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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

Sharon McMurray 

SEN Literacy Unit, Stranmillis University
College, Belfast, UK

Correspondence

Sharon McMurray, SEN Literacy Unit,
Stranmillis University College, Belfast, UK.
Email: s.mcmurray@stran.ac.uk

This paper considers samples of independent writing highlighting the integral role of phonology, orthography and morphology in spelling development for children from 5–6 years to 7–8 years (3 years of formal schooling). It also introduces an approach to monitoring spelling development by considering the sources of knowledge that are evident in children's attempts to spell when writing independently. Synthetic phonics can be a powerful and effective strategy for both reading and spelling; however when the development of a synthetic phonics strategy fails to take account of the importance of compatibility with orthographic and morphemic knowledge its predominant use can lead to long term spelling difficulties for children who cannot acquire this knowledge from implicit learning when reading. Furthermore, this paper proposes that there may be an optimum period for ensuring the interaction between phonemic, orthographic and morphemic knowledge (5–6 years to 7–8 years; 3 years of formal schooling) during which time significant gains can be made for all children. This optimum period is particularly important for children who are at risk of long-term spelling difficulties because they spell by sounds alone as a result of insensitivity to orthographic and ortho-morphemic patterns.

1 | INTRODUCTION

Fast and efficient retrieval of spellings from memory is an important skill in the translation of ideas into rich and meaningful texts. Yet in spite of a shift from the traditional approach of rote, visual memorization that predominated until the 1990s, the more recent move to an alphabetic strategy has not brought about improvements in the spelling performance of children who struggle. According to McMurray (2006) and Daffern (2017) there are three overarching components that underpin learning to spell effectively: phonology, orthography and morphology referred to by Wolter and Dilworth (2013:77) as the “linguistic trilogy.” Stage theorists (Marsh, Friedman, Welch, & Desberg, 1980; Gentry, 1982; Frith, 1985) proposed that learning to spell is a linear process which proceeds from phonology to orthography to morphology. According to this position, children begin as sound-based spellers, while the roles of orthography and morphology do not become prominent until later in development following qualitative shifts in strategy use (Larkin & Snowling, 2008). Contrary to the claims of stage theorists, more recent research has found that 6-year-old children are able to attend to the orthographic features of words prior to fully mastering the alphabetic principle (Treiman, Kessler, Pollo, Bryne, & Olson, 2016; McMurray, 2006). Thus, as Treiman and Bourassa (2000, p. 17) argue, it is an “oversimplification to label young children as sound-based spellers.” Furthermore, Bourassa and Treiman (2014) consider orthographic rules to be a critical skill in the early stages of learning to spell.

An alternative, non-linear perspective was first proposed by Treiman (1994). Treiman argued that rather than passing through stages, it is more likely that development is continuous, reflecting gradual improvements in children's phonological and orthographic knowledge. The work of McMurray (2006) and Daffern (2017) support this non-linear view. These theorists agree that learning to spell is a non-linear process in which learners become increasingly efficient in the use and coordination of phonological, orthographic and morphological knowledge. However, whilst Daffern's research focused on children aged 7.5–12 years of age McMurray's (2006), 3-year longitudinal study focused on children 5–8 years. McMurray (2004, 2006) provides evidence that children as young as 5–6 years, can demonstrate the ability to draw on all three sources of linguistic knowledge when spelling, and that they do this through implicit learning when reading.

2 | THE ROLE OF IMPLICIT LEARNING IN THE DEVELOPMENT OF ORTHOGRAPHIC KNOWLEDGE

In an educational environment, where the primary method of teaching children to spell is an alphabetic strategy, children who are insensitive to orthographic patterns when reading are seriously disadvantaged. To come to a common understanding of what we mean by orthographic knowledge, it is essential to make a clear distinction between alphabetic knowledge and orthographic knowledge. Alphabetic knowledge relates to the letters of the alphabet and the phonemes they represent. Because English has multiple mappings between graphemes and phonemes, orthographic knowledge is required to know if a spelling “looks right.” A representation of the word, or key word parts, must be in the orthographic lexicon to know if the correct letters have been chosen from the range of plausible alternatives, for example, “because” not “becos.” Orthographic knowledge, therefore, is knowledge of clusters of letters that represent phonemes blended together as units, that is patterns in print at the intra-syllabic unit, syllable and whole word level. Orthographic knowledge is also identifiable in parts of words that cannot be identified by sound: for example, double letters or silent letters or individual phonemes that can be represented by a number of different letters; a further example is the “cuh” sound which can be represented by “c” or “k” at the start of a word or “ck” at the end of a word. McMurray (2004, 2006) contends that good readers who are good spellers can detect patterns in print, and can abstract rules and regularities from their reading experience, unlike good readers who are insensitive to orthographic patterns, and do not benefit from frequency sensitivity when reading (the good readers poor spellers group; Lennox & Siegel, 1993, 1994, 1998). Children with dyslexia have been found to have an implicit learning

deficit (Fernandez, Vaquero, Jimenez, & Defior, 2011), meaning they will require explicit instruction in the abstraction of orthographic regularities to capitalise on the beneficial role of these regularities in learning to spell (Berninger, Yen-Ling, Abbott, & Breznitz, 2008).

Insensitivity to orthographic patterns cannot be picked up at the preschool stage because of children's insufficient reading experience (McMurray, 2010; McMurray & McVeigh, 2016) and may be one reason why its role in long term difficulties has not been identified. A consequence of the predominance of an alphabetic strategy has been neglect in ensuring the development of orthographic knowledge from the beginning of the formal learning process; the neglect is evidenced in disfluent readers and in spelling errors that represent the sounds in words but with the wrong selection of letters.

