LSHSS

Tutorial

Why Children With Dyslexia Struggle With Writing and How to Help Them

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Purpose: Children with dyslexia often have related writing difficulties. In the simple view of writing model, high-quality writing depends on good transcription skills, working memory, and executive function—all of which can be difficult for children with dyslexia and result in poor spelling and low overall writing quality. In this article, we describe the challenges of children with dyslexia in terms of the simple view of writing and instructional strategies to increase spelling and overall writing quality in children with dyslexia.
Method: For spelling strategies, we conducted systematic searches across 2 databases for studies examining the effectiveness of spelling interventions for students with dyslexia as well as including studies from 2 meta-analyses. To locate other instructional practices to increase writing quality (e.g., handwriting and executive function), we examined recent meta-analyses of writing and supplemented that by conducting forward searches.
Results: Through the search, we found evidence of effective remedial and compensatory intervention strategies in spelling, transcription, executive function, and working memory. Some strategies included spelling using sound-spellings and morphemes and overall quality using text structure, sentence combining, and self-regulated strategy development.
Conclusions: Many students with dyslexia experience writing difficulty in multiple areas. However, their writing (and even reading) skills can improve with the instructional strategies identified in this article. We describe instructional procedures and provide links to resources throughout the article.

Students with dyslexia often also have writing difficulties. This is not surprising, as reading is theorized to be a central component of writing in some cognitive models of writing development (e.g., Graham, 2018; Hayes, 1996). The writing difficulties of students with dyslexia can be partially attributed to their reading difficulties and can manifest in many ways in their writing, such as poor spelling, poor legibility, lack of diverse vocabulary, poor idea development, and/or lack of organization.

Dyslexia and writing difficulties co-occur for two overarching reasons. First, reading and writing rely on related underlying processes (Graham & Hebert, 2010, 2011). For example, dyslexia involves difficulties related to processing phonological information needed for decoding words, whereas writing requires encoding phonological information when writing words. Because the disability impacts the underlying process for both the reading and writing systems, the prevalence of writing difficulties for students with dyslexia is not unexpected. Second, reading is a subskill required throughout the writing process. Writers often need to read source materials before writing their own text and also need to read and reread their own writing to diagnose text problems, such as spelling errors, grammar errors, and disorganization (Hayes, 1996). The presence of reading difficulties complicates this task, especially if students have poor handwriting skills that make it even more difficult for them to read their own writing.

The focus of this article is to address the various types of writing issues children with dyslexia may have and to provide information about research-based practices that can work toward remediation of these difficulties. First, we use the simple writing model to provide an overview of the skills needed for writing. To illustrate some of the writing difficulties students with dyslexia have, we then provide a case study of a student with dyslexia (Jordan) and discuss how some of his writing errors indicate difficulties related to reading challenges. Next, we provide theory for why students with dyslexia may struggle with writing by presenting research and theory about some of the links among their reading and writing difficulties. Finally, we identify instructional strategies shown to be effective for improving

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writing skills (and related reading skills) of students with reading and writing disabilities.

Conceptual Framework: Simple View of Writing

One way to characterize the skills involved in writing is to use the simple view of writing (Berninger & Amtmann, 2003). This theoretical model includes the subskills that are essential for the writing task and provides a framework for showing how those skills are interrelated. The model includes skills in four overarching categories: transcription, executive functions, working memory, and text generation (see Figure 1). We use the model as a heuristic, meaning that it is useful as a basic framework for understanding the components of writing, but we do not use it as a comprehensive description of how writing occurs. Researchers have proposed more comprehensive cognitive models of writing development (e.g., Graham, 2018; Hayes, 1996; Hayes & Flower, 1980; Scardamalia & Bereiter, 1986), but we decided to use the simple view of writing because it focuses on important aspects of writing skills that are relevant for teaching students with dyslexia. As we discuss various reasons students with dyslexia may have difficulty with writing, we will reference the simple view of writing to help explain how these difficulties may impact their writing. We will then link suggested interventions with the model as well in order to illustrate why the interventions are likely to be effective.

The simple view of writing is represented by a triangle, with each of the vertices linked to a specific writing skill or outcome. The two vertices at the base of the triangle represent (a) transcription skills (e.g., spelling, handwriting) and (b) executive function skills (e.g., self-regulation, planning, organization). Berninger, Abbott, Abbott, Graham, and Richards (2002) provide evidence that these skills enable (c) text generation, which is represented by the top vertex of the triangle. Because of the complexity of writing, the center of the triangle is used to illustrate that all of these skills are constrained by (d) working memory.[1]

When more working memory resources are needed for any individual component of the process, fewer resources are available to manage other components of writing tasks. For example, a writer with poor spelling skills may need to rely more on his or her working memory when spelling words, which leaves fewer working memory resources available for generating ideas for his or her writing or holding them in memory throughout the writing process. All too familiar is the anecdote of the student who stops to ask a teacher how to spell a word, only to return to his or her writing and state, "I forgot what I was going to say."

[1]It should be noted that the simple view of writing separates working memory from executive function, although it is more often included under the umbrella of executive function skills, along with cognitive flexibility and inhibitory control (see Zelazo, Blair, & Willoughby, 2016). For the purposes of this article, we also discuss working memory and executive function skills as separate, in order to situate our discussion within the simple view of writing, which provides a straightforward framework for considering the links between dyslexia and writing.

Because all of the writing components operate in working memory and require considerable resources and attention, it is postulated that, when transcription skills are sufficiently automatic, more working memory space and resources are available for self-regulation strategies such as goal setting, planning, monitoring, and revising, allowing writers to generate text more similar to that of skilled adult writers (Berninger et al., 2002).

Writings Difficulties of Students With Dyslexia in the Simple View of Writing

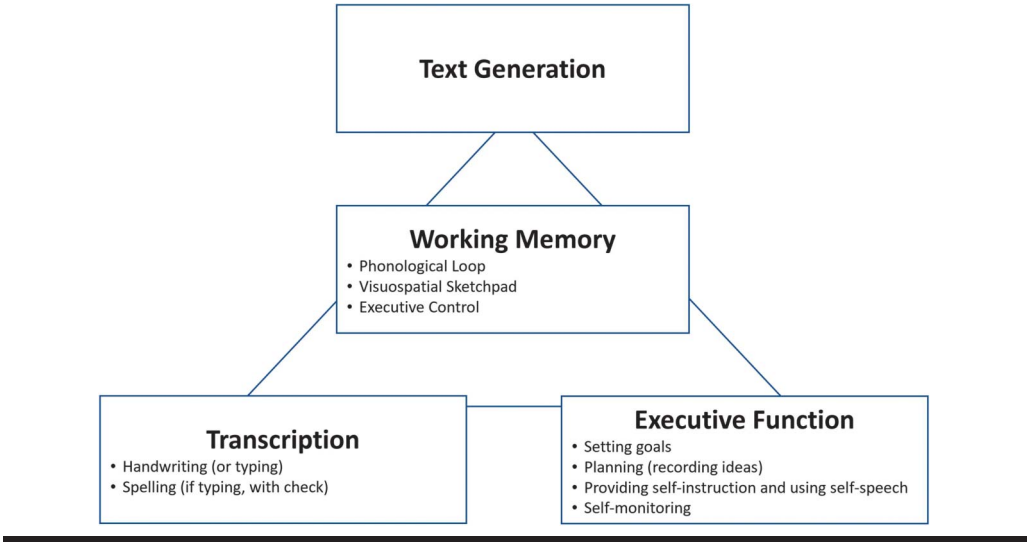
As we discussed previously, many students with dyslexia also have related writing difficulties. These difficulties can occur in many areas of writing related to the simple view of writing model and can manifest in many different ways. For example, the writing of students with dyslexia may suffer from one or more of the following issues: a high percentage of misspelled words, difficult-to-read handwriting, poor organization, a lack of fully developed ideas, and/or a lack of diverse vocabulary.

It is important to note that the causes of some of these writing difficulties may not be obvious. For example, it might be assumed that the cause of poor handwriting is poor motor control. Although this may be true, it could also be that the true causes of handwriting difficulties are more complicated than it first appears. Some researchers (e.g., Berninger, Nielsen, Abbott, Wijsman, & Raskind, 2008) have demonstrated that poor handwriting skills may actually be the result of poor spelling skills. These researchers hypothesize that students with poor spelling skills hesitate more often when writing words, leading to less fluent letter writing (Berninger et al., 2008). When writing a single word, this may not make much difference to a writer's overall handwriting skills, but consistent hesitation and dysfluent word writing may not allow students to improve their handwriting skills. Similar to how spelling may contribute to poor handwriting, poor handwriting may sometimes contribute to poor organization in the writing of these students. We will explore some of the research behind these issues in more detail later in the article, but first, we illustrate some of the writing challenges a student with dyslexia might experience using a writing sample from Jordan, a fourth grader with reading disability.

