2025). A standardized spelling test is now a compulsory element of the assessment of literacy difficulties and if spelling is poor, this triggers an assessment of orthographic processing using a standardized test. Mather et al. (2024) are the authors of the new TOD (Tests of Dyslexia) which include tests to assess orthographic processing.

Ehri (2024) stresses the importance of explicit spelling instruction explaining that reading is not enough for spelling accuracy. Ehri (2024) provides evidence that recognition of legitimate spelling patterns results in only partial retention of orthographic patterns which is sufficient for word recognition when reading, but is insufficient for the development of the orthographic processing skills needed for spelling accuracy. Ehri (2024) contends that onset and rime patterns such as "bent, tent, spent" and multi-letter units such as the suffix "ing" (p.8) are learned through a process of unitization whereby grapheme-phoneme units enable multi-letter units to form, which in turn connect these larger spelling patterns to the sound units in words they represent, enabling storage in memory. The process Ehri (2024) describes as unitization, does not happen automatically for children with orthographic processing difficulties hence the importance she places on explicit spelling instruction (2020, 2024). This is supported by Fernandez et al. (2011) who found that children with dyslexia have an implicit learning deficit, which may make it difficult to acquire orthographic representations implicitly from reading experience. Because children with orthographic processing difficulties show no benefit from frequency sensitivity when reading (Mather and Jaffe, 2021), they must be explicitly taught patterns such as onset and rime, in a structured and developmental sequence for orthographic knowledge to develop (McMurray, 2020).

1.3 Strategies used in SSP that are problematic for children with orthographic processing difficulties and/or working memory difficulties

1. DfE (2023) essential core criteria for the validation of SSP programmes advises publishers not to include consonant clusters or onset and rime and to teach phoneme-grapheme correspondences only. As a result, the term "phonics" has become synonymous with a phoneme level only approach to phonics teaching. Children are, therefore, being trained to look for phonemes only, and not orthographic patterns. This entrenches the difficulties experienced by children with poor orthographic processing (McMurray, 2020).

2. Children are taught to "read printed words by identifying and blending (synthesizing) individual phonemes, from left to right all through the word" (DfE, 2023). This strategy places excessive demands on working memory making blending beyond the capacity of many of 5–8-year-old children. According to Alloway (2011) the average 5-year-old can hold one item in short term temporary storage within working memory, the average 7-year-old two, the average 10-year-old three, and the average 14-year-old four items. Only 5% of one syllable words in English are two phonemes long, 43% are three phonemes long and 52% of one syllable words have more than 3 phonemes (Wyse and Goswami, 2008). This explains why, when learning to read in English, blending phonemes as an activity, is extremely difficult if not impossible for children due to limitations in working memory capacity. This problem is not experienced by children learning to read in Spanish or Italian where syllables are only two phonemes long and there is phoneme-to-grapheme consistency, i.e., one letter-one sound. Difficulties decoding unknown words is not a diagnostic criterion for dyslexia in these languages. This is also because there are no multiple mappings therefore no orthographic choices to be made.

3. Ehri's (2020) error analysis found that breaking the speech stream between phonemes causes students to forget initial phonemes during blending. In this research study 5–6-year-old children, who were taught to "stretch and pronounce phonemes without breaking the speech stream" (p.S52), were more successful when decoding than the group who did break the speech stream between phonemes (Ehri, 2020). However, the strategy of taking each sound in turn as recommended by DfE (2023) does not stipulate the importance of ensuring that there is no break between each phoneme. Furthermore, teachers are not advised to ensure that children develop strategies to enable them to cope with the working memory demands of blending phonemes in one syllable words with more than two phonemes.

4. The DfE (2023) note 6 promotes the use of decodable books made up of words that can be decoded using phoneme-to-grapheme correspondences only, to make sure that children "learn to rely on phonic strategies." This reliance on phonemic decoding and encoding can become a major contributor to spelling difficulties and difficulties with reading fluency if children become over-reliant on alphabetic mapping and orthographic knowledge fails to develop (Ehri, 2020, 2024; Mather and Jaffe, 2021, 2024; McMurray, 2020).

SSP works well for 75% of children because good orthographic processing supports the phonemic decoding strategy enabling the retention of words in orthographic memory for fast and efficient

retrieval. Children with poor orthographic processing can learn phoneme-to-grapheme correspondences, but when asked to spell words containing phonemes that can be spelled a number of different ways, they have no orthographic units stored in memory to enable the correct selection of letters and their spellings are phonologically plausible. It is important to consider the extent to which phonologically plausible spellings are evident in the writing samples of the 267 children in this study.

Furthermore, as early as 2012 Bell and McLean pointed out that, “...effective literacy skills specialists experienced in teaching synthetic phonics may not be successful in teaching those skills to those dyslexics whose phonological skills make them unreachable by this approach” (p.136).

Given that the DfE (2023) recommend more SSP intervention for children experiencing difficulty, and this is common practice in Northern Ireland, have any of the 267 children in this study been unable to develop phoneme-to-grapheme correspondences despite 4 years of SSP intervention.

1.4 The importance of language development

The role of spelling in vocabulary development is supported by evidence presented by Miles and Ehri (2019). They cite research spanning from 2005–2016 in support of the importance of learning spellings. A further advantage of teaching spelling was noted by Ehri (2020) who advises that teaching spelling units enables children to generalize to new words.

McMurray’s (2004) Ph.D. research provides evidence that learning to spell plays a significant role in language development. McMurray (2004, 2020, 2022) contends that effective, explicit instruction to develop orthographic knowledge, spelling accuracy and language development can only be achieved through an integrated approach to learning to spell because the connection between orthographic units and morphemic units must be taught together. Morphemes are the smallest units of meaning in spoken language.

The selection of schools in McMurray’s Ph.D. study was randomized using criteria to ensure matched experimental and control schools (RCT) and a 3 year quasi-experimental research design was conducted with children 5–8 years of age. This resulted in post intervention average standardized spelling score for the experimental schools of 113, almost one standard deviation above the mean ($p < 0.0001$). The focus on developing sensitivity to patterns in print linked to meaning and language development, resulted in the very strong effect size of 1.19. All children in the experimental schools increased their standardized spelling score from Year 2, 5–6 years to Year 4, 7–8 years (equivalent Year 1–3 in England) with the average standardized spelling score increase being 19 standard points from baseline in the experimental schools. The standardized spelling score for 24% of children in the control schools decreased over the same period with the average standardized spelling score increase for the control schools being 5 standard points (McMurray, 2006, 2020; Lavan and Talcott, 2020). Phonologically plausible spellings were still evident in independent writing in the control schools at the end of the study (Year 4: children 7–8 years of age).

According to McMurray the extent of the explicit and focused language development required to establish connections between orthographic units and morphemic units is not appropriate for children aged 4–5 years. At 4–5 years of age, the focus should be on teaching letter names, establishing phoneme-to-grapheme correspondence, and strategies for blending phonemes together including recognition of initial consonant blends. McMurray (2004, 2020) advises that teaching spelling with a focus on onset and rime patterns in Year 2 Northern Ireland (5–6 years of age) enables the identification of children with orthographic processing difficulties through focused activities designed specifically for this purpose. This enables informed extensive intervention at a whole class level to be taught commencing in Year 3 (6–7 years of age, equivalent Year 2 in England) (McMurray, 2004, 2020).

At 6–7 years of age onset and rime spelling patterns should be taught with the associated word meanings (morphemic knowledge) for each of the spellings in the pattern. Taking the onset and rime pattern, cap, lap, gap, map, nap, rap, clap, trap, strap, wrap as an example, the spelling “lap” represents 4 free morphemes: 1. a noun – part of your body “the cat sat on my lap”; 2. a noun – a circuit in a race “I ran a lap of the track” 3. a verb – water breaking gently against the shore “the water lapped against the shore,” 4. a verb – animals drinking by collecting liquid on their tongue “the cat lapped up the milk.”

