Tutorial

The Link Between Language and Spelling: What Speech-Language Pathologists and Teachers Need to Know

Carol Moxam[a] iD

Purpose: Speech-language pathologists (SLPs) working within the pediatric field will find themselves working with school-age children and consequently collaborating with teaching staff. Knowledge of the links between language, speech, and literacy can support and inform successful collaboration between the SLP and the teacher and their shared goal of facilitating the school-age child in accessing the curriculum. To facilitate and develop the collaborative working practices of SLPs working with school-age children and teaching staff, it is helpful, to both parties, to develop and extend their explicit understanding of the link between language, speech, and spelling.

Method: In this tutorial, I describe how verbal and written speech and language skills are inextricably linked and key to spelling development and progress. I will (a) discuss the complexities of spelling in the English language; (b) describe the links between language, speech, and spelling; and (c) propose a linguistically informed approach to spelling intervention.

Conclusion: SLPs have expertise in the key speech and language domains such as phonology, morphology, and semantics and are therefore well placed to play an important role in supporting learners in making links between these domains in relation to spelling development and intervention.

Within any education system, written expression is a major communication channel. Furthermore, written expression forms the basis for the school-age learner to express their knowledge and learning in the classroom. Essentially, the written form is a vital step in allowing a child to progress from internal thought and opinions to the written expression of these. A key component of success in written expression is accurate spelling (Kohnen et al., 2009). Given that difficulties in spelling are more common than difficulties in decoding (Temple, 1997), it is surprising that spelling has received less attention in the literature than its counterpart reading, both decoding and comprehension. Support for a greater focus on spelling comes from research and practice, which has shown a reciprocal relationship between reading (i.e., decoding) and spelling (Graham & Santangelo, 2014). In addition, there is evidence to show that spelling intervention can induce positive changes in reading and vice versa (Brunsdon et al., 2005; Kohnen, Nickels, Brunsdonet, & Coltheart, 2008;

Kohnen, Nickels, Coltheart, & Brunsdon, 2008; O'Connor & Jenkins, 1995), with positive effects most likely to flow from spelling to reading (Kohnen et al., 2010). Consequently, given its key role in written expression, there is a need to incorporate spelling, to the same degree as reading, into instruction and intervention. For the sake of clarification within this tutorial, the term "reading" will relate to decoding (the orthographic counterpart to spelling), unless stated otherwise.

There is a growing list of researchers and clinicians (Apel & Masterson, 2001; Bahr et al., 2012; Berninger et al., 2008, 2010; Bourassa & Treiman, 2001; Daffern, 2017; Garcia et al., 2010; Masterson & Apel, 2010a, 2010b, 2013; Nunes et al., 2003; Quick & Erickson, 2018; Silliman et al., 2017) who are raising the profile for a metalinguistic approach to spelling assessment and intervention. Meta-analysis (Graham & Santangelo, 2014) and synthesis of data (Sayeski, 2011; Wanzek et al., 2006) indicate that, to improve spelling skills, explicit formal instruction in spelling strategies and opportunities for practice are central. Furthermore, Galuschka et al. (2014) suggest both phonemic instruction and phonics instruction need to be implemented in conjunction with each other to increase spelling performance.

This tutorial has three primary aims: first, to be a useful addition to the growing literature on the links between

[a]The Children's Speech and Language Clinic, Newcastle University, Newcastle upon Tyne, United Kingdom

Correspondence to Carol Moxam: carol.moxam@ncl.ac.uk

language and spelling; second, to bridge the gap between speech-language pathologists' (SLP') depth of knowledge regarding speech and language and teachers' expertise in teaching practices including phonics; and finally, to bring this literature and knowledge together to inform and support classroom instruction and intervention for the novice or struggling speller. To this end, this tutorial puts forward a metalinguistic spelling approach to spelling assessment and intervention within a metacognitive framework. I refer to this approach as metapractice. The links between language and spelling are captured in Figure 1. Here, I pull together not only the linguistic but also the sensory and motor aspects involved in spelling. Once the multiple linguistic levels and motor and sensory processes involved in the spelling process are considered, as in Figure 1, one cannot fail to be impressed by the achievements of most young spellers as they work toward mastery.

By the end of this tutorial, the reader will be able to identify the linguistic sources implicated in different errors found in English school-age children's spellings and provide a process for the practice of spelling intervention. A case study is used, aimed at enabling the school-based SLP to support teaching staff working with the struggling speller. To this end, this tutorial discusses and describes the underlying linguistic influences involved in spelling development and progress. In this tutorial, I will (a) discuss the complexities of spelling in the English language; (b) continue the themes from the first section and describe the links between language, speech, and spelling; and (c) propose and describe the metapractice approach to spelling assessment and intervention.

For the busy school-based SLP, spelling assessment, instruction, and intervention may be considered more suited to teaching staff. This tutorial sets out to highlight, for SLPs, that their unique depth of knowledge of key linguistic domains places them in an ideal situation to provide

support and intervention for teaching staff and their school-age children who present with spelling difficulties. For the school-based SLP, who has received limited training in spelling development and disorders, this tutorial makes explicit how they can capitalize on their linguistic knowledge in the domain of spelling. Finally, for the SLP and teaching staff, awareness of the links between language, speech, and spelling could inform and enrich collaborations in goal setting, classroom instruction, and intervention.
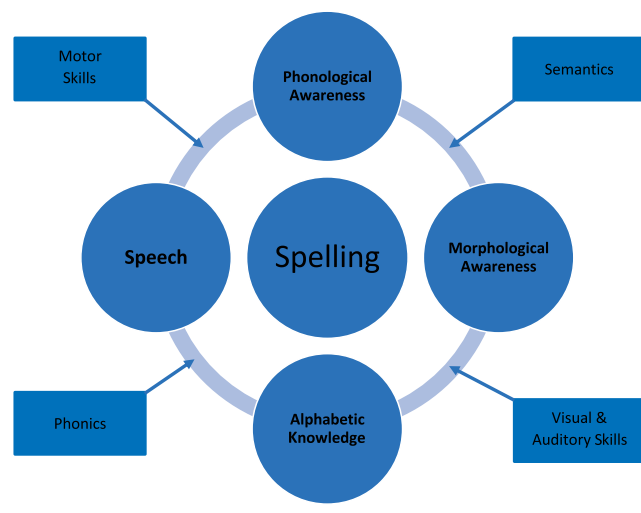
Complexities of Spelling in the English Language

A language is said to be transparent when there is a highly regular relationship between phoneme (sound) and grapheme (a letter or group of letters). If only one grapheme regularly represents a single phoneme, the orthography would be considered completely transparent. A small minority of writing systems, for example, Spanish, Finnish, Italian, Greek, and Turkish, have relatively transparent orthographies (Serrano & Defior, 2008). For these languages, there is high consistency and transparency in phoneme–grapheme correspondence. From the perspective of the novice learner, developing spelling skills within a transparent orthography (Apel, 2011; Serrano & Defior, 2008; Zourou et al., 2010) is the ideal, as the phoneme-grapheme correspondences are highly consistent, thereby aiding the spelling process. Consequently, for the novice speller, learning spelling in a transparent language has its advantages. Cross-linguistic studies demonstrate that basic spelling skills are acquired faster in languages that are transparent (Caravolas & Bruck, 1993) relative to irregular and inconsistent languages. The English alphabetic system is considered a highly irregular and inconsistent orthography and is categorized as opaque, in the sense that phoneme–grapheme correspondences are not obvious to the learner. Consequently, for the novice or struggling speller, learning to spell, in an opaque language such as English, can be a challenging and complex task, as Figure 1 suggests. Therefore, the task of spelling is deemed more challenging in some languages (opaque languages) than others (transparent languages). The increased complexity of spelling within an alphabetic language, such as English, presents the speller with challenges that arise from several sources: process, multiple spelling options, the context of spelling, and learning ability.

Figure 1. Links between language and spelling framework.

