Writing Development in Struggling Learners

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Writing Development in Struggling Learners

Understanding the Needs of Writers across the Lifecourse

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PART 1

Introduction

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The Development of Writing Skills in Individuals with Learning Difficulties: An Introduction

*Peggy McCardle, Vincent Connelly and Brett Miller**

This volume highlights writing development and its relation to other cognitive domains, such as language and reading, for individuals who struggle to acquire writing proficiency, including those with specific learning disorders (SLD; e.g., dyslexia, dysgraphia, and specific language impairment) which affect writing skills (e.g., handwriting, composition). Writing and writing development are presented from a trans-national perspective with an integrated focus on conceptualizing writing as a developmental process. This trans-national perspective from across six European nations, Australia and the United States seeks to capture those essentials of instruction and intervention in writing that seem to be cross-cutting rather than language or culture specific, in order to facilitate a cohesive and integrative discussion of issues relevant to the acquisition of writing skills.

Focused primarily on struggling writers or individuals with SLD, this volume seeks to complement existing resources, such as the *Handbook of Writing Research 2nd edition* (MacArthur, Graham, & Fitzgerald, 2016) or those focused on improving writing in typically developing students (e.g., Graham & Harris, 2005; Miller, McCardle, & Long, 2014), The authors in this volume primarily target professionals working with developing writers (e.g., educators, speech-language pathologists, occupational therapists) and writing researchers, with many of the contributing authors highlighting implementations of specific intervention programs. This volume systematically highlights and links to major writing research domains, with a thematic focus on the development of writing skills in individuals who struggle, complementing the foci of the other recent volumes of the "Studies in Writing" series. As part of the "Studies in Writing" series, this volume extends the focus to be encompassing of struggling writers, who are often overlooked in writing education and research.

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* The opinions and assertions presented in this article are those of the authors and do not purport to represent those of the *Eunice Kennedy Shriver* National Institute of Child Health and Human Development, the U.S. National Institutes of Health, or the U.S. Department of Health and Human Services.

To address writing development, both for typically developing learners and those who struggle, it is important to have a clear conceptualization of writing itself. In part 2, two sets of authors address models of writing. O'Rourke, Connelly, and Barnett (Chapter 2) outline the recent cognitive model of writing development put forward by Hayes and Berninger (2014), and discuss its relevance and application to those with SLD and the ambiguities and information gaps in this and other cognitive models as they apply to struggling writers. The authors conclude that simply relying on the diagnostic labels of children who struggle to write (e.g., dyslexia, language learning disorder) to determine writing interventions will only take us so far. To go further requires not only knowledge of the child's needs but also an understanding of writing gained through current and continued enhancements of models of writing. Complementing this chapter, Wengelin and Arfé (Chapter 3) address the relation of reading to writing and highlight links between difficulties in each of those abilities. Taking a developmental approach, these authors discuss models that explain reading and writing difficulties at the word and text level, and how we might best understand the relations between reading and writing processes within these models, as well as implications for assessment. The importance of achieving a balance between instruction in oral language, reading and writing skills throughout development is emphasised, as well as the interactive nature of the development of spoken and written language systems.

It is a natural progression from models of writing to part 3's discussion of writing development itself. Tolchinsky and Jisa (Chapter 4) provide an overview of the development of writing systems as a mode of communication, before transitioning to a developmental perspective of how individuals learn to write. The authors describe the move from early pre-writing through emergent writing and invented spelling, tracing the parallel between the development of graphic signs and the representational function of writing. Further to this, these authors explore the linking of early writing to language, and how linguistic and cognitive abilities influence writing—how children learn to use writing as a productive means of communication and how they acquire meta-knowledge about writing. Making the point that strategic learning relies on writers' cognitive abilities and their experiences, self-efficacy, and motivation, Gregg and Nelson (Chapter 5) review empirical work in each of these areas as they relate to writing in adolescents and adults. After defining written expression, they discuss persistence, self-regulation, and self-efficacy, linking these to a writer's sense of audience, text structure, and even how today's student writers must learn to handle multimodal information in our technological age. Then as promised, they review empirical studies on writing in individuals with learning disorders; they include in this review studies of handwriting, spelling, punctu-

ation and grammar, discourse, cohesion, and writing fluency. Lamenting the dearth of research addressing what they see as key areas that contribute to writing, they call specifically for more research addressing the difficulties that students with SLD face when learning to write. Gregg and Nelson conclude by making the important point that it is assumed that most writing interventions will have an impact on the executive processing skills of struggling writers, but that there is, in fact, a dearth of solid evidence to support this assumption.

