Capturing the nature of the spelling errors in Developmental Language Disorder: A scoping review

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Abstract

Purpose: This scoping review aims to identify and analyze the nature of the spelling errors produced by children with Developmental Language Disorder (DLD) across different orthographies. Building on a previous meta-analysis identifying the extent of the spelling difficulties of children with DLD (Joye et al., 2019) the review extends our understanding of the nature of the spelling errors produced by children with DLD. Three questions are addressed: Do spelling difficulties in children with DLD stem from weak phonological, orthographic, or morphological representations? What are the patterns of spelling performance in DLD depending on orthographic depth? Do comorbid difficulties with DLD impact spelling?

Methods: The scoping review followed the 5 phases outlined by Arksey and O'Malley (2005) and extended by Levac et al. (2010): (a) specifying the research question; (b) identifying relevant studies; (c) selecting studies; (d) charting the data; and (e) collating, summarizing, and reporting the results.

Results: Eighteen studies that provided a qualitative description of the nature of spelling errors produced by children and adolescents with DLD were identified. Spelling performance was examined in relation to control groups that were matched on age, on language features (language, spelling or reading age) or on co-occurring difficulties.

Conclusions: The present paper highlights the key elements that need to be considered when practitioners examine spelling difficulties and provides benchmarks for assessment in a range of alphabetic languages for school-aged children. The qualitative analyzes indicated that when practitioners evaluate spelling performance in children or adolescents with DLD, three factors should be considered: phonological representations, morphological awareness, and reading skills.

Keywords (3-6): Spelling – Developmental Language Disorder – Phonological difficulties

Children with Developmental Language Disorder (DLD) experience difficulty in acquiring language at the same rate as their peers, despite appropriate environmental stimulation and in the absence of neurological impairments (Bishop et al., 2017; Leonard, 2014). Research has typically focused on children's oral production and comprehension, capturing difficulties experienced with phonology and morphosyntax (Caccia & Lorusso, 2019; Delage & Durrleman, 2018; Macchi et al., 2019; Wright et al., 2018). There is increasing evidence that, in addition to their difficulties with spoken language, children with DLD also encounter difficulties in the production of written texts (Dockrell et al., 2007; Graham et al., 2020; Mackie et al., 2013; Puranik et al., 2007; Scott & Windsor, 2000). These difficulties with the production of written text manifest themselves from the initial stages of learning to write in preschool (Boudreau & Hedberg 1999; Cabell et al., 2011) and are associated with difficulties in other emergent literacy skills such as alphabet knowledge and the concept of print (Cabell et al., 2010). Furthermore, compared to age-matched peers, children with DLD experience a delay in starting to write (Cordewener et al., 2012). Despite the increasing research examining the written texts of children with DLD, the factors which underpin the spelling errors produced by these children are underexplored. This is problematic as spelling difficulties affect writing directly and school performance in general (Savolainen et al., 2008). In addition, spelling error analysis offers practitioners insight into the language profiles of the students they support (Bahr et al., 2012; Daffern, 2017).

In a recent meta-analysis, Joye et al., (2019) examined the developmental patterns of spelling in children with DLD and the sources of variation in spelling performance across different orthographies. Children and young people with DLD experienced problems with spelling in comparison to age-matched peers but not language-matched peers. Moreover, the results corroborated the impact of phonological and reading skills on spelling in children with DLD and they suggested that difficulties in nonphonological skills may also impact spelling

performance. However, the lack of information about the nature of the errors produced by the participants in the reported studies limits the implications of the review for practice. The meta-analysis by Joye et al. (2019) highlighted the need to better understand the nature of these spelling difficulties. The present paper aims to address this gap and to consider the practical implications of the findings that are currently available.

Phonological, orthographic, and morphological representations in spelling

In alphabetic systems, the combination of written symbols represents oral language (Treiman & Bourassa, 2000). In this way, phonological representations reflect both knowledge of how to segment spoken words and the knowledge of the correspondences from phonemes to graphemes in words (Bear et al., 2012). To spell words correctly, writers typically resort to phonology, but they also need to process word parts (morphemes) that signal grammar and meaning (Garcia et al., 2010) and develop an orthographic lexicon (Olson et al., 1994). Writing words therefore 1), requires sensitivity to letter sequences and to clusters of letters within a word, 2), engages morphological knowledge, namely the capacity to analyze and manipulate the morphemic elements in words (Bahr, Silliman, Berninger & Dow, 2012) and 3), mobilizes the orthographic spelling memory of words (Moats, 2009). For instance, results of studies obtained in multilingual learning contexts (Zhao et al., 2017) and in early spellers (Varnhagen et al., 1999) emphasized that phonological, orthographical, and morphological representations all contributed to word spelling. A deficit or difficulty in any of these skills therefore can impact the ability to spell words correctly.

Spelling development

According to the Triple Word Form Theory of spelling development (Berninger & Abbott, 2010; Garcia et al., 2010; Richards et al., 2006) children are able to use phonological, lexical and morphological skills in parallel early on and coordinate these skills to produce words on paper accurately. As children develop, they gain more explicit control over these

skills. In this model, both phonological (phoneme to grapheme conversion: e.g. translate /skuːl/ in "school") and lexical information (recognition of known words by sight alone) are processed at the same time (Daffern et al., 2015). In that sense, the triple word form theory for spelling parallels the lexical quality hypothesis developed by Perfetti and Hart (2002) for reading development. Indeed, the lexical quality hypothesis also highlights that word representations involved in reading include phonological, orthographic, and semantic-syntactic knowledge.

Learning to spell includes the acquisition of specific lexical features in terms of word root spelling (phonological and lexical routes; e. g. "boy") but also of inflectional morphological spelling and derivational morphological spelling (Bryant & Nunes, 2004). Inflectional morphological spelling corresponds to the variable part of the word, the one that marks a grammatical function (e.g. "two boy**s**"). By contrast, derivational morphology occurs at the beginning or end of a word and produces semantic changes by transforming the grammatical form of a word (e.g. "paint***er*** = the person who paints") and/or its meaning (e.g. "***re***paint = paint again").

Spelling error analysis has provided a base for investigating the role of these three different knowledge sources in spelling, in typically-developing children (Bahr et al., 2012; Daffern & Ramful, 2020), bilingual children (Bahr et al., 2015; Howard et al., 2006; Raynolds & Uhry, 2010; Sun-Alperin & Wang, 2008) and in children with specific learning difficulties (Bahr et al., 2020; Quick & Erickson, 2018). The current scoping review draws on this evidence base to explore spelling error analysis as an indicator of the development of the phonological, orthographic, and morphological domains in children with DLD. It gathers information on the nature of the spelling errors produced by children with DLD across a range of studies, to inform practice and interventions.

Orthographic depth: From transparent to opaque orthographies

Languages differ in their orthographic depth and this has a direct impact on spelling development (Katz & Frost, 1992; Schmalz et al., 2015; Ziegler & Goswami, 2005). Seymour et al. (2003) defined orthographic depth as a continuum between alphabetic writing systems with one-to-one phoneme-grapheme correspondence (e.g. Finnish) and those with inconsistent and complex phoneme-grapheme correspondences (e.g. English). Studies comparing word and pseudoword spelling at the end of the first year of schooling in English-Czech (Caravolas & Bruck, 1993), and French-Portuguese-Spanish (Serrano et al., 2011) have shown faster rates of spelling development for more transparent languages (i.e. Czech and Spanish) over less transparent languages (English, Portuguese and French). Studies in later grades in English-German (Wimmer & Landerl, 1997), and English-Italian (Marinelli et al., 2015) confirm the long-lasting influence of English inconsistency on spelling accuracy beyond the second year of formal schooling. Figure 1 shows an adaptation of the orthographic depth classification from Seymour et al. (2003), characterizing the orthographic depth of the languages included in the present review.