The Challenge of Spelling

The process of spelling requires acts of production and recognition (Ise & Schulte-Körne, 2010). Production, from a motoric sense, means that the writer must automatically and fluently form each letter in the correct sequence with correct letter formation (i.e., correct start and finish point when forming letters). This ensures that letters and words are correctly formed and distinguishable from each other. In addition, the writer has to recall the appropriate phoneme/s, select from a range of options the correct grapheme/s to represent these phoneme/s, hold the

information in their short-term memory while they assemble and organize the letters in the correct sequence, and in many cases, draw on auditory and visual sequential memory to support and ensure all graphemes for the target phoneme/s are written in the correct order.

Multiple spelling options within an alphabetic language mean there are multiple options but limited cues to inform which of these numerous spelling options to choose from. For example, in spelling the word "skate," the speller could choose the *sk* or *sc* option. In another example, in the word "quick," does the speller choose *cw*, *qw*, *kw*, or *ckw* for the initial sound, given that each option is a phonetically plausible option for the initial /k/ sound in "quick." Even chwick (just think *choir*) is plausible!

Regarding the context, in almost every European alphabetic system (Ise & Schulte-Körne, 2010), there is inconsistency in phoneme–grapheme correspondences that are important for spelling. English orthography provides more opportunities to misspell than misread a word (Fletcher-Finn et al., 2004). For example, *scool*, *skool*, and *sckool* are all phonetically plausible misspellings for the target word *school*.

Learning ability relates to the fact that the process of learning spellings may be more challenging for some than others. Some learners may become aware of the patterns and rules of spelling with minimal attention, conscious awareness, or effort. These learners may be more able to take advantage of incidental learning (i.e., implicit learning; Reber, 1967) through a process called "statistical learning" (see Saffran et al., 1997, for details). Learning ability suggests that struggling spellers likely find it challenging to learn in this way.

Two major theories of spelling include the stage/phase models (Bear & Templeton, 1998; Ehri, 1995; Frith, 1985; Gentry 1982) and cognitive neuropsychological theories of development. In the former, the view is that children's spelling moves through distinct stages of spelling, including prewriting, sound, morphological, and complete stages. The stage/phase models provide a useful developmental framework for spelling. Cognitive neuropsychological theories of spelling development, such as the dual route model (Coltheart et al., 2001), suggest a division of labor within routes for spelling single words. The dual route model provides a useful framework for the processes involved in spelling. Spelling processing within a cognitive neuropsychological model is achieved through retrieving stored spellings (lexical route) or converting sounds to letters (sublexical route). The lexical route is considered a memory-based route for spelling (Houghton & Zorzi, 2003), and the sublexical route is considered as a phonics-based route. Semantic information may or may not be accessed in spelling, leading to a distinction between a lexical–semantic route and a lexical route. For the target words *which* and *night*, for example, the speller who is aware of the alternative options would need to refer to semantic information to make an informed decision between the homophones: *which/witch* and *knight/night*.

Other theories of spelling development include a constructivist view (Ferreriro & Teberosky, 1982) where spelling moves through stages (presyllabic, syllable, and alphabetic). The child is believed to construct their spelling from what they already know, for example, spelling people as *ppl* where their knowledge the grapheme used to stand for a syllable in the target word. The overlapping wave theory (Kwang & Varnhagen, 2005; Varnhagen et al., 1997) is a process-orientated approach. Spellers are strategic in their spelling, drawing on whatever strategies they have to aid their spelling, including phonological, morphological, and orthographic knowledge.

These theories outlined above have merit. Children do go through stages of progressing to more sophisticated levels of spelling and make use of sound-to-letter conversion, along with whole-word retrieval processes to aid spelling. On the other hand, these models are limited in that they miss the multiple linguistic contributions to the spelling process and development, as illustrated in Figure 1. More recent models of spelling development (e.g., Berninger et al., 2010; Daffern, 2017; Masterson & Apel, 2010b; Treiman & Kessler, 2014) take an integrated, multilinguistic account of spelling. Here, elements such as orthography (which includes alphabetic knowledge and orthotactics), phonology, morphology, and semantics are seminal to the spelling process, development, and intervention. These newer theories of spelling development emphasize the need to make explicit the linguistic elements involved, not only in the development but also in the instruction of and intervention practices for spelling.

The Links Between Language, Speech, and Spelling

Newer theories of spelling development suggest the speller must simultaneously draw on language and literacy domains, including phonological and morphological awareness as well as orthographic knowledge, to achieve success in spelling. The links between language and spelling framework (see Figure 1) highlight these key areas. These have been shown, by Berninger et al. (2006) within the triple word form theory, to be important for spelling success. The notion of the triple word form theory (Berninger et al., 2006) is hypothesized to contribute and determine spelling success. Here, the quality of word representations at orthographic, morphological, and phonological levels is seen as fundamental to the understanding and processing of the internal structure of words for spelling. Within this theory, the linguistic features of words are considered and made explicit in a way that informs the spelling process. The triple word form theory suggests that learning to spell draws on storing and analyzing, in memory, the linguistic forms (phonological, orthographic, and morphological) and the parts inherent within them (phonemes; letters, letter patterns, and groups; prefixes; and inflectional and derivational suffixes; Garcia et al., 2010). The aim is for high-quality linguistic knowledge for analysis and storage that

ultimately informs spelling intervention, learning, and development. What follows is a description of the roles of the multiple linguistic levels of knowledge and processes, as indicated in the links between language and spelling framework.

Orthographic Awareness

Orthography (Apel, 2011) is considered to include alphabetic knowledge and orthotactics (Materston & Apel, 2000). Alphabetic knowledge or "the alphabetic principle" (O'Connor & Bell, 2004) is the knowledge that consonant and vowel sounds in words (phonemes) link with a letter or group of letters (graphemes). In addition, the alphabetic principle comprises the knowledge that there are often alternative options (e.g., the sound dʒ can be represented by the letters *j, g,* or *dge;* the sound /i:/ can be represented by *ee, ey, y, e, ea, ei, ie,* etc.). Orthotactics relates to the positional constraints of graphemes in words and reflects understanding of acceptable and unacceptable letter sequences.

Alphabetic Knowledge—Consonants and Spelling

Alphabetic knowledge, both letter name and letter sound, has been shown to be a foundation skill important for spelling development (Foulin, 2005; Levin et al., 2006; Piasta & Wagner, 2010; Treiman & Kessler, 2003). Alphabetic knowledge relates to the ability to convert a phoneme to the correct grapheme. The alphabetic principle (O'Connor & Bell, 2004) is the knowledge that phonemes link to graphemes and that one can convert one to the other. Novice spellers often use the name of the grapheme to represent a word or syllable (Read, 1986), for example, *are* spelt as *r* and *people* spelt as *ppl.* Letter knowledge for spelling entails letter name and letter sound structure. Letters vary in the degree to which their letter sound properties are represented in their names and the degree to which they are "iconic"—how much their letter names represent the sound they make.

Treiman and Kessler (2003) suggest that English letter names are iconic in that 23 out of 26 letters of the English alphabet, when spoken aloud, have the letter sounds inherent within them. However, many have additional phonemes inherent in their letter names. The [ɛ] sound (as in end) is inherent in the letter name of the consonant graphemes *f, l, m, n, s,* and *x.*; the vowel [i:] (as in *bead*) is inherent in the production of the consonant letter name for the letters *b, d, g, p, t,* and *v,* in this case following the consonant; the vowel [eɪ] (as in *day*) can be heard in the letter names *j* and *k,* again following the consonant; and the vowel [ɑ:] (as in *star*) can be heard in the letter name *r* where the vowel precedes the letter name production [*ar*]. These features explain why the beginner speller might spell the words *car* and *are* as *cr* and *r,* respectively. Another important factor to consider is noniconic letters. An example of a noniconic letter in the English alphabet is the letter *w* where its letter name is /dʌbəlju/. This letter name does not contain its associated sounds. The letter *y* is particularly challenging as its letter name contains the sound heard in the letter sound for the letter *w.* This explains why the word *when* may be spelt as *yen.*

For the beginner speller, properties of letter names are challenging as it may not be clear which part of the letter name constitutes the letter's sound—the vowel sound that comes before or after the consonant, both or neither. Treiman and Broderick (1998) found that beginner spellers (U.K. education system ages 4–6 years) were more likely to know the sounds of letters if the letter sound was present at the beginning of its associated letter name, as in the letters /*p, t, d, b, a*/, than if the letter sound is at the end of its letter name, as in the letters /*l, m*/. The suggestion is that consonants are easier to discriminate when the vowel sound appears after the consonant, when you say its letter name, than when the vowel appears before the consonant, perhaps because the consonant is more salient coming before a vowel than after.