McMurray (2004, 2006) reports significant gains in learning to spell that can be achieved by all children when an integrated approach to teaching all three sources of knowledge is implemented ($p < .0001$; Effect size 1.19). This research is important because teaching methods in the UK continue to follow a phonics-first staged approach which focuses on phoneme (fine grain; Ziegler & Goswami, 2005) knowledge. Treiman (2017) points to the need for research to examine different teaching methods. She acknowledges that as children learn to read, spelling knowledge can develop, but advises that instruction can help spelling development progress more quickly.

A significant risk factor is that in cases where the term "phonology" is interpreted as being synonymous with a phoneme level approach to phonics, that is synthetic phonics (fine grain level phonics), coarse grain levels of phonics teaching (intra syllabic unit, syllable) and their link with orthography may be neglected.

3 | SYNTHETIC PHONICS ALONE-A CAUSE OF LONG-TERM SPELLING DIFFICULTIES

A synthetic phonics approach teaches children to segment spoken words into phonemes and map these onto graphemes (Steffler, 2001; Zhao, Joshi, Dixon, & Chen, 2017). As these sound-to-letter correspondences increase in accuracy, the alphabetic principle is established and children can utilise this knowledge to support the spelling of phonologically regular words and word parts (Daffern, 2015). This alphabetic principle has been considered a driving force in the early course of learning to spell (Zhao et al., 2017, Department for Education [DfE], 2013). However, when faced with words that include phonemes that can be spelled a number of different ways, the alphabetic strategy is insufficient, because it is dependent on sufficient orthographic knowledge being in place to ensure the correct choice of letters.

It is important to recognise that phonics is not a unitary phenomenon (Lennox & Siegel, 1998), and according to McMurray (2006) can be divided into four levels of sound:- phonemes (representing alphabetic knowledge), onset and rimes (c/an, m/an, r/an; b/est, w/est, t/est, r/est), syllables (in/ter/est/ing) and whole words (yacht, queue, the, are, eye). The latter three levels, which are larger than the individual phoneme level, can be described as orthographic knowledge; the development of orthographic knowledge at these coarse grain levels is essential for normal spelling development. It is critical that phonics teaching, therefore, includes more than phoneme-level knowledge of sounds. The ability to recognise orthographic units, that is, letter patterns that represent phonemes blended together, negates the necessity for decoding phoneme by phoneme for reading or encoding phoneme by phoneme for spelling and enables the development of automatic retrieval from memory. (McMurray & McVeigh, 2016; McMurray, 2006).

This automaticity, which can be developed through learning to spell, also enhances reading fluency. The deep nature of English orthography is characterised by a complex orthographic spelling system where one phoneme can be represented by different graphemes. Consider the vowel phoneme in toe, though, grow, note, float or the vowel phoneme as in flew, blue, shoe, room, through. Conversely a grapheme can represent more than one phoneme. Consider different sounds made by the letter (grapheme) "a" as in want, can, late, draw. The development of orthographic awareness is essential for the beginning speller to prevent dependence on encoding phoneme by phoneme which can lead to entrenched spelling errors that are difficult to change. In cases where this strategy is the only

strategy the child can use, the phonemes in words are known and easily identified, but incorrect letters which represent the phonemes are chosen, for example, cum for come, becos for because, sed for said, skool for school, cote for coat, cilt for killed. It is essential that the acquisition of orthographic knowledge is not left to implicit learning when reading. Just as some children can have a phonological deficit (insensitivity to sounds in words), there is a group of children who are insensitive to orthographic patterns. In the synthetic phonics “first and fast approach” to beginning reading, it has been a flaw to assume that the sources of knowledge essential for its success are in place or can develop through implicit learning.

This point is also made by Nunes and Bryant (2009) with regard to morphology. They suggest that it is a questionable educational practice to leave the discovery of morphology to implicit learning.

4 | MORPHEMIC KNOWLEDGE

The DfE (2013) did introduce a morphological element to their 2013 spelling guidance; this advice, however, is overshadowed by the predominance of a phoneme-based approach, and the almost total absence of the underpinning role of orthographic patterns in assisting the development of a phonics strategy, at all four levels of sound. There has also been neglect in understanding the role of orthographic rules in assisting the development of morphological knowledge. Orthography is the glue that holds the development of phonology and morphology together at compatible levels. Unfortunately, the DfE, 2013 guidance does not seek to ensure the development of all three sources of linguistic knowledge at compatible levels, in an integrated way.

Morphemes are the smallest unit of meaning in spoken language. English consists of free morphemes and bound morphemes. Morphemes that can stand alone as a word are called “free” morphemes. Single syllable words are examples of words that have one morpheme; for example, home/work/cup/board are words consisting of one morpheme, however, they can be combined to make new words that have two morphemes; for example, homework and cupboard. Bound morphemes (affixes) do not stand alone as words but change the meaning of words (free morphemes) when they are bound to them, as in, for example, well- unwell//event-uneventful. It is important to consider meaning (morphemic knowledge) with children of 5–6 years of age who are learning to spell and not just the orthographic pattern or rule. A point also made by Kemp and Bryant (2003). The spelling “lap” represents four free morphemes: “the cat sat on my **lap**”; “the water **lapped** against the shore”; “I ran a **lap** of the track” and “the cat **lapped** up the milk.” Consider the spelling of the free morpheme “read” as in “Can you **read**?” or “I have **read**.” Five morphemes can be spelled with the letters “bow” as in “a **bow** on a dress” or “the **bow** of the ship” or “to **bow**” (tilt your head) or “a violin is played with a **bow**” or “a **bow** and arrow.” Consider the spelling of the bound morpheme “ed” frequently misspelled when it is spelled by sound, for example, “landid (landed), helpt (helped), jumpt (jumped), dancd (danced), cald (called).” How a morpheme or morphemes in a word are pronounced can only be determined by the meaning of the word and the context in which the spelling of the morpheme appears in a sentence. Hurry, Curno, Parker, and Pretzlik (2006) also stresses the importance of morphemes being linked to their meaning function.