Insert Figure 1

Given the anglocentricity of the current literature on literacy development (Share, 2008), and the impact of orthographic opacity on learning to read and spell, there is a strong argument for looking at evidence from a range of languages. The present scoping review attempted to gather evidence from spelling error analysis in children with DLD from the widest possible range of alphabetic orthographies. Because the majority of studies on spelling of children and adolescents with DLD have been conducted in English, studies conducted in other languages such as Italian, Spanish, Swedish and French can establish whether the

difficulties experienced in the spelling of participants with DLD in English are a general feature of DLD or are manifested in different ways across orthographies. Finally, we further considered the differential impact of comorbid difficulties with phonology or with reading to provide a more nuanced assessment of spelling difficulties experienced by children with DLD.

The influence of comorbid difficulties

Over the years, criteria for the identification of language impairments have varied, often including exclusionary criteria such as cognitive impairment. More recently there has been a move away from using these criteria to a more inclusive framework (Bishop et al., 2016). This framework acknowledges that children with DLD may have a range of associated (comorbid) problems (Bishop et al., 2017). The meta-analysis by Joye et al. (2019), highlighted the importance of providing a detailed profile of children with DLD in research papers, in particular to capture comorbidity with other disorders (phonological or reading impairment for instance) and to understand the extent to which the spelling errors made by children with DLD reflect typical or atypical patterns of development. Indeed, reading supports orthographic knowledge in spelling development, suggesting that decoding is a good predictor of learning consistent orthographic rules (Caravolas et al., 2001) and that children who have difficulties reading are likely to have difficulties with spelling. As such, exploring the impact of dyslexia on the spelling of children with DLD is important for planning interventions.

Given the variability between studies in terms of tasks used, language target, age and diagnosis' criteria of DLD participants, and the nature of their matched peers (language or spelling or reading level, chronological age), a detailed analysis of the results is needed. These variables are considered when discussing studies' results in the present scoping review.

Goals of the scoping review

The current scoping review focuses on a qualitative analysis of the spelling patterns of children with DLD. An important consideration for both theory and practice is whether the spelling errors reflect difficulty with specific components of the language system which can be targeted in intervention. Critically for practice, there are currently no clear benchmarks about the type of spelling errors one might expect to find in school-aged students with DLD, and how they can inform both oral and written language interventions. Therefore, a review of the evidence available to-date is critical for practitioners who need to assess spelling performance (ASHA, 2016).

Method

Scoping review

We followed the five steps recommended by Arksey and O'Malley (2005) and Levac et al. (2010) to conduct the current scoping review: (a) specifying the research question; (b) identifying relevant studies; (c) selecting studies; (d) charting the data; and (e) collating, summarizing, and reporting the results. In steps (b) and (c) we used the meta-analysis conducted by Joye et al. (2019) as the initial selection of the studies. The optional sixth phase, consulting with stakeholders, was not conducted. This sixth phase is intended to contribute to the review by consulting about the inclusion criteria and providing insights into the content and the review itself. For the current scoping review, the stakeholders (speech-language pathologists and researchers) are represented on the research team.

Phase 1: Specifying the Research Questions

After reviewing the meta-analysis by Joye et al. (2019) and after conducting our own review of the research (see steps 2 and 3 below), we identified three key questions, 1) Do spelling difficulties in children with DLD stem from weak phonological, orthographic, or morphological representations? 2) What are the patterns of performance in children and

adolescents with DLD across language with varying orthographic depth? 3) Do comorbid difficulties impact spelling in children and adolescents with DLD?

Phase 2: Identifying Relevant Studies.

We aimed to address these questions by reviewing findings of studies selected in the literature and which provided a qualitative description of spelling errors produced by children and adolescents with DLD. Our starting point was the recent meta-analysis of 31 studies which focused on spelling in children with DLD (Joye et al., 2019). We used the 31 studies from that meta-analysis to identify relevant studies and inform the present review. In Joye et al. (2019) the authors followed the guidance of the PRISMA statement (Moher et al., 2009) and of the EPPI-centre (Gough et al., 2012, 2013) namely the participants' selection criteria; the location and the selection of studies by the screen of databases.

Phase 3: Study selection

The selection of studies for inclusion in the scoping review was conducted in two phases. First, among the 31 studies used in Joye et al's meta-analysis (2019), we extracted 11 studies that described the nature of the spelling errors produced by children with DLD. Second, we screened the reference lists of those 11 studies and checked the literature published on the topic in the last two years (since the meta-analysis) and examined their titles, abstracts and full-texts. This resulted in the inclusion of an additional five studies. Two studies that had been published on the topic since the meta-analysis were also added at this stage, after screening their title, abstract and full text. Figure 2 provides a description of the entire review process.

Insert Figure 2

Phase 4: Mapping the Data

We reviewed information regarding the nature of errors produced by children and adolescents with DLD in different forms of spelling (lexical spelling, inflectional and derivational morphological spelling, and orthographical spelling), the target language in the studies and their degree of opacity (from more opaque : English, French, to less opaque : Swedish, Italian and Spanish), the nature of the task used to assess spelling performance (words dictation vs narrative) the type of control group (either matched on chronological age or other developmental features such as vocabulary, spelling or reading) and the presence of a co-morbid problem (phonological or reading impairment).

Phase 5: Collating, Summarizing, and Reporting the Results

Following the recommendations of Colquhoun et al. (2014) Tables 1, 2, and 3 present the selected studies for data extraction. All these studies are marked with asterisks in the reference list.

Insert Tables 1, 2 and 3

Qualitative analysis of results

Do spelling difficulties in children with DLD stem from weak phonological, orthographic, or morphological representations?

Silliman et al. (2006) assessed different types of spelling errors produced by eight English speaking children with DLD from six to 11 years old and their spelling-matched peers: phonological accuracy (e.g., "*kep*" for "*k**ee**p*"), orthography legality (e.g., "*prit*" is orthographically legal, but "*tdpmnf*" is orthographically illegal) and morphological spelling errors (e.g., "*fowned*" for "*found*"). Thirty words were dictated within a sentence context to

the participants. English speaking children with DLD produced more phonological spelling errors (43%) than their spelling-matched peers (38%) and more morphological spelling errors (26% vs 17%). By contrast, there was no difference between children with DLD and their spelling-matched peers in orthographical legality. These results indicated that phonology and inflectional morphology posed a specific problem for English speaking children with DLD in elementary school in comparison to spelling-matched peers. The authors suggested that these difficulties could reflect both phonological and morphological deficits.

In another study conducted in English, Larkin et al. (2013) asked children with DLD (9 years old) and spelling-matched peers (7 years old) to perform a non-word spelling task and a morphological spelling task. In the non-word spelling task, the participants had to write 10 nonwords from the Treiman and Bourassa (2000) early spelling task, and in the morphological spelling task the children had to write 6 words (sail, chase, race, puff, kick and bake) as bare stems and with inflected forms *ed*, *-ing* and *-3s*. The authors measured the number of phonologically unacceptable spelling errors, orthographic spelling, and morphological spelling errors. Children with DLD made more phonologically unacceptable spelling errors on the nonwords (20.06%) than their spelling-matched peers (4.59%). Furthermore, with morphological spelling, children with DLD spelled stem words less accurately (19.3%) than their spelling-matched peers (29.3%). They were also poorer than their spelling-matched peers with more omissions and errors in the production of verb inflections such as "*-ed"* and "*-ing"*. Both the data from Larkin et al. (2013) and Silliman et al. (2006) indicated that, compared to spelling-matched peers, children with DLD experienced problems with inflectional morphology. There is less consistency between the two studies in terms of phonology. This may reflect the fact that Larkin et al. (2013) used non-words where children must use phonology to spell the words accurately.