Jordan: A Writing Case Study for a Student With Dyslexia

Jordan (a pseudonym) is a 10-year-old fourth grader. He participated in a research study led by the first author, and his scores indicate a level of difficulty that would qualify him for special education services based on a diagnosis of dyslexia. His scores on the word reading subtests of a standardized test, the Woodcock Reading Mastery Test–Third Edition, indicate a level of reading difficulty—below the 17th percentile—that is often used as an evidence of dyslexia (see the scores in Table 1).

Figure 1. A model of the simple view of writing.



Jordan also shows difficulty with writing. He was given the Essay Composition Subtest of the Wechsler Individualized Achievement Test–Fourth Edition. For this test, children have 10 min to write about a favorite game and three reasons they like it. Jordan's essay writing places his performance at the 25th percentile compared with other fourth graders. Jordan's writing sample (see Figure 2) illustrates some of the writing difficulties of children with dyslexia.

His difficulties map onto the dimensions of the simple view of writing. First, Jordan has some difficulty with transcription skills. In terms of handwriting, Jordan appears to form letters in unconventional ways. For example, he appears to start and end the lowercase *o* on the bottom of the line. His handwriting also impairs the reader's ability to follow because he omits spaces between words and extends letters below the line, such as the *L* in *battelships** and the *A* in *play* on Line 2. For spelling, he appears not to have memorized the spellings of frequent but irregular words such as *friends* (written *frinds**) and has an incomplete understanding of the "drop the E" convention that results in *plaing** for *playing* (he overgeneralizes and drops the final *Y*).

These difficulties appear to strain his working memory, as the simple view predicts. Jordan spells *because* in two different ways—one of them correct. So, he knows the correct spelling of *because*. His handwriting also appears to degrade as he writes (the third line has many more letters below the line than the first). These transcription difficulties indicate difficulty balancing transcription accuracy with the expression of ideas that requires strong executive function. Overall, he may be struggling with transcription simply because transcription is hard and also because the need to focus on other aspects of writing taxes his executive control. He has difficulty remembering the spoken word he intends to write (suggesting challenges retaining information in the phonological loop) or has difficulty retaining his visual representations of the letters (perhaps difficulty within the visuospatial sketchpad) in the face of other demands.

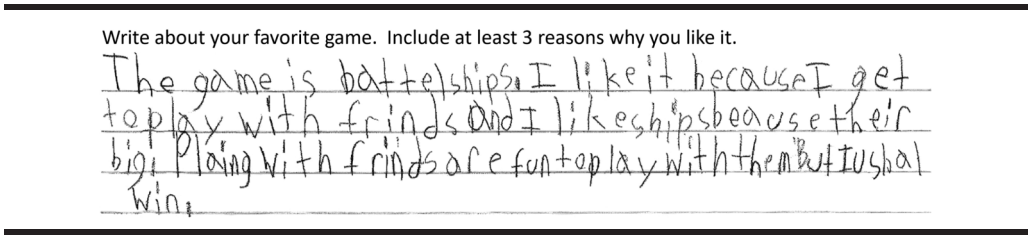
Turning to the other base of the simple view, the content of Jordan's paragraph suggests difficulty with executive function. The content of the paragraph is quite limited: He repeats his primary reason for enjoying Battleship ("I get to play with friends," and "Playing with friends

Table 1. Reading and writing scores for our example student with dyslexia (Jordan).

Test	Standard score	Percentile
WRMT3 Word Identification Subtest	82	12th
WRMT3 Word Attack Subtest	81	10th
WRMT Reading Comprehension Composite	85	16th
Word Comprehension Subtest	86	18th
Passage Comprehension Subtest	86	18th
Test of Silent Reading Efficiency and Comprehension	84	14th
WIAT4 Essay Composition Subtest	90	25th

Note. Scores at the 16th percentile are 1 *SD* below the mean. Scores at or below this often result in qualification for reading disability based on word reading difficulty, that is, dyslexia. WRMT3 = Woodcock Reading Mastery Test–Third Edition; WIAT4 = Wechsler Individual Achievement Test–Fourth Edition.

Figure 2. A writing sample from Jordan, a fourth-grade student with reading disability as identified by performance on word reading tests. The transcribed text follows (misspelled words followed by asterisks): *The game is battelships*. I like it because I get to play with frinds* and I like ships beause* their big. Plaing* with frinds* are fun to play with them But I ushal win*.



are fun to play with them"). Perhaps, these ideas are subtly different (first, the game is an excuse to spend time with friends, and second, he enjoys the gameplay), or he may simply have repeated himself. Either way, this confusion suggests he probably wrote his ideas as he thought of them, rather than creating an organizer first. In addition, the sentence "Playing with friends are fun to play with them" also has a circular logic that suggests he did not monitor his writing as he went.

On the basis of the simple view of writing model, it is likely that Jordan's difficulties with transcription skills and executive function skills are linked, due to constraints of working memory. Because Jordan has difficulty with transcription skills, more working memory resources are allocated to those tasks when he is transcribing his sentences. This decreases the available working memory capacity for holding ideas and organizational plans in memory while writing (even at the sentence level), leading to incoherence. Conversely, Jordan's lack of executive function skills for goal setting and planning (e.g., making a list of ideas before writing) places a burden on working memory resources, leaving fewer resources available for monitoring spelling and conventions.

In addition to the interrelationships among the difficulties with writing skills, Jordan's difficulties can also be shown to be related to his reading disability (i.e., dyslexia). We will explore these connections later, but we first provide theory and research evidence for why dyslexia and writing difficulties co-occur. Then, we will return to Jordan's case study based on the research evidence.

Theory and Research Evidence Linking Dyslexia and Poor Writing Skills

Data indicate that there is a strong relationship between dyslexia and writing difficulty, and we explore these data within the simple view. First, we focus on transcription, particularly spelling and handwriting. We then follow this up with a discussion of relationships between dyslexia and writing in both executive function and working memory skills.

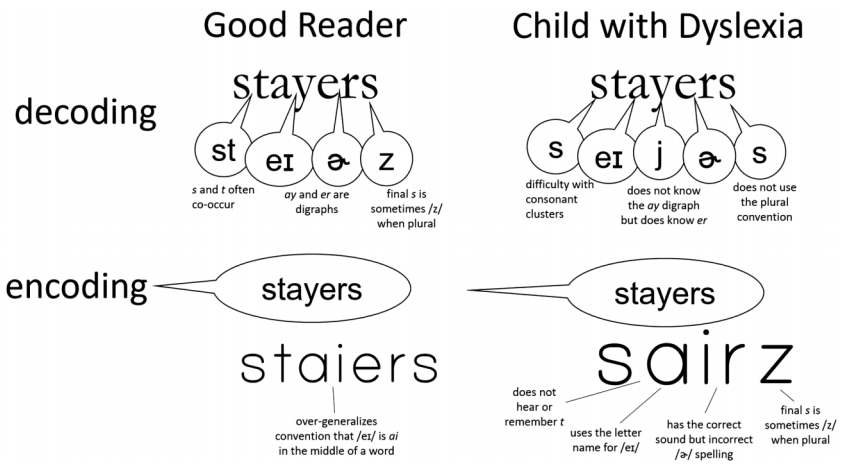
Spelling Skills and Dyslexia

Spelling and reading involve reciprocal parts of one task—connecting letters and sounds. As a result, people with dyslexia often exhibit similar levels of spelling difficulty (Scarborough, 1998), and children with dyslexia often show spelling difficulty into adolescence (Ehri, 1997). The source of difficulty is in phonological processing (Ramus & Szenkovits, 2009). People with dyslexia show impairment in the ability to encode, retain, and access phonological information. This makes it difficult to read unknown words (decode them): Readers must produce a grapheme for each phoneme, retain each in memory, combine them into a single pronunciation, and connect this pronunciation with a word in memory (Kearns, Rogers, Koriakin, & Al Ghanem, 2016). Spelling unknown words (encoding) requires a complementary process, listening to an unknown spoken word, breaking it into phonemes, selecting the appropriate grapheme for the phoneme, repeating this process for each phoneme, and then checking the result to make sure it looks like a real word (see Figure 3 for an example of the reciprocal processes). For this reason, children's spelling abilities predict their later reading abilities (Ouellette & Sénéchal, 2017)

Because reading and spelling skills both require phonological skills, spelling and phonological skills are strongly linked (Furnes & Samuelsson, 2010). People with dyslexia are likely to make spelling errors that indicate some sounds were not adequately processed (Bruck, 1993; Cassar, Treiman, Moats, Pollo, & Kessler, 2005; Pennington et al., 1986). For example, a child with dyslexia might spell *jump* as *jup** or blind as *blid** (Bourassa, Treiman, & Kessler, 2006)—suggesting that the child did not distinguish the two bilabial sounds (/m/ and /p/) in *jump* or the alveolar ones (/n/ and /d/) in *blind*. It also appears that people with dyslexia use different sources of information to spell words than their peers with typical achievement. College students with dyslexia appear to rely on words' meaningful parts (morphemes) to support their spelling (Bourassa et al., 2006)—more so than their typical peers (Bruck, 1993; Frith, 1978). It is also noteworthy that spelling difficulty continues to be associated with word reading difficulty into the upper elementary and middle school grades. Studies generally suggest that the link between word reading skills and reading comprehension declines as children age, but the association with spelling remains very strong (Badian, 1999).