The range of meanings for one spelling is discussed with the whole class for language development purposes and to motivate children to think about ways they can use spellings with more than one meaning. Receptive and expressive language can be well in advance of the ability to communicate in written language. For this reason, the differentiation in the written follow up activities takes account of working memory and orthographic processing difficulties and leaves more challenging written morphemic activities until the next stage of the programme, for children with specific processing difficulties.

McMurray (2004, 2020) found that phonemic, orthographic and morphemic knowledge develop in parallel from the beginning for children who do not have orthographic processing difficulties. These children can learn implicitly from their reading experience and become increasingly proficient in their use as demonstrated in the sample of writing in Figure 1.

This sample of writing (Figure 1) was written at the end of the second year of formal schooling (5–6 years of age, Year 2 NI, equivalent Year 1 in England). The only words that were explicitly taught for the purpose of spelling were CVC words and a small number of high frequency words. The following correctly spelled words had not been explicitly taught (*like, new, called, every, time, take, for, near, away, sports, day, nearly, came, first, bean, race, little*). This child has good orthographic processing ability and can abstract the orthographic rules and regularities in print from reading experience as demonstrated by the correct spellings and the spelling errors in this sample. Phonemic, orthographic and morphemic knowledge are developing in parallel because this child can learn implicitly from reading experience. For example, the incorrect spelling “brghte” for “brought,” demonstrates developing orthographic knowledge because the child knows that “ght” should be in the spelling. A phonologically plausible spelling would be “brot.” Similarly, the incorrect spelling “agian” demonstrates orthographic awareness of the letters that should be in the word. A phonologically plausible spelling would be “agen.”

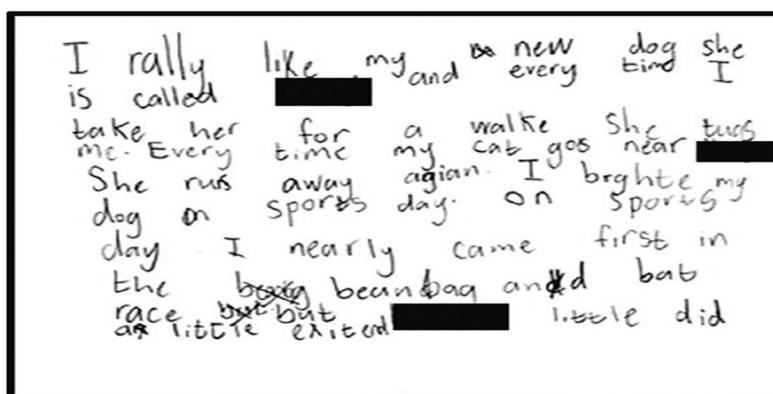


FIGURE 1

May 1999 Child A (Year 2 NI children 5–6 years of age). McMurray, S. (2020). Learning to spell for children 5–8 years of age: The importance of an integrated approach to ensure the development of phonic, orthographic and morphemic knowledge at compatible levels. *Dyslexia* 26, 442–458. doi: 10.1002/dys.1663.

The sample of writing in Figure 2 was written by a child in the same class. There was no statistical difference in the verbal ability of Child B and Child A. There is, however, a significant difference in their orthographic processing ability. All the words that are spelled correctly in this writing sample had been explicitly taught. Child B spelled the words that had not been taught the way he said them, and the incorrect spellings are phonologically plausible (vre -very, tol- tall, dat- dad, ped-played, futbl-football). It is important to establish the extent to which pronunciation impacts spelling in the 267 samples in the current study.

In Figure 3 Child B continued to spell words the way he said them without the orthographic knowledge needed to spell words he had not been taught, for example, just-jesd, lifid- lifted, wes-was, desrod-destroyed, weos-was, sil-stil, sot-shot, cilt-killed.

By the end of the first term in Year 4 (NI, 7–8 years of age, equivalent Year 3 in England) Child B had developed sensitivity to orthographic patterns. This was achieved through the spelling intervention which was designed to ensure the development of phonic, orthographic and morphemic knowledge at compatible levels. The design of the spelling programme was based on McMurray's (2004) hypothesis that it is not until the brain has experience of a significant number of visual patterns and sequences, consistent in sound and spelling, that it can

begin to make sense of the common elements in the specific formula (pattern) that make up, for example, rhyme patterns and sequences in general. Each rhyme pattern is different; for example, man, can, ran, fan//got, lot, hot, but rhyme patterns, consistent in sound and spelling, have common elements –that is, same end pattern and sound with changes only in the initial sound. What is sufficient experience for one child, to abstract these statistical relationships between phonology and orthography, may be insufficient experience for another and cannot be achieved via implicit learning when reading for the group of children with orthographic processing difficulties. Repeated attempts to spell the same rhyme pattern can be unproductive for this group. This may be because repeating the same rhyme pattern does not supply the brain with sufficient information regarding common elements relating to rhyme patterns in general. Experience of many patterns is needed to develop sensitivity to, and storage of, orthographic patterns for effective recall.

Child B was the child who took the longest to develop sensitivity to orthographic patterns and when this was achieved there was a significant improvement in his spelling in independent writing as seen in Figure 4. His standardized spelling score improved by 29 standard points from baseline in January 1999 to May 2001.

Child B has only eight spelling errors in a total of 99 words written: (press-prese), (chewing-chuthing & chuwing), (shoe-shuy), (thrown- thorn), (shovel- shevel), (lifted- levted), (sting-stink), McMurray (2004, 2020). His orthographic processing ability has improved significantly as demonstrated by the correct spelling of words that include sounds that can be spelled more than one way, e.g., if “machine” was spelled by sound alone, it could be spelled “masheen,” called could be spelled “cawld,” adventure could be spelled “advencher.”

In the SSP only approach to beginning reading, it has been a flaw to assume that the orthographic knowledge essential for its success is in place or can develop without explicit teaching for all children (McMurray, 2020). Just as phoneme-to-grapheme correspondence must be taught in a systematic and structured way so too must onset and rime patterns. McMurray (2020, 2022) contends that the predominant strategy for

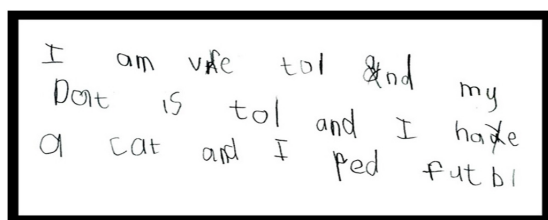


FIGURE 2

May 1999 Child B. McMurray, S. (2020). Learning to spell for children 5–8 years of age: The importance of an integrated approach to ensure the development of phonic, orthographic and morphemic knowledge at compatible levels. *Dyslexia* 26, 442–458. doi: 10.1002/dys.1663.

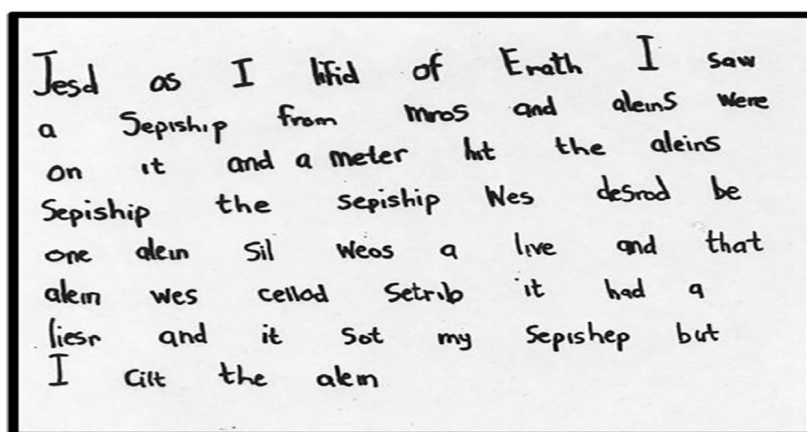


FIGURE 3

January 2000 Child B. McMurray, S. (2020). Learning to spell for children 5–8 years of age: The importance of an integrated approach to ensure the development of phonic, orthographic and morphemic knowledge at compatible levels. *Dyslexia* 26, 442–458. doi: 10.1002/dys.1663.