In part 4, Instruction and Intervention Approaches, are three chapters addressing a range of approaches to assisting struggling writers. In Chapter 6, Silliman and colleagues argue that writing should be conceptualized as a multidimensional communication process expressed through spelling, and discuss the importance of spelling to writing, where spelling includes significant work on morphology and word derivations. The triple word form theory (Bahr, Silliman, & Berninger, 2009; Bahr, Silliman, Berninger, & Dow, 2012; Garcia, Abbott, & Berninger, 2010) then forms the basis of writing instruction for those with spelling and language learning difficulties. They conclude that a basic knowledge of spelling patterns helps both typical and struggling writers to successfully develop the key translation skills that they will require for the more complex aspects of producing meaning in writing—even today with the many technological tools available to writers to support their spelling.

Technological tools are the focus of the work presented by Rønneberg and colleagues (Chapter 7) who argue that too many young writers, especially those with SLDs, receive more negative than positive feedback on their writing, and that their potential as writers is not well-supported by current technologies. These authors outline solutions based on evidence from studies of writers, in which struggling writers can be moved forward by accepting "good enough" products and providing reinforcement for what is accomplished, separating writing from editing, and setting successive goals—thus truly implementing a developmental approach to instruction. The emphasis here is on the writers getting what is needed from supportive technology so that they are motivated and empowered to continue writing. For this to happen, the authors argue that current tools need to focus not just on readers but also on the needs of struggling writers.

Unfortunately, struggling writers are precisely the group that is most often overlooked in the classroom. During a typical day in secondary education, these students move from one subject-specific class to another where teaching staff often miss these students' writing difficulties. This lack of attention to the needs of adolescent writers is reflected in a recent UK study demonstrating that children with SLD made no progress in writing during their period of secondary

education from age 11 to 16 (Dockrell, Lindsay & Connelly, 2009). Myhill and Jones (Chapter 8) convincingly lay out the complexity of writing, describe the characteristics of struggling adolescent writers, and offer approaches to supporting these adolescents as they work to develop their writing abilities. The authors discuss at length the importance of developing and supporting metalinguistic skills in these adolescents and provide their own data on the effectiveness of putting support into action in this area.

In the current anti-testing climate, assessment is not always a popular topic, yet it remains an essential one. Assessment provides our primary tool to gauge progress and evaluate the success of a student, a process, or a program. Assessment results can provide key formative and summative information to help determine a learner's needs and potentially to provide insight on how to address them. Part 5 aims to highlight the role of assessment of writing from multiple viewpoints. In Chapter 9, Rose provides an example of the role of assessment in an integrative program on writing. The heart of the author's discussion is not about assessing the student or the program but the actual task of learning. He illustrates this via a social theory of learning and a functional theory of language, and describes a program of reading and literacy development for indigenous students who were lagging behind their non-indigenous peers. Rose leads us through the steps in a writing program for these students, and based on the success of both the reading and writing components of this program, argues that many indigenous students who have been diagnosed as SLD are more likely suffering from ineffective instruction. His assessment of tasks has led to a functional program that, using assessments developed to measure student progress in reading and writing, demonstrates student success.

Chapter 10, the second chapter in the Assessment part, discusses the role of curriculum-based measures in assessing writing. Dockrell, Connelly, Walter, and Critten highlight the importance of valid and reliable assessments of the products of students' writing efforts, and the key value of providing instruction and intervention targets. After a discussion of various approaches to assessment, and the value of formative assessment, these authors present their own work to examine the potential of a writing curriculum-based assessment (CBM-W), which they found to be useful in differentiating those with SLD; they are continuing to refine and study this measure. Curriculum based assessment is not without disadvantages or critics, but it does focus on measuring change in writing and can provide a limited basis for comparisons across teaching systems and languages.