Consider also the pronunciation of the morphemes “prove, glove and stove” and “cough, bough, though, through and rough.” These orthographic groupings were common in spelling lists up to the 1990s. Proponents of this traditional view believed that children memorize the sequence of letters in each word with no reference to the sounds in words, or patterns that apply to more than one word at a time (Treiman, 1994, 1998). Indeed Peters (1970, 1985, 1992, 1993), whose influence on spelling within classrooms in the UK was considerable believed that the most important attribute in spelling was good visual perception. Learning to spell according to Peters (1993, p. 180):

“depends on looking carefully at words containing the same letter sequences without regard to sound.”

This theoretical position neglected the important role of sounds in learning to spell and the current phoneme/grapheme approach has neglected the important role of orthography; both have led to failure for different groups of children.

5 | THE IMPORTANCE OF ENSURING THE DEVELOPMENT OF PHONEMIC, ORTHOGRAPHIC AND MORPHEMIC KNOWLEDGE AT COMPATIBLE LEVELS

All of the sources of knowledge associated with the spelling of a word should be established at point of learning and not as a later “add on” to remediate difficulties. There is sufficient evidence of the extent of failure to suggest that the current difficulties with reading fluency and spelling, experienced by some children, have been caused by failure to ensure the development of all three sources of knowledge in tandem.

Norwich, Koutsouris, and Bessudnov (2018), state that “...almost 20% of children in English Primary Schools on entering Key Stage 2 (KS2) are delayed or non-starting readers (DfE, 2017), and analysis of the DfE phonics test in 2016 indicates that around 10% did not reach the nationally set threshold level at the end of Year 2. Secondly, there is an ongoing debate about the primacy of certain phonics approaches over others (synthetic vs. analytic) but the research evidence is inconclusive (Henbest & Apel, 2017). Since the Rose (2006) report, English policy has favoured the synthetic phonics approach. However, the fact that 10% of pupils taught using synthetic phonics still experience difficulties in reading suggests that other approaches should be tried for these children.” (Page 3).

The assumption by teachers and policy makers that orthographic and morphemic knowledge are in place to support a synthetic phonics approach is as erroneous as the belief that the whole-language approach to learning (Goodman, 1967; Smith, 1971) is sufficient for the absorption of a phonics strategy through implicit learning when reading.

A focus on one primary source of knowledge only, such as phoneme to grapheme correspondence, for children who do not process orthographic and morphemic knowledge implicitly from their reading experience, means that phoneme to grapheme correspondence is the only source of knowledge on which a child experiencing difficulty can draw (Devonshire & Fluck, 2010; McMurray & McVeigh, 2016). The strategy intended to be of benefit becomes a major contributor to entrenched spelling difficulties.

6 | WORKING MEMORY DIFFICULTIES AND THE ORTHOGRAPHIC FACTOR

Another important consideration is raised by research into working memory. According to Alloway (2011), a child of 7 years of age with average working memory capacity, can hold only two items in memory. This level of capacity makes blending many words in English difficult for children with average working memory and it is beyond the capability of those with working memory difficulties. The reason is that many syllables in English can be up to six phonemes long, for example, strand. It is clear, therefore, that encoding phoneme by phoneme (for spelling) and blending phoneme by phoneme (for reading), are not appropriate strategies for children with working memory difficulties in the 5–7 age group. Children experiencing difficulty need to have the opportunity to utilise a more effective orthographic strategy at “onset and rime” level otherwise entrenched difficulties occur that would not arise if teaching to reduce the load on working memory were incorporated. By way of illustration, the six phoneme word “strand” requires recall of only two orthographic units, “str” & “and” if onset and rime orthographic patterns that are consistent in sound and spelling are taught. Orthographic units at the onset and rime level support “chunking” (Kelly & Phillips, 2016), which is an essential and long-standing strategy for children with weak working memory (Gathercole &

Alloway, 2008). Furthermore, onset and rime patterns enhance storage in long term memory, reasoning by analogy and encoding speed and accuracy (Goswami, 1988; Squires & Wolter, 2016); they also reduce the complexity of the spelling system (Kessler, 2003).

Spelling at phoneme level is a particularly arduous task, not only for children with poor working memory, but also for those with literacy difficulties and/or speech and language difficulties (Larkin & Snowling, 2008; McMurray, 2008). In spite of this difficulty, spelling at phoneme level remains the most frequently used method in UK teaching practice (Devonshire, Morris, & Fluck, 2013). Furthermore strict adherence to phoneme-grapheme translation, can lead to phonetically plausible errors, such as “sed” for “said” (McMurray, 2008), and “sgie” for “sky” (Bourassa & Treiman, 2001). Unfortunately, as teaching moved away from rote visual memorisation the move to a phonics-based approach in the 1990s encouraged “invented spellings” (Gentry, 1982), formed purely on the basis of sound. More recent research, however, has found that exposure to phonetically plausible spellings can have an adverse effect on spelling knowledge (Bosman & Van Orden, 1997) because phonetic spellings can become embedded in memory and resistant to change (McMurray, 2008).

Furthermore, even regular words are not necessarily straightforward for children learning to spell, as the transparency of their phonemic components vary (Bourassa & Treiman, 2001). For example, young children have a tendency to omit phonemes in onset clusters as they regard these as cohesive units, for example, “flat” is spelled as “fat” (Treiman, 2017). Likewise, syllable final clusters are also susceptible to omission as children can treat nasals (such as /n/ and /m/) as a property of the preceding vowel (Bourassa & Treiman, 2001). Thus, as Treiman and Bourassa (2000, p. 9) state “consistent sound-spelling correspondences would not necessarily be a cure-all during the early stages of development” thus it is important to develop orthographic and morphemic knowledge, to support the retrieval of the correct spelling.