People do not always spell using encoding. Eventually, they develop a representation of the word in which the letters, sounds, and meanings are very tightly connected (Ehri, 2005). When that happens, spelling a word does

Figure 3. A representation of the difference between decoding (pronouncing written words by linking graphemes to phonemes and combining them) and encoding (writing spoken words by parsing the words into graphemes and writing each using knowledge of grapheme–phoneme correspondences and spelling conventions). In the spellings, the good reader has overapplied the spelling convention that *ay* is the spelling of /eɪ/ at the end of a word. If the written word looks incorrect, the spelling might be adjusted to writing the letters and adjusting the spelling as needed afterward. The good reader might realize that *staiers* looks incorrect and rewrite it correctly. Problems with encoding are particularly pronounced in people with dyslexia because encoding requires the ability to process the sound information correctly and represent it on the page. The reader with dyslexia in Figure 3 does not include the *T*—probably because of difficulty processing sound information.



not really involve encoding. The person simply remembers which letters to use and writes them. In many cases, people may use encoding and memory together. For example, Jordan's misspelling of *because*—after spelling it correctly earlier in the writing sample—probably suggests that he has much of the word memorized. The *ause* part is pronounced /ʌz/ so the correct pronunciation of that must be from memory. Missing the *C* probably indicates he failed to use encoding for that part.

Part of the challenge for children like Jordan is that English has a remarkably complex orthographic (letter) system. English has just 26 letters but about 40 phonemes, so some sounds must be spelled with multiple letters (e.g., /ʧ/ spelled with *CH*). In addition, sounds sometimes have multiple spellings (e.g., /ʧ/ spelled with *TCH* as in *batch*). However, the system has many "exemplary regularities" (Perfetti, 1992, p. 18) and helpful spelling conventions (a selection is given in Table 2). Jordan's writing suggests that he does not have a firm grasp on these. For example, *battelship** should have *LE* instead of *EL* at the end of *battle*, a convention for spelling /əl/ or /l̩/ at the end of words, one used in more than 4,000 English words readers might

Table 2. Examples of regular spelling patterns.

Name	Description	Example
FLSZ	*F*, *L*, *S*, and *Z* are doubled when they follow a short vowel.	*buff* vs. *beef* *bill* vs. *boil* *bass* vs. *base* *buzz* vs. *booze*
TCH/CH *DGE/GE*	*TCH* and *DGE* are used after a short vowel; *GE* and *CH* otherwise.	*batch* vs. *beach* *badge* vs. *cage*
WA	/ɑ/ is spelled with *A* when /w/ precedes it.	*watch* vs. *botch*
V	*V* never ends a word.	*have* *weave*
AI/AY *AU/AW* *EA/(E)Y* *OA/OW* *OI/OY*	The first of these is used in the middle of a word; the second, at the end.	*mail*, *may* *launch*, *law* *veal*, *valley* *boat*, *bow* *boil*, *boy*
C/G	These make different sounds if followed by *A*, *O*, *or U* than if followed by *E*, *I*, or *Y*.	*cat*, *cot*, *cut*; *cede*, *cite*, *cyan* *gap*, *got*, *gut*; *gent*, *gin*, *gym*

encounter in first through eighth grades (analysis based on data from Fitt, 2001, and Zeno, Ivens, Millard, & Duvvuri, 1995). He used *plaing** for *playing* (but spelled *play* correct), potentially indicating that he has partial understanding of the convention to drop the *E* at the end of a word before adding a suffix beginning with a vowel (e.g., *place* to *placing*). The good news is that children like Jordan can improve their spelling and reading by learning about English spelling conventions (also sometimes called patterns or [perhaps inaccurately] rules).[2]

Learning to spell can also improve the quality of written compositions (Berninger & Richards, 2010; Sanders, Berninger, & Abbott, 2017). Put differently, this means that learning to spell better results in children writing better overall. In short, the value of teaching spelling to children with dyslexia extends beyond reading into written composition.

In summary, people with dyslexia have difficulty with spelling because reading and spelling are related abilities. The errors people with dyslexia make when spelling are similar to the errors they make when reading. In addition, English spelling makes the task somewhat challenging anyway—although this does not mean children with dyslexia should be taught that English is a mess or totally confusing. There are many ways in which the system works well, and children with dyslexia can be taught to use it to improve their spelling.

Handwriting. Handwriting problems are often associated with dyslexia, although researchers and practitioners do not always consider them together (cf. Pagliarini et al., 2015).[3] However, children with dyslexia show persistent difficulty with handwriting (Sumner, Connelly, & Barnett, 2016). As a result, it is important to consider handwriting on its own within the transcription dimension of the simple view.

Data appear to be clear that children with dyslexia experience handwriting difficulty, often showing difficulty writing quickly with correct letter formation. It is easy to conclude that these difficulties are the result of poor motor function, but studies have indicated that this may not be the case. Across all types of children—that is, when you consider a wide range of learners including those without dyslexia—there is a relationship between motor function and writing composition quality. However, this is not the case for children with dyslexia (Graham, Berninger, Abbott, Abbott, & Whitaker, 1997). For example, Stanley and Watson (1980) examined the performance of children with and without dyslexia on a composition and figure drawing task. Both groups of children drew figures with similar speed and accuracy, whereas the students with dyslexia wrote more slowly and with more spelling errors. If handwriting difficulty was the result of motor problems, differences would occur in drawing and writing. This is not what the authors observed, suggesting that handwriting problems are related to spelling—not graphomotor—difficulty.

There is support for the connection between handwriting and spelling. Research on composition has found that some of the best early predictors of success have been the speed shown when writing the alphabet and coding orthographic material in spelling (Berninger, 2004; Montgomery, 2008). To examine this further, Berninger et al. (2008) evaluated the role of non-handwriting graphomotor planning in dyslexia and showed that it did not have a significant relationship with the quality of written compositions. However, handwriting and spelling are themselves strongly linked (Tarnopol & Feldman, 1987). Although the reason for this connection is not clearly established, poor letter formation may result from the working memory demand of retaining the correct phonological information in memory while producing the correct letter form. If children are focused primarily on spelling, they may struggle to simultaneously coordinate the handwriting task.

That does not mean that poor motor control should be ruled out of handwriting difficulties but instead suggests that the poor motor control exhibited by students may be the result of hesitations and lack of rhythmic movements due to uncertainty in spelling. In one study examining handwriting movements, Pagliarini et al. (2015) found that handwriting is controlled by two principles of organization: (a) *isochrony*, or the speed or timing of the movement in relation to the trajectory length, and (b) *homothety*, or the relative duration of the movement. The researchers also found that handwriting difficulties have a direct association to dyslexia and these difficulties can be characterized in terms of compliance with the rhythmic principles of writing. The dyslexic group was found to be slower in average writing speed and wrote less fluently than the typically developing group. Children who wrote less fluently turned out to read more slowly, make more errors, and have poorer receptive vocabulary. Overall, the study showed the individuals with dyslexia displayed rhythmic motor difficulties in handwriting.

To summarize, the data on handwriting suggest that handwriting difficulties may result from difficulty with spelling in children with dyslexia. Even those data indicating

[2]Some studies (e.g., Moll & Landerl, 2009) have shown a dissociation between reading and spelling skills because reading is more strongly associated with rapid naming than spelling. That is, good spelling does not require the processing speed required for good reading. However, it is likely that this is a greater concern in more transparent orthographies than English. Moll and Landerl's study was conducted in German, and other studies have shown that English readers process words differently from their peers in more transparent orthographies (e.g., Rau, Moll, Snowling, & Landerl, 2015; Torppa, Georgiou, Niemi, Lerkkanen, & Poikkeus, 2017). As a result, we focus on the strong association between reading and spelling but acknowledge that there may be a dissociation between reading speed and spelling as English-speaking children with dyslexia become more accurate and better able to spell.

[3]Difficulty with handwriting, particularly in the absence of word recognition or language comprehension difficulty, is sometimes called *dysgraphia* (Berninger et al., 2015; Thompson et al., 2018). However, researchers have not agreed on common measures for identifying this difficulty, and it is not clear whether dysgraphia includes cases where children have fine motor problems beyond handwriting. Moreover, handwriting difficulties are frequently associated with other academic difficulties, so it is difficult to separate a specific dysgraphic profile. As a result, we do not use that term here, but we acknowledge that others do.

motor difficulties still suggest that this may result from spelling uncertainty. As a result, children with dyslexia have poor handwriting. It is possible that improved spelling will lead to improvements in handwriting, but the reverse is also true. On this basis, recent interventions for students with dyslexia have included both types of support (e.g., Berninger, Richards, & Abbott, 2015), and the very good news is that handwriting can be improved as the result of structured teaching focused on handwriting specifically (Christensen, 2005).