Another important aspect of letter name structure is its inconsistency with some letter names inconsistently related to their letter sounds. For example, the letter *c* can represent the sound [k] as in *cat, choir,* or *school;* the sound [s] as in *ice;* and the sound [ʃ] as in *ocean.* In another example, the letter *y* can represent [y], [ai], or [i:] as heard in the words *yes, by,* and *baby,* respectively. In summary, letter names and the vowel and consonant sounds inherent in them can result in spelling errors, such as *by* or *bye* spelt as *bi* or *nice* spelt as *nis.*

Alphabetic Knowledge—Vowels and Spelling

Another important aspect of letter name structure is the inconsistency with which some letter names relate to letter sounds. For example, a speller who misspells *bot* for *boat* has clearly used the alphabetic principle; they have spelt *boat* using plausible phoneme–grapheme rule application [b], [o], [t]. Here, the sound in the letter name of *o* has the diphthong [əʊ] quality sound and has consequently been used to represent the diphthong [əʊ] pattern. Thus, relying on letter names or letter sound for signaling vowels can result in phonetically accurate but orthographically incorrect spellings.

A vowel diphthong is described by Ladefoged (2005) as a sound that changes in vowel quality during its production. Although there are two distinct vowels inherent within a vowel diphthong (see Table 1), there is no syllable

Table 1. Vowel elements in vowel diphthongs.

Vowel diphthong	Example word	First vowel sound	Second vowel sound
ɛɪ	F**a**ce	ɛ as in b**e**d	ɪ as in p**i**t
əʊ	C**oa**t	ə as in **u**pon	ʊ as in g**oo**d
aɪ	K**i**te	a as in sk**y**	ɪ as in p**i**t
aʊ	C**ow**	a as in sk**y**	ʊ as in g**oo**d
ɔɪ	B**oy**	ɔ as in sh**or**t	ɪ as in p**i**t

break in their oral production. This means that vowel diphthongs have changing phonetic properties, and a novice or struggling speller could potentially focus on only one aspect of this and try to represent this in their spelling.

It is feasible to hypothesize that a beginner or struggling speller may focus on the first or second vowel quality of vowel diphthongs in their spelling. In the case of spelling *paper* as /pep/, where the speller has made use of the letter /e/ for the diphthong [ɛɪ], the speller has used the initial vowel sound [ɛ] to represent the vowel diphthong in the first syllable of *paper*. Short vowels are also important for spelling. In most cases, this is seen when spellers use the letter's name as a clue to spell vowels because the letter name has phonetic properties close to the target sound, and this can result in incorrect spelling. For example, in the word *bacon,* the vowel diphthong, in the first syllable, has the same name as the vowel letter name for the /a/ grapheme. This can result in misspelling, for example, *break* spelt as *brak.*

Orthotactic Awareness

Orthotactic knowledge is used to refer to the positional constraints of graphemes that represent sounds in words (Goulandris, 1994). It reflects understanding of acceptable and unacceptable letter sequences and consequently plays a key role in spelling. This also includes, for example, knowledge of spaces between words. More specifically, this relates to the rules around placement of grapheme or graphemes within words, and this is important for correct realization of spellings. Examples include the fact that the letter sequence *ck* can never occur at the start of an English word and the letter *v* can never occur at the end of an English word. In another example, the long [e:] vowel pattern means that the [e] at the end of a one-syllable word such as *hate* leads to the "a" being realized as [ɛɪ]; the [a] in *hat* becomes an [ɛɪ] in [hɛɪt]. Furthermore, certain letter sequences frequently appear together, for example, *ing, tion, able,* and knowledge of these are key for spelling.

Speech, Phonological Awareness, and Spelling

Spelling difficulties are seen in children with phonological disorder (Schuele, 2004) and children with speech sound disorder (McNeil et al., 2017). The current thinking is that speech difficulties are linked to higher risks of literacy problems in the context of poor language and/or phonological awareness skills deficits (Pennington & Bishop, 2009) and/or when the speech difficulties are severe (Dodd, 1995). The links between speech, phonological awareness, and spelling are therefore key in spelling development.

Speech and Spelling

SLPs and teaching staff, working on literacy, need to engage with the relationship between speech and spelling when working with children and when talking with parents about their child's progress or otherwise. It is likely that, like me, SLPs have experienced and had to reassure parents about the links between child speech and the influence, or otherwise, on spelling. Parents and likely education staff may question the behavior of the child who is "sounding out," that is, pronouncing each letter separately, in order to aid spelling. For the purposes of devising an intervention plan, it is important to note how the child articulates the sounds they are sounding out, what they eventually write, and whether these elements are likely linked. Furthermore, linked to this is the child's sensitivity to the phonetic features of words (Bourassa & Treiman, 2003) and spelling.

Children are sensitive to a sound's phonetic features (Bourassa & Treiman, 2003). This sensitivity is attributed to the influence of phonologically conditioned allomorphs, that is, morphemes that vary according to context. A classic example is past tense *–ed,* which can be realized as [t], [d], or [ɪd]. These allomorphs are problematic for spelling because, as shown in Table 2, their form is influenced by neighboring sounds and morphophonology and may be realized as phonetically correct but orthographically incorrect.

Consequently, morphophonology influences the novice speller's representation of these allomorphs in spelling. This entails that the novice or struggling speller will try to represent the phonetic features of the words they hear rather than adhere to the morphological rules and spelling conventions. This sensitivity to the phonetic features of sounds can result in what is described as, at worse, illogical at best phonetic spelling. However, on examination, the speller is making logical choices through their phonetic analysis and using this to inform their orthographic choices. For example, common spelling errors that result from phonetic sensitivity include the spelling of regular plurals and regular past tense forms as given in Table 2.

In other examples, spelling *dry as jri* or *hand as had* can be explained by children's phonetic sensitivity. The child may classify some segments of a spoken word differently than assumed by the conventional writing system. For instance, spelling *dry as jri,* although erroneous, is phonetically plausible. Essentially, when a child comes across a word such as *dry* for spelling, they tend to write the digraph /dr/ as /j/. Treiman (1993) suggests that children write /d/ before /r/ as a /j/. In this example, when /d/ occurs before /r/, the contact between the blade of the tongue

Table 2. Signaling regular plural and past tense forms.

Phonological conditioned allomorph	Context	Example
Plural segment is /s/	After voiceless sound	cup–cups
Plural segment is /z/	After voiced sound	birdz–birds
Plural segment is /iz/	After s, z, sh, sound	rosiz–roses
Past tense segment is /t/	After voiceless sound	pickt–picked
Past tense segment is /d/	After voiced sound	bangd–banged
Past tense segment is /id/	After alveolar plosive	plantid–planted

and the alveolar ridge is made further back in the mouth (postalveolar region) than when /d/ occurs before a vowel. Furthermore, the closure is released more slowly than when /d/ precedes a vowel due to the phased transition into the alveolar approximant. This gives /d/ before /r/ a degree of friction that is like the friction that occurs in [dʒ], which is normally spelt as /j/. Phonetic sensitivity is therefore critically important in spelling in alphabetic script. In the case of spelling *hand* as *had,* English-speaking children may consider nasality to be a property of the vowel rather than a separate unit. Consequently, in spelling *hand* as *had,* the speller has signaled the vowel within their spelling but has assumed that the nasal consonant is part of the vowel and therefore assimilates it with the end /d/ consonant rather than representing it as a separate unit. In summary, there are many linguistic processes that influence spelling, including morphophonology; articulatory gestures of place, manner, and voice; anticipation of other phonemes; and the exaggerated pronunciations of letters, often heard by the novice speller (who is drawing on auditory and kinaesthetic feedback) in their spelling recitations. All these factors are likely to influence the novice or struggling speller rather than motor processing.