7 | THE INTERRELATED NATURE OF PHONOLOGY, ORTHOGRAPHY AND MORPHOLOGY

It is important to consider the impact of insensitivity to orthographic patterns on the extent to which a child can use a morphemic strategy for selection of the correct spelling or for word building purposes. It is, therefore, essential that children develop, through the use of onset and rime patterns, sensitivity to orthographic patterns, that do not carry meaning. This sensitivity to orthographic patterns that occur in onset and rime groupings aids the development of sensitivity to other orthographic patterns (McMurray, 2006). This development, in turn, underpins the ability to recognise ortho-morphemic patterns across words. According to Daffern (2018) morphological knowledge, reflects the capacity to analyse and manipulate morphemes. In written language, it is orthographic knowledge, orthographic rules and context, that determine the spelling of morphemes. English requires sensitivity to the meaning-related structure of words (Green et al., 2003, cited in Daffern, 2017, p. 311). Along with orthographic conventions, morphological knowledge is an important factor that drives the spelling selection process (Bourassa & Treiman, 2001) and they offer reciprocal benefits. English spelling is more regular at the level of the morpheme than the phoneme when a morpheme carries meaning across a range of words (Devonshire et al., 2013). An example of this is the morpheme graph as in autograph, photograph, telegraph or as mentioned previously adding “ed” to make the past tense of regular verbs.

The link between phonic, orthographic and morphemic knowledge, and the importance of the integrated use of all three, can be demonstrated in this nonsense word. Consider the invented spelling “**gotle**.” Consider how you would pronounce it. Did you read it by taking each phoneme in turn and then blending them together or did you read the word in syllables because you recognised combinations of letters that represent combinations of sounds, removing the necessity to decode phoneme by phoneme? Either way, your pronunciation of the vowel sound will have been a guess because there are two possible pronunciations and you have nothing to guide you to the correct one. I am assuming that you will have identified syllables in your attempt to read the word. Did you pronounce it got/le,

with the syllable division between the t and the l? Or did you pronounce it go/tle with the syllable division between the o and the t? You will see that there are two possible words sharing the same spelling. Now if I provide you with a meaning for each of these words, it becomes clear how each word should be pronounced because the correct pronunciation is denoted by meaning (morphological knowledge). Got/le meaning “to get something by stealing it,” as in the sentence. “She gotled it when he wasn't looking.” OR go/tle meaning to go somewhere slowly' as in the sentence “He gotled on his way home and was late for his dinner.”

As with orthography, the role of morphology becomes increasingly significant as it overrides potential sound-based errors and supports the assembly of increasingly morphologically complex words (Bourassa & Treiman, 2001; McMurray, 2004).

7.1 | Think “sources of knowledge” when considering children's spelling errors

By looking at children's spelling in their independent writing we can ascertain how their spelling knowledge is developing. Attempts at spelling are attempts to spell the sounds heard in a word. As discussed previously in this paper, if a child can only draw on knowledge of phoneme to grapheme correspondences, then spelling errors will abound. Attempting to categorize spelling errors such as a “sep” for ship is futile. Questions such as “*are the digraph 'sh' and the short vowel 'e' for 'i' orthographic errors?*” are questions which offer no insight. Instead consideration of the sources of knowledge evident in spelling errors is much more informative. The only source of knowledge evident in this misspelling is alphabetic. The child has used phoneme to grapheme correspondence to spell the word. There is no evidence of orthographic knowledge in “sep” for ship. Treiman (1993, 1994, 1995) documented how young children often cannot hear the second consonant in a word. Treiman found that regular words containing both onset clusters and final consonant clusters presented difficulty for inexperienced spellers. Second consonants were found to be more susceptible to omission than the first consonants.

Failure to recognise that the spelling errors which children make may be the result of neglect in explicit teaching to develop orthographic and morphemic knowledge, allows the “good readers/good spellers” group to advance well beyond their peers. Children who are “good readers/poor spellers” and “poor readers/poor spellers,” who cannot acquire this knowledge from implicit learning when reading, are disadvantaged from the beginning. The stages that appear apparent in children's writing and which have given rise to stage theories, have been manufactured artificially because of this early neglect in spelling policy. Consequently, the resulting pedagogies which aim to follow this staged approach to spelling development, reinforce the disadvantage experienced by the “good readers/poor spellers” group and the “poor readers/ poor spellers” group.

8 | EVIDENCE FROM TWO CASE STUDIES

8.1 | Child A

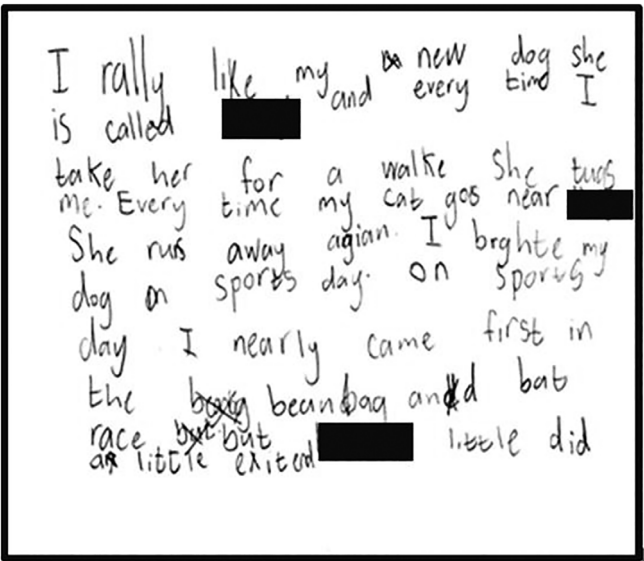
(Names blacked out to ensure anonymity).