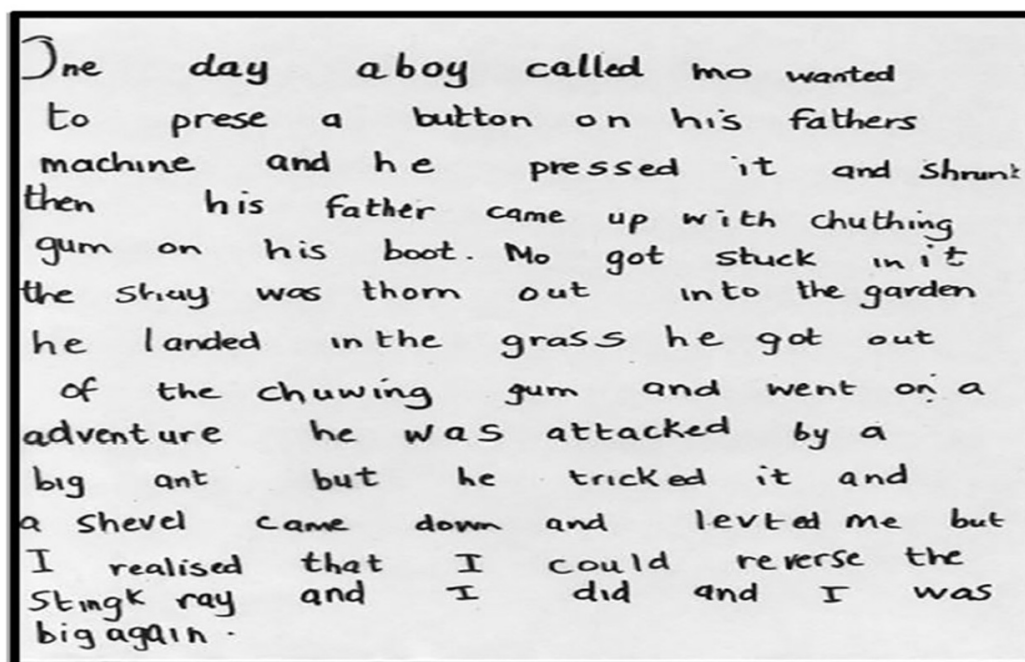


FIGURE 4

December 2000 (7–8 years of age). McMurray, S. (2020). Learning to spell for children 5–8 years of age: The importance of an integrated approach to ensure the development of phonic, orthographic and morphemic knowledge at compatible levels. *Dyslexia* 26, 442–458. doi: 10.1002/dys.1663.

reading unknown words should be decoding using phoneme-to-grapheme correspondence but strategies should also be taught to ensure the development of commonly occurring initial consonant orthographic units to support working memory until the systematic and structured teaching of an integrated approach to learning to spell commences in January of the second year of formal schooling (5–6 years, McMurray, 2020, 2022).

Research evidence to support intervention programmes often focuses on group averages to make claims about effectiveness. Where effect size and statistical significance are moderate or low then it is clear that a group of children may not be progressing at an expected rate for their age, or may even be regressing. The extent

of difficulties experienced by children who underachieve is hidden in the average score. Failure to highlight this group results in a lack of transparency and expectations that the intervention will benefit everyone when this is not the case.

There has been no research, up to the time of writing this paper, that has investigated the sources of linguistic knowledge children in mainstream schools with the severest difficulties in literacy development, draw on in their attempts to spell correctly. This research is important given the continued focus in schools to teach phonics at phoneme-to-grapheme level only and the recommendation to use the same method when providing further support for children who struggle. The analysis of spelling

in independent writing provides a window into the child's mind, enabling the assessment of the development of phonemic, orthographic and morphemic knowledge. These three sources of linguistic knowledge are essential for normal literacy development (Daffern, 2017; McMurray, 2004, 2020). McMurray (2020) has highlighted the importance of ensuring that they develop in an integrated way within an optimal timeframe from 5–8 years of age. Given that Treiman et al. (2019) have established that from a very early age (5–6 years) orthographic correctness is the most significant indicator of later spelling ability (at age 7), the sources of linguistic knowledge that children with the most significant literacy difficulties draw on at 8–9 years of age is the focus of this research. This age group was chosen to ensure that the focus was on children with the severest and most persistent specific literacy difficulties. Children aged 8–9 years (Year 5 in Northern Ireland) are beyond the optimum period for the development of orthographic knowledge identified by McMurray (2004, 2006, 2020) which occurs between 5 and 8 years of age (Years 2 to 4 in Northern Ireland).

Treiman et al., 2019 (p.92) stated that although phoneme based measures do not advance orthographic knowledge for the majority of children “It is possible that phoneme-based measures would be significantly better predictors of future performance than letter-based measure for children who are even less advanced than those studied here. The analysis we conducted with the poorest spellers in the study provide a hint of such an effect, and further research is needed to examine the possibility.” The research in this paper considers whether the poorest spellers, do or do not, benefit from phoneme based measures as hinted by Treiman et al. (2019). Furthermore, Carroll et al. (2025) suggested that further research is needed to investigate the role of orthographic processing, which is a key consideration based on the findings of this research.

1.5 Aim of the study and research questions

The overarching aim of this study was to examine spelling attempts in writing samples from a large group of children with significant specific literacy difficulties of a dyslexic-type, who were beyond the optimum period for the development of orthographic knowledge identified by McMurray (2004, 2006, 2020) and Treiman et al. (2019). These children were 8–9 years of age and at the start of their fifth year of formal schooling. The research aimed to establish the sources of linguistic knowledge these children were using to spell when writing independently and the extent to which they could identify the phonemes in the words they were attempting to spell.

Research Questions (RQ)

The research questions to address the stated aim are:

RQ1. Is there evidence to support Bell and McLean's (2012) claim that some dyslexic children have severe phonological difficulties that teaching phoneme-to-grapheme correspondence cannot address?

RQ2. Is a small bank of high frequency words the only evidence of orthographic knowledge for poor spellers? (Daffern and Critten, 2019)

RQ3. Do the spelling errors in the writing samples support Georgiou et al.'s (2021) claim that children with dyslexic-type difficulties have a deficit in orthographic knowledge?

RQ4. Does the teaching of phoneme-to-grapheme correspondences only, enable the development of orthographic knowledge or are children's spelling errors phonologically plausible?

RQ5. Is spelling impacted by how a child pronounces words?

2 Methodology

2.1 Participants

All of the children who participated in this study were formally assessed by the Education Authority psychology service. These children demonstrated a cognitive profile which included a standardized score of 90 or above in one or more of the subtests of the Wechsler (2016) Intelligence Scale for Children (WISC). Standardized scores for single word reading, reading comprehension and spelling were also obtained using the Wechsler (2017) Individual Achievement Test (WIAT-111UK). To meet regional criteria for additional support from the literacy service, standardized test scores had to be in the below average range and a discrepancy between actual and expected attainments in standardized tests of word reading, reading comprehension or spelling large enough to be expected to occur in only 2% or fewer of pupils of that age. Although this profile may indicate specific literacy difficulties of a dyslexic-type, no formal clinical diagnoses of dyslexia were obtained.

The literacy support service teachers also gathered baseline data which included assessment of reading rate using the York Assessment of Reading for Comprehension YARC (2011). The presentation of reading difficulties for most of the children referred to the EA literacy service includes very slow reading rate and overdependence on decoding phoneme-by-phoneme.