Phonological awareness refers to the ability to explicitly identify, reflect on, and manipulate the sound structures of a language (Masterson & Apel, 2010a). To master spelling in an alphabetic script, the learner must have an explicit understanding that words consist of syllables. In addition, the learner needs to appreciate the internal structure of these syllables, including onsets and rimes (intrasyllabic level) and phonemes (phonemic level). These phonemes are represented by a grapheme. According to the phonological deficit hypothesis (Goswami & Bryant, 1990), a deficit in phonological awareness is enough to cause difficulties when spelling new or unfamiliar words.

Phonemes are the smallest segment of a spoken language's phonological structure that cues meaningful differences between words. It allows the speller to identify the number of sounds in words that supports decisions around grapheme selection in spelling words. Learning to spell in English depends on accurate mapping between phonemes and graphemes (Zourou et al., 2010). However, the English alphabetic system often has several graphemes that can be used to represent the same phoneme as shown in Table 3, a characteristic I describe, in my practice, as higher level

alphabetic knowledge. In this view, progress in spelling is seen as the speller moves from basic phoneme–grapheme knowledge to a higher level of knowledge where they realize that a phoneme can have multiple options of grapheme representation.

At the intrasyllabic level, phonemes are combined to form larger units. These units relate to the onset, the initial consonant/s (e.g., *c* in *cat* and *spl* in *splash*), the rime (*at* in *cat* and *ash* in *splash*), the vowel nucleus (*a* in *cat* and *splash*), and the coda, the consonants after the vowel nucleus (*t* in *cat* and *sh* in *splash*). These elements are key for spelling. Rimes have neighbors that may vary in orthographic and/or phonological form (see Table 4). Therefore, at the intrasyllabic level, explicit (orthographic and phonological) rime awareness is key to successful spelling. Syllabic awareness allows the speller to break words into syllables and then assign graphemes or groups of graphemes to each syllable. These elements can be informed by linguistic knowledge at the phonemic, semantic, and/or morphological levels.

Morphemes, Semantics, and Spelling

For spelling to progress, the speller needs to move from spelling based on sound-based patterns (phonology) to spelling-based knowledge of morphology and meaning (semantics). Awareness of morphemes in words is known as morphological awareness. The understanding and ability to reflect on and manipulate the meaningful parts of a language (such as roots, prefixes, and suffixes) contribute to spelling (Apel & Lawrence, 2011). This knowledge helps the learner to understand and appreciate morpheme forms and their semantic contribution to spelling.

Morphological Awareness

Morphological awareness is the ability to consciously analyze, reflect on, and manipulate the structure of words in terms of their units of meaning, that is, morphemes (Carlisle, 1995). The hypothesis that certain spelling difficulties arise from limited morphological awareness is referred to as the morphological deficit hypothesis (Bourassa & Treiman, 2001). This hypothesis attributes difficulty in spelling to the learner not having an awareness of how words are broken down into morphemes and, consequently, the awareness or ability to apply morphological structures to English words. Inability to signal morphology in spelling puts learners at risk of not progressing beyond sound-based to meaning-based spelling.

Within the domain of morphology, a distinction is made between inflectional and derivational morphology. Explicit awareness of inflectional and derivational morphology is key to spelling, as it supports the learner's progression from an alphabetic and phonological task to one that includes morphology. In this way, it allows the speller to appreciate how morphemes can be reflected orthographically in the light of, what can be conflicting, phonological information.

Table 3. Example of alternative spelling options.

Phoneme	Common spelling options	Examples
[t]	t, tt	Put, butt
[f]	F, ff, ph, gh	Fox, coffee, phone, cough
[dʒ]	J, g	Jug, gem
[k]	k, ck, c, ch, que, q,	Kite, lock, cat, school, chemist, antique, quiet
[ʃ]	ch, sh	Chef, shelf
[iː]	ie, ea, ee,	Chief, beat, bee

Table 4. Homophone variants and spellings.

Homophone variant	Description/phonological form	Orthographic rime forms
Heterographic homophone	Spelt differently and sound the same	H**erd**–h**eard**
Homographic heterophone	Spelt the same and sound different	B**eef**, ch**ief**, l**eaf**, H**int**–p**int**
Homographic homophone	Spelt the same and sound the same	H**ave**–g**ave** S**ave**–g**ave** H**int**–m**int**

For example, with regard to inflectional morphology, the spelling of the past tense morpheme units in the words *played, jumped,* and *waited* has the phonological form *[d]*, *[t]*, and *[id],* respectively, with each form, the allomorphs, being a variant of the past tense morpheme. A speller signaling these allomorphs, within their spelling, is reflecting the sound properties of the target. However, perhaps they are unaware that the orthographic representation is *–ed* and remains so in spite of the phonological form suggesting otherwise. In addition, at the phonetic level, speech is represented by strings of phones. Each phone represents a combination of articulatory gestures, including place, manner, and voicing (Ladefoged, 2005). It is likely that together these factors help explain why the speller makes phonological and orthographic errors when signaling morphemes in spelling. Developing explicit awareness of morphemic units and their function in conveying meaning in the written form informs a learner's morphosyntactic awareness and knowledge of the internal structure of words. Consequently, knowing that *played, walked,* and *wanted* each have two morphemes (the verb base morpheme and the inflectional morpheme *–ed*), which are represented in a consistent way regardless of phonological presentation, will enable a child to accurately spell these words.

Derivational morphology is important for the generation of new words from a base morpheme, resulting in a new word. This word will differ in meaning and may differ in word class. For the speller, this knowledge is useful for creating new words for spelling. For example, adding the derivational suffix *–ful* to the base *play* creates the word *playful,* thereby altering the meaning of the word and changing the word class from a verb to an adjective. The relevance and importance of morphology to spelling is evident from recent instructional studies (Apel & Diehm 2013; McCutchen et al., 2013; Wolter & Dilworth, 2013; Wolter & Squires, 2014), meta-analyses (Bowers et al., 2010; Goodwin & Aln, 2010, 2013), and reviews (Carlisle & Goodwin, 2013), which have found significant effects of morphological instruction for improving spelling.

Semantic Awareness

Semantics becomes important when one considers homophones, that is, words that sound the same but have different meanings. Semantic knowledge is necessary for the child to use correct spelling to signal the correct meaning. Relying on just what is heard without taking account

contextual knowledge will result in incorrect spelling. For example, without semantic knowledge, the individual may not be able to choose the correct word from a range of options. For example, in the sentence, *I went to/two/ too the shops to/too/two buy/bye/by two/too/to pairs/ pears of shoes and my friend came too/two/to,* the speller may or may not know the alternative forms for homophones but needs to in order to ensure meaningful spellings. The speller may have limited knowledge of alternative option and thus may go with what they know, which may or may not be the correct option. Thus, semantic knowledge can inform or hinder spelling at sentence level, and when considered in combination with orthography, it can present a confusing picture. The speller may or may not know that there are several meanings for the word /tu/ but not know the alternative spellings (to, too, two), or they may know the alternative spellings but not the associated meanings.

A Metalinguistic Metacognitive Approach to Spelling Intervention

The metalinguistic approach within a metacognitive framework "metapractice" is proposed as an approach to assessment and intervention that clinicians and teachers can utilize in the assessment and intervention of spelling.

Metalinguistic Element

The links between language and spelling framework suggest a linguistic approach to assessment and intervention. The metalinguistic aspect of metapractice promotes explicit instruction in orthographical, phonological, morphological, and semantic processes involved in spelling. This metalinguistic approach entails supporting the child in building explicit awareness, through visual and verbal techniques, of how to manipulate the structural features of language important for spelling.

The linguistic aspect has implications for assessment and intervention of spelling difficulties and disorders. The suggestion is that the linguistic analysis (i.e., phonological, orthographic, morphological, and semantic) of spelling errors that underpin the incorrect spelling informs the interventionist as to where attention needs to focus for spelling remediation. Traditional approaches to spelling assessment are considered in absolute terms; the speller is either correct or not. This approach is limited in its capacity and

sensitivity in recognizing emerging and acquired utilization of linguistic skills important for spelling. Incorrect spellings can reflect progress and change at a linguistic level, and this can be used to inform intervention. For example, the spelling of the target word *station* where the speller moved from *statshun* to *stasion,* although incorrect, suggests awareness of alternative spelling patterns. The aim is for spelling assessment to ensure that spellers' linguistic skills, current and emerging, are considered so appropriate intervention can be suggested. In this way, SLPs or classroom educators can support the novice or struggling speller, from a position of informed knowledge, to progress in their spelling.