Reversals. People with dyslexia appear to show a tendency to reverse letters and words when spelling (*b* and *d* or *saw* and *was*). This is one reason people have a fundamental misunderstanding that dyslexia is a visual processing problem (Orton, 1925). It cannot be overstated: Dyslexia is not a visual processing problem. Reversals in spelling do not indicate that it is.

However, this topic is somewhat complex, and there are confusing nuances about apparent cases of reversals. Here is a brief summary of data on this point:

1. Most children sometimes transpose similar letters such as *b* and *d*, and the percentage of reversals is similar between children with and without dyslexia. The reversals stand out in children with dyslexia because there are more reversals in their writing overall (although not in relative terms) and because they confirm our own biases (Fischer, Liberman, & Shankweiler, 1978; Moats, 1983).
2. When children with dyslexia perform visual tasks that do not involve letters, they perform as well as children with typical achievement. When visuals are paired with sounds, children with dyslexia mix them up (Vellutino, Pruzek, Steger, & Meshoulam, 1973).
3. When they reverse letters, children write the left-facing version (*b*) more often than the right-facing one (*d*). Right-facing letters are more common in English, so they may be using the more common pattern (Treiman, Gordon, Boada, Peterson, & Pennington, 2014). What is important to understand is that reversals do not occur in both directions with equal frequency, so reversals are not arbitrary—as we would expect if it is a visual problem.
4. Almost all people with dyslexia have phonological difficulties, but a very small minority also may have visual deficits. Some people with dyslexia do have problems with visual attention, that is, how much visual information they can process (Goswami et al., 2002; Valdois, Bosse, & Tainturier, 2004). However, studies do not show that reversals specifically occur more in people with dyslexia.

Taken together, these data validate the idea that dyslexia is a phonological deficit, and reversals are not part of what is a visual processing deficit in some people. As a result, spelling instruction should not focus on reversals, although strategies to help children associate the correct letter with the correct sound are almost certainly important (see Intervention section).

Overall, data suggest that children with dyslexia have spelling difficulty that is strongly related to their reading difficulty. The data also indicate that the spelling problem originates in difficulty processing sound information, similar to the problem with reading. Children with dyslexia also appear to use morphemes to support their spelling. These data provide some clues about how we can provide effective spelling instruction for children with dyslexia.

Executive Function

As discussed in a recent Institute of Education Sciences report, research findings have suggested that children with dyslexia have difficulty with executive function skills, such as inhibition control and switching attention (Zelazo et al., 2016). For example, Altemeier, Abbott, and Berninger (2008) found that students with dyslexia have difficulty inhibiting prepotent responses. When reading an unknown word, they often overrely on their first instinct and guess at the word before sounding out all of the letters, not inhibiting their response before confirming it is accurate. Similarly, Brooks, Berninger, and Abbott (2011) found evidence that difficulty switching attention may impact learning to read, due to momentary breakdowns in efficiency of cross-code integration of phonological and orthographic information.

According to the simple view of writing model, executive functioning in writing involves the ability to plan, organize, set goals, self-regulate, and self-monitor. Inhibition control and other executive functions are correlated with writing tasks in normally developing populations (Hooper, Swartz, Wakely, De Kruif, & Montgomery, 2002), influence handwriting (Berninger et al., 2006) and overall written output (Hooper et al., 2002), and add unique variance to models of integrated reading–writing tasks such as notetaking and report writing (Altemeier et al., 2008). Individual differences in executive function for self-regulation of the writing process may affect high-level composing and lower level transcription processes (spelling and handwriting). For example, handwriting automaticity depends on executive control to integrate the multiple processes (e.g., motor planning, orthography). Thus, for students with dyslexia, some handwriting issues may be related to poor executive function skills that contribute to poor coordination in time of phonological codes with serial finger movements in letter formation and production (Berninger, 2009). Although more research needs to be conducted in the examination of the relationships among the reading, writing, and executive function skills of students with dyslexia, this work demonstrates that deficits in executive function can impact both reading and writing skills for these students.

The attention required for handwriting and other transcription skills may also detract from students' ability to plan and organize text at higher levels of language. Deficiencies in these areas could be addressed by providing students with strategy instruction aimed at improving planning and organization before writing. When students plan

and rehearse their ideas before writing, it mitigates the impacts transcription difficulties might have on the quality of ideas and organization of a student's text. In other words, taking notes to plan and organize ideas before writing can act as an external memory, reducing the cognitive load during the writing task (Graham, 2018) and allowing students to switch their attention between writing functions more readily.

Working Memory

Some researchers include working memory within the constellation of executive functioning skills. However, in the simple view of writing, working memory is separate from executive function and is represented as a constraint for the writing task. Working memory is made of three components: central executive, phonological loop, and the visuospatial sketchpad. Each of these components is linked to specific reading and writing skills, and deficits in any working memory are likely to lead to related deficits in both. Kellogg (1996) explored the heavy demands placed on working memory by writing tasks and how each of the components is used to support different components of the writing task.

Because dyslexia is primarily a phonological awareness deficit, the phonological loop is the most obvious aspect of working memory that might impact both reading and writing. The phonological loop helps students hold acoustic and verbal information in memory while manipulating it, a skill that is needed for reading. Information held in phonological memory decays over time but can be refreshed through rehearsal. However, if students have difficulty representing phonological information accurately, due to a phonological awareness deficit (such as those exhibited by students with dyslexia), they may also have difficulty holding the information in memory or rehearsing it correctly. Deficits in phonological memory compound this problem, because students with poor working memory skills may not be able to hold as much phonological information in their short-term memory. This can lead to difficulties in decoding longer words when reading, or spelling longer words and writing longer sentences in writing.

Comparable with how the phonological loop is used to hold and manipulate auditory information, the visuospatial sketchpad is used to hold and manipulate visual information, such as shapes of letters, but is also important for conceptualizing organizational diagrams, visual plans, and relationships among ideas. As we have already discussed, dyslexia is primarily a phonological processing problem, not a visual processing problem. There is some evidence that students with dyslexia have difficulty remembering orthographic patterns and that this difficulty is caused by an inability to process the phonological information and link it with the visual components of the orthography (i.e., letter order). This may also be related to deficits in visuospatial memory, as students who cannot hold a sequence of letters in their visual memory may have difficulty when writing those letters during spelling and writing tasks. In addition, it may be that, due to fewer reading and writing experiences, students with dyslexia also have difficulties visualizing organizational patterns for ideas.

The central executive is a system that regulates and controls information in working memory, including how information is used in the phonological loop and visuospatial sketchpad. The central executive helps in retrieving information from long-term memory, task switching, and determining how to allocate and switch attention resources. Students with deficits in working memory may have difficulty regulating their attentional resources, such as determining how much attention to allocate for phonological loop resources when manipulating sounds and words when reading and writing, or visuospatial sketchpad resources when planning and organizing ideas for writing or reading comprehension tasks. Research shows a relationship between dyslexia and deficits in central executive. For example, Montgomery (2008) found that handwriting difficulties were frequently comorbid with attention disorders such as those found in students with attention-deficit/hyperactivity disorder.

Revisiting Jordan's Writing Difficulties Through the Dyslexia Lens

Earlier in the article, we examined Jordan's writing in relation to the simple view of writing model and showed the potential relationships among his writing skills. After exploring how writing skills and dyslexia co-occur, it is clear that some of Jordan's writing difficulties stem from his reading disability in several ways. First, Jordan is having some difficulty with transcription skills, including spelling and handwriting (refer back to Figure 2). The research is clear that spelling difficulties co-occur with decoding difficulties for students with dyslexia, and it may be that his handwriting difficulties are partially related to those spelling and decoding difficulties as well. Second, we illustrated that students with dyslexia often have difficulties with working memory (including the phonological loop and visuospatial sketchpad), which may be exacerbating Jordan's transcription difficulties. Because he has incomplete phonological representations for words, for example, Jordan must devote a considerable amount of working memory resources to the writing task, and any potential deficit in working memory will leave even fewer resources available for executive function tasks. Third, we illustrated that students with dyslexia often have difficulties with executive function skills, such as goal-directed behavior, planning, and organization. Jordan's difficulty with sentence level grammar and clarity show that he either (a) did not have working memory resources available to reread his writing and identify errors, (b) had difficulty rereading his own writing due to transcription difficulties and his reading disability, or (c) both. It is also probable that Jordan did not set goals or develop a plan for his writing, which may show deficits in executive function related to his dyslexia. Despite the difficulties Jordan faces in writing, there are effective interventions available to help him, and knowing

the relationship between his reading and writing problems can help teachers develop an appropriate instructional plan.