Reading rate could not be calculated for 32.58% ($n = 87$) of the children due to exceeding the number of errors permitted for a reading rate to be calculated on this test. 24.7% ($n = 66$) children scored between 70 and 79 and 24% ($n = 64$) scored between 80 and 84.

18.72% ($n = 50$) had scores in the average range (85–115). Twenty-five of these children had scores between 85 and 89 and twenty four children had scores between 90 and 99. One child obtained a score of just over 100. These scores demonstrate that a significant number of children fall within the lower end of the average range for reading rate relative to the national average for their age. It implies that these children demonstrate a degree of slow and dysfluent reading. They are spending time decoding words which can negatively impact on understanding (YARC, 2011, p2) at the cost of time and effort (p73).

Information about how spelling was taught in the child's school was provided on the data collection cover sheet which was completed by the Education Authority Literacy support teacher and

submitted with the writing sample. All of the children were being taught to learn to spell using a phoneme-grapheme approach.

2.2 Selection of the sample (September 2019)

Inclusion in this research was on a voluntary basis and permission was sought at all levels by the Education Authority. In Northern Ireland there are five regional literacy support services. Four of the five regions agreed to participate, and one region declined. As this research was above and beyond the normal workload for the Education Authority literacy service teachers, agreement was sought from each individual teacher in the four Education Authority regions that agreed to participate. Permission was then sought from the primary schools the children attended. With the agreement of the school, permission was sought from the children in Year 5 (NI 8–9 years-of-age), who were about to commence support from the Education Authority literacy service teacher. The child's parents or guardians were also asked to give permission. If any child or parent declined at the outset or during the study, then their writing sample was not sent to the researchers. No child or parent declined participation during the study. The writing samples were anonymized by the Education Authority prior to being sent to the researchers. Agreement to participate was achieved for 267 children in Year 5 in 143 schools.

2.3 Ethical approval

Ethical Approval was obtained from the Ethics Committee within the authors' university. Ethical approval was also obtained from the Education Authority who gathered all baseline assessment data including the samples of independent writing and provided access to the researchers, with strict adherence to data protection legislation and the secure storage of data.

2.4 Data collection

In October 2019 baseline data on spelling was obtained from 267 children in Year 5 (8–9 years of age) who each completed a sample of independent writing under the supervision of the Education Authority literacy service specialist teacher assigned to them. The independent writing samples were collected as part of their baseline assessment process prior to commencing support. These writing samples were completed in a one-to-one setting in the child's school. All literacy service teachers were briefed by the lead author of this paper in August 2019 about the controlled conditions for collecting the writing sample (for example, an attractive environment with no words on the walls that might be copied, encouragement given to persist but no help with spelling), and the brief that should be given to the children to stimulate interest in writing. The children were asked to write about their best day. The words in the title (My best day) were not counted as correct spellings because they could be copied from the title at the top of the children's response page. Up to 30 minutes was allowed for this independent writing activity, however, children completed

in 10–15 minutes and spent the remaining time drawing a picture. When the child finished writing he/she immediately read back what they had written and the teacher transcribed what the child read back (the transcript). This transcript was used to list the correct and incorrect spellings.

2.5 Data analysis

The authors assigned samples of writing to 4 categories. The categories were developed from the authors' experience working with children with extensive literacy difficulties. Categorization was discussed and agreed by the four moderators who had previously been Special Educational Needs Coordinators in mainstream schools. They all had a master's degree in teaching and assessing children with dyslexia and extensive teaching experience. 100% agreement was required for each sample. Each sample was independently assessed by each moderator and in cases where there was not 100% agreement the sample was discussed and 100% agreement reached by strict adherence to the categories. The best sample from each category was used in the paper to allow the boundaries to be clear. To be included in a category the samples had to meet all the criteria for that category.

Category 1: Unreadable

Samples are unreadable and look like a jumble of letters.

Attempts to denote individual words are limited to the occasional simple (2 or 3 letter) high frequency words.

Evidence of initial consonant sounds being correct for some, but not all of the attempts to spell words within the sample of writing.

Insufficient evidence of phonemic knowledge beyond the initial sound in the word with the occasional final sound identifiable in some of the samples.

Insufficient evidence of the development of phoneme-to-grapheme correspondence because so little is written in the sample.

Category 2: Readable with the transcript

Small bank of simple correctly spelled high frequency words.

Some correctly spelled phonemically regular words.

Evidence of words being spelled the way the child says them.

Attempts to spell all or some of the phonemes in a word and the word is readable but spelling is incorrect.

Reading the transcript enables identification of words with the incorrect letter or letters for the vowel sounds.

Unusual spelling that is not close to how some of the words sound or should look.

There is limited (i.e., one or two words) or no evidence of correct orthographic choices for words with multiple mappings.

Category 3: Transcript needed to read some words

The text is easily read because the reader can draw on contextual clues made possible because of the greater number of correctly spelled words.

The phonemic knowledge demonstrated in misspellings allows incorrectly spelled words to be read as they sound, even though they don't look like the word.

Evidence of words being spelled the way the child says them.

The transcript is needed to decipher a small number of words that are not identifiable because the letters used do not represent the sound sufficiently well or because the reader feels a check is needed to ensure the correct interpretation of what is written.

Correct spellings are predominantly high frequency words or words that are phonemically regular.

There is limited evidence of orthographic knowledge being used to make correct spelling choices for phonemes that can be spelled a number of different ways.

Category 4: Transcript not needed to read words

The writing samples can be read without reference to the transcript.

All misspellings are readable because they represent the phonemes in the words sufficiently well to make recognition possible.

Some evidence of orthographic knowledge but children in this category did not write at length

2.6 Limitations of the study

The sample consists of children receiving support through four of the five regional literacy support services in Northern Ireland. Findings may not generalize to all children with literacy difficulties, particularly those not accessing such services.

The study used a single writing prompt (“My best day”); patterns may differ with other writing tasks.

Readability categories were determined by consensus among moderators; while agreement was high, some degree of subjective judgment in classification is inevitable.

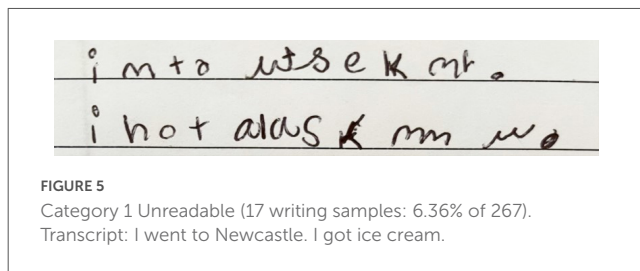
3 Results

The writing samples were classified based on their readability. Of the 267 samples of independent writing examined, only 23 could be read without reference to the transcript (8.61% of 267). Three children were reluctant to write anything, and their submissions were blank (1.12% of 267). Seventeen children’s writing was unreadable (6.36% of 267). The remaining samples had varying degrees of readability, and the transcript was required to allow the reader to read and understand the writing in full (83.9% of 267). Three categories of readability were identified (categories 2–4: 247 samples in total).

The title “My best day” was written on the sheet directly above where the children wrote their stories. “My,” “best” and “day” are not counted if spelled correctly because they can be copied.

3.1 Category 1

Samples in this category are unreadable (see Figure 5). Six of the 17 scripts had no identifiable words and in a further 6 the only identifiable word was “I” (4 scripts) or “to” (2 scripts), 5 scripts had two identifiable words (I, in), (to, the), (is, dog), (a, big), (I, to, see Figure 5). Based on the transcripts the average number



of words attempted was eleven. Figure 5 is a typical example. There is no viable evidence of the development of an effective phoneme-to-grapheme strategy or the acquisition of orthographic knowledge.

The percentage of correct spellings demonstrating orthographic knowledge (that is, words that require spelling choices for phonemes that can be spelled a number of different ways) is given in categories 2–4 below. The high frequency word “was” if spelled correctly is included in the count of orthographically correct words (misspellings include “woz” or “wus”). The correct spelling of the high frequency word “the” is also included in the count of orthographically correct words as it has to be learned as an orthographic unit. In all cases where the word “the” is used, it is spelled correctly.