Because reading proficiency is known to support spelling development, Mackie et al. (2013) assessed the nature of spelling errors produced in a written text by English speaking children with DLD (*Mean Age* = 10.8 years old) and children matched on single word reading (*Mean Age* = 7.8 years old). They counted the proportion of phonologically unacceptable spelling errors (when there was no possible sound for grapheme correspondence, e.g., "*clars*" for "*clouds*"), orthographically unacceptable spelling errors (when the sequence of letters was not permissible in English, e.g., "*wusz*" for "*once*") and inflectional morphological spelling errors (omissions of "*-ed*", "*-ing*" on the verb and "–*s*" on the nouns). English speaking children with DLD produced more phonologically unacceptable spelling errors (*M* = 0.59; *SD* = 0.35) and more inflectional morpheme omissions with the past tense *"-ed"* (*M* = 0.22; *SD* = 0.01) than their reading-matched peers (respectively *M* = 0.45; *SD* = 0.35 and *M* = 0.03; *SD* = 0.22). By contrast, children with DLD did not produce more orthographically unacceptable spelling errors (*M* = 0.07; *SD* = 0.13) than their reading-matched peers (*M* = 0.03; *SD* = 0.09).

Overall, the data suggest that, when compared to literacy-matched peers, problems in spelling are evident across both phonological and morphological aspects of spelling in English at the end of elementary schools but not in terms of orthographic legality. These difficulties in written word production reflect the problems that children with DLD have with oral language (Bishop, 1992; Botting & Conti-Ramsden, 2004; Leonard, 2014).

Patterns of spelling performance in DLD across languages with varying orthographic depth

Studies using dictation tasks will be presented first followed by those conducted using written narratives. The results obtained in these two types of tasks cannot be analyzed in the same way because they do not involve the same writing processes: in dictated tasks, the words to be written are predetermined, while in written narratives participants can choose words

they know, which may result in fewer spelling errors as they may opt for words they feel confident to spell.

Word dictation

It was predicted that difficulties in the spelling performance in children with DLD would vary in relation to the orthographic depth of the target language. Following the continuum proposed by Seymour et al. (2003), studies conducted in opaque orthographies (English and French) will be presented first followed by those conducted in more transparent orthographies (Swedish, Spanish and Italian).

Opaque orthographies. Critten et al. (2014) asked English speaking children with DLD (aged 9-10) and two control groups-one younger group matched on language (aged 6-8) and one group matched on chronological age (aged 9-10)-to write 24 dictated words containing inflectional morphemes (12 regular past tense *-ed* and 12 regular plural *-s*) and 18 words containing derivational morphemes where there was a change from the base word to the derived form (6 with orthographic change, as in "*attention*", 6 with phonological change, as in "*different*" and 6 with phonological and orthographic change as in "*student*"). The authors assessed the phonological acceptability of the spelling errors produced and noted grapheme omissions. Children with DLD produced more phonologically unacceptable spelling errors than both their age-matched and their younger language-matched peers. Children with DLD also produced more spelling errors in inflectional morphology than their age-matched peers but not than their language matches. By contrast, errors in derivational morphology were produced more frequently by children with DLD than both their age-matched peers and their younger language-matched peers.

In French, Broc et al. (2013) compared the spelling performance of two groups of participants with DLD (from seven to 11 years old and from 12 to 18 years old) with their age-matched peers in a dictation task, which included 10 regular words and 10 irregular

words. Spelling can be derived by applying one-to-one sound-letter correspondences for regular but not irregular words. From seven to 18 years old, participants with DLD and their age-matched peers both produced more spelling errors on irregular words than on regular words. When errors were analyzed for phonological acceptability, the spelling performance of children with DLD differed between childhood and adolescence. From seven to 11 years, children with DLD produced more phonologically unacceptable spelling errors per word than their age-matched peers both in regular and in irregular words. From 12 to 18 years old, the proportion of phonologically unacceptable spelling errors decreased in both participants with DLD and their age-matched peers. Both groups of teenagers (DLD and age-matched peers) produced very few phonologically unacceptable spelling errors.

Another study in beginning French spellers with DLD provides complementary results about the early stages of spelling development for this population. Godin et al. (2018) qualitatively assessed the spelling errors of 16 children with DLD in their second year of primary education on a word dictation task. Half of the children with DLD were matched with TD participants on spelling skills (DLD-S) and half with TD participants on chronological age and morphological awareness (DLD-AM). The group of DLD-S displayed spelling scores in line with those of TD peers while the groups of DLD-AM were already showing impaired spelling at the beginning of the year. They compared early processes related to spelling: vocabulary and phonological awareness, in both of these DLD groups and in 16 aged-matched TD peers, as well as later spelling (in May of the same school year) and phonological acceptability of the misspellings. Despite half of cohort showing early spelling in line with TD peers at the beginning of the year, children with DLD displayed poorer phonological awareness and vocabulary skills than their TD peers, as well as poorer spelling in February of the same school year. Furthermore, when the phonological acceptability of their spelling was assessed, there were also subtle differences between TD peers and both DLD groups. These

results are based on a very small sample of young children with DLD, and are marked by high interindividual variability. However, together with Broc et al.'s results on older children (2013), they highlight early difficulties with phonological processes and whole-word knowledge, which may impact accuracy and phonological acceptability of spelling attempts as children get older.

Transparent orthographies. Nauclér (2004) assessed the spelling performance of Swedish children with DLD and age-matched peers at six, eight, nine and 17 years old. The authors did not specify the nature of words dictated. At every age group, participants with DLD produced twice as many phonologically unacceptable spelling errors than their age-matched peers (Nauclér, 2004). This longitudinal study demonstrated that the number of phonologically unacceptable spelling errors decreases with age: participants with DLD produced half as many phonologically unacceptable spelling errors at 17 years of age than six-year-olds with DLD did (Nauclér, 2004).

In Italian, Brizzolara et al. (2011) asked adolescents with DLD (*M*= 16.5 years old) matched with age-matched peers to write 135 words: 70 regular words for which the correct orthography could be derived by applying one-to-one sound-letter correspondences (e.g., *"s/o/l/e"*), 10 regular words requiring syllabic conversion rules (e.g., *"gh/i/r/o"*) and 55 irregular words with unpredictable transcription according to phonology-to-orthography conversion rule (e.g., "*cuore*" may be phonologically plausible written either as "*cuore*" or "*quore*"). The results indicated that adolescents with DLD, as well as their age-matched peers, performed correctly in the spelling of regular words with one-to-one sound-letter correspondences. Although adolescents with DLD produced errors for just 12% of the words of the irregular words, these error rates were still higher than their age-matched peers (6% of irregular words misspelled).

In sum, in dictation tasks, children with DLD produced more phonologically unacceptable spelling errors. However, this error pattern varied by age and the nature of the words dictated. Firstly, participants with DLD in high school produced fewer and less phonologically unacceptable spelling errors, than their age-matched peers. However, they tended to produce phonologically unacceptable errors in higher proportion for an extended period of time. Secondly, children with DLD produced less phonologically unacceptable spelling errors when the spelling could be derived by applying one-to-one sound-letter correspondences than when the phoneme-grapheme correspondences were irregular. Finally, children with DLD appeared to have specific difficulties with derivational morphology, but not inflectional morphology. This issue will be returned to in the following section where results from written narratives are presented.

Written narratives

Studies using written narratives to assess the spelling skills of participants with DLD have been mainly conducted in opaque orthographies. Only one study conducted in a transparent orthography was identified. These studies focus their analyzes of spelling errors either on phonological acceptability or on inflectional morphology. The following sections address each of these in turn.