Interventions to Improve the Writing Skills of Children With Dyslexia

The co-occurrence of dyslexia and writing skills leads to questions about how to approach writing for these students. As we illustrated by examining Jordan's writing, the writing difficulties faced by students with dyslexia can vary, and the difficulties in one area may be related to difficulties in other areas. In other words, stress on one part of the complex writing system can impact a student's ability to use another part of the system, impacting text generation and writing quality. Because of that, a multifaceted approach to instruction, with multiple interventions, is likely to be more effective than a single intervention.

In this section, we provide an overview of instructional strategies, organized according to components of the simple view of writing model that are addressed by the intervention (transcription or executive function). Next, we discuss the interventions in terms of whether they are aimed at (a) remediation of a skill or (b) compensation for a skill deficit. Remediation involves directly addressing a student's skill deficit in an attempt to improve the skill, whereas compensation involves providing students with strategies to reduce the cognitive demands of writing and make the writing task more manageable. The decision to focus on remediation or compensation in a particular lesson may depend on the purpose of the writing task, and teachers may sometimes include both compensation and remediation strategies within a single intervention. Table 3 classifies strategies into remediation or compensation categories.

To identify strategies, we conducted systematic searches (see Appendix), examined meta-analyses for studies used with students with reading and writing disabilities, and conducted forward searches to identify studies of additional strategies. When identifying and recommending strategies, we include strategies that have been shown to be effective for students with both reading and writing difficulties, who struggle with writing for a variety of reasons.

Interventions to Address Poor Transcription Skills

There are a variety of remediation and compensation strategies for transcription skills. For some skills, there are both remediation and compensation strategies that teachers can use flexibly to meet students' needs.

Strategies That Support Spelling Development

The nature of English itself gives us some hints about the kinds of instruction that may be effective for improving spelling. We located 19 studies that (a) used experimental designs that support causal inference (randomization or single-case methods) and (b) had positive effects on spelling achievement. We examined the instructional components of all the interventions and counted how often each of these components was used in those studies. Four instructional components were present in at least four studies, data that we think suggest these components may be useful parts of a spelling program for students with dyslexia. We describe each of these here (see Table 4 for a number of studies supporting each strategy).

Phonics. Phonics instruction was by far the most frequent of the instructional components related to spelling

Table 3. Strategies to help children with dyslexia write better.

	Skill area			
	Transcription			
Strategy type	Spelling	Handwriting	Executive function	Working memory (WM)
Compensation	• Using knowledge of morphemes • Spell-check	• Learning keyboarding • Using speech-to-text systems • Dictating	• Structures Writing provides content for writing to compensate for planning difficulties	• Self-regulated strategy development (SRSD) reduces WM load by providing steps • Structures Writing Program reduces WM load by providing ideas, vocabulary, and spelling • Sentence combining reduced WM by providing content and spelling

Remediation	• Improving phonics skills
	• Learning letter–sound relationships and rules
	• Improving orthographic memory and analysis
		• Improving letter formation
		• Using modeling and self-verbalization
		• Using visual cues
		• Multicomponent interventions
			• SRSD to improve
			  ○ Planning
			  ○ Organization
			  ○ Goal setting
			  ○ Self-monitoring
			• Structures Writing to improve organization
			• Sentence combining to improve sentence level planning and organization	

Table 4. Instructional components in studies with positive effects on spelling.

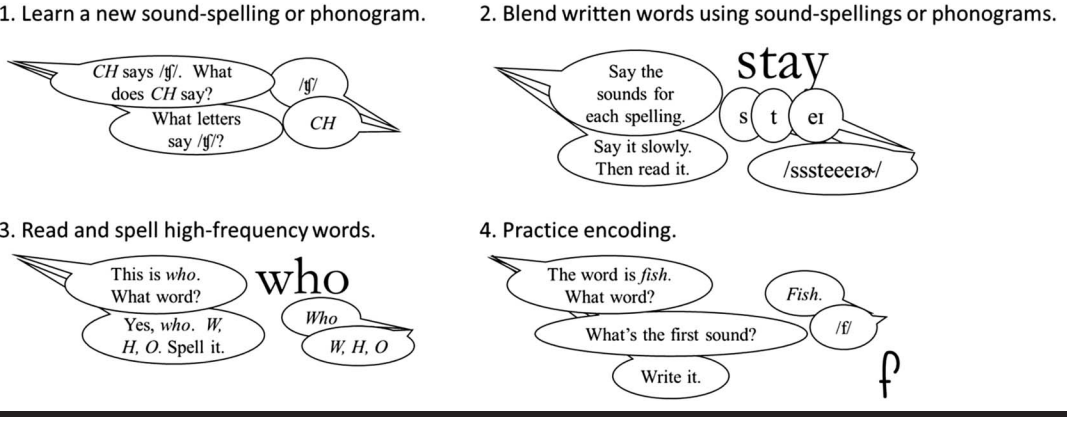
Element	Studies
Multicomponent phonics program	8
Letter–sound analysis	7
Morphological analysis	5
Orthographic analysis or memory	3
Word meaning	2
Syllabic analysis	2
Vocabulary and reading comprehension program	2

achievement, the focus in eight of the 19 studies. These studies included multicomponent phonics interventions and involved teaching students to (a) recognize and pronounce grapheme–phoneme correspondences (e.g., *T* = /t/, also called sound-spellings) and phonograms (the spellings of rhyming parts of words like *OAT* = /oʊt/), (b) decode words using sound-spellings and phonograms, (c) practice pronouncing and spelling high-frequency words, and (d) practice encoding using sound-spellings and phonograms (see Figure 4 for examples of these activities). Most programs also include reading words in sentences and texts with words chosen to focus on new and review skills. In our review, there were eight studies that used these types of phonics programs and found that they positively affected spelling outcomes: Guyer, Banks, and Guyer (1993); Lim and Oei (2015); Morris et al. (2012); O'Shaughnessy and Swanson (2000); Savage, Carless, and Stuart (2003); Schlesinger and Gray (2017); Schneider, Roth, and Ennemoser (2000); and Vaughn et al. (2010). Phonics instruction has been very effective in improving the reading achievement of children with dyslexia, so it is no surprise that it has a similar effect on spelling in children with dyslexia (National Institute of Child Health and Human Development, 2000). Phonics instruction helps children solidify the relationships between letters and sounds and helps them to identify each sound in a word. For example, reading *jump* would involve providing a sound for each letter, so this would reinforce the connection between /mp/ and *mp*. After extensive phonics practice, readers will be unlikely to make the *jump–jup** error anymore. This knowledge will almost certainly translate to spelling because spelling unknown words involves encoding the sounds to write letters, just as reading unknown words involves decoding the letters to produce sounds. Moreover, many of these phonics programs deliberately include encoding practice. There are many programs available that include most or all of these skills. Databases that provide information about programs with evidence of effectiveness come from the What Works Clearinghouse, the National Center for Intensive Intervention, and the Best Evidence Encyclopedia, among others.

Learning sound-spellings and phonograms. In effective spelling-focused programs, one important feature was instruction on sound-spellings (Berninger, Lee, Abbott, & Breznitz, 2013; Darch, Kim, Johnson, & James, 2000; Hart, Berninger, & Abbott, 1997; Santoro, Coyne, & Simmons, 2006; Shippen, Reilly, & Dunn, 2008; Vadasy, Sanders, & Peyton, 2006). Obviously, learning sound-spellings is part of phonics instruction, but it can also support spelling even if they are not taught as part of a phonics program. Conrad (2008) even showed that practicing spelling words benefits word reading—even more than reading benefits spelling.

In addition, children with dyslexia may benefit from learning how to select spellings when there are multiple possible options. For example, /ʧ/ can be spelled with *CH* or *TCH*, if a reader would be able to read a word either way. However, they might have less luck spelling unfamiliar /ʧ/ sounds because either spelling could be correct: For example, *cach** and *catch* both say *catch*. However, there is a pattern children can learn: The *TCH* spelling is used after a short vowel (a lax vowel sound, usually spelled with a single *A*, *E*, *I*, *O*, or *U*; refer back to Table 2 for examples of this and other short-vowel patterns). The point is that some spelling patterns support spelling accuracy but would have little additional impact on reading (Caravolas, Hulme, & Snowling, 2001). Learning such spelling patterns still has value because they support transcription accuracy and therefore text generation.

Figure 4. Examples of activities in phonics lessons that improve reading and spelling.



One way to reinforce spelling patterns is to have students complete a dictation activity. In dictation, teachers have students examine words in sound-spelling or phonogram units. Students spell the word one unit at a time. See Figure 5 for an example.