3.2 Category 2

In Figure 6 some simple correctly spelled high frequency words are evident: “is, I, in, he, to, get, and, a, go, for, us” providing support for RQ2. The words dog, pond, can be spelled phonemically. This provides evidence of phonemic knowledge being correctly applied when mappings are one-to-one.

There is evidence of attempts to spell words the way they are pronounced by the child (RQ5), for example, “olir” for other. Olir is a commonly occurring mispronunciation of the word “other” by young children in NI. Substitution of the “l” sound for the “th” in the word other, can occur due to poor articulation of the “th” sound or because the child has poor auditory discrimination and cannot distinguish the sound within the word. With regard to the misspelling of the word “doesn’t”, it is likely that the child does not pronounce the “n” sound, hence the spelling “dosit.” Had the child been able to draw on orthographic knowledge of what the word looks like, the “e” and the “n” would not have been omitted. Although best is in the title it has not been spelled correctly. This may be because the child says “besdie” in his speech and therefore attempted to spell it as he says it. This a common colloquial pronunciation of the word best in areas of Northern Ireland.

“Wok” (walk) is an example of a phonologically plausible spelling; an attempt to spell the phonemes in the word and the word is readable, but the spelling is incorrect. The transcript is needed to enable identification of words with the incorrect letter or letters for the vowel sounds: “wein” (when), “hes” (his), “sad” (side), “lied” (lead). In the misspelling “wein” (when) the child has not heard the “h” sound following the “w.” Many children with dyslexic-type difficulties cannot hear the difference between “w” and “wh.” It is not uncommon for children in this group to either leave the “h” out of words starting with “w” or add it in when it is not needed.

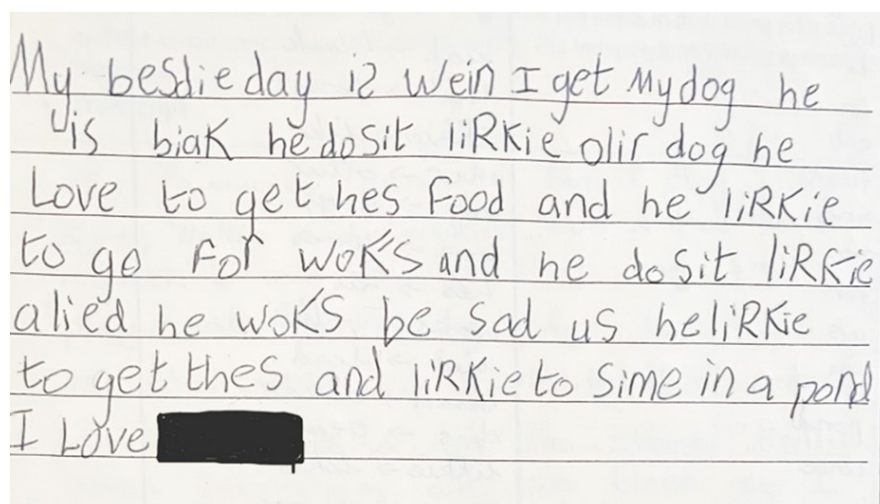


FIGURE 6

Category 2 Readable with the transcript (127 writing samples: 47.56% of 267). Transcript: My best day is when I got my dog. He is black. He doesn't like other dogs. He loves to get his food and he likes to go for walks, and he doesn't like a lead. He walks beside us. He likes to get treats and likes to swim in a pond. I love xxxxx (total words 56).

The incorrect spelling of like (“liRkie”) is more difficult to explain as the capital R has been added consistently in all four attempts to spell the word. This unusual spelling, “liRkie,” is not close to how the word sounds or looks and unlike “olir” and “besdie,” it is not a word that is commonly mispronounced in NI, but may be a phonological issue specific to this child which a classroom teacher would be able to identify. Because the letters ‘l’ and ‘c’ are omitted from the spelling of the word black, the transcript is needed to identify this word. The word “treats” also requires the transcript to identify the word (thes).

The correct spelling of the word “love” provides evidence of the correct selection of letters for the vowel sound. A phonologically plausible spelling would be “luv.” Evidence of orthographic knowledge is limited to the small bank of high frequency words and the correct spelling of the words “love” and “food.” The vowel sound “oo” in “food” could be spelled different ways as in, “rude, blue, knew, fruit, feud, soup, through” but “oo” is the most common spelling for this phoneme and therefore, “food” may have been spelled phonemically. This was the only sample in this category that had two words that demonstrated orthographic awareness. The other samples had one or no words demonstrating the selection of the correct letters for words with sounds with multiple mappings.

The percentage of correctly spelled words that included orthographic choices in category 2 is 13.84% of the total number of words spelled correctly. The word “the” is spelled correctly in 66 of the 127 samples. If the word “the” is not included in the orthographic group then the percentage would be 8.39%.

3.3 Category 3

In Figure 7 the text is easily read because the reader can draw on contextual clues made possible because of the greater number of correctly spelled words: ‘upon, was, to, sleeping, in, the, car,

and, brother, mummy, at, find, so, we, out, of, car, on, apple, won, pink, puppy.’ Correct spellings are predominantly phonemically regular words: “sleeping, pink, brother, time” (the word time is also a frequently displayed word in classrooms), or high frequency words: “a, I, to, was, in, the, and, at.”

There is evidence of orthographic knowledge in the words, “apple, puppy, mummy (double letters), won (a phonologically plausible spelling is wun), car (kar). The misspelling of the word “bule” (blue) may be an attempt to spell the word drawing on orthographic knowledge with the letters being placed in the wrong order.

The phonemic knowledge demonstrated in these phonologically plausible misspellings allows incorrectly spelled words to be read as they sound, even though they may not look like the word. For example, the word “used” is misspelt “youst.” “Once” is misspelled “ones.”

With is misspelled “wif” because some children pronounce the sound at the end as an “f” sound (RQ5). “W” has been added to going (“gowing”) because a “w” sound is often pronounced in the word (RQ5). The silent “h” in ghost is left out (gost). The misspellings for the words parking space “prekeing spas” also demonstrate the child’s attempt to spell the words by sound.

The wrong letters for the vowel sound have been selected for the word train (trean), the word ride (rad) and the word went (want, wante).

The transcript is needed to decipher a small number of words that are not identifiable because the letters used do not represent the sounds in the word sufficiently well or because the reader feels a check is needed to ensure the correct interpretation of what is written, blake (blanket), tlel (tail), kudt (couldn’t), chot (coat).

The percentage of correctly spelled words that demonstrate orthographic knowledge in category 3 is 13.87% of the total number of words spelled correctly. The word “the” is spelled correctly in 61 of the 97 samples. If the word “the” is not included in the orthographically correct spellings then the percentage would be 9.74%.