Child A had a standardized score at the start of the research of 121 (Table 1) and at the end of the research Child A's standardised score was 130 (the ceiling of the test). This sample of writing (Figure 1) was written in June, Year 2 after almost 6 months on the intervention (which commenced in January of Year 2 NI, equivalent Year 1 England). The words Child A had learned to spell from participation in the intervention were; *I, my, dog, she, is, and, her, for, a, tug, me, cat, run, on, day, in, the, bat, but, did, bag*. Words that Child A had learned to spell via implicit learning when reading were; *like, new, called, every, time, take, near, away, sports, first, bean, race, little*. Spelling errors were; *rally* for really, *walke* for walk, *gos* for goes, *agian* for again, *brghte* for brought, *exitend* for excited.

TABLE 1 Baseline standardised test results (January, Year 2 NI)

Standardized test: Average score for each test =100	Standardized score: January year 2	Standardized score: May year 4
British picture vocabulary scales	117	
British spelling test series	121	130
Primary Reading test	98	110

FIGURE 1 Child A: June Year 2 (Year 2 children 5–6 years). Standardised spelling score 121 (above average)



It is clear that Child A is able to categorize spellings and store them in memory in an organised way. Child A is learning about the rules and regularities in print implicitly through frequency sensitivity gained from reading. Child A's spelling in this sample of writing demonstrates that Child A is processing three sources of linguistic knowledge: phonemic, orthographic and morphemic. Child A's orthographic lexicon is developing and being organised for effective retrieval.

Let us consider the words Child A had not been taught but had spelled correctly, and also Child A's spelling errors. When considering the correct spellings and spelling errors, it is important to consider whether there is evidence of orthographic and/or morphemic knowledge in the word, or parts of the word, that could not be spelled by sounds alone.

In the word "called" there is clear evidence of orthographic knowledge as the "cuh" sound at the beginning of the word could have been spelled with a "k" or a "c," orthographic knowledge is also evident in the double "ll" and morphemic knowledge is evident as the bound morpheme "ed" has been spelled correctly. There is nothing in the sound of the word that would tell child A that an "e" is needed as only the "d" sound can be heard. From child A's reading experience, Child A knows that to make the past tense of regular verbs you add "ed" and even though Child A has added an "n" into the misspelling of excited Child A is still showing awareness of the necessity to have an "e" in the spelling of the bound morpheme "ed." Child A will become increasingly adept at applying this rule with further reading experience. Child A implicitly knows the rule but would not be able to verbalise it at this early stage. Child A would not know how the knowledge has been acquired and would not be able to explain the rule; *add "ed" to make the past tense of regular verbs*. Steffler (2001) also makes the point, that it is not until knowledge is made explicit that children are able to verbalise what they know.

Consider the spelling error in the word “again” (agian). This spelling error demonstrates clearly that Child A has orthographic knowledge. There is no need to be concerned about the “i” and the “a” being in the wrong order. Further exposure to the word or direct effort to learn the spelling will be sufficient to produce the correct spelling. If “said” had been spelled “sed” then this spelling error would be a cause for great concern. High frequency words such as “said” spelled “sed” are a warning signal that the child is not acquiring orthographic knowledge through implicit learning when reading. Phonemic spellings that represent the sounds in words but the wrong letters are chosen, do not represent progress.

Let us consider the spelling error for the word “brought” which was spelled “brghte” confirming developing orthographic awareness. Child A has recalled parts of the word correctly; “br,” a common blend and “ght.” Children with no orthographic awareness spell brought “brot.”

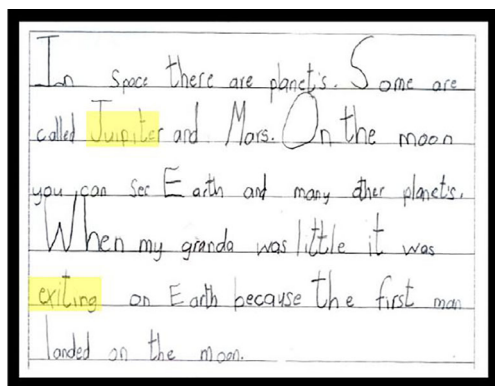


FIGURE 2 January Year 3 (Year 3 children 6–7 years)
[Colour figure can be viewed at wileyonlinelibrary.com]

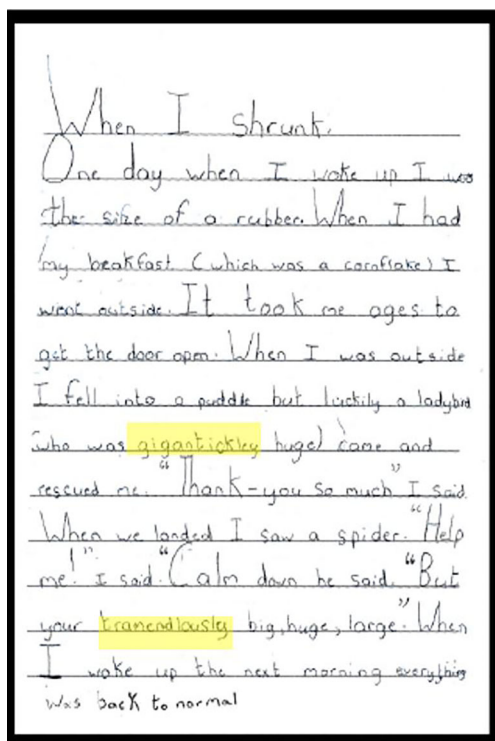


FIGURE 3 December Year 4 (children 7–8 years)
[Colour figure can be viewed at wileyonlinelibrary.com]

If you consider Child A's spelling in Figure 1 which provides evidence of Child A's ability to draw on all three sources of knowledge, it is clear from the samples of writing in Figures 2 and 3 that Child A is becoming increasingly efficient in the use and coordination of phonological, orthographic and morphological knowledge.