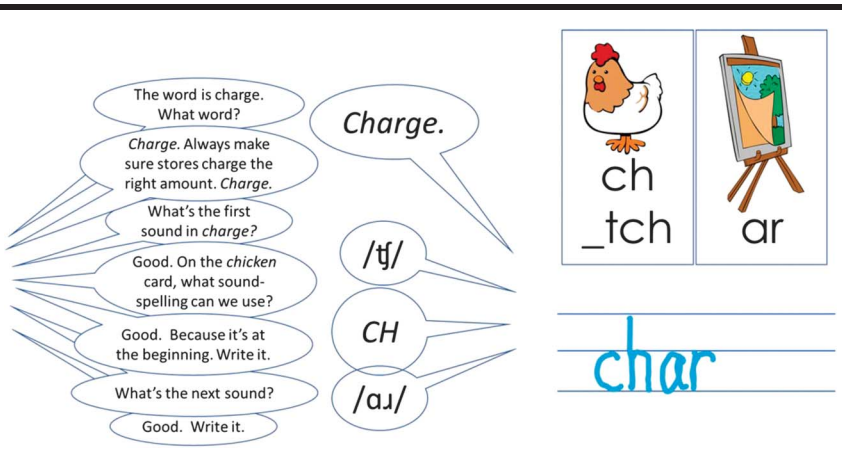
Analysis of the morphemes in words. The phonological challenges children with dyslexia experience can make it difficult for them to use phonological information. In some cases, even the best phonics instruction may not result in adequate word reading improvement. One way to circumvent this problem is to teach children to recognize a different kind of unit, a morpheme. Morphemes are meaningful units in words, including affixes and base words. *Replacement* has the prefix *re-*, the base word *place*, and the suffix *-ment*. The problem with morphemes is that they are less efficient than sound-spellings because fewer words can be spelled correctly using morpheme information than using sound-spellings alone. English has many more morphemes than sound-spellings. For example, there are only 70 affixes with at least 100 occurrences in English words, versus 224 for sound-spellings. However, many words have more than one morpheme (Nagy & Anderson, 1984), and readers at all ability levels appear to use morphological information (Kearns, 2015). In short, there are good reasons for teaching students to spell using morphemes. To that end, five studies with positive spelling effects included instruction on using morphemes to spell words (Darch et al., 2000; Kirk & Gillon, 2009; Shippen et al., 2008; Vadasy et al., 2006; Vaughn et al., 2010). These programs usually involved teaching both the spelling and meaning of affixes, with a greater emphasis on their spelling and pronunciation. Another valuable activity involves teaching base-word families, emphasizing how a base word changes when one or more affixes are attached to it (e.g., happy, happier, unhappy; Archer, Gleason, & Vachon, 2003; O'Connor, Beach, Sanchez, Bocain, & Flynn, 2015).

Orthographic analysis and word memory. Three studies indicate that children's spelling improves when they are taught strategies to remember the exact spellings of words (Berninger et al., 2013; Fulk, 1996; Hart et al., 1997). For example, Berninger et al. (2013) taught students two strategies to remember the written forms of words, the Photographic Leprechaun and the Proofreader's Trick. The strategies both involved visualizing a word and answering questions about its spelling. For example, in the former, a reader like Jordan would look at a word, close his eyes, and answer questions such as "What is the second to last letter?" Then, he would open his eyes to check the answer. The latter was the same except that the children spelled the word backward with their eyes closed.

It is important to note that only three studies included this kind of instruction. In addition, two of these were in studies by the same research group, and the instruction in both included other components. However, the results were positive overall, so we included this study.

Spell-check. Spell-check has been available for quite some time, although evidence of effectiveness is limited (Morphy & Graham, 2012) and (similar to the caveat for keyboarding skills) the effectiveness of spell-check will likely depend on students' ability to use it. Use of spell-check is also limited to computer-based writing and assumes that students can approach a reasonable approximation for the words they want to spell and identify the correct spelling for the word when options are provided.

Figure 5. An example of a spelling dictation activity. In spelling dictation, the teacher has children systematically spell words by breaking them into phonemes and writing the associated graphemes one at a time after the teacher's cues. In this example, the teacher has a set of cards where each card represents an English phoneme (or associated phonemes, as in *r*-controlled vowels). The image on each card contains the target phoneme and serves as a reminder of the pronunciation. Each card contains the most common spellings of the phoneme. For /ʧ/, the card includes both *CH* and *TCH*. The spellings sometimes include devices to help with spelling, such as the blank before *TCH* that indicates it cannot come at the beginning of a word. In this example, the teacher reminds the children of this pattern before they write the word to support them in selecting the correct one of the two.



Strategies to Help Students Improve Handwriting

Although there are ways to compose texts that do not require handwriting, it is still one of the most prevalent forms of writing in school, and some research shows that teaching handwriting can help improve reading outcomes for students with dyslexia. In a recent meta-analysis, Santangelo and Graham (2016) found that teaching handwriting instruction can improve legibility and fluency of students' writing and lead to improvements in writing quality and length of students' writing. Many studies involved students with significant handwriting difficulties, which we have demonstrated is a common attribute of students with dyslexia. It is important to note that Santangelo and Graham found that studies involving motor instruction did not produce better handwriting skills. However, individualizing handwriting instruction and using technology were effective. We identified some of the individual handwriting strategies from studies that included students with significant reading and writing difficulties.

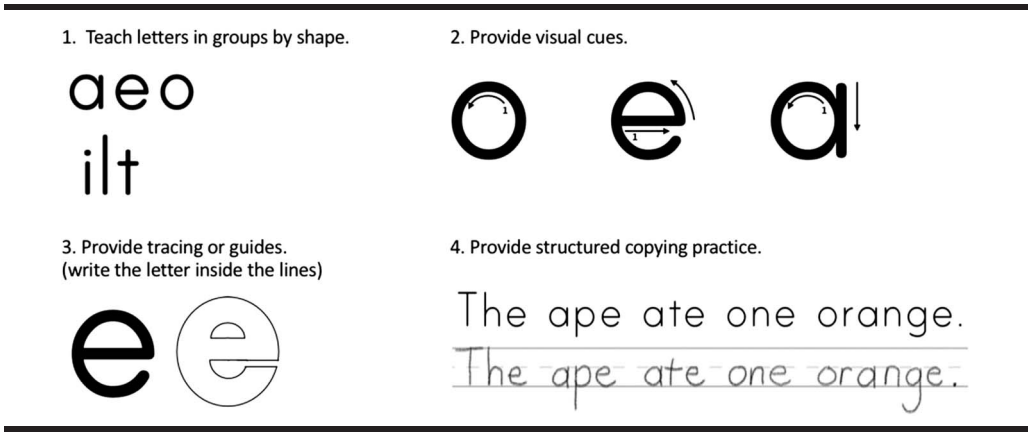
Multicomponent interventions. By far, the most common and effective approach to teaching handwriting to students with handwriting difficulties has been the use of individualized approaches involving multiple components (e.g., Berninger et al., 1997; Christensen, 2005; Denton, Cope, & Moser, 2006; Graham, Harris, & Fink, 2000; Jones & Christensen, 1999; Peterson & Nelson, 2003; Sovik, Arntzen, & Thygesen, 1986; Veena, Romate, & Bhogle, 2002; Weintraub, Yinon, Hirsch, & Parush, 2009; Zwicker & Hadwin, 2009). Every study identified in Santangelo and Graham's (2016) meta-analysis as using a multicomponent intervention for handwriting instruction was found to be effective. Such interventions often group letters by shared characteristics (e.g., Christensen, 2005; Graham et al., 2000) and include some combination of teacher modeling (e.g., Jones & Christensen, 1999), assistance to correct specific errors, use of models or tracing letters' tracks (e.g., Weintraub et al., 2009), specific feedback (e.g., Denton et al., 2006), self-feedback (e.g., circle your best letter; Graham et al., 2000), and practice and repetition (e.g., Peterson & Nelson, 2003). See Figure 6 for an example of several tasks from a multicomponent intervention developed by the Center on Accelerated Student Learning; we have provided the URL in the reference list (Graham & Harris, n.d.).

Use of models to teach handwriting. A few studies with students with disabilities suggested that the use of models is effective. Specific strategies include copying letters from models (Berninger et al., 1997; Walser, 1981), matching letters to models (Walser, 1981), or use of visual cues (Berninger, 1987). Some of these strategies were shown in the multicomponent interventions but were also shown to be effective on their own.

Technology for developing handwriting skills. Using technology was also found to be effective in two studies involving students with handwriting problems (Carrieres & Plamondon, 1994; Sovik et al., 1986). In both studies, the researchers used a digitizing tablet, and students traced letters. This approach seems promising, as technology can provide instant feedback, providing the teacher more flexibility in how practice is applied. However, we suggest incorporating the use of technology into a multicomponent intervention.

Keyboarding. There is some literature that shows the impact of using keyboarding to compensate for poor handwriting skills, but this should be approached cautiously. In a meta-analysis, Graham and Perin (2007) examined studies comparing students' writing when they were allowed to use a word processor with when they used paper and pencil. They found an effect size of 0.50, indicating that students wrote higher quality texts when typing. However, a more nuanced examination by Graham, Harris, and Hebert (2011) indicated that this is only effective for students who have experience using a word processor/keyboard and that it can underestimate the writing skills of some students if they do not have experience in typing. In these cases, teachers would want to provide instruction in keyboarding before expecting it to be an effective way to compensate for poor handwriting skills. This presents the teacher with a choice to (a) teach keyboarding skills to help students circumvent handwriting difficulties, (b) remediate handwriting skills, or (c) both.