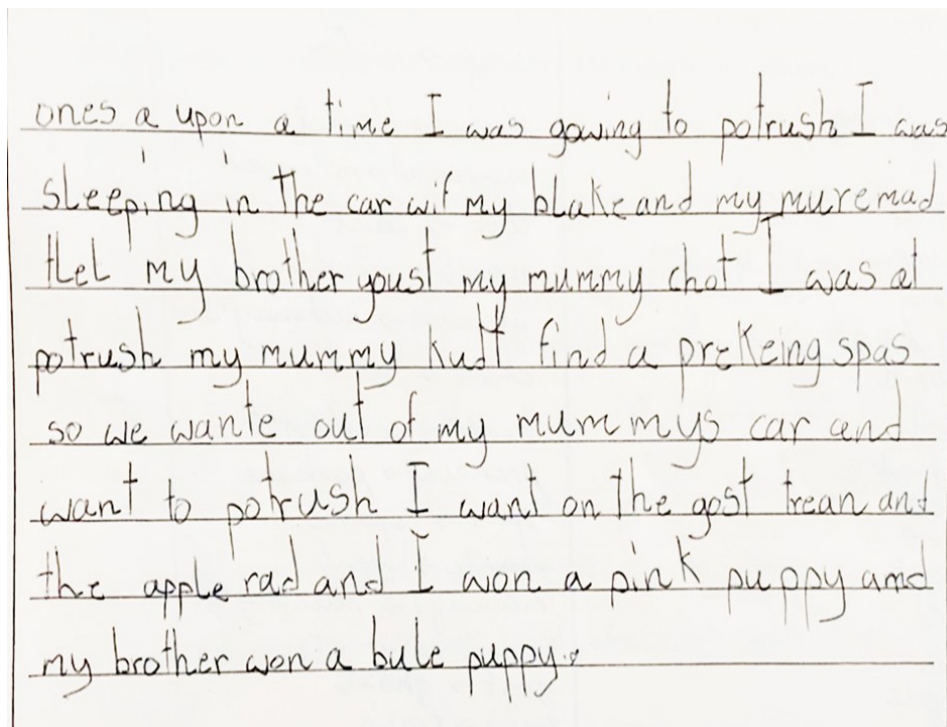


FIGURE 7

Category 3 Transcript needed to read some words (97 Writing samples: 36.3% of 267). Transcript: Once upon a time I was going to Portrush. I was sleeping in the car with my blanket and my mermaid tail. My brother used my mummy's coat. I was at Portrush. My mummy couldn't find a parking space, so we went out of my mummy's car and went to Portrush. I went on the ghost train and the apple ride, and I won a pink puppy, and my brother won a blue puppy (total words 75).

3.4 Category 4

There were 23 samples in this category, and they could all be read without the transcript, but children did not write at length. This means that there was not a wide range of vocabulary used. Spelling errors were still evident but the words being attempted were easily identifiable. Most of the words used in the category 4 samples were regular in their spelling, raising the possibility that children in this category wrote so little because they wanted to limit what they were writing to words they knew they could spell.

In Figure 8 there were three incorrect spellings: “aksed” (asked), “biled” (build), “finisht” (finished). Whilst there is some evidence of orthographic knowledge in this sample, for example, “home”

evidence of orthographic knowledge is limited. Although “k” and “s” are in the wrong order in the word “asked,” this incorrect spelling provides some evidence of orthographic knowledge. It has all of the correct letters needed to spell the word, and “ed” has been correctly added to make the past tense. When the word asked is spelled by sound the final letter is often written as a “t” because the end sound is often heard as a “t” sound, as seen in the misspelling of “ed” in the word “finisht” (finished). The misspelling of the bound morpheme “ed” in the word finished provides evidence that the child is spelling by sound and has not been taught or is not applying the orthographic rule consistently for adding “ed” to make the past tense of regular verbs.

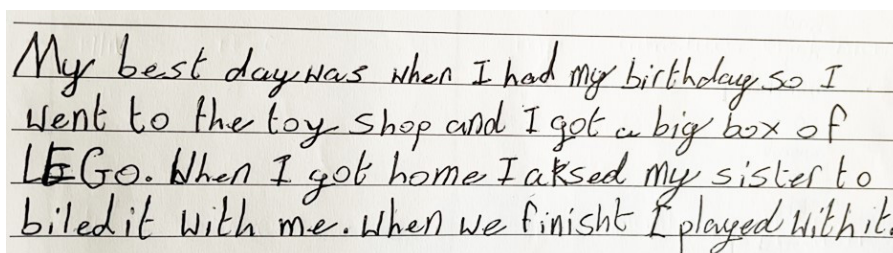


FIGURE 8

Category 4 Transcript not needed (23 writing samples: 8.61 of 267). Transcript: My best day was when I had my birthday, so I went to the toy shop, and I got a big box of lego. When I got home, I asked my sister to build it with me. When we finished, I played with it (total words 44).

The percentage of correctly spelled words that included orthographic choices was 23% of the total number of words spelled correctly. If the word “the” is not included in the orthographically correct spellings then the percentage would be 20%.

4 Discussion

Bell and McLean (2012) claimed that some dyslexic children have severe phonological difficulties that teaching phoneme-to-grapheme correspondence cannot address. The 17 samples in category 1 support this claim (RQ1). There is insufficient evidence of a small bank of high frequency words for this group of children as the only correctly spelled high frequency words were I, in, to, the, is, a (RQ2). The majority of spelling attempts appear as jumbled letters, bearing no resemblance to the actual words, except for two regular words big and dog in two of the samples. There is limited or no evidence of phonologically plausible spellings indicating that there is insufficient knowledge of phoneme-to-grapheme correspondence despite 4 years of schooling to develop this knowledge. This raises issues regarding the ethics of persisting with a phoneme-to-grapheme only approach such as SSP, when it is beyond the child’s processing ability. To ensure a focus and reliance on phonemic knowledge the DfE (2023) core phonics criteria discourages the teaching of orthographic units (initial consonant clusters and onset and rime). It is, therefore, reasonable to suggest that these children have not been taught alternative strategies. Taking into account Treiman et al. (2019) findings that orthographic correctness at 5–6 years of age predicts later spelling ability, it is a concern that these children’s spelling difficulties are entrenched to the extent seen in these samples. This suggests difficulty with orthographic processing and the development of orthographic knowledge in addition to the phonological difficulties. It is important to note that this group represents only 6.36% of all of the 267, 8–9 year old children in this study. These were children with the severest difficulties in literacy development in 143 schools.

Orthographic knowledge of what a word looks like is necessary for spelling accuracy but other factors can impact the acquisition of orthographic knowledge. Spelling errors (Category 2: Figure 6) such as “olir” for other (mispronunciation), besdie for best (colloquial) and dosit for doesn’t (poor discrimination of phonemes) indicate that spelling errors can be a result of more than an orthographic deficit or a lack of knowledge of orthographic rules, and that a combination of factors should be considered including the child’s pronunciation and/or auditory discrimination difficulties.

The phonologically plausible incorrect spellings used by the 224 children in categories 2 and 3 indicate that their primary strategy is phoneme-to-grapheme correspondence (alphabetic mapping) without the orthographic knowledge needed to select the correct letters for phonemes with multiple mappings. Orthographic knowledge was observed in less than 14% of correctly spelled words in the samples in Categories 2 and 3 suggesting an orthographic deficit (RQ3). The teaching of phoneme-to-grapheme correspondence did not enable the development of orthographic knowledge as observed by the prevalence of phonologically plausible spelling errors (RQ4). Because the spelling errors demonstrated knowledge of phoneme-to-grapheme

correspondences, and a lack of awareness of what the words they were trying to spell should look like, these findings are consistent with Georgiou et al.’s (2021) argument that the orthographic deficit is as significant as the phonological deficit. The samples in category 2 and 3, do not support RQ2 as some orthographic knowledge had developed beyond a small bank of high frequency words. However, many of these were high exposure words, for example, the, was, mummy, daddy, love, football.

As seen in Table 1, in the 23 samples in category 4 there was a higher proportion of orthographic knowledge observed, and children in this group could spell more than a small bank of high frequency words. These children did not write at length, and the range of different words used may indicate that they were limiting what they could write to what they could spell correctly.

Are the issues identified in 2019 still current?

Six specialist teachers (ST), each with a Master degree in teaching and assessing children with dyslexia, were asked to consider the difficulties exhibited by children experiencing severe literacy difficulties that they were working with in the school year 2024/2025, to establish whether the authors’ analysis of the 267 samples in this study, issues with reading rate (baseline assessment of reading rate (YARC) in October 2019), and the critique of the DfE (2023) core phonics criteria are representative of ongoing issues. The STs independently considered the statements in Tables 2–6 below. Only statements agreed by the STs were included in the tables and taken forward to a focus group meeting.