The chapters contributing to this volume address many important areas, but it is clear that the study of writing difficulties is clearly in need of more unified

and systematic research. The final chapter provides an agenda for promoting transdisciplinary and trans-national research and practice collaborations, with the hope that such work can help to unify the field's view of writing development for SLD learners. We review critical unresolved challenges as well as new challenges that can be expected, and offer a model for moving forward.

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PART 2

Models of Writing

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Understanding Writing Difficulties through a Model of the Cognitive Processes Involved in Writing

*Lynsey O'Rourke, Vincent Connelly and Anna Barnett**

The cognitive tradition of writing research has produced a number of models of the processes involved in producing written text. The models and frameworks have mainly been derived from work on competent adult writers, although there are a growing number of investigations of the writing development of younger children. (For example, until recently 80% of peer reviewed studies on writing were on adults; Juzwik et al., 2006). These many models rely on traditional cognitive research methods to determine the processes involved with writing.

Children with "specific learning disorder" in DSM-5 include those with difficulties in learning, reading, maths, and written expression, defined by a lack of progress in the requisite academic skills; these skills must fall well below the average and not be explainable by other neurological, developmental and sensory disorders (American Psychiatric Association, 2013). Disorders of written expression in particular as a sub-set of specific learning disorders are identified by problems with spelling accuracy, grammar and punctuation, poor and slow handwriting, and a lack of clarity and organisation of written expression. These problems with written expression co-occur with other learning disorder categories in common use, such as dyslexia and Language Learning Difficulty (LLD) (See Connelly, Dockrell, & Barnett, 2011). Therefore, it is to be expected that writing difficulties will be associated with a range of developmental problems (Dockrell, 2009).

In this chapter, we consider these developmental problems in the light of a recent cognitive model of the development of writing processes (Hayes & Berninger, 2014), to illustrate how such models can be useful when thinking about the difficulties children with specific learning disorders encounter when learning to write. We also remark on the ambiguities and gaps in knowledge in

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these cognitive models and the consequent issues that need to be considered when working with some of the special populations of children who struggle with writing.

Of course, there are many other cognitive models of writing and we are not stating that the model we discuss is more worthy than other models published; we do not have space to include details of others and so concentrate on the one model in detail as an example. Other popular cognitive models of writing, such as the Bereiter and Scardamalia (1987) model, have many commonalities with the model we discuss as well as having some significant differences in how they explain change in writing behaviours (See MacArthur & Graham, 2016). There are also alternative non-cognitive models of writing and while these are also beyond the scope of this chapter, we do recognize the usefulness of these alternate, usually socio-cultural, models and the possibility of integrating such research with the work described here to produce a broader understanding of writing (for further exhortations along these lines, see Boscolo, 2014).

Hayes & Berninger (2014) Cognitive Processes in Writing Framework

Hayes and Berninger's recent model (or as they term—framework) on cognitive processes in writing was specifically designed to be adapted to work with individuals who have writing difficulties (Hayes & Berninger, 2014). This work is an update and amalgam of much previous work on the development of writing processes with the origins going back over thirty years (Flower & Hayes, 1980); this ongoing work has been steadily modified and updated by more recent research evidence (e.g., Chenoweth & Hayes, 2003). The current framework is based around a skilled typically developing writer but is also informed by work on children with writing difficulties (Berninger & Amtmann, 2003).