Figure 6. Examples of handwriting activities in a multicomponent lesson.



Technology Strategies to Help Students Compensate for Both Handwriting and Spelling Difficulties

Technological developments continue to provide new ways to compensate for writing difficulties and reduce the complexity of writing. The number of these technology solutions and the pace at which they improve and change make it difficult to evaluate the efficacy of their use. Therefore, we limit our recommendations to three approaches with some research behind them that are also recommended by dyslexia experts (see Table 5).

Interventions to Address Poor Executive Function Skills

We present three interventions for improving poor executive function skills in writing: sentence combining, text structure instruction, and self-regulated strategy instruction. These interventions reduce the cognitive load for executive function tasks by breaking down complex skills into more manageable components for the beginning writers and/or incorporating compensatory strategies that help students focus on higher level skills.

Importantly, these skills also address language-related components of writing, including grammar, syntax, discourse structure, and organizational features of text. The use of these strategies compensates for the primary difficulties students with dyslexia face (e.g., spelling difficulties), allowing them to focus on higher order language skills related to text construction. Practitioners are encouraged to employ these strategies with a focus on the intersection of oral language and written expression, to emphasize language components of writing and executive function skills simultaneously.

Sentence Combining

Sentence combining has been shown through meta-analysis to be effective for improving writing skills of adolescents (Graham & Perin, 2007) and elementary grade students (Graham, McKeown, Kiuhara, & Harris, 2012) and has also been demonstrated to improve reading fluency skills (Graham & Hebert, 2011). We include sentence combining under executive function rather than transcription skills, because the goal of instruction is to help students plan and organize ideas at the sentence level. Sentence combining is a general intervention that involves providing students with two or more simple sentences (called *kernel sentences*) and teaching them to combine those kernel sentences into a single, more complex sentence, while keeping the original ideas intact. The following example illustrates how sentence combining exercise works:

> *Kernel Sentence 1:* Jellyfish have hoods and tentacles.
> *Kernel Sentence 2:* Their tentacles are numerous.
> *Kernel Sentence 3:* Their hoods are gelatinous.
> *Combined sentence:* Jellyfish have gelatinous hoods and numerous tentacles.

As shown in the example, providing the kernel sentences for students reduces the cognitive load during sentence writing instruction by (a) eliminating the need for students to generate ideas for the sentences, (b) providing content and vocabulary for students, and (c) providing students with the spelling of complex (and not so complex) words. This allows the students to think about how the ideas are related and develop plans and goals for writing better sentences, improving executive function skills, text generation, and writing quality.

Moreover, sentence combining exercises can be utilized in a myriad of ways to focus on particular language skills and make connections between oral language and writing. The focus of the previous example was adjective use, but sentence combining exercises can be used to teach a variety of grammatical structures, including compound sentences with connectors, compound subjects, compound

Table 5. Technology solutions to help students compensate for poor transcription skills.

Program	Description/features	Research	Where to find it
Co-writer, *NEO2*	A word processor with text predict, provides suggestions based on orthography and phonology of attempted words; the program offers a read-aloud option that will read the word options aloud as well as the final writing product.	Cullen et al. (2008)	http://donjohnston.com/cowriter/
Dragon Naturally Speaking	A speech recognition program that can be used to dictate a variety of writing tasks for students. Students use commands such as "Cap that" or "period" to include proper conventions. The text is shown on the screen as they dictate, which allows students to reread to make revisions or edits.	Higgins & Raskind (1999)	https://www.nuance.com/dragon.html
Livescribe	An assistive technology that can help dysfluent writers keep up with notetaking. The Livescribe technology is a smart pen that has a camera and a recording device. It can be used to take notes, while also listening to a presentation.	Belson et al. (2013)	http://www.livescribe.com/en-us/

predicate phrases, prepositional phrases, dependent clauses with because, and adverb clauses, to name a few. A nonexhaustive set of example exercises are included in Figure 7.

As students gain more experience and facility with sentence combining exercises composed of two or three kernel sentences, practitioners can use more complex exercises to help children develop more complex language skills related to writing. Exercises with five or more kernel sentences can be used to facilitate the use of complex elements that can be combined in multiple ways. Several sentence combining exercises might be grouped to help students connect ideas across sentences or in paragraphs. Practitioners can also develop de-combining exercises that require children to break more complex sentences into simpler ideas units. These kinds of exercises can help students develop flexibility in their language use when writing. See Figure 8 for examples of more complex sentence combining activities.

For Jordan and other students with dyslexia, these exercises are critical for improving writing skills. Jordan's writing included attempts at combining multiple ideas within a single sentence but included sentence level grammar errors that show a lack of sophistication in using dependent clauses. It may be that students with dyslexia either lack skills for complex sentence writing or have difficulty utilizing these skills when they write. Either way, this deficit is likely due to difficulties with transcription skills associated with demands on working memory during writing. Sentence combining instruction is an effective approach for remediating sentence construction of students with dyslexia because it reduces the demands transcription skills have on working memory. In turn, as students with dyslexia improve their sentence construction skills, it frees up cognitive resources that can be devoted to other executive functions and transcription.

Teachers can implement sentence combining intervention at a low cost, as they can create their own sentences

Figure 7. A nonexhaustive set of example exercises to illustrate how sentence combining can be used to teach and facilitate higher order language use in students' writing.

	Using Conjunctions or Connector Words to Link Ideas, Clauses, or Sentences (e.g., *and, but, if, so, or, nor, for*)
Example 1	Sea turtles eat jellyfish. Sea turtles eat sea grasses. One potential answer: Sea turtles eat jellyfish *and* sea grasses. A second potential answer: Sea turtles eat jellyfish *or* sea grasses. *(Exercises like this can be used to teach the use of compound predicate phrases using the connectors* 'and' *or* 'or.' *They can also be used address how the use of the different connector words leads to important changes in meaning.)*
Example 2	Juan likes to listen to piano music while he writes. Erica likes to listen to rock music while she does chores. Potential answer: Juan likes to listen to piano music while he writes, but Erica likes to listen to rock music while she does chores. *(Exercises like this one can be used to show students how to develop compound sentences using linking words.)*
	Combining independent and dependent clauses
Example 3	Erica enjoys listening to dance music when she exercises. The dance music energizes her. (because) Potential answer: Erica enjoys listening to dance music when she exercises because it energizes her. *(Exercises like this can be used to teach how to show causal relationships among ideas.)*
Example 4	The mathematician will arrive at the incorrect answer. The order of operations is not followed correctly. (if) Potential answer: If the order of operations is not followed correctly, the mathematician will arrive at the correct answer. *(Exercises like this can be used to show conditional relationships among ideas.)*
	Prepositional Phrases
Example 5	The pistil is the part of the flower that can produce fruit. It is in the center of the flower. Potential answer: The pistil, found in the center of the flower, is the part of the flower that can produce fruit. *(Exercises like this one can be used to teach the use of prepositional phrases.)*

Figure 8. Examples of complex sentence combining exercises that can be used to teach sophisticated language use in writing within and across sentences.

Multi-component exercises
The policeman commandeered a bicycle. He commandeered when he chased a criminal. The bicycle belonged to a child. The bicycle was small. The bicycle had training wheels. (*Exercises like the one above can be combined in multiple ways. Students can be challenged to combine it in more than one way, compare their answers with peers, and discuss whether there are advantages to combining them in particular ways.)*
Paragraph-level exercises
1. The seafloor moves. It moves due to an earthquake. It moves due to a meteorite. (or) It moves due to a volcanic eruption. (or) This happens first. 2. Water moves. The water is deep. The water is in the ocean. This happens second. 3. The water travels. It travels from the deep sea. It travels toward land. It creates a wave. This happens third. 4. The wave grows in height. It grows as it gets closer to land. The wave becomes a tsunami. This happens last. *(Exercises like this one can be used to help students build sentence writing skills and connect ideas across sentences in a paragraph. This can also be used to teach students how to use transition words (e.g., first, second, last.)*
Sentence De-combining
As Sergio and Anna raced toward the finish line of the obstacle course, their classmates jumped up and down cheering loudly. (*Exercises like this one can be designed to challenge students to de-combine longer sentences to help them understand multiple language components.*)

using content and skills from class. A valuable resource for teachers looking who would like to learn to more about sentence combining is the *Teacher's Guide to Effective Sentence Writing (What Works for Special Needs Learners), written by Bruce Saddler (2012)*.