Table 2 shows the number and age groups of the children considered by each of the STs. The teachers were working with a total of 84 primary aged children in January 2025. The largest groups were children aged 7–8 years ($n = 23$) and 8–9 years ($n = 25$).

Findings from the independently completed questionnaire found that 83 children decode phoneme by phoneme with only one

TABLE 1 Average numbers per sample for: total words written, range of words used, correct and incorrect spellings.

Category	Total number of words written	Range of different words used	Correct spellings	Incorrect spellings
2	31	20	9	11
3	39	24	16	8
4	41	23	19	4

TABLE 2 Number and age groups of the 84 children considered by specialist teachers (ST) in January 2025.

AGE	5–6	6–7	7–8	8–9	9–10	10–11	Total 1
Year group	Y2	Y3	Y4	Y5	Y6	Y7	
ST1		1	4	2	1	2	10
ST2	2	1	6	5	2	4	20
ST3	1	1	4	9	6	1	22
ST4		2	1	2	4	2	11
ST5			1	7	5	1	14
ST6			7				7
Total 2	3	5	23	25	18	10	84

TABLE 3 READING DECODING AND BLENDING - Statements arising from concerns regarding DfE (2023) core phonics criteria and baseline assessment of 267 participants.

Question number	Age of children in each year group	5–6	6–7	7–8	8–9	9–10	10–11	Total
	Total number of children in each year group	3	5	23	25	18	10	84
1 A	Children decode words phoneme by phoneme when reading.	3	5	22	25	18	10	83
1 B	Children decode words phoneme by phoneme when reading. Because this is their “default” position, it is very hard to improve automatic sight word recognition using the same decoding phoneme by phoneme strategy.	3	5	22	24	16	10	80
1 C	Because decoding is their “default” position, it is very hard to establish new/different strategies.	3	5	15	22	16	10	71
2	Children don’t recognise patterns in words because they have not been trained to look for these.	3	5	22	25	18	10	83
3	Children are entrenched in the habit of “sounding out” every letter in every word, even when they recognise the whole word.	3	5	13	22	11	5	59
4	Children are taught to decode words phoneme by phoneme and apply this to irregular words because they don’t know when a word is regular or irregular.	3	5	20	21	13	9	71
BLENDING								
5	Children take each sound in turn all through a word by saying each sound individually, breaking the speech stream between each sound.	3	5	23	25	18	10	84
6	Children run each sound into the next sound ensuring that there is no break between each sound in the speech stream.	0	0	0	0	0	0	0

Specialist teachers’ responses to these statements in relation to children they worked with in the school year 2024/2025.

TABLE 4 SPELLING - Statements arising from the analysis of the 267 samples of writing, and the issues noted in this paper regarding DfE (2013) see page 5, DfE (2014) see page 4 and DfE (2023) see pages, 5, 7 and 8.

Question number	Age of children in each year group	5–6	6–7	7–8	8–9	9–10	10–11	Total
	Total number of children in each year group	3	5	23	25	18	10	84
1	Children spell by identifying the sounds they hear in words	3	5	23	25	18	10	84
2	Children can “stretch out” a word orally, to segment the word into individual phonemes, without distorting the sounds in the word.	0	0	0	0	0	1	1
3	Children “stretch out” a word orally, to segment the word into individual phonemes, and often distort the sounds in the word, even at the level of regular CVC words	3	5	15	18	13	8	62
4	Children never “stretch out” the sounds in a word to segment the word into individual phonemes/sounds	0	0	8	7	5	1	21
5	Children observed spelling aloud don’t name the letters, they say the sound	3	5	21	20	11	3	63
6	Children don’t name the letters because they don’t know the letter names?	3	5	9	10	7	2	44
7	Children observed spelling aloud who know the letter names and say the sounds, revert back to saying the sound even when encouraged to say the letter name	1	3	9	10	7	2	32
8	When spelling, the letters chosen for the phonemes represent the way the child pronounces the word. Poor articulation and pronunciation impact spelling by sound alone, because the child doesn’t know what the word should look like.	3	5	20	25	18	10	81

Specialist teachers’ responses to these statements in relation to children they worked with in the school year 2024/2025.

TABLE 5 SPELLING – Statements resulting from the use of phonologically plausible but incorrect choice of letters for phonemes with multiple mappings in the 267 samples of writing.

Question number	Age of children in each year group	5–6	6–7	7–8	8–9	9–10	10–11	Total
	Total number of children in each year group	3	5	23	25	18	10	84
1	Children can link the consonant phonemes to the letter when it is one to one mapping but mix up sounds represented by more than one letter e.g., spelling cat with a k - kat	1	0	16	13	15	7	52
2	Children have difficulty with consonant letters that have more than one sound, for example, y as in (yellow and happy), g (as in girl, giraffe) choosing the j sounds for g; c (as in circle and cat) choosing the s sound for c or vice versa	3	5	21	22	17	7	75
3	Children cannot choose the correct spelling for long vowel sounds and vowel digraphs because of the range of different spellings for these sounds	3	5	23	25	18	10	84
4	Children aged 8–11, recognise few, if any, of the vowel digraphs when presented with these in isolation. For example, “ee” may be the only digraph that is recognised				24	16	9	49/53
5	Children use phoneme-to-grapheme correspondence to spell, and choose letters that represent the phoneme, but it is the wrong choice of letters for phonemes with multiple mappings	3	5	23	25	18	10	84

Specialist teachers' responses to these statements in relation to children they worked with in the school year 2024/2025.

TABLE 6 Auditory discrimination- Statements arising from spelling errors in the 267 samples of writing that indicate that children may have auditory discrimination difficulties.

Question number	Age of children in each year group	5–6	6–7	7–8	8–9	9–10	10–11	Total
	Total number of children in each year group	3	5	23	25	18	10	84
1	Children cannot hear the difference between the “w” sound as in went and “wh” sound as in when and mix them up when spelling	1	4	21	23	16	7	72
2	Children have great difficulty choosing the correct letter for the short vowel sounds a, e, i, o, u even though the short vowel sounds do not have multiple mappings	3	5	22	22	16	10	78

Specialist teachers' responses to these statements in relation to children they worked with in the school year 2024/2025.

child able to recognize initial consonant blends as an orthographic unit, without the necessity to blend the individual phonemes. For 80 of the 84 children it was very hard to achieve sight word recognition using this decoding strategy because they were entrenched in the habit of “sounding out” every letter and could not recognize words by sight. Furthermore, for 71 children it was very hard to establish a new strategy because decoding phoneme by phoneme had been overlearned to such an extent. These children (71) applied this decoding strategy to attempt to read irregular words because they didn't know when a word was regular or irregular. 59 of the 84 children were entrenched in the habit of “sounding out” every letter in every word, even when they recognized the whole word. Only one child demonstrated the emergence of recognizing patterns in words.

In the focus group meeting the specialist teachers agreed that children had been taught to focus on phonemes only and had not been taught to look for letter patterns at onset and rime, syllable and even whole word level. One ST provided the example of a child reading the irregular word “the” making a sound for each letter “t”, “huh” “eh.” The method for teaching phonics was SSP for all 84 children.

All 84 children “sounded out” each phoneme in turn, breaking the speech stream. In the focus group meeting the STs agreed that this does not constitute blending, it was simply evidence of recognition of phonemes. One teacher expressed the view that taking each sound in turn does not develop word recognition, at the rate needed for reading fluency. There is often a delay after saying the sounds as the child tries to remember the word. Consequently, reading is very labored and pedantic. All of the STs were in agreement and each ST could identify a child or children who had to be told what the word said after the child had been successful in sounding out the phonemes. The sounding out did not facilitate word recognition for children with the severest orthographic difficulties.

All 84 children spell by identifying the sounds they hear in words. 62 children “stretch out” words to segment them and often distort the sounds, even for phonemically regular CVC words. Only one of the 63 children who stretch out words to segment them could do so without distorting the sounds in the word and 21 of the 84 children never stretched words out to segment them.