Over time Child A was making fewer and infrequent minor errors in spelling as can be seen in Figures 2 and 3 (spelling errors highlighted).

8.2 | Child B

TABLE 2 Baseline standardised test results (January, Year 2 NI)

Standardized test: Average score for each test =100	Standardized score January year 2	Standardized score May year 4
British picture vocabulary scales	113	
British spelling test series	80	109
Primary Reading test	78	93

Now let us consider Child B's samples of writing. Child B's baseline standardised spelling score was 80 and Child B's post intervention score was 109 representing an increase of 29 standard points (Table 2). Child B is in the same class as Child A. This sample of writing was written at the same time as Child A's Figure 1. There is no statistically significant difference in the verbal score for Child A (117) and Child B (113) as the confidence bands for Child A and Child B's BPVS (British Picture Vocabulary Scale) scores overlap. (The BPVS is considered to correlate highly with intelligence tests.) Child B's progress learning to read was unexpectedly poor despite very good use of language and reasoning ability at oral and practical levels.

It is clear from Child B's sample of writing, that Child B is spelling the words as Child B pronounces them, and the spelling errors show no orthographic awareness. The only words Child B spells correctly, have been taught through the spelling intervention with the exception of "have" (Figure 4).

The stage 1 spelling intervention used in this research runs for 20 weeks commencing January of year 2. Spellings are not sent home to be learned. Stage 1 is designed to identify children who have orthographic processing difficulties, and to help all children establish effective learning strategies for both phonological and orthographic processing. In Stages 1–2 the rhyme patterns move very slowly to enable children with orthographic processing difficulties, to develop awareness of orthographic patterns. The morphemic knowledge associated with the words in the

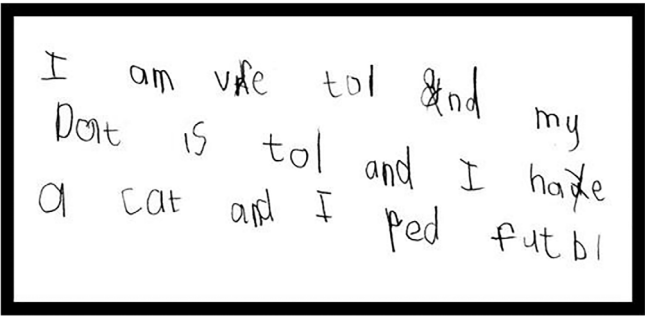


FIGURE 4 Child B June Year 2 (5–6 years). Standardised spelling score 80 (below average)

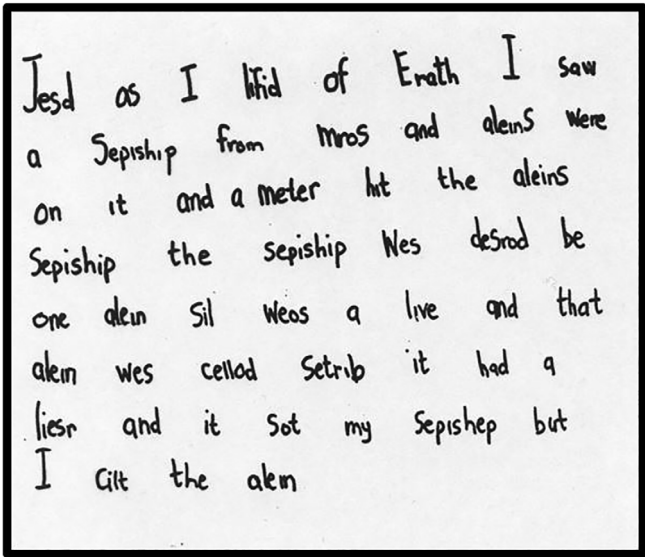


FIGURE 5 January Year 3 (6–7 years)

rhyme patterns in stage 2 provides significant challenge for the majority of the class (who find rhyme patterns easy), and raises spelling performance significantly. In stage 2 high frequency words and the addition of curriculum words

TABLE 3 Spelling errors in Child B's second writing sample as seen in Figure 5

Correct spelling	Child B's attempt	Error
Still shot	- sil sot	Second initial consonant sound has been omitted and also double "l" at end of still. This is consistent with Treiman's research.
Just lazer was meteor	Jesd liesr weos, wes meter	Spelling errors indicate attempts to spell the sounds in the words as child B pronounced them.
called destroyed killed	Callod desrod cilt	Verb inflection "ed" spelled by sound rather than the orthographic rule for the morpheme "ed."
earth aliens	Erath aleins	Incorrect sequencing of letters. Child B spelled both words as they are pronounced by child B.
spaceship strip	Sepishep setrib	Addition of vowel sound in consonant blend in both words; also incorrect final consonant in strip
but Mars	be mros	Incorrect vowel and omission of final consonant because child B may omit the sound in speech. Spelling by sound for the word Mars.

as instructed in the manual provides further extension for more able spellers; it also ensures that words that are taught will be required by children when writing independently. For children like Child B, who are at risk of long-term spelling difficulties, the focus is on providing frequency sensitivity to orthographic rhyme patterns to develop orthographic knowledge.

It is clear from this sample of writing (Figure 5) that Child B is still spelling words the way Child B says them and is unable to draw on orthographic or morphemic knowledge (Table 3).