In this framework (See Figure 2.1) Hayes and Berninger postulate that a typical writer will develop writing though the development and integration of three "levels" for producing writing: resource, process, and control levels. Successful writing demands the interactions of these levels and simultaneous processing, when possible, across levels to both speed up the writing process and to ensure that no relevant ideas are lost due to cognitive bottlenecks or dysfluent processes before they can be written down (Olive, 2014). The process of writing therefore involves increasing integration of these levels where, for the most skilled writers, the product is actually greater than the simple sum of its parts (Connelly & Dockrell, 2016).
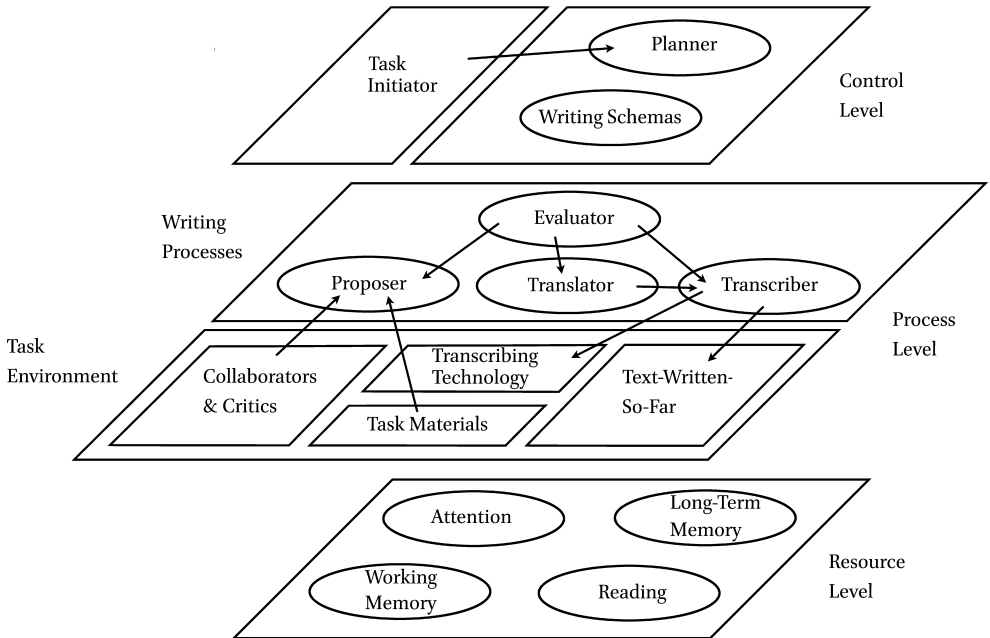
FIGURE 2.1 *The Hayes & Berninger (2014) framework representing the organization of cognitive processes involved in writing*
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However, prior to full integration, writing will tend to be slow and be constrained by the levels that demand the most processing power. Many of the cognitive processes mapped out within the three levels draw upon common cognitive processes used in many everyday activities such as memory, speaking, listening, and reading. Thus, those individuals with specific learning difficulties in these areas will struggle to develop their writing processes from the very beginning of learning to write. There are some suggestions from Hayes and Berninger about how those children with writing difficulties can be more clearly understood. For example, children who are deaf have difficulties in developing their working memory, which impacts on word and sentence level aspects of writing (Arfé, Nicolini, & Pozzebon, 2014) and children who find it difficult to grasp inference in speech may have difficulty with the proposing of ideas, leading to poorer quality written texts (Hayes & Berninger, 2014). Our goal in this chapter is to take the various parts of the framework and link them to recent evidence about children who struggle to learn to write (especially those two most common learning disorders often referred to as dyslexia and LLD) and to illustrate where there are debates about our gaps in knowledge in terms of the framework for future research.

The Resource Level

The resource level draws on four cognitive areas required for writing that can be slow to develop in children with specific learning difficulties: attention, long term memory, working memory, and reading. Attention in this framework is a variant of what is also termed executive function elsewhere, a resource that the control level can draw upon when writing. Long-term memory is broadly defined in this framework and includes not just memory of facts and events but also memory for motor planning, motor control, and motor execution skills (including letter form knowledge) as well as the large domain of language.

The model is not yet precise in how these different resources interact with the development of writing. For example, the clustering of language and motor skills within the resource of long-term memory may require some fractionating. It has recently been shown that motor planning for letter forms by 8 year olds can be influenced by the text written so far (Pontart et al., 2013). Recent work on children with Developmental Co-ordination Disorder (DCD) has shown that these children can have typical language skills but difficulties with writing that reflect a motor problem (Prunty, Barnett, Wilmut, & Plumb, 2014). In a recent review of writing research, Olive (2014) argues there is clear evidence that motor processes are separate from central conceptual and linguistic processes. Thus, in order to understand how children with language or motor difficulties struggle with writing, it may be useful to consider motor and language areas as separate resource areas to be drawn upon whose contributions can be perhaps individually measured against writing.