63 children say the sounds in the words not the letter names. 44 of these 63 children did not know all of the letter names. Letter sounds had been taught as labels for letters rather than letter names

because this is a requirement in SSP programmes. Children who knew the letter names persisted in saying the sounds even when encouraged to say the letter names. All of the STs agreed that letter names should be taught before letter sounds to avoid the confusion when letters have more than one sound, and to avoid the resulting disadvantage when spelling.

Spelling for 81 of the children was impacted by how the child pronounces words.

The STs were in agreement that the multiple mappings presented significant difficulties for all of the children. 52 of the 84 children could link the consonant phoneme to the letter when it was 1: 1 mapping. 75 children were reported to have difficulty with consonant letters that represent more than one sound. All 84 children use phoneme-to-grapheme correspondence to spell, and choose letters that represent the phonemes, but it is the wrong choice of letters for phonemes with multiple mappings. All 84 children could not choose the correct spelling for long vowel sounds and vowel digraphs because of the range of different spellings for these sounds. 49 of 53 children (8–11 years) recognized few, if any, of the vowel digraphs when presented with these in isolation. In the focus group meeting all of the STs agreed that “ee” may be the only digraph that is commonly recognized.

All of the specialist teachers agreed that teaching onset and rime patterns produced positive results when teaching spelling, but that greater benefits would have been achieved if this teaching had occurred earlier in their literacy development as they were now dealing with entrenched difficulties.

In the focus group meeting the STs agreed that difficulty discriminating sounds impacted spelling accuracy. 72 of the 84 children could not hear the difference between the “w” sound in the word went and the “wh” sound in the word when, and these are frequently mixed up when spelling. 78 children had great difficulty discriminating, and therefore choosing, the correct letter for the short vowel sounds a, e, i, o, u, even though the short vowel sounds do not have multiple mappings.

5 Conclusion

The writing samples in this study demonstrate over-reliance on phoneme-to-grapheme correspondence when spelling resulting in varying degrees of difficulty acquiring orthographic knowledge. This research does not support Treiman et al.’s (2019) conjecture that phonological plausibility may lead to orthographic correctness for poor spellers. When considered in conjunction with McMurray’s (2004, 2020) claim that the optimum period for the development of orthographic knowledge is 5–8 years of age (years 1–4 NI), these Year 5 children (8–9 years of age) have passed this optimum period and may have been disadvantaged because they were taught to spell by sound, drawing on phoneme-to-grapheme correspondence only. Phonologically plausible spellings should not be considered progress and teachers should be alert to the possibility that a child of 5–6 years of age may have orthographic processing difficulties which will become more entrenched if there is not explicit structured teaching to develop orthographic knowledge.

It is important now, that a clear distinction is made between alphabetic mapping (phoneme-to-grapheme links) and

orthographic mapping (letter-sound links representing onsets, rimes, syllables and irregular words). Children with the underlying cognitive processing ability to process orthographic knowledge (i.e., orthographic units) implicitly, learn to read easily and fluently, and abstract the orthographic knowledge needed for spelling accuracy, from their reading experience. Learning phoneme-to-grapheme correspondences is supported by a child’s orthographic processing ability, and whilst there is no doubt that phoneme-to-grapheme correspondence should be taught first, observations from the 267 spelling samples suggest earlier intervention to develop orthographic knowledge may benefit this group. The DfE (2023) core phonics criteria advises against the inclusion of initial consonant blends and clusters within synthetic phonics programmes, that is, two or three phonemes recognized as an orthographic unit, but these could be included in SSP programmes to initiate first steps toward orthographic learning for children with working memory and/or orthographic processing difficulties. When phoneme-to-grapheme correspondences have been taught, teaching should move quickly to develop recognition of these early orthographic units within synthetic phonics. This is a lead in to the systematic and structured teaching of spelling.

Children who learn to read easily but are unable to spell correctly are children whose orthographic processing is sufficient for recognition of orthographic patterns when reading, but insufficient for recall when spelling. Children with strong orthographic processing read fluently and their spelling demonstrates orthographic correctness from a very young age as demonstrated by Treiman et al. (2019). As teaching phoneme-to-grapheme correspondence was insufficient for the development of spelling skills for the 267 children in this study and reading fluency is impacted by the over reliance on decoding when reading, it is reasonable to suggest that orthographic processing difficulties may be a cause of reading failure alongside the phonological deficit, and not a consequence of it.

It has been a weakness in the interpretation of the phonological deficit that account was not taken of the orthographic issues that arise due to multiple mappings between phonemes and graphemes, the complex syllable structure in English, and the impact these two factors have on memory storage and retrieval. The findings from this study support McMurray’s (2020) claim that the acquisition of orthographic knowledge has been left to chance, with the expectation that children will acquire this knowledge through implicit learning when reading. It is clear that the children in this study with severe specific literacy difficulties of a dyslexic-type could not acquire orthographic knowledge from reading experience and that teaching phoneme-to-grapheme correspondences only is insufficient for its development.

6 Recommendations

Further research should consider whether early intervention to support the development of orthographic knowledge together with, and not instead of, teaching phoneme-to-grapheme correspondences can positively impact the spelling outcomes for children with severe literacy difficulties as seen in the

267 children in this research, and whether the observational findings in this research apply to the wider group of children with literacy difficulties in mainstream primary classrooms. McMurray (2004, 2006, 2020) provides robust evidence that learning to spell is the vehicle that can provide the systematic sequence and structure needed to significantly impact spelling accuracy through the development of vocabulary understanding, orthographic knowledge, and the associated links with phonology and morphology for all ability groups (impact factor 1.19). However, there were only two experimental and two matched control schools in this study. A larger sample is needed to ensure that there are sufficient numbers of children with severe literacy difficulties to determine to what extent it would proactively address their needs. It may, therefore, be beneficial to replicate McMurray's Ph.D research in a large number of mainstream primary schools with children 5–8 years of age, to ensure that the phoneme-to-grapheme knowledge that has been developed with children 4–5 years of age using SSP, is supported and utilized in the development of orthographic units that represent larger units of sound to enhance spelling accuracy and reading fluency. The average spelling score was almost one standard deviation above the mean (113) with all children in the experimental schools increasing their standardized score over the period of the research (McMurray, 2004, 2006, 2020). For this reason, future research should be within a whole class approach to improve the vocabulary knowledge and spelling performance of all ability groups within mainstream classes as greater success is achieved when intervention is proactive rather than reactive. Given the high impact factor in McMurray's Ph.D research the difficulties experienced by children with orthographic processing difficulties (up to 25% as evidenced by DfE statistics), who are unable to make satisfactory progress with systematic synthetic phonics only, should be addressed if this research is replicated with fidelity.

However, a large-scale study could be problematic in the UK given current DfE policy. There has been widespread adoption of SSP for reading and spelling throughout primary education following the Rose report (Rose, 2006) and the publication of the DfE's core phonics criteria (DfE, 2010, 2023). The Education Endowment Foundation (EEF) (2025) note that “most schools use an SSP approach.” This makes it extremely challenging to undertake robust research into the effectiveness of additional approaches because of the strict requirements set by DfE (2023) for phonics teaching and intervention for those who struggle.

Data availability statement

The datasets presented in this article are not readily available because access to the writing samples dataset is restricted to original researchers. Requests to access the datasets should be directed to SM, sharon@literacydifficulties.com.

Ethics statement

The studies involving humans were approved by Stranmillis University College. The studies were conducted in accordance

with the local legislation and institutional requirements. Written informed consent for participation in this study was provided by the participants' legal guardians/next of kin.

Author contributions

SM: Conceptualization, Writing – review & editing, Data curation, Methodology, Writing – original draft, Formal analysis, Investigation. MM: Formal analysis, Writing – review & editing, Methodology, Investigation, Data curation. PB: Formal analysis, Writing – review & editing.

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