Child B was in the first term of Year 4 when this sample of writing was completed (Figure 6) and there are now only eight spelling errors in a total of 99 words. Child B can spell almost any word needed. Child B's mother and teacher each

FIGURE 6 December Year 4 (children 7–8 years)

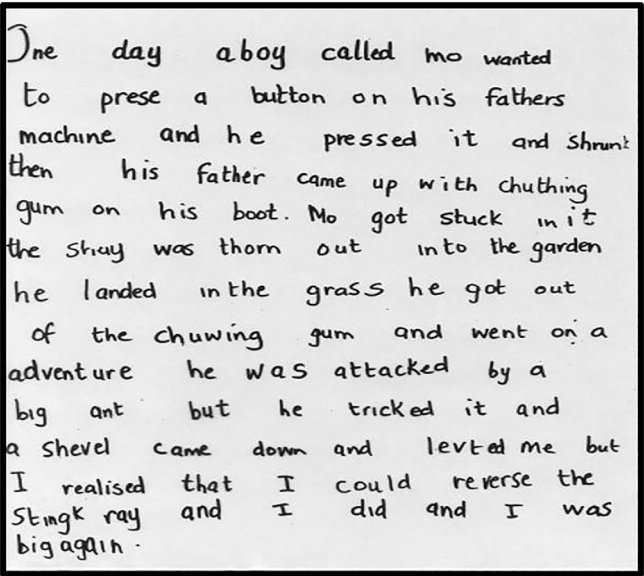


TABLE 4 The spelling knowledge that Child B demonstrated at the end of the first term of Year 4 as seen in Figure 6

Phonemic knowledge only required to spell these words	then, to, and, day, he, a, up, boy, his, it, with, gum, got, in, of, went, by, big, but, me, that, did,
Orthographic knowledge required (more than one way to spell some of the sounds in these words)	one , came, the , was , by , could , again , grass , button , adventure , boot , machine , father , shrunk
Verb inflections added correctly (orthographic rule for the spelling of the morpheme "ed"). Orthographic knowledge also required for letters underlined and in bold	wanted, pressed , called , landed, attacked , tricked , realised

identified almost to the week when "it clicked" for Child B. Child B's brain is now making sense of patterns in written language and is retaining and retrieving correct spellings from the orthographic lexicon. It has taken Child B from January Year 2 to October year 4, to develop sufficient sensitivity to orthographic patterns to enable automatic and accurate

TABLE 5 Spelling errors in writing sample

Correct spelling	Child B's attempt	Correct spelling	Child B's attempt
Stuck	Stock	Chewing	Chuthing
Shoe	Shuy	Thrown	Thorn
Shovel	Shevel	Sting	Stingk
Lifted	Levtd		
Press	Prese		

retrieval of spellings from memory. It may be that this progress was only possible because it was within the optimum period for development of interaction between these knowledge bases. However, this requires further, larger scale research, to establish if these early school years do represent the optimum time for development (Table 4).

Child B showed greater mastery of vowel sounds in words and the orthographic rule for adding the morpheme for the past tense of regular verbs “ed.” Although these errors still appear in Child B’s writing, they are much less frequent. See Table 5.

McMurray (2004) & McMurray & McVeigh (2016) propose 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, van/got, lot, hot, pot; however, rhyme patterns, consistent in sound and spelling, have common elements—that is, the same end pattern with changes only in the initial sound. What may be sufficient experience for one child, to abstract these statistical relationships between phonology and orthography, may be insufficient experience for another. Repeated attempts to spell the same rhyme pattern for weeks on end can be unproductive for some children. This outcome may be because repeating the same rhyme pattern over and over again, does not supply the brain with sufficient information regarding common elements relating to rhyme patterns in general. Similarly, reliance on phoneme to grapheme correspondence, without regard to orthographic patterns, also prevents the brain from abstracting the statistical relationships between