Phonologically unacceptable spelling errors.

Opaque orthographies. Mackie and Dockrell (2004) compared the spelling performance of English speaking children with DLD (*Mean Age* = 11 years old) to that of language-matched peers (*Mean Age* = 7.3 years old) and age-matched peers. Participants were asked to produce a written narrative from pictures. Children with DLD produced more phonologically unacceptable spelling errors than both comparison groups. Other studies have not replicated this finding. Dockrell and Connelly (2015) compared spelling performance of English speaking children with DLD who were 10 years old to both their vocabulary-matched peers

who were 7.11 years old and their age-matched peers. Children with DLD did not produce more phonologically unacceptable spelling errors than their younger vocabulary-matched peers but there were more errors in their texts than in those of age-matched peers.

In narratives of personal events, Broc et al. (2013) compared the number of phonologically unacceptable spelling errors produced by French participants with DLD from seven to 11 years old and from 12 to 18 years old to those produced by their age-matched peers. No significant differences were found with age matched peers at either age group (Broc et al., 2013).

Transparent orthographies. Soriano-Ferrer and Contreras-González (2011) assessed the number of phonologically unacceptable spelling errors produced by Spanish children with DLD aged from seven to nine years old compared to age-matched peers. Children were given a written narrative task, where they had to recall, in writing, a story given to them orally. The story was composed of 19 propositions, with a simple grammatical structure. Children with DLD produced more phonologically unacceptable spelling errors than their age-matched peers but both groups produced four times as many errors when the phoneme correspondence was irregular than when phoneme-grapheme correspondence was regular. Children with DLD, like their age-matched peers, were more accurate with regular phoneme grapheme correspondence, which is very common in Spanish.

Overall, in written narrative tasks, children with DLD produced phonologically unacceptable spelling errors. This spelling pattern has been observed both in a standardized narrative task and with a bespoke prompt. However, when a personal narrative was used, phonologically unacceptable spelling errors were not reported. Furthermore, this single study conducted in a transparent orthography illustrated that children with DLD were sensitive to the regularity of the phoneme-grapheme correspondence.

Inflectional morphological spelling errors.

Only studies conducted in opaque orthographies have examined errors in inflectional morphological spelling. In a written spontaneous narrative task, Windsor, Scott, and Street (2000) assessed the spelling performance of children with DLD from 10 to 12 years old, compared to both younger children from seven to 10 years old matched on language level and age-matched peers. The authors found that spelling performance in children with DLD did not differ from their younger language-matched peers for the third person singular "-*s"*, use of the verb "*to be*", and use of articles (*a, an, the*). Conversely, when they compared children with DLD to participants matched on chronological age, their inflectional morphological spelling performance was always less accurate: children with DLD produced more omission on *"–ed"* and more omission on *"–s"* in regular plural nouns than their age-matched-peers. With irregular verbs, children with DLD omitted the irregular verbal form (*"grow up"* instead of "*grew"*) and, when participants attempted to mark tense, it was based on the regular 'ed' form instead of the irregular form ("*he standed"* instead of "stood"). Errors were also produced on the noun composite in children with DLD, with a majority being omissions of the plural mark (*–s*). These results converge with those of Mackie and Dockrell (2004) and Dockrell and Connelly (2015). In Mackie and Dockrell (2004), children with DLD produced more grammatical omissions than both their language and chronological age-matched peers. These omissions were either ending omissions such as *-ing* and plural *–s*, or omissions of the verb "*to be*" when obligatory in the past tense. In Dockrell and Connelly (2015), children with DLD did not produce more morphological spelling errors than their vocabulary-matched peers but did produce more than their age-matched peers.

Broc et al. (2014) compared inflectional morphological spelling errors in the personal narratives produced by French participants with DLD from seven to 11 years old and from 12 to 18 years old to those produced by age-matched peers. French children with DLD also produced more inflectional spelling errors than their age-matched peers but only in the

younger age group. In adolescence, from 12 to 18 years old, there were no significant difference between children with DLD and their age-matched peers.

These results in morphological spelling are largely corroborated by a more recent cross-linguistic comparison of French and English spelling in a population of children with DLD aged eight to 11 (Joye et al., 2020). This study analyzed spelling errors qualitatively, using a four-category scale to classify errors as either phonological, orthographic, morphological or semantic in nature. Children with DLD were also compared to age- and spelling-matched peers. Errors of inflectional morphology were a specific focus of the study, given the error rates reported in the English literature detailed above, and the complexity of the French morphological system. In both French and English, children with DLD displayed a higher rate of morphological errors than their age- but not spelling-matched peers. Interestingly, this was only evident in a curated list of dictated words, but not in a free narrative, where morphological error rates were low *for all groups* in English, and very high *for all groups* in French.

These results suggest that participants with DLD experience a developmental delay in their ability to accurately use inflections in their spelling, a delay that is commensurate with their spelling/language age. Error patterns are similar to younger language matched peers but more frequent than their age-matched peers. The language in which children are learning to spell impacts on performance.

Do comorbid difficulties with DLD impact spelling?

Two specific problems which co-occur with DLD (phonological impairment and dyslexia) were predicted to impact spelling performance. To date, however, few studies have included participants with DLD and controlled for the presence of these co-morbid difficulties. The following section examines studies that assessed the impact of phonological impairment and dyslexia on the spelling performance of children with DLD.

Phonological impairment

Bishop and Clarkson (2003) compared the nature of the spelling errors produced by 161 typically developing children, aged between 7.5 to 13, with 75 twin children of the same age who either had DLD, or were co-twins of affected children (pure DLD, DLD with phonological impairment, pure phonological impairment resolved DLD). The authors examined whether spelling difficulties related to the severity of DLD or to their phonological problems. They measured phonologically unacceptable spelling errors and grammatical errors (omissions of obligatory word / inflections produced on inflectional morphology on verb/pronoun agreement/tense/case). The results showed that the English speaking children with only DLD and children with DLD and phonological impairment produced a higher proportion of phonologically unacceptable spelling errors than their controls. By contrast, children who only had a phonological impairment and children with resolved DLD did not produce more phonologically unacceptable spelling errors than younger children in this study. There was no difference between any of the children for errors with inflectional morphology. This highlights that in English, DLD and DLD with phonological impairment both impacts the production of phonologically unacceptable spelling errors but not in the production of inflectional spelling errors.

Dyslexia

Some authors have compared spelling performance between children with DLD only, children with DLD and dyslexia, and children with dyslexia only.

Opaque orthographies. McCarthy et al. (2012) compared the nature of spelling errors produced by English speaking children with DLD, children with dyslexia, children with both DLD and dyslexia (D + DLD) and their age-matched peers (nine years old) in a word dictation task. The authors explored whether the groups of children produced the same spelling errors patterns. They assessed phonological unacceptable errors (with added or

omitted graphemes), orthographical unacceptable errors (incorrect sound-symbol correspondences, incorrect rules for combining letters, incorrect patterns that govern spelling within the root or base word, and incorrect positional constraints on spelling patterns), mental-graphemic representation errors (phonetic spelling of a non-phonetic word, incorrect spelling of unstressed syllables and vowels preceding “n”, “g”, “r”, “l”, and any example of where one “just needs to know it is spelled that way”), and semantic awareness errors (correct spelling that indicates the wrong meaning of the word used). Children with DLD and dyslexia and the children only with dyslexia produced more phonologically unacceptable spelling errors than children with only DLD and their age-matched control. In English, dyslexia increased the spelling difficulties and led to the production of more phonologically unacceptable errors.