Language clearly demands a central place in any framework for the cognitive processes in writing. Yet, it is not clear why language is not more visibly highlighted in the framework and is instead considered to be part of long-term memory. There is much evidence showing that oral language is key to supporting the development of written language (McCutchen, Stull, Herrera, Lotas, & Evans, 2014; Mehta, Foorman, Branum-Martin, & Taylor, 2005; Wagner et al., 2011). There is also growing understanding of (1) the ways in which children with LLD who struggle with oral language also struggle with writing (Dockrell, & Connelly 2009; Dockrell, Lindsay, Connelly & Mackie, 2007), (2) that one of the key impacts of LLD on writing is through poor vocabulary (Dockrell, Lindsay, & Connelly, 2009), and (3) that these vocabulary difficulties can have different impacts on writing than do difficulties in other language areas such as grammar (Dockrell & Connelly, 2015, 2016). In addition, this differs across languages: other research on language and writing has shown that different languages make their own specific demands on the development of spelling and grammar (Kandel, Hérault, Grosjacques, Lambert, & Fayol, 2009). Lan-

guages with more transparent orthographies may present more grammatical challenges earlier on to those struggling with writing (Arfé, Dockrell, & De Bernardi, 2016) than do those languages with deeper orthographies that may be typified by more problems with spelling and handwriting (Dockrell, Lindsay, & Connelly, 2009).

Reading is also a key area of cognition related closely to writing (Shanahan, 2006). Children with reading difficulties tend to have problems with the phonological aspects of language that impair the development of both reading and spelling. Poor word recognition and poor spelling will have long term impacts on reading comprehension, depth of vocabulary, and familiarity with grammatical structures. Rapid fluent reading when reviewing a text eases cognitive load on working memory and allows quick access to long term memory and subject-specific knowledge. For example, reading and re-reading text written so far is common in typical readers and writers, and rereading is associated with increased text quality (Wengelin, Leijten, & Van Waes, 2010). Some other work has also shown that amount of re-reading in adolescents is associated with more sophisticated sentence-level planning and text production schemas (Beers, Quinlan, & Harbaugh, 2010) and that there is a strong relationship between reading, cognitive load, and spelling error detection within the text written so far (Van Waes, Leijten and Quinlan, 2010). Therefore, individuals with reading difficulties will likely be slower at reading the text written so far, poorer at spotting written errors such as spelling mistakes, and more limited in their engagement with that text.

A substantial body of knowledge has also shown that working memory is a particular difficulty for the majority of children with specific learning difficulties. There is much research investigating how working memory resources can constrain writing since the production of writing demands that many different cognitive processes be simultaneously activated to produce text (Flower & Hayes, 1980). There are debates in the literature as to whether working memory is a general resource that provides an overall general capacity and can be accessed as required by any combination of resource-demanding processes involved in writing or whether working memory capacity is fractionated into smaller resource pools related to specific processes (Fayol, 1999; McCutchen, 2011; Torrance & Galbraith, 2006). Kellogg, Whiteford, Turner, Cahill, & Merlens (2013) endorse the classical view of working memory as it relates to writing and view it as possessing a central executive with slaved storage systems, such as the phonological loop and visuo-spatial sketch pad (Baddeley, 2007) allied to verbal, visual, and spatial short term memory systems. Kellogg and colleagues (Kellogg et al., 2013) have applied this model to writing and reviewed the evidence for the components of working memory in writing. For example,

they present evidence for a central executive role in most critical writing functions (such as planning, translating, and reviewing) and posit that the central executive functions of updating representations in working memory, switching between tasks, and inhibiting responses are all important to writers.

Interestingly, overall working memory capacity has been found to be only weakly related to text quality in some studies of younger primary school children (Swanson & Berninger, 1996a), but is more strongly related in teenage children (Swanson & Berninger, 1996b). However, at most ages children and adults writing in specific areas such as sentence construction or word spelling show disruption when loading specific aspects of working memory such as the phonological loop (Kellogg, Olive, & Piolat, 2007). This supports the idea that parts of the working memory system support specific aspects of writing. For example, Kellogg and colleagues (2013) review research demonstrating processing and storage roles for the phonological loop to support verbal working memory while translating ideas into appropriate written language and indicating that this has a major impact on word and sentence processing (e.g., Chenoweth & Hayes, 2003). Further, there may be evidence to support a role for an orthographic loop in the production of accurate spelling (Richards, Berninger, & Fayol, 2009). There also continues to be debate about the potential role of the visuo-spatial sketchpad and visual memory for planning functions in writing, with more convincing evidence for advanced writers but less for younger writers (Galbraith, Ford, Walker, & Ford, 2005; Olive, Kellogg, & Piolat, 2008). Rather than conclude that children should benefit from training to improve working memory (for which there is little effective classroom evidence, e.g., Dunning, Holmes, & Gathercole, 2013), Kellogg and colleagues (2013) point to strategies to reduce working memory load on writers. For example, tapping into expert topic knowledge enables writers to bypass working memory and directly access long term memory (McCutchen, 2011). Alternatively, the load on the central executive may be reduced by teaching writing strategies that allow the writer to serially implement writing processes in the classroom (See Graham & Perin, 2007). There is also evidence that working memory load is reduced through direct access to related cognitive abilities in language (e.g., research showing that girls' superior language skills allow them to make faster progression in writing than boys; Bourke & Adams, 2011).