Metacognitive Element

The metacognitive aspect (see Appendix A) of the metapractice approach is informed by Flavell's (1979) work and has two primary aims. The first aim is to encourage the learner to take responsibility for their learning and in a very explicit way through promoting and supporting their active engagement in the process of spelling. Furthermore, the process can be promoted through making explicit (in both verbal and written means) to the child the task aims and objectives and the rationale for this, what they are doing and why, what they currently know and need to know, what strategies or techniques they need to use, and how the strategy will support learning. This process can be supported through the What Have I Learned Cards (WHILC; see Appendix B). Here, children are encouraged to reflect on their learning in verbal and written forms. The WHILC aims to promote and support the reflective process inherent within a metacognitive instructional framework. In addition, Top Tips Cards (see Appendix C) provide the learner with tips to support learning. The metacognitive element encourages teaching practices that promote thinking about thinking in spelling. Furthermore, it aims to build awareness of the content purpose of the strategies, knowledge, and skills being learnt. The second aim is to support generalization from the original learning context to other settings such as home and school. This can be promoted through, for example, making explicit how the learning within the original context (e.g., school) relates to and is useful within and other contexts such as home. The metacognitive aspect of metapractice is considered at three levels: person, task, and strategy.

Metacognitive person-level knowledge refers to the learner's knowledge regarding the learning process. The relevance here is that personal self-efficacy can impact on the level of active engagement by the learner. Metacognitive task knowledge is the learner's knowledge of the nature of the task in hand and the possible challenges; you as a learner may have some specific task knowledge but need to develop further skills. In this way, the learner and interventionist (SLP or teacher) have a shared knowledge of the demands of the task. Metacognitive strategy knowledge refers to knowledge and awareness of the types of strategies that could be used to reach a goal. In addition, it refers

to knowledge of when and under what circumstances strategies can be used. For example, knowing subvocal rehearsal is a useful strategy to aid spelling of a single word but not for spelling a list of words.

Metapractice Intervention—Feedback

Success in literacy is attributed to corrective feedback (Wanzek et al., 2006) and reflection (Berninger et al., 2008). Therefore, their inclusion in intervention is key. The learner is provided with immediate and informative feedback and praise, both verbal and written, on what they have done or are doing within a task or after a task. The feedback needs to inform their practice, for example, comparison between their written representation of the word and correct orthographic target representation. Praise needs to reinforce the process the child is or needs to be exhibiting. This can be supported through explicit (verbal and written) feedback. Below, I will set out guidelines, using an example case, to illustrate how metapractice can be utilized to inform assessment and intervention

A Child Case Example

School-based SLPs or teaching staff could encounter a child such as Tom, a school-age child aged 9 years. Tom's speech and language skills are within the expected average range for his age as compared to his peers. Furthermore, there were no reported sensory or motor difficulties. Tom presents with the spelling profile, as illustrated in Table 5. Using the links between language and spelling framework, one can draw on this to guide decisions around the linguistic knowledge and processes one needs to consider in regard to assessment and intervention. Evidently, Tom's spellings are phonetically accurate but orthographically incorrect. Despite in-school phonics (synthetic and analytical approaches), Tom's spelling remains a real challenge for him. From the linguistic analysis (see Table 5) and drawing on spelling assessment data (see Appendix D), Tom's spelling indicates a primarily phonetic spelling profile with some alphabetic inaccuracies. The indication is that there is a need for higher level alphabetic knowledge development (orthographic knowledge–alphabetic level) and phonological awareness at the intrasyllabic level (phonological level). Tom also demonstrates some difficulties in signaling correct past tense forms (morphological level) in the words he has attempted to spell. Tom also shows confusion over homophones (semantic level).

Metalinguistic Intervention

Given Tom's spelling profile, instruction needs to develop his knowledge and awareness of the internal structure of words drawing on linguistic elements of phonology, orthography, morphology, and semantics. Table 5 provides suggestions for linguistic levels of intervention for Tom. For Tom, the development of metalinguistic awareness at the levels discussed would support his ability to think explicitly

Table 5. Linguistic analysis and intervention suggestions for Tom.

Target word	Tom's spelling	Linguistic domain of difficulty	Interpretation	Intervention suggestion
voice	Vose	Orthography	Knowing alternative spelling options for [s]. Is aware of /s/ saying s but he now needs to learn the alternatives.	**Higher level alphabetic knowledge** – teaching the alternative spelling patterns for consonants starting with /s/ spelling options.
knew	new	Orthography	Is aware of alternative pattern for [n]	**Semantic awareness** – focus on teaching concept of
heard	herd	Alphabetic	Homophone error knew–new	homophones and variants (see Table 1).
dear	deer	Semantics		
stories	storys	Morphology	Is aware of how to signal plural in spelling	**Morphological awareness** – focus on teaching
classes	clasis		Is aware of use of s but not of alternative options	inflectional morphology. In this case, plural forms and how to signal them in spelling –s or –es endings (change y to i then add es).
frightened	friend	Phonological	Is aware of at least one appropriate spelling	**Phonological awareness** at intrasyllabic level –
stopped wrapped	stopt	awareness	pattern for target (ite) needs to be aware	focus on common rime pattern differences and
invented	rapt	Morphology	of options for the pattern (ight)	similarities, e.g., ite for ight as well as other
	invented		Limited knowledge for /i/ and /r/ spelling pattern.	common rime patterns.
			Is aware of the –ed pattern and can apply it.	**Morphological awareness** – focus on teaching inflectional morphology; in this case, past tense forms and how their sounds imply a spelling, but you use –ed ending.
				Vowel awareness for /i/ pattern – teach alternative spelling options for vowel patterns.
hedge	Heche	Orthography	Sound and graphemic errors [ch] for [dʒ]	**Orthography awareness** – focus on alternative spelling patterns for j.
information	infmashon	Orthography	Phonetic spelling of key spelling pattern.	**Phonological and orthography awareness –** focus
explosion	exploushon		Not aware of fact that –tion is the most common pattern.	on alphabetic knowledge alongside phonological awareness focusing on common rime families –tion, –sion, and -cian. Be useful to highlight –tion as the most common pattern and –cian used when word refers to a job or career.
used	uoosd	Orthography	Split vowel digraph error uoo for u-e	**Orthography awareness** – focus on teaching long
		Morphology	Inflectional morphology error for past tense forms	vowel patterns.
				Morphological awareness – focus on inflectional morphology—past tense forms.

about the linguistic skills relevant to his spelling. Metapractice for Tom fits the triple word form theory (Berninger et al., 2006). For Tom, learning to spell entails supporting him in analyzing several levels of language (phonology, orthography, semantics, and morphology) and their parts (phonemes, graphemes, letter patterns, and morphemic units).

Metacognitive Intervention

The metacognitive process (see Appendix A, Orientation) of making learning explicit within the metapractice approach has two primary aims for Tom: first, to encourage his ability to take responsibility for his learning through his active engagement in the learning process, and second, to support generalization from the original learning context to other settings such as home and school. This can be promoted through making explicit to Tom knowledge at person, task, and strategy levels.

At the person level (see Appendix A, Demonstration), this would entail making explicit to Tom what he currently already knows and now needs to know (i.e., he can spell using sound-to-letter correspondences), his learning processes (i.e., his use of sound-to-letter conversion is correct, and he now needs to learn the alternative grapheme options), and when to put his knowledge into functional use in other contexts outside the original learning context. At the task level, Tom's knowledge of the nature of the task in hand is made explicit. For example, "I am going to read some words to you and you are going to see if you can identify, from my list (e.g., cats, ice, house, etc.) the letter or letters that make the [s] sound (the task) and then we are going to make a grid of all the ways to write the [s] sound with some example words to remind us." Then, to inform Tom of the potential challenges, in this case, "It is not always easy to know which spelling option to choose. In this task, you are learning about the [s] spelling patterns. There are some common ones and some rarer ones. You know some (show him his spelling of the target word voice with the s spelling option) but you need to learn the other common options." In this way, Tom has a clear idea of the task he is doing and why. At the strategy level (see Appendix A, Practice), Tom needs to be aware of his spelling strategy strengths and needs. His spellings are phonetically accurate and therefore, in some cases, close to the target. Furthermore, Tom's knowledge and awareness of the types of strategies or techniques that could be used to reach a goal are made explicit. This is achieved through, for example, drawing on data from Tom's spelling analysis and alerting Tom to what he knows: "Tom you already know that the past tense pattern can be spelt as –ed (then show Tom his spelling of the word invented), and this is the way you can show the past tense." Then, Tom would be informed of what he needs to know now: "When the word refers to past tense, you always use the –ed ending even if it sounds like something else." Finally, Tom needs to know when and under what circumstances he can use these strategies to support his onward learning.