Transparent orthographies. Scuccimara et al. (2008) and Chilosi et al. (2009) compared spelling performance in Italian children with only dyslexia, children with dyslexia and a history of DLD, and age-matched peers. Scuccimara et al. (2008) dictated 40 high frequency, concrete words with a regular orthographic structure and 40 nonwords) to seven-year-old children. The authors categorized the nature of spelling errors as phonologically unacceptable spelling errors (substitution, omission, insertion or inversion of vowel, consonant, or syllable) and non-phonological spelling errors (incorrect grapheme, illegal segmentation, stress misplacement or insertion of double consonant). Both the children with only dyslexia and those with dyslexia and a history of DLD produced more spelling errors across the categories than their age-matched peers. Moreover, in terms of the production of non-phonological spelling errors children with dyslexia with a history of DLD produced more spelling errors (22%) than children with dyslexia only (14%). However, there were no differences between the two dyslexic groups in phonologically unacceptable spelling errors. In the same sense, Chilosi et al. (2009) dictated 48 words and 24 nonwords to 26 children dyslexia and DLD and

20 children only with dyslexia (*mean age* = 10.4 years old). Both groups produced more spelling errors on non-words (32% and 29% of spelling errors respectively) than on real words (26% and 22% of spelling errors respectively). These results indicated that in Italian, as in English, in comparison to age-matched peers phonologically unacceptable spelling errors are an area of significant weakness for both children only with dyslexia and those also with a history of DLD. Studies conducted with English and Italian children comparing children with DLD, DLD and dyslexia and dyslexia alone highlight three points: children with DLD, dyslexia and both DLD and dyslexia perform more poorly than the control groups; children only with DLD perform better than children with DLD and dyslexia and those with dyslexia alone; and no differences have been observed between children with DLD and dyslexia and children only with dyslexia. Co-occurring difficulties with reading and DLD impact spelling performance in both opaque (English) and transparent (Italian) orthographies.

Discussion

It has already been established across a range of studies that children with DLD have difficulties with spelling (Joye et al., 2019). The aim of this scoping review was to examine the nature of the spelling errors produced by children with DLD, the impact of the target language and the effect of comorbid difficulties with phonology and literacy.

Consistent, across tasks and languages, phonologically unacceptable spelling errors were a core feature found in the written language of children with DLD. Furthermore, in the studies reviewed children with DLD also had difficulties with inflectional morphological spelling development. Finally, in derivational morphological spelling children with DLD produced more derivational morphological spelling errors than younger peers matched on language level. These factors should be considered when practitioners evaluate written language in children with DLD.

Results indicated that comorbid difficulties differentially impacted spelling in DLD. An additional phonological impairment does not further impair the children's spelling. In contrast, dyslexia combined with DLD significantly affects spelling performance. When children had both dyslexia and DLD, they produced more phonologically unacceptable spelling errors than when they had dyslexia only.

Finally, it is important to note that the findings we reported in this article only apply to alphabetical languages. Comparing spelling performance across languages is indeed challenging, especially for orthographies of different language families. Although assessment and comparison of spelling skills across alphabetic orthographies are not straightforward, DLD seems to affect spelling errors in both opaque and transparent languages, although the latter appears less impacted. Assessing spelling errors across different languages might nevertheless inform on the extent to which acquisition of orthographic information by children with DLD depends on the language specificities.

Clinical implications

The results of the scoping review indicate that the assessment of spelling skills in children with DLD provides useful information for diagnostic purposes and intervention planning. This section aims to provide practitioners with a set of recommendations they might consider when assessing and planning intervention for school-aged children and young people with DLD. Accordingly, we suggest the following checklist for practitioners. This procedure may also be relevant to other populations and indeed might form the core of most spelling assessments. However, in the light of the literature reviewed in the present scoping review, we wish to stress the importance of identifying the types of phonological and morphological errors produced by children with known or suspected language difficulties. This should allow practitioners to tailor interventions that specifically target those phonological and morphological features that are difficult for the children. It is worth noticing that using

standardized tests facilitate the work of practitioners, especially at the diagnostic level. Unlike self-made tests or adapted tests, standardized tests make it possible to compare the results obtained by children with DLD to norms obtained from TD children of the same chronological age.

STEP 1: Capture information about the child's history with language difficulties.

As a whole, the results reviewed in the present scoping review for spelling mirror many of the difficulties already evidenced in the oral language of children with DLD, that is: difficulties with representing phonological and morphological segments.

Are there difficulties with phonological representations?

There are a number of ways to assess phonological representations. According to the Stackhouse and Wells' psycholinguistic model (1997), they can be assessed in tasks of words' rhyme sensitivity, alliteration tasks (e.g., produce as many words as possible beginning with /m/: mummy, more, my, man, etc.) or in the learning of nursery rhymes. Tasks of phoneme elision, rhyming, blending or nonword repetition are also common ways of assessing the ability to represent and manipulate sounds in words or pseudowords. Finally, another important phonological skill to assess is rapid naming, as it has been related to good reading outcomes in children with DLD (Bishop et al. 2009).

Are there difficulties with morphological awareness?

Most standardized language tests include a morphosyntactic task, where children get to produce plural or other inflected forms. For practitioners, it is worth looking back at these particular items and check how children performed on these particular 'markers' of syntactic difficulties early on (and maybe still perform). These may include, in English, plurals, possessives, 3rd person -s or past tense -ed. If children are met at school age, checking whether those markers were present in the developing language of children by asking parents if the child forget/forgot words or chunks of words in their speech, for example, at age 4-5.

There are some useful checklists of 'red flags' that may be used for directing parents/careers or teachers interviews for this purpose (Visser-Bochane et al., 2017).

STEP 2: Analyze qualitatively the child's spelling errors to underpin targeted intervention

This step 2 is very important because spelling error analysis may be a time-efficient and relevant way of trying to unpin language difficulties of them children with DLD at school age.

Phonological spelling errors

Phonological spelling errors should be assessed by both dictated tasks (words and pseudo-words) and written narrative tasks. However, it should be noted that written narratives of personal events task may be less sensitive than other types of written narrative tasks (from pictures, based on tale or standardized tasks) but they are naturalistic and ecological (close to what students are asked to do on a daily basis), and seem to capture spelling performance accurately (see Dockrell et al. 2014). On the contrary, nonword spelling tasks may be particularly sensitive to phonological difficulties (Larkin et al., 2013) and represent a useful tool for those children whose difficulties are suspected primarily in the phonological domain. This phonological spelling errors assessment has to be complemented by other types of assessment data as those from morphological spelling errors which the prevalence was highlighted in this scoping review in the DLD population.

Morphological spelling errors

Inflectional morphological spelling can be assessed in written task narratives and dictation of words in a sentence context. Practitioners may assess and control for the presence of grammatical word ending omissions (*-s, -ing* and *–ed* in English but vary depending on the language). When morphological awareness is affected in both oral and written language, one focus of the intervention might be to make these segments more explicit in both the oral and written modalities. Traditional approaches to morphosyntax intervention (Eisenberg et al.,

2020) may thus be combined or supplemented with more explicit approaches (Balthazar et al., 2020) where both the oral and written form of the problematic suffixes might be emphasized. In such approaches, the relative transparency of the written form (e.g., regular past tense consistently spelled -ed, but pronounced either /t/, /d/ or /ɪd/) might provide support for anchoring those morphemes in oral language (Apel & Masterson, 2001). To complete, another finding and point for discussion related to the poor performance with derivational morphology.

Derivational morphological spelling can be assessed in dictated tasks including words with derivational prefixes/suffixes and bases. Practitioners may assess the knowledge of word base and derivational prefixes/suffixes spellings. If children present weaknesses in this domain, as assessed by a spelling task involving morphologically-complex words, as well as more traditional tasks of morphological awareness, practitioners might consider using a morphological intervention, to strengthen those weak phonological and semantic connections.