Kellogg and colleagues (2013) also encourage explicit repetitive practice for writers in specific skills such as spelling, handwriting, or sentence combining to automatise writing processes and demand fewer resources within working memory. While the mechanisms by which repetitive practice allows skills to become more automatic are still being debated, there is abundant evidence through secondary task experiments that repetitive practice does reduce cog-

nitive load; there is also abundant evidence of effective intervention in skills through repeated practice (Graham & Perin, 2007). The important aspect of a reduction of cognitive load is that it would appear to allow a writer to begin to process writing functions in parallel through supporting the integration of those functions at the resource and the process level (Olive, 2014).

The Process Level

The process level (see Figure 2.1 for relative hierarchy of the levels) includes the specific writing processes used to create text; it is based on the previously published Chenoweth & Hayes (2003) model of text generation. Thus, the process level includes the proposer, translator, and transcriber processes interacting with an evaluator process alongside an interactive component; that interactive component takes into account the various factors important to monitor and respond to in the task environment (i.e., the task materials, text written so far, transcribing technology and any "collaborators and critics"). There is much published work on the different aspects of text generation specified in the model, since it represents the conceptually oldest piece of the framework to be proposed (Flower & Hayes, 1980).

Developing Text Generation

Translating ideas to text depends on the development of the text generation aspect of the framework. The key processes to be developed are transcription and translation, with a more slowly developing evaluator function. Relatedly, the proposer is assumed to be a function derived directly from language. Thus, transcription is thought to be the first process to constrain writing in the primary grades (up to 5th grade, ages 6–10). It depends on the coordination of linguistic abilities, orthographic knowledge, fine motor skill, and the degree to which coordination of all three occurs automatically. When this coordination reaches a certain point, then cognitive resources are freed up; as writers move to intermediate grades (ages 11–14), translation skills develop, and together with more automated transcription, "text generation can steadily graduate from single words to grammatical clauses, then to paragraphs combining several sentences" (p. 27, Alamargot & Fayol, 2009). There then follows a period when translation slowly matures; thus, a lack of translation maturity becomes the constraining factor in intermediate grade level writing. Again, through instruction and practice, translation develops to a point where cognitive resources are available to support advanced composition and structuring text, usually when children are progressing into the later grades (Berninger & Swanson, 1994).

It is generally accepted that as writers develop their writing processes, over time and given adequate practice, these processes require less effort and use fewer cognitive resources. Olive (2014) describes how skilled writers may coordinate levels of processing, such as transcription and translation, so that they can be run concurrently in a cascading system. This process is then coordinated by the central executive. This cascade allows a continuous flow of information from process to process, without requiring processes to run to completion. Furthermore, the ability for processes to cascade and run in parallel depends on the size of demand, working memory capacity, and whether resources are indeed transferable. Thus, younger children and those older children with writing difficulties often find it difficult to implement parallel processing and tend to rely more on serial processing (Olive & Kellogg, 2002). Individual differences in resource areas such as language, working memory, and reading impact on the ability to parallel process information by creating information bottlenecks at points in the text generation process.