For example, you could suggest to Tom, "When you are talking about the past tense, the end part of the word may sound like t, d, id as in walked, played, wanted, but you still use the –ed form." Once Tom has the concept, he can move on to putting this knowledge into practice with a range of words.

Metapractice Intervention—Feedback

Tom would be provided with immediate, informative, and explicit feedback and praise on what he has or is doing within a task or after a task (see Appendix A, Reflection). The feedback would inform his practice, and the praise needs to be encouraging as to the process Tom is or needs to be exhibiting. Feedback would make use of both verbal and written modalities. In addition, WHILC could be drawn to support this, for example, making clear and explicit letter-by-letter comparisons between his written representation of the target word and the correct orthographic target representations. Thus, instead of a cross alongside the word *new*, he would receive three ticks (one for each letter correct). He would then be asked to reflect on his learning, for example, "In the word knew, as in I knew he was lying, what do you need to remember for this spelling?" The expected response is "I use the *kn* spelling pattern." Finally, one could reiterate the homophone nature of words *knew* and *new*, that is, the fact that the words *knew* and *new* sound the same but are spelt differently and mean different things.

Conclusion

The links between language and spelling framework suggest a metacognitively based metalinguistic approach to assessment and intervention. Knowledge of the linguistic processes involved in spelling errors guides and informs interpretation of assessment data and intervention decisions. Links can be drawn between assessment data and linguistic domains implied, and intervention focuses on what and how to apply these linguistic elements to aid spelling. The links between language and spelling framework make explicit the key linguistic knowledge and sensory and motor domains for consideration regarding spelling assessment and intervention. The SLP and the teacher can draw on the links illustrated to guide their assessment and intervention decisions. A metacognitive instructional approach forms the process of practice and instructional organizing framework to support and actively engage the learner in the metalinguistic learning process for spelling. This metapractice approach takes an informed (linguistic) and explicit (metacognitive) approach to spelling assessment, analysis, and intervention. The aim is to induce a system-wide change in spelling. The speech and language therapist is ideally placed to assess key speech and language domains that impact spelling and inform key others (e.g., parents, teaching staff) as to these links and how they can inform spelling assessments, intervention, and development.

References

Apel, K. (2011). What is orthographic knowledge? *Language, Speech, and Hearing Services in Schools, 42*(4), 592–603. https://doi.org/10.1044/0161-1461(2011/10-0085)

Apel, K., & Diehm, E. (2013). Morphological awareness intervention for kindergartners and first and second grade students form low SES homes: A small efficacy study. *Journal of Learning Disabilities, 47*(1), 65–75. https://doi.org/10.1177/0022219413509964

Apel, K., & Lawrence, J. (2011). Contributions of morphological awareness skills to world-level reading and spelling in first grade children with and without speech sound disorders. *Journal of Speech, Language, and Hearing Research, 54*(5), 1312–1327. https://doi.org/10.1044/1092-4388(2011/10-0115)

Apel, K., & Masterson, J. J. (2001). Theory-guided spelling assessment and intervention. *Language, Speech, and Hearing Services in Schools, 32*(3), 182–195. https://doi.org/10.1044/0161-1461(2001/017)

Bahr, R. H., Silliman, E. R., Berninger, V. W., & Dow, M. (2012). Linguistic patterns analysis of misspellings of typically developing writers in grades 1–9. *Journal of Speech, Language, and Hearing Research, 55*(6), 1587–1599. https://doi.org/10.1044/1092-4388(2012/10-0335)

Bear, D. R., & Templetion, S. (1998). Explorations in developmental spelling: Foundations for learning and teaching phonics, spelling, and vocabulary. *The Reading Teacher, 52*(3), 222–242.

Berninger, V. W., Abbott, R. D., Nagy, W., & Carlisle, J. (2010). Growth in phonological, orthographic, and morphological awareness in grades 1 to 6. *Journal of Psycholinguistic Research, 39*(2), 141–163. https://doi.org/10.1007/s10936-009-9130-6

Berninger, V. W., Abbott, R. D., Thomson, J., Wagner, R., Swanson, H. L., Wijsman, E. M., & Raskind, W. (2006). Modeling phonological core deficits within a working memory architecture in children and adults with developmental dyslexia. *Scientific Studies of Reading, 10*(2), 165–198. https://doi.org/10.1207/s1532799xssr1002_3

Berninger, V. W., Winn, W. D., Stock, P., Abbott, R. D., Eschen, K., Lin, S.-J., Garcia, N., Anderson-Youngstrom, M., Murphy, H., Lovitt, D., Trivedi, P., Jones, J., Amtmann, D., & Nagy, W. (2008). Tier 3 specialised writing instruction for students with dyslexia. *Reading and Writing, 21*(1–2), 95–129. https://doi.org/10.1007/s11145-007-9066-x

Bourassa, D. C., & Treiman, R. (2001). Spelling development and disability: The importance of linguistic factors. *Language, Speech, and Hearing Services in Schools, 32*(3), 172–181. https://doi.org/10.1044/0161-1461(2001/016)

Bourassa, D. C., & Treiman, R. (2003). Spelling in children with dyslexia: Analyses from the Treiman–Bourassa early spelling test. *Scientific Studies of Reading, 7*(4), 309–333. https://doi.org/10.1207/S1532799XSSR0704_1

Bowers, P. N., Kirk, J. R., & Deacon, S. H. (2010). The effects of morphological instruction on literacy skills: A systematic review of the literature. *Review of Educational Research, 80*(2), 144–179. https://doi.org/10.3102/0034654309359353

Brunsdon, R., Coltheart, M., & Nickels, L. (2005). Treatment of irregular word spelling in developmental surface dysgraphia. *Cognitive Neuropsychology, 22*(2), 313–351. https://doi.org/10.1080/02643290442000077

Caravolas, M., & Bruck, M. (1993). The effect of oral and written language input on children's phonological awareness: A cross-linguistic study. *Journal of Experimental Child Psychology, 55*(1), 1–30. https://doi.org/10.1006/jecp.1993.1001

Carlisle, J. F. (1995). Morphological awareness and early reading achievement. In L. B. Feldman (Ed.), *Morphological aspects in language processing* (pp. 189–210). Earlbaum.

Carlisle, J. F., & Goodwin, A. (2013). Morphemes matter: How morphological knowledge contributes to reading and writing. In C. A. Stone, E. R. Silliman, B. J. Ehren, & G. P. Wallach (Eds.), *Handbook of language and literacy: Development and disorders* (2nd ed., pp. 265–282). Guilford.

Coltheart, M., Rastel, K., Perry, C., Langdon, R., & Zieger, J. (2001). DRM. A dual route cascaded model of visual word recognition and reading aloud. *Psychological Review, 108*(1), 204–256. https://doi.org/10.1037/0033-295X.108.1.204

Daffern, T. (2017). Linguistic skills involved in learning to spell: An Australian study. *Language and Education, 31*(4), 307–329. https://doi.org/10.1080/09500782.2017.1296855

Dodd, B. (1995). *Differential diagnosis and treatment of children with speech disorder.* Whurr.

Dodd, B. (1996). *Queensland University Inventory of Literacy (QUIL).* Department of Speech Pathology & Audiology, The University of Queensland.

Ehri, L. C. (1995). Phases of development in learning to read by sight. *Journal of Research in Reading, 18*(2), 116–125. https://doi.org/10.1111/j.1467-9817.1995.tb00077.x

Ferreriro, E., & Teberosky, A. (1982). *Literacy before schooling.* Heinemann.