When scores are below standard scores in word dictation or in written text or where unexpected error patterns occur, go to Step 3.

STEP 3: Consider the presence of co-occurring problems

In step 3, consider the presence of dyslexia because this co-occurring problem could explain a part of the spelling difficulties and should inform targeted interventions. Children with co-morbid DLD and reading difficulties, once identified, should thus be a primary focus of intervention. Although the presence of co-morbid reading difficulties in children with DLD might not necessarily change the *content* of intervention, it will likely impact its *delivery*: practitioners might need to consider the way they present written content to children with both DLD and dyslexia, and provide models for pronouncing novel words, in addition to teaching the relevant word components for independent decoding and spelling, and providing all the

necessary visual and auditory support to promote the building of accurate phonographic, orthographic and morphographic mappings (Ehri, 2014).

From these 3 steps practitioners may determine a complete spelling needs profile in relation to history, language features and the presence or not of co-occurring problems.

Conclusion

The present scoping review gathers evidence from a range of studies on the nature of the spelling errors produced by children with DLD, in both opaque and transparent languages. Difficulties were observed on phonological aspects of spelling in all languages considered, although they seemed less prominent in more transparent languages and in older students. On the contrary, students with additional reading difficulties presented with more impaired phonological spelling than their peers without additional dyslexia. Morphological difficulties were also evidenced in the spelling of opaque languages, and in particular with inflections in English. Where possible, we suggest potential targets for intervention in the phonological and morphological domains, based on the evidence available in the review. We also provide recommendations for gathering information and informing intervention with this population, with a suggested ‘assessment pathway’.

References

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)

Arksey, H., & O'Malley, L. (2005). Scoping studies: Towards a methodological framework. *International Journal of Social Research Methodology, 8,* 19–32. https://doi.org/10.1080/1364557032000119616

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

Balthazar, CH., Ebbels, S., & Zwitserlood, R. (2020). Explicit Grammatical Intervention for Developmental Language Disorder: Three Approaches. *Language, Speech, and Hearing Services in Schools, 51*(2), 226-246. https://doi: 10.1044/2019_LSHSS-19-00046.

Bear, D.R., Invernizzi, M., Templeton, S., & Johnston, F. (2012). *Words their way: Word study for phonics, vocabulary, and spelling instruction* (5th Ed). Pearson Education Inc.

Berninger, V. W., & Abbott, R. D. (2010). Listening comprehension, oral expression, reading comprehension, and written expression: Related yet unique language systems in grades 1, 3, 5, and 7. *Journal of Educational Psychology, 102*(3), 635–651. https://doi.org/10.1037/a0019319

Bishop, D. V. M. (1992). The underlying nature of specific language impairment. *Journal of Child Psychology and Psychiatry and Allied Disciplines, 33,* 3-66.

*Bishop, D. V. M., & Clarkson, B. (2003). Written language as window into residual language deficits: a study of children with persistent and residual speech and language impairments. *Cortex, 39,* 215-237. https://doi.org/10.1016/S0010-9452(08)70106-0

688 Bishop, D., McDonald, D., Bird, S., & Hayiou-Thomas, M. E. (2009). Children who read
689 words accurately despite language impairment: Who are they and how do they do it?
690 *Child Development*, *80*(2), 593–605.
691 Bishop, D V M, Snowling, M. J., Thompson, P. A., & Greenhalgh, T. (2016). CATALISE: A
692 Multinational and Multidisciplinary Delphi Consensus Study. Identifying Language
693 Impairments in Children. *PLOS ONE*, 26. https://doi.org/10.1371/journal.pone.0158753
694 Bishop, D. V. M., Snowling, M. J., Thompson, P. A., Greenhalgh, T., & CATALISE-2
695 Consortium (2017). Phase 2 of CATALISE: a multinational and multidisciplinary
696 Delphi consensus study of problems with language development: Terminology. *Journal*
697 *of Child Psychology and Psychiatry*, *58*(10), 1068-1080.
698 https://doi.org/10.1111/jcpp.12721
699 Botting, N., & Conti-Ramsden, G. (2004). *Characteristics of children with specific language*
700 *impairment.* In L. Verhoeven & H. van Balkom (Eds.), Classification of developmental
701 language disorders: Theoretical issues and clinical implications (pp. 23-38). Lawrence
702 Erlbaum Associates.
703 Boudreau, D. M., & Hedberg, N. L. (1999). A Comparison of Early Literacy Skills in
704 Children With Specific Language Impairment and Their Typically Developing Peers.
705 *American Journal of Speech-Language Pathology*, *8*(3), 249-260.
706 https://doi.org/10.1044/1058-0360.0803.249
707 *Brizzolara, D., Gasperini, F., Pfanner, L., Cristofani, P., Casalini, C., & Chilosi, A. M.
708 (2011). Long-term reading and spelling outcome in Italian adolescents with a history of
709 specific language impairment. *Cortex, 47*(8), 955–973.
710 https://doi.org/10.1016/j.cortex.2011.02.009
711 *Broc, L., Bernicot, J., Olive, T., Favart, M., Reilly, J., Quémart, P., Catheline, N., Gicquel,
712 L., & Jaafari, N. (2014). Évaluation de l'orthographe des élèves dysphasiques en

situation de narration communicative: Variations selon le type d'orthographe, lexicale versus morphologique. *Revue Européenne de Psychologie Appliquée*, *64*(6), 307–321. https://doi.org/10.1016/j.erap.2014.09.004

*Broc, L., Bernicot, J., Olive, T., Favart, M., Reilly, J., Quémart, P., & Uzé, J. (2013). Lexical spelling in children and adolescents with specific language impairment: Variations with the writing situation. *Research in Developmental Disabilities*, *34*(10), 3253–3266. https://doi.org/10.1016/j.ridd.2013.06.025

Bryant P., Nunes T. (2004) Morphology and Spelling. In T. Nunes & P. Bryant (eds), Handbook of Children's Literacy. Springer. https://doi.org/10.1007/978-94-017-1731-1_6

Cabell, S. Q., Justice, L. M., Konold, T. R., & McGinty, A. S. (2011). Profiles of emergent literacy skills among preschool children who are at risk for academic difficulties. *Early Childhood Research Quarterly*, *26*(1), 1-14. https://doi.org/10.1016/j.ecresq.2010.05.003

Cabell, S. Q., Lomax, R. G., Justice, L. M., Breit-Smith, A., Skibbe, L. E., & McGinty, A. S. (2010). Emergent literacy profiles of preschool-age children with Specific Language Impairment. *International Journal of Speech-Language Pathology*, *12*(6), 472-482. https://doi.org/10.3109/17549507.2011.492874

Caccia, M., & Lorusso, M. L. (2019). When prosody meets syntax: The processing of syntax-prosody interface in children with developmental dyslexia and developmental language disorder. *Lingua*, *224*, 16-33. https://doi.org/10.3389/fpsyg.2019.01458