Teach Children to Self-Regulate

One of the most effective approaches to improving the writing skills of students with writing difficulties is self-regulated strategy development (SRSD). The effectiveness of SRSD has been demonstrated in meta-analyses of group-design experimental research (Graham & Harris, 2003; Graham, McKeown, et al., 2012; Graham & Perin, 2007) as well as single-subject–design research (Rogers & Graham, 2008). It has been shown to be effective for students with reading and writing disabilities across the full range of grade levels. Students who have dyslexia may especially benefit from SRSD, as they often have fewer opportunities to learn how to use executive functions targeted by the intervention, including self-regulation skills, goal setting, self-speech, and self-monitoring. Students are taught to use these self-regulation skills through self-instruction involving defining the problem, focusing on attention and planning, engaging in writing, error correction, coping, and self-reinforcement, for example, when students might be taught to say things such as "My goals for this persuasive essay are to include three reasons," or when self-evaluating, they might be taught to say, "Am I following my plan?" The teacher models specific self-speech, acting as an external voice for the student, and then the student practices using the self-speech until he or she internalizes it and come up with some of his or her own self-instructions.

These self-regulation strategies are often paired with planning, organization, and revision strategies specific to writing and are taught in six stages: (a) develop background knowledge, (b) discuss it, (c) model it, (d) memorize it, (e) support it, and (f) independent performance. Some features of SRSD help to simultaneously improve and reduce the demands of executive function skills, by sequencing them in a way that chunks the writing task and makes it manageable for the writer. This allows the writer to dedicate more working memory resources to text production.

For example, many SRSD strategies include a mnemonic that helps remind students of important steps for completing the writing task (see Figure 9 for examples of SRSD mnemonics). A useful web resource for educator training in SRSD is https://iris.peabody.vanderbilt.edu/module/srs/.

Teach Children Text Structures

Text structure instruction has been identified as an effective strategy for improving the expository reading and writing skills of students, especially those with learning disabilities (Duke & Pearson, 2002; Gersten, Fuchs, Williams, & Baker, 2001; Roehling, Hebert, Nelson, & Bohaty, 2017). Hebert, Bohaty, Nelson, and Brown (2016) found that these strategies were particularly effective when writing was involved and also found larger effect sizes for students with learning disabilities. For teaching students with dyslexia writing skills, text structure instruction may be particularly beneficial because it can simplify the writing organizational choices for students, based on the structure needed for their purpose. There are five basic text structures: description, compare/contrast, sequence, cause/effect, and problem/solution.

A promising approach to teaching these text structures is the Structures Writing program, which has been shown to be specifically effective for improving the informational writing skills of students with reading and writing disabilities (Hebert, Bohaty, Nelson, & Lambert, 2018; Hebert, Bohaty, Nelson, & Roehling, 2018). In this approach, students are provided information to write about, which reduces the cognitive load of the students by providing them with ideas, vocabulary, and spelling within an information frame (see Figure 10 for an example). This approach is designed to improve executive function skills in writing by reducing cognitive demands of transcription skills and idea generation, focusing students' attention on learning a step-by-step approach to organizing and writing information according to the text structure chosen. More information and resources for Structures Writing can be obtained by contacting the first author of the current article.

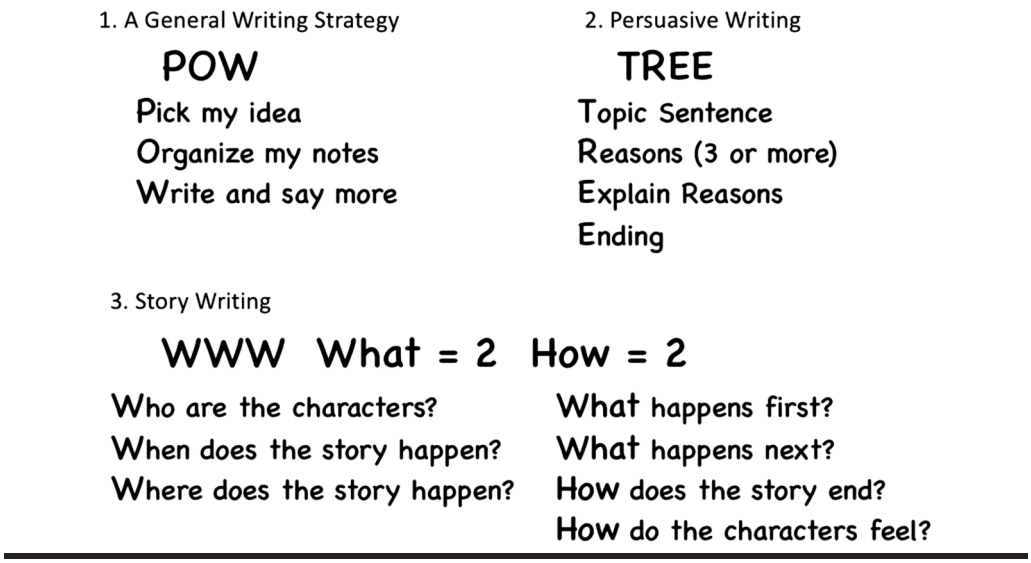
Figure 10. An example information frame used in the Structures Writing program to teach students how to organize and write a simple description passage.

Structure: SD Topic: Travois
Characteristics/Facts▼
used by Native Americans to move things
pulled by dog or horse
made of two poles and wooden platform
held tipi, food, tools, children

Summary

Students with dyslexia suffer from reading difficulties that co-occur with writing difficulties for a variety of reasons. We presented one writing sample of a student with dyslexia (Jordan) to help illustrate the writing difficulties these students face as well as research on the underlying relationships. We then presented several interventions for remediating writing difficulties and/or helping students compensate for skill deficits. Although we attempted to provide a set of recommended strategies that target skills that students with dyslexia may struggle with, this list of interventions is far from complete. Meta-analytic efforts over the past 15 years have revealed a compendium of effective strategies for improving students' writing skills. These include effective strategies for teaching writing skills to adolescent writers (Graham & Perin, 2007) and elementary writers (Graham, McKeown, et al., 2012); strategies

Figure 9. Examples of self-regulated strategy development (SRSD) strategy mnemonics.



for using writing to improve learning outcomes (Bangert-Drowns, Hurley, & Wilkinson, 2004); strategies for using writing to impact reading (Graham & Hebert, 2011); strategies illustrating the impacts of writing assessment on writing outcomes (Graham et al., 2011); strategies targeting specific skills, such as handwriting (Santangelo & Graham, 2016), spelling (Graham & Santangelo, 2014), and SRSD (Graham & Harris, 2003); and strategies that have specifically been effective for students with learning disabilities (Gillespie & Graham, 2014). In addition to these meta-analyses, we point the reader to two additional useful resources developed by the Institute of Education Sciences: (a) a practice guide for teaching elementary school students to be effective writers (Graham, Bollinger, et al., 2012) and (b) a practice guide for teaching secondary students to write effectively (Graham et al., 2016).

We also encourage educators to use a combination of interventions to address the specific writing needs of their students with dyslexia. To illustrate how a teacher might approach this, we look one more time at the writing of our case study student, Jordan. We noted that Jordan had some difficulty with transcription skills, specifically some minor handwriting and spelling issues. Jordan's handwriting difficulties would not rise to the level of referral to an occupational therapist. Therefore, we would suggest targeted handwriting instruction for specific letters, such as circular letters like *o* and *a*, along with regular distributed practice. The spelling issues might be best addressed with a combination of phonics instruction and dictated spelling instruction targeting high-frequency words, in addition to regular classroom spelling instruction. Finally, Jordan has difficulty constructing sentences and holding onto ideas. To address these issues, we might recommend incorporating sentence combining instruction to improve sentence-level writing skills as well as teaching Jordan a planning strategy to compensate for working memory challenges; SRSD instruction would be a good choice for this. In this way, Jordan's complex writing challenges are addressed using a combination of interventions targeting an array of writing skills.

Finally, use of the instructional strategies we described can improve the writing skills of students with dyslexia, making it easier for those students to express their ideas. However, instruction should not stop with improvements in basic skills alone. Practitioners must help children use their improved skills to tell stories, teach others interesting information, and share their opinions and make arguments to address issues they care about (Graham et al., 2017). In this way, targeted writing (and reading) interventions will help children with dyslexia exercise the immense power of communication by the written word.

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Appendix

Search Procedure

To locate articles on intervention to support spelling, we searched ERIC and PsycINFO using four keyword categories, namely, that the studies involved (a) children or adolescents, (b) dyslexia in the title or abstract, (c) spelling in the title or abstract, and (d) instruction or intervention. We initially identified 196 studies that contained the required target words. We read them to make sure that they involved instruction for people with dyslexia and related difficulties, had research designs that would allow us to state confidently that the instruction is likely to be effective, measured spelling skill, and concerned reading in English. We decided to eliminate studies of other languages because of the unique characteristics of English orthography. We also examined meta-analyses by Galuschka, Ise, Krick, and Schulte-Körne (2014), Goodwin and Ahn (2013), Scammacca et al. (2007), Wanzek et al. (2013), and Williams, Walker, Vaughn, and Wanzek (2017). We read each article to ensure they met inclusion criteria. We then removed studies where the authors did not observe significant improvement in spelling. The result was a set of 19 articles, those reported in this article.