Flavell, J. H. (1979). Metacognition and cognitive monitoring: A new area of cognitive-development inquiry. *American Psychologist, 34*(10), 906–911. https://doi.org/10.1037/0003-066X.34.10.906

Fletcher-Finn, C. M., Shankweiler, D., & Frost, S. J. (2004). Coordination of reading and spelling in early literacy development: An examination of the discrepancy hypothesis. *Reading and Writing, 17,* 617–644. https://doi.org/10.1023/B:READ.0000044297.85675.f5

Foulin, J. N. (2005). Why is letter–name knowledge such a good predictor of learning to read? *Reading and Writing, 18,* 129–155. https://doi.org/10.1007/s11145-004-5892-2

Frith, U. (1985). Beneath the surface of developmental dyslexia. In K. E. Patterson, J. E. Marshall, & M. C. Coltheart (Eds.), *Surface dyslexia: Neuropsychological and cognitive studies of phonological reading* (pp. 301–330). Erlbaum. https://doi.org/10.4324/9781315108346-18

Galuschka, K., Ise, E., Krick, K., & Schulte-Körne, G. (2014). Effectiveness of treatment approaches for children and adolescents with reading disabilities: A meta-analysis of randomised controlled trials. *PLOS ONE, 9*(2), e89900. https://doi.org/10.1371/journal.pone.0089900

Garcia, N. P., Abbott, R. D., & Berninger, V. M. (2010). Predicting poor, average, and superior spellers in grades 1 to 6 from phonological orthographic, and morphological, spelling, or reading composites. *Written Language & Literacy, 13*(1), 61–98. https://doi.org/10.1075/wll.13.1.03gar

Gentry, R. J. (1982). An analysis of developmental spelling in GNYS AT WRK. *The Reading Teacher, 36*(2), 192–200.

Goodwin, A. P., & Aln, S. (2010). A meta-analysis of morphological interventions: Effects on literacy achievement of children with literacy difficulties. *Annals of Dyslexia, 60,* 183–208. https://doi.org/10.1007/s11881-010-0041-x

Goodwin, A. P., & Aln, S. (2013). A meta-analysis of morphological interventions in English: Effects on literacy outcomes for school-age children. *Scientific Studies of Reading, 17*(4), 257–285. https://doi.org/10.1080/10888438.2012.689791

Goswami, U., & Bryant, P. (1990). *Essays in developmental psychology. phonological skills and learning to read.* Psychology Press.

Goulandris, N. K. (1994). Teaching spelling: Bridging theory and practice. In G. D. A. Brown & N. C. Ellis (Eds.), *Handbook of spelling: Theory, process and intervention* (pp. 407–423). Wiley.

Graham, S., & Santangelo, T. (2014). Does spelling instruction make students better spellers, readers, and writers? A meta-analytic review. *Reading and Writing, 27,* 1703–1743. https://doi.org/10.1007/s11145-014-9517-0

Houghton, G., & Zorzi, M. (2003). Normal and impaired spelling in connectionist dual-route architecture. *Cognitive Neuropsychology, 20*(2), 115–162. https://doi.org/10.1080/02643290242000871

Ise, E., & Schulte-Körne, G. (2010). Spelling deficits in dyslexia: Evaluation of an orthographic spelling training. *Annals of Dyslexia, 60*(1), 18–39. https://doi.org/10.1007/s11881-010-0035-8

Kohnen, S., Nickels, L., Brunsdon, R., & Coltheart, M. (2008). Patterns of generalisation after treating sub-lexical deficits in a child with mixed dysgraphia. *Journal of Research in Reading, 31*(1), 157–177. https://doi.org/10.1111/j.1467-9817.2007.00366.x

Kohnen, S., Nickels, L., & Castle, A. (2009). Assessing spelling skills and strategies: A critique of available resources. *Australian Journal of Learning Disabilities, 14*(1), 113–150. https://doi.org/10.1080/19404150902783450

Kohnen, S., Nickels, L., & Coltheart, M. (2010). Skill generalisation in teaching spelling to children with learning difficulties. *Australian Journal of Learning Difficulties, 15*(2), 115–129. https://doi.org/10.1080/19404158.2010.502588

Kohnen, S., Nickels, L., Coltheart, M., & Brunsdon, R. (2008). Predicting generalisation in the training of irregular-word spelling: Treating lexical spelling deficits in a child. *Cognitive Neuropsychology, 25*(3), 343–375. https://doi.org/10.1080/02643290802003000

Kwang, T. E., & Varnhagen, C. K. (2005). Strategy development and learning to spell new words: Generalisation of a process. *Developmental Psychology, 41*(1), 148–159. https://doi.org/10.1037/0012-1649.41.1.148

Ladefoged, P. (2005). *Vowels and consonants: An introduction to the sounds of languages* (2nd ed.). Blackwell.

Levin, I., Shatil-Carmon, S., & Asif-Rave, O. (2006). Learning of letter names and sounds and their contribution to word recognition. *Journal of Experimental Child Psychology, 93*(2), 139–165. https://doi.org/10.1016/j.jecp.2005.08.002

Masterson, J., & Apel, K. (2000). Spelling assessment: Charting a path to optimal intervention. *Topics in Language Disorders, 20*(3), 50–65. https://doi.org/10.1097/00011363-200020030-00007

Masterson, J. J., & Apel, K. (2010a). Linking characteristics discovered in spelling assessment to intervention goals and methods. *Learning Disability Quarterly, 33*(3), 185–198. https://doi.org/10.1177/073194871003300307

Masterson, J. J., & Apel, K. (2010b). The spelling sensitivity score: Noting developmental changes in spelling knowledge. *Assessment for Effective Intervention, 36*(1), 35–45. https://doi.org/10.1177/1534508410380039

Masterson, J. J., & Apel, K. (2013). Spelling assessment frameworks. In C. A. Stone, E. R. Silliman, B. J. Ehren, & G. P. Wallach (Eds.), *Handbook of language and literacy: Development and disorders* (2nd ed., pp. 584–601). Guilford Press.

McCutchen, D., Stull, S., Herrera, B. L., Lotas, S., & Evans, S. (2013). Putting words to work: Effects of morphological instruction on children's writing. *Journal of Learning Disabilities, 47*(1), 86–97. https://doi.org/10.1177/0022219413509969

McNeil, B. C., Wolter, J., & Gillon, G. T. (2017). A comparison of the metalinguistic performance and spelling development of children with inconsistent speech-sound disorder and their age-matched and reading-matched peers. *American Journal of Speech-Language Pathology, 26*(2), 456–468. https://doi.org/10.1044/2016_AJSLP-16-0085

Nunes, T., Bryant, P., & Olsson, J. (2003). Learning morphological and phonological spelling rules: An intervention study. *Scientific Studies of Reading, 7*(3), 289–307. https://doi.org/10.1207/S1532799XSSR0703_6

O'Connor, R. E., & Bell, M. K. (2004). Teaching students with reading disability to read words. In C. A. Stone, E. R. Sillman, B. J. Ehren, & K. Apel (Eds.), *Handbook of language and literacy: Development and disorders* (2nd ed., pp. 481–498). Guilford Press.

O'Connor, R. E., & Jenkins, J. R. (1995). Improving the generalization of sound/symbol knowledge. *The Journal of Special Education, 29*(3), 255–275. https://doi.org/10.1177/002246699502900301

Pennington, B. F., & Bishop, D. V. M. (2009). Relations among speech, language, and reading disorders. *Annual Review of Psychology, 60*(1), 283–306. https://doi.org/10.1146/annurev.psych.60.110707.163548

Piasta, S. B., & Wagner, R. K. (2010). Learning letter names and sounds: Effects of instruction, letter type, and phonological processing skill. *Journal of Experimental Child Psychology, 105*(4), 324–344. https://doi.org/10.1016/j.jecp.2009.12.008

Quick, N., & Erickson, K. (2018). A multilinguistic approach to evaluating student spelling in writing samples. *Language, Speech, and Hearing Services in Schools, 49*(3), 509–523. https://doi.org/10.1044/2018_LSHSS-17-0095

Rashotte, C., Torgesen, J., & Wagner, R. (1999). *Comprehensive Test of Phonological Processing*. Pearson.