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

737 Caravolas, M., Hulme, C., & Snowling, M. J. (2001). The Foundations of Spelling Ability:
738 Evidence From a 3-year Longitudinal Study. *Journal of Memory and Language, 45,*
739 751-774. http://dx.doi.org/10.1006/jmla.2000.2785
740 *Chilosi, A. M., Brizzolara, D., Lami, L., Pizzoli, C., Gasperini, F., Pecini, C., Cipriani, P., &
741 Zoccolotti, P. (2009). Reading and Spelling Disabilities in Children with and Without a
742 History of Early Language Delay: A Neuropsychological and Linguistic Study. *Child*
743 *Neuropsychology, 15*(6), 582-604
744 Colquhoun, H. L., Levac, D., O'Brien, K. K., Straus, S., Tricco, A. C., Perrier, L., . . . Moher,
745 D. (2014). Scoping reviews: Time for clarity in definition, methods, and reporting.
746 *Journal of Clinical Epidemiology, 67,* 1291–1294.
747 https://doi.org/doi:10.1016/j.jclinepi.2014.03.013.
748 Cordewener, K. A. H., Bosman, A. M. T., & Verhoeven, L. (2012).Characteristics of early
749 spelling of children with Specific Language Impairment. *Journal of Communication*
750 *Disorders, 45*(3), 212-222. https://doi.org/10.1016/j.jcomdis.2012.01.003
751 *Critten, S., Connelly, V., Dockrell, J. E., & Walter, K. (2014). Inflectional and derivational
752 morphological spelling abilities of children with Specific Language Impairment.
753 *Frontiers in Psychology, 5.* https://doi.org/10.3389/fpsyg.2014.00948
754 Daffern, T. (2017). Linguistic skills involved in learning to spell: An Australian study.
755 *Language and Education*, *31*(4), 307–329.
756 https://doi.org/10.1080/09500782.2017.1296855
757 Daffern, T., Mackenzie, N., & Hemmings, B. (2015). The development of a spelling
758 assessment tool informed by Triple Word Form Theory. *Australian Journal of*
759 *Language and Literacy*, 38(2), 72-82.

760 Delage, H., & Durrleman, S. (2018) Developmental dyslexia and specific language
761 impairment: distinct syntactic profiles? *Clinical Linguistics & Phonetics, 32*(8), 758-
762 785. https://doi.org/10.1080/02699206.2018.1437222
763 *Dockrell, J. E., & Connelly, V. (2015). The role of oral language in underpinning the text
764 generation difficulties in children with specific language impairment: Text generation in
765 children with specific language impairments. *Journal of Research in Reading, 38*(1),
766 18–34. https://doi.org/10.1111/j.1467-9817.2012.01550.x
767 Dockrell, J. E., Lindsay, G., Connelly, V., & Mackie, C. (2007). Constraints in the Production
768 of Written Text in Children with Specific Language Impairments. *Exceptional Children,*
769 *73*(2), 147-164. https://doi.org/10.1177/001440290707300202
770 Eisenberg, S. L., Bredin-Oja, S. L., & Crumrine, K. (2020). Use of Imitation Training for
771 Targeting Grammar: A Narrative Review. Language, Speech, and Hearing Services in
772 Schools, 51(2), 205–225. https://doi.org/10.1044/2019_LSHSS-19-00024
773 Ehri, L. C. (2014). Orthographic Mapping in the Acquisition of Sight Word Reading, Spelling
774 Memory, and Vocabulary Learning. *Scientific Studies of Reading*, *18*(1), 5-21.
775 https://doi.org/10.1080/10888438.2013.819356
776 Garcia, N., Abbott, R., & Berninger, V. (2010). Predicting poor, average, and superior
777 spellers in grades 1 to 6 from phonological, orthographic, and morphological, spelling,
778 or reading composites. *Written Language & Literacy, 13*(1), 61–98.
779 https://doi.org/10.1075/wll.13.1.03gar
780 Graham, S., Hebert, M., Fishman, E., Ray, A. B., & Rouse, A. G. (2020). Do Children
781 Classified With Specific Language Impairment Have a Learning Disability in Writing?

A Meta-Analysis. *Journal of Learning Disabilities*, *53*(4), 292–310. https://doi.org/10.1177/0022219420917338

*Godin, M.-P., Gagné, A., & Chapleau, N. (2018). Spelling acquisition in French children with developmental language disorder: An analysis of spelling error patterns. *Child Language Teaching and Therapy*, *34*(3), 221-233. https://doi.org/10.1177/0265659018785938

Gough, D., Oliver, S., & Thomas, J. (Eds.). (2012). *An introduction to systematic reviews*. London, UK: SAGE.

Gough, D., Oliver, S., & Thomas, J. (2013). Learning from research: Systematic reviews for informing policy decisions: A quick guide [Online]. London, UK: Nesta. Retrieved from http://www.alliance4usefulevidence.org/assets/Alliance-FUE-reviews-booklet-3.pdf

Howard, E. R., Arteagoitia, I., Louguit, M., Malabonga, V., & Kenyon, D. M. (2006). The development of the English developmental contrastive spelling test: A tool for investigating Spanish influence on English spelling development. *Tesol Quarterly*, *40*(2), 399-420. https://doi.org/10.2307/40264528.

*Joye, N., Dockrell, J. E., & Marshall, C. R. (2020). The Spelling Errors of French and English Children With Developmental Language Disorder at the End of Primary School. *Frontiers in Psychology*, *11*, 1789. https://doi.org/10.3389/fpsyg.2020.01789

Joye, N., Broc, L., Olive, T., & Dockrell, J. (2019). Spelling Performance in Children with Developmental Language Disorder: A Meta-Analysis across European Languages. *Scientific Studies of Reading*, *23*(2), 129-160. https://doi.org/10.1080/10888438.2018.1491584

805 Katz, L., & Frost, L. (1992). Reading in Different Orthographies: The Orthographic Depth
806 Hypothesis. In R. Frost, & L. Katz (Eds.), *Orthography, Phonology Morphology, and*
807 *Meaning* (pp. 67-84). Amsterdam: Elsevier.
808 *Larkin, R. F., Williams, G. J., & Blaggan, S. (2013). Delay or deficit? Spelling processes in
809 children with specific language impairment. *Journal of Communication Disorders,*
810 *46*(5-6), 401–412. https://doi.org/10.1016/j.jcomdis.2013.07.003
811 Leonard, L. B. (2014). Specific Language Impairment across Languages. *Child Development*
812 *Perspectives, 8*(1), 1-5. https://doi.org/10.1111/cdep.12053
813 Levac, D., Colquhoun, H., & O'Brien, K. K. (2010). Scoping studies: Advancing the
814 methodology. *Implementation Science, 5,* 69.
815 http://www.implementationscience.com/content/5/1/69
816 Macchi, L., Casalis, S., & Schelstraete, M-A., (2019). Phonological and orthographical
817 reading routes in French-speacking childnre with severe developmental language
818 disorder. *Journal of Communication Disorders, 81,* 105909.
819 https://doi.org/10.1016/j.jcomdis.2019.05.002
820 *Mackie, C., & Dockrell, J. E. (2004). The nature of written language deficits in children with
821 SLI. *Journal of Speech, Language, and Hearing Research, 47*(6), 1469–1483.
822 https://doi.org/10.1044/1092-4388(2004/109)
823 *Mackie, C. J., Dockrell, J., & Lindsay, G. (2013). An evaluation of the written texts of
824 children with SLI: the contributions of oral language, reading and phonological short-
825 term memory. *Reading and Writing, 26*(6), 865-888. https://doi.org/10.1007/s11145-
826 012-9396-1