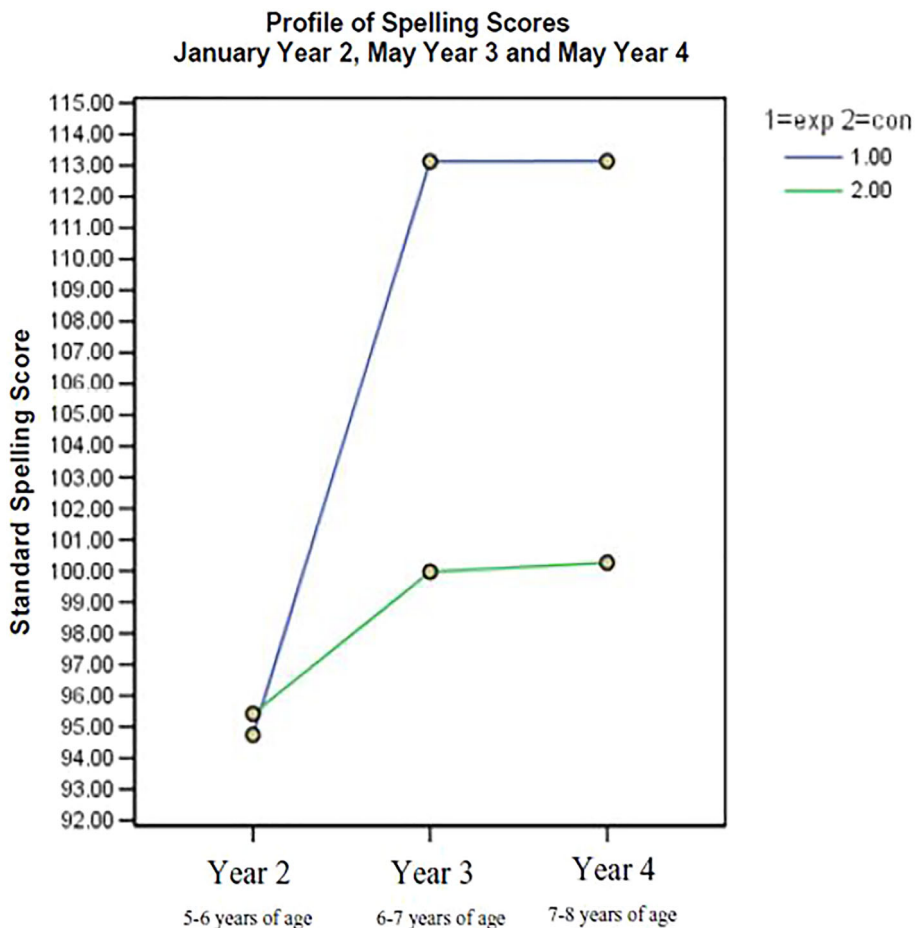


FIGURE 7 Profile of spelling scores January Year 2, May Year 3 and May Year 4 for the Experimental and Control schools [Colour figure can be viewed at wileyonlinelibrary.com]

phonology and orthography. The “formula” remains undiscovered and without the formula the appropriate calculations, at a subconscious level, cannot be made to generate the correct spelling (McMurray, 2004).

McMurray (2004, 2006) suggests that future research is needed to investigate the possibility that there may be an optimum time period for establishing effective interactions between all three sources of linguistic knowledge. The basis for proposing that future research is needed, draws on evidence from a 3 year quasi-experimental research design (Figure 7).

The graph illustrates that the Experimental Schools performed significantly better than the Control Schools. It can also be seen that the Control Schools were unable to make up this significant gap even in the final year when both the Experimental and the Control Schools experienced a ceiling effect. The Experimental Schools average post intervention spelling score was 113 standard points ($p < .0001$; effect size 1.19) almost one standard deviation above the mean. Were it the case that the Experimental Schools progress was accelerated in years 2 and 3 and the ceiling reached, it would be reasonable to expect that the Controls Schools would catch up by the end of year four. It would just take longer. The fact that the pattern of progress was the same for both the Experimental and Control groups may be an indicator that the first 4 years of schooling might be the optimum time period, for connections between the three sources of linguistic knowledge to be established. All of the children in the Experimental Schools increased their standardised scores over the period of the research. For children in the Control schools, the standardised scores for 25% of the children decreased over the period of the research. These are the children who could not learn about morphology and orthography implicitly from their reading experience, and for whom spelling may now be a long term or lifelong difficulty.

It is interesting to note that optimum periods for the development of language (Skuse, 1984) and vision (Holmes et al., 2011; Repka et al., 2002) fall within this time frame. In relation to the development of connections in the brain, Ratey (2002) advises that age makes it harder to reroute and establish new connections.

Educational programmes that focus heavily on one processing route to the exclusion of others, may be detrimental for children who require explicit instruction in all three sources of linguistic knowledge, at compatible levels, to ensure activation of all processes.

It is essential that we help children to develop phonological, orthographic and morphological processing in parallel, so that children can make the connections linking phonological, orthographic and morphemic knowledge. For many children this does not happen without sufficient linguistic experience at both an implicit level, through frequency sensitivity, and at an explicit level through intentional teaching and reinforcement. This experience needs to be gained within an integrated approach which allows the brain to make connections, which integrate all the processes within the entire neurological system at an implicit and explicit level.

9 | IN SUMMARY

Spelling development for children who have no difficulty processing orthographic and morphemic knowledge is underpinned and supported by implicit learning when learning to read. As a result of frequency sensitivity to words in print, orthographic and morphemic knowledge are learned implicitly supporting the organisation, storage and retrieval of words from memory.

Orthographic processing difficulties cannot be determined pre-school because children have limited experience of print at this age. It is not until the end of year 3 NI (6–7 years of age) that children with orthographic difficulties are clearly identifiable but it may be too late at this point to provide the necessary experience to ensure the development of orthographic knowledge at compatible levels with phonology.

Children who have difficulty processing orthographic knowledge show no benefit of frequency sensitivity when reading (good readers-poor spellers) and together with the group of poor readers-poor spellers the 20% + of children with potentially entrenched difficulties can be easily identified.

Whilst phonics is an important source of knowledge in spelling and reading development, its overemphasis, as seen in the UK adoption of synthetic phonics, prohibits normal literacy development for children who do not benefit from implicit learning when reading. This over-emphasis prevents the brain from integrating the three main sources of linguistic knowledge at compatible levels because children have been trained to focus on phoneme grapheme correspondences taking each sound in turn “*all through the word.*” DfE (2010:2). Further problematic recommendations in this core criteria document are:

“that children apply phonic knowledge and skills as their first approach to reading and spelling even if a word is not completely phonically regular” (page 2),

“that, as pupils move through the early stages of acquiring phonics, they are invited to practise by reading texts which are entirely decodable for them, so that they experience success and learn to rely on phonemic strategies” (page 2), and

“It is important that texts are of the appropriate level for children to apply and practise the phonic knowledge and skills that they have learnt. Children should not be expected to use strategies such as whole-word recognition and/or cues from context, grammar, or pictures.” (page 3)

The promotion of blending at phoneme level, where words have more than two phonemes, is beyond the capability of 5–8 year old children who have working memory difficulties. Neglect in teaching orthographic patterns at the intra-syllabic unit level means that children with working memory difficulties and insensitivity to orthographic patterns fail to develop automatic recall of spellings and automatic sight word recognition for reading.

The group of children with orthographic processing and working memory difficulties have been seriously and unnecessarily disadvantaged in schools where there has been a focus on synthetic phonics as described in the DfE (2010) document, without ensuring that the other sources of linguistic knowledge develop at compatible levels.

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ORCID

Sharon McMurray  <https://orcid.org/0000-0002-2293-1928>

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