Read, C. (1975). *Children's categorisation of speech sounds in English*. National Council of Teachers of English.

Read, C. (1986). *Children's creative spelling*. Routledge and Kegan Paul.

Reber, A. S. (1967). Implicit learning of artificial grammars. *Journal of Verbal Learning and Verbal Behaviour, 6*(6), 855–863. https://doi.org/10.1016/S0022-5371(67)80149-X

Sacre, L., & Masterson, J. (2000). *Single Word Spelling Test*. NFER-Nelson.

Saffran, J. R., Newport, E. L., Aslin, R. N., Tunick, R. A., & Barrueco, S. (1997). Incidental language learning listening (and learning) out of the corner of your ear. *Psychological Science, 8*(2), 101–105. https://doi.org/10.1111/j.1467-9280.1997.tb00690.x

Sayeski, K. L. (2011). Effective spelling instruction for students with learning disabilities. *Intervention in School and Clinic.* https://doi.org/10.1177/1053451211414191

Schuele, C. M. (2004). The impact of developmental speech and language impairments on the acquisition of literacy skills. *Mental Retardation and Developmental Disabilities, 10*(3), 176–183. https://doi.org/10.1002/mrdd.20014

Semel, E., Wig, E. H., & Secord, W. (2017). *Clinical Evaluation of Language Fundamentals–Fifth Edition*. Pearson.

Serrano, F., & Defior, S. (2008). Dyslexia speed problems in a transparent orthography. *Annals of Dyslexia, 58*, Article 81. https://doi.org/10.1007/s11881-008-0013-6

Silliman, E., Bahr, R. H., Nagy, W., & Berninger, V. (2017). Language bases of spelling in writing during early and middle childhood: Grounding applications to struggling writers in typical writing development. In B. Miller, P. McCardle, & V. Connelly (Eds.), *Writing development in struggling learners,* (pp. 99–119). Brill. https://doi.org/10.1163/9789004346369_007

Temple, C. M. (1997). *Brain damage, behaviour and cognition: Developments in clinical neuropsychology*. Psychology Press.

Treiman, R. (1993). *Beginning to spell: A study of first-grade children*. Oxford University Press.

Treiman, R., & Broderick, V. (1998). What's in a name: Children's knowledge about the letters in their own names? *Journal of Experimental Child Psychology, 70*(2), 97–116. https://doi.org/10.1006/jecp.1998.2448

Treiman, R., & Kessler, B. (2003). The role of letter names in the acquisition of literacy. *Advances in Child Development Behaviour, 31*, 105–135. https://doi.org/10.1016/S0065-2407(03)31003-1

Treiman, R., & Kessler, B. (2014). *How children learn to write words*. Oxford University Press.

Varnhagen, C. K., McCallum, M., & Burstow, M. (1997). Is children's spelling naturally stage like? *Reading and Writing: An Interdisciplinary Journal, 9,* 451–481. https://doi.org/10.1023/A:1007903330463

Wanzek, J., Vaughn, S., Wrexler, J., Swanson, E. A., Edmonds, M., & Kim, A. H. (2006). A synthesis of spelling and reading interventions and their effects on the spelling outcomes of students with learning disabilities. *Journal of Learning Disabilities, 39*(6), 528–543. https://doi.org/10.1177/00222194060390060501

Wolter, J., & Dilworth, V. (2013). The effects of a multilinguistic morphological awareness approach for improving language and literacy. *Journal of Learning Disabilities, 47,* 76–85. https://doi.org/10.1177/0022219413509972

Wolter, J. A., & Squires, K. (2014). Spelling instructional and intervention frameworks. In C. A. Stone, E. R. Silliman, B. J. Ehren, & G. P. Wallach (Eds.), *Handbook of language and literacy: Development and disorders* (2nd ed., pp. 602–616). Guilford Press.

Zourou, F., Ecalle, J., Magnon, A., & Sanchez, M. (2010). The Fragile nature of phonological awareness in children with specific language impairment. Evidence from literacy development. *Child Language Teaching and Therapy, 26*(3), 347–358. https://doi.org/10.1177/0265659010369288

Appendix A

Metacognitive Framework: Making Learning Explicit

Strategic level	Behavioral level
1 **Orientation** Information about the nature and demands of the task. **Top Tips Cards presented**	**To clearly identify and delineate tasks and learning objectives from the outset** • Learning is made transparent through use of verbal scripts that reflect the individual needs of the learner. • Expectations on the learner are made clear. • Learning is related to learners' interest and current learning needs. • The facilitator explains why the task is being carried out from the child's development and learning point of view, thereby putting the learning into context what's *in it for me* aspect.
2 **Demonstration** What knowledge and strategies are likely to be effective in achieving the learning aims	**Modeling of expected behaviors** • The facilitator makes explicit the knowledge and strategies that are pertinent to the task. • The facilitator highlights what knowledge, skills, and processes the child currently used and now needs to use. • The facilitator verbalizes and/or models to the learner the behaviors that they wish to see the learner exhibit. • The learner may be encouraged to use *teach back*, that is, to tell the facilitator, in their own words, what it is that they are expected to do. • Top tip card/s now complements and supplements learning through emphasizing the underpinning knowledge and skills required in the task.
3 **Practice** Operationalization of strategy knowledge	**The learner has the opportunity to put the knowledge and behavior into practice in a functional way.** • Facilitators model and demonstrate the required learning. • Facilitator's provide informative and descriptive feedback to facilitate learning. • The learner is given multiple opportunities to put into practice skills and strategies pertinent to the task. • Informative and descriptive feedback is provided to facilitate learning.
4 **Reflection** Personalized feedback and reflection at person level **"What have I learned?" forms completed.**	**Reflection considers** • whether they achieved the learning aim, • what was learnt in the task, • what was done in the task to achieve the aim, • why the task/activity was carried out, • what knowledge and skills are needed to aid future learning, • when and where they can use the strategy knowledge in the future.

Appendix B

Example of What Have I Learned Card

What have I learnt?	My special spelling trick for today was the….
How to use this trick to help me spell	I can use this trick when….
Why is it important?	It is important because I can…
When can I use it?	When I am…

Example - What Have I Learned Card

Example - Top Tips Card: Shun Spelling Patterns

Appendix D

Assessment for Spelling

Assessment used and purpose

Spelling ability – Assessing spelling ability at a lexical (real word spelling). Fine grain qualitative analysis entailing detailed investigation of learners' spelling ability. This relates to sublexical (pseudoword spelling) level and application of orthographic (application of graphemes and their alternatives), phonological (syllabic, intrasyllabic, and phonemic knowledge application), semantic (homophone knowledge), and morphological (derivational and inflectional knowledge). Pseudoword spelling test indicated the learner's ability to apply sound-to-letter rules compared to typically developing spellers. Informal sample of spelling ability. Spelling ability at text level.
- Single-Word Spelling Test (Sacre & Masterson, 2000)
- Subtest of Queensland University Inventory of Literacy (Dodd, 1996)
- Informal story writing

Phonological Processing

Broad spectrum standardized of ability to manipulate sounds in words at syllable, intrasyllabic, and phonemic levels.
- Comprehensive Test of Phonological Processing (Rashotte et al., 1999)

Questionnaires – Compliment, support, corroborate, and verify findings from assessment data from parent/carer and child perspective. Supplementing qualitative and quantitative data collected. Informal assessment of feelings, views, and attitude with regard to the parent and child views of literacy strengths and weaknesses.
- Parent and child questionnaires

Narrative ability – Informal sample of written narrative taken. Tapping written narrative skills and comparing with verbal narrative skills. In addition, single word spelling is compared to sentence and text level spelling.
- Informal story writing

Alphabetic knowledge – Informal assessment of alphabetic knowledge at sound and letter level. Skills assessed—process and application of linguistic knowledge for spelling. Phoneme–grapheme knowledge and rule application at letter level from verbal presentation for letter names and letter sounds. Ability to write the correct letter from the verbal presentation of its name and sound.
- Phoneme–grapheme rule application

Language ability – To aid in building a profile of verbal linguistic skill strengths and needs. Taping linguistic skills and ability in terms of morphology, syntax, grammar and semantics.
- Clinical Evaluation of Language Fundamentals–Fifth Edition (Semel et al., 2017)