827 Marinelli, C. V., Romani, C., Burani, C., & Zoccolotti, P. (2015). Spelling acquisition in
828 English and Italian: A cross-linguistic study. *Frontiers in Psychology, 6*. 1843.
829 https://doi.org/10.3389/fpsyg.2015.01843
830 *McCarthy, J. H., Hogan, T. P., & Catts, H. W. (2012). Is weak oral language associated with
831 poor spelling in school-age children with specific language impairment, dyslexia or
832 both? *Clinical Linguistics & Phonetics, 26*(9), 791–805.
833 https://doi.org/10.3109/02699206.2012.702185
834 Moats, L. C. (2009). Teaching spelling to students with language and learning disabilities. In
835 G. A. Troia (Ed.), *Instruction and assessment for struggling writers: Evidence-based*
836 *practices* (pp. 269–289). New York, NY: Guilford Press.
837 Moher, D., Liberati, A., Tetzlaff, J., & Altman, D. G.; The PRISMA Group. (2009). Preferred
838 reporting items for 725 systematic reviews and meta-analyses: The PRISMA statement.
839 *PLoS Medicine, 6*(7), e1000097.
840 *Nauclér, K. (2004). Spelling development in Swedish children with and without language
841 impairment. *Journal of Multilingual Communication Disorders, 2*(3), 207–215.
842 https://doi.org/ 10.1080/14769670400018315
843 Olson, R., Forsberg, H., & Wise, B. (1994). Genes, environment, and the development of
844 orthographic skills. In V. W. Berninger (Ed.), *The varieties of orthographic knowledge:*
845 *Theoretical and developmental issues* (Vol. 1, pp. 27–71). Dordrecht, the Netherlands:
846 Kluwer Academic Press
847 Perfetti, C. A., & Hart, L. (2002). The lexical quality hypothesis. In L. Verhoeven, C. Elbro,
848 & P. Reitsma (Eds.), *Precursors of functional literacy* (pp. 67–86). Amsterdam: John
849 Benjamins Publishing Co. https://doi:10.1075/swll.11.14per.

Puranik, C. S., Lombardino, L. J., & Altmann, L. J. (2007). Writing through retellings: an exploratory study of language-impaired and dyslexic populations. *Reading and Writing*, *20*(3), 251-272. https://doi.org/10.1007/s11145-006-9030-1

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

Raynolds, L. B., & Uhry, J. K. (2010). The invented spellings of non-Spanish phonemes by Spanish-English bilingual and English monolingual kindergarteners. *Reading and Writing: An Interdisciplinary Journal*, *23*(5), 495-513. https://doi.org/10.1007/s11145-009-9169-7

Richards, T. L., Aylward, E. H., Field, K. M., Grimme, A. C., Raskind, W., Richards, A. L., Nagy, W., Eckert, M., Leonard, C., Abbott, R. D., Berninger, V. W. (2006). Converging evidence for triple word form theory in children with dyslexia. *Developmental Neuropsychology*, *30*(1), 547-589. https://doi.org/10.1207/s15326942dn3001_3

Savolainen, H., Ahonen, T., Aro, M., Tolvanen, A., & Holopainen, L. (2008). Reading Comprehension, Word Reading and Spelling as Predictors of School Achievement and Choice of Secondary Education. *Learning and Instruction*, *18*(2), 201-210. https://doi.org/10.1016%2Fj.learninstruc.2007.09.017

Schmalz, X., Marinus, E., Coltheart, M., & Castles, A. (2015). Getting to the bottom of orthographic depth. *Psychonomic Bulletin & Review*, *22*(6), 1614-1629. https://doi.org/10.3758/s13423-015-0835-2

Scott, C. M., & Windsor, J. (2000). General language performance measures in spoken and written narrative and expository discourse of school-age children with language learning disabilities. *Journal of Speech, Language, and Hearing Research*, *43*(2), 324-339. https://doi.org/10.1044/jslhr.4302.324

*Scuccimarra, G., Cutolo, L., Fiorillo, P., Lembo, C., Pirone, T., & Cossu, G. (2008). Is there a distinct form of developmental dyslexia in children with specific language impairment? Findings from an orthographically regular language. *Cognitive and Behavioral Neurology, 21*(4), 221–226. https://doi.org/10.1097/WNN.0b013e31818a5caf

Serrano, F., Genard, N., Sucena, A., Defior, S., Alegria, J., Mousty, P., Leybaert J., Castro, S. L., & Seymour, P. H. K. (2011). Variations in reading and spelling acquisition in Portuguese, French and Spanish: A cross-linguistic comparison. *Journal of Portuguese Linguistics, 10*(1), 183–204. https://doi.org/10.5334/jpl.106

Seymour, P. H., Aro, M., & Erskine, J. M., in collaboration with COST Action A8 network, (2003), Foundation literacy acquisition in European orthographies. *British Journal of Psychology, 94*, 43-174. https://doi.org/10.1348/000712603321661859

*Silliman, E. R., Bahr, R. H., & Peters, M. L. (2006). Spelling patterns in preadolescents with atypical language skills: Phonological, morphological, and orthographic factors. *Developmental Neuropsychology, 29*(1), 93–123. https://doi.org/10.1207/s15326942dn2901_6

*Soriano-Ferrer, M., & Contreras-González, M. (2012). Narraciones escritas en niños con Trastorno Específico del Lenguaje (TEL). *Universitas Psychologica, 11*(4), 1341–1351.

Sun-Alperin, M. K., & Wang, M. (2008). Spanish-speaking children's spelling errors with English vowel sounds that are represented by different graphemes in English and Spanish words. *Contemporary Educational Psychology, 33*(4), 932-948. https://doi.org/10.1016/j.cedpsych.2007.12.005

Treiman, R., & Bourassa, D. C. (2000). The development of spelling skill. *Topics in Language Disorders, 20,* 1-18. https://doi.org/10.1097/00011363-200020030-00004

899 Varnhagen, C. K., Boechler, P. M., & Steffler, D. J. (1999). Phonological and orthographic
900 influences on children's vowel spelling. *Scientific Studies of Reading, 3(4),* 363.
901 https://doi/10.1207/s1532799xssr0304_3
902 Visser-Bochane, M. I., Gerrits, E., van der Schans, C. P., Reijneveld, S. A., & Luinge, M. R.
903 (2017). Atypical speech and language development: A consensus study on clinical signs
904 in the Netherlands: Consensus study on clinical signs. *International Journal of*
905 *Language & Communication Disorders, 52*(1), 10–20. https://doi.org/10.1111/1460-
906 6984.12251
907 Wimmer, H., & Landerl, K. (1997). *How learning to spell German differs from learning to*
908 *spell English.* In C. A. Perfetti, L. Rieben, & M. Fayol (Eds.), Learning to spell:
909 Research, theory, and practice across languages. Mahwah, N.J., London : Lawrence
910 Erlbaum.
911 *Windsor, J., Scott, C. M., & Street, C. K. (2000). Verb and noun morphology in the spoken
912 and written language of children with language learning disabilities. *Journal of Speech,*
913 *Language, and Hearing Research, 43*(6), 1322–36.
914 https://doi.org/10.1044/jslhr.4306.1322
915 Wright, L., Pring, T., & Ebbels, S. (2018), Effectiveness of vocabulary intervention for older
916 children with (developmental) language disorder. *International Journal of Language &*
917 *Communication Disorders, 53,* 480-494. https://doi.org/10.1111/1460-6984.12361
918 Zhao, J., Joshi, R. M., Dixon, L. Q., & Chen, S. (2017). Contribution of phonological,
919 morphological and orthographic awareness to English word spelling: A comparison of
920 EL1 and EFL models. *Contemporary Educational Psychology, 49,* 185-194.
921 https://doi.org/10.1016/j.cedpsych.2017.01.007

922 Ziegler, J. C., & Goswami, U. (2005). Reading Acquisition, Developmental Dyslexia, and
923 Skilled Reading Across Languages: A Psycholinguistic Grain Size Theory.
924 *Psychological Bulletin*, *131*(1), 3-29. https://doi.org/10.1037/0033-2909.131.1.3
925

Figure 1. Adaptation of the languages classification relative to orthographic depth, from Seymour, Aro and Erskine (2003). A continuum from more transparent to more opaque orthographies depending on the languages included in the present review.

Figure 2. Scoping review procedure