Research with adults has demonstrated that bottlenecks in processing can occur between different areas during text generation. For example, Roux and Bonin (2012) asked participants to write the names of pictures superimposed with either other congruent or interfering pictures. Semantic information from interfering pictures was shown to reduce the fluency of written production, demonstrating a bottleneck in processing between translation and transcription functions during lexical selection. Other data on adults has demonstrated that processing bottlenecks between the proposer and translator modules were directly linked to differing language abilities in adults (Chenoweth & Hayes, 2003). This has been confirmed in work with children with language learning difficulties (LLD) who show very impaired writing in terms of quality of ideas and language, especially related to grammatical complexity, compared to their same age peers (Dockrell & Connelly, 2015, 2016; Puranik, Lombardino, & Altmann, 2007); these impairments were predicted by the students' language difficulties.

Other children, such as those who have problems with spelling when transcribing (e.g., those with dyslexia or LLD) have processing bottlenecks around transcription. We know these children do not have difficulty with the translator, as they can dictate essays to the same standard as peers. However, the quality of their written essays is worse than peers and is predicted by spelling ability (Sumner, Connelly, & Barnett, 2014a); they often exhibit long pauses around the spelling of difficult words, and they display a hesitant writing style that is related to poorer compositional quality (Sumner, Connelly, & Barnett, 2013). Such students generally take a long time to produce short texts with poorer written vocabulary than their same age peers. The poorer written vocabulary is

due to the selection of words for transcription that are simple to spell but that are not necessarily the most appropriate for the written context, and thus is predicted by the spelling capability of the children (Sumner, Connelly, & Barnett, 2016). This is evidence of the translator process having to deal with the consequences of a transcription difficulty. The slowness of text generation by these children is thus also a product of the evaluator, transcriber, and translator having to select, deselect, and reselect written vocabulary throughout text generation. Thus, children with spelling difficulties generally exhibit long pauses between words as well as within words when producing written text (Sumner, Connelly, & Barnett, 2013).

Children with spelling difficulties remain slow, hesitant writers well into adulthood, even when the spelling is provided for them in a copy task (Afonso, Suarez-Coalla, & Cuetos, 2015; Connelly, Dockrell, Walter, & Critten, 2012; Sumner, Connelly, & Barnett, 2014a, 2016). However, adults with spelling difficulties who progress into Higher Education are much more likely to be able to overcome their hesitant writing style and produce writing comparable to their peers in terms of the quality of ideas and overall content, although still retaining more errors of spelling, grammar, and punctuation (Connelly, Campbell, MacLean, & Barnes, 2006; Sumner, Connelly, & Barnett, In Press). Despite this progress, the poorer spelling, grammar, and punctuation of these texts still leads those assessing the texts to give them lower scores compared to text produced by their peers without such difficulties (Coleman, Gregg, McLain, & Bellair, 2009).

While there is much evidence about the roles and interaction of the core processes of proposer, translator, transcriber, and evaluator, there is much less known about the "task environment". Obviously, the task environment can have direct consequences for those with writing difficulties. For example, information technologies are often prescribed to help those children with writing difficulties. Evidence of current writing practices in u.s. schools demonstrates that use of information technology is still uncommon for writing in primary, middle and high schools (Cutler & Graham, 2008; Graham, Capizzi, Harris, Hebert, & Morphy, 2014; Gillespie, Graham, Kiuhara, & Hebert, 2014), and that teacher-provided adaptations for struggling writers that used information technology were far behind other adaptations in frequency of use (Graham, Harris, Bartlett, Popadopoulou, & Santoro, 2016). This is despite strong evidence that the use of technology to teach writing to struggling writers has been shown to be an effective and motivational tool for improvement (Morphy & Graham 2012).

However, information technology can come with its own burdens that are often not taken into account when it is introduced to the classroom (Mac-

Arthur, 2006). For example, using a keyboard efficiently requires a child to be explicitly taught keyboarding (Connelly, Gee, & Walsh 2007); otherwise children may perform keyboarding in a less than efficient manner (Grabowski, 2008) or spend more time looking at the keyboard than at the monitor (Johansson, Wengelin, Johansson, & Holqvist, 2010), and there is a high risk that their written outputs will be of lower quality than handwritten equivalents (Christensen, 2004; Connelly et al., 2007). Other recent research seems to show that use of keyboards for note taking encouraged simple literal transcription rather than the précis which is more usual in handwritten note taking (Mueller & Oppenheimer, 2014). Therefore, there remains much to be researched within the task environment to understand how information technology can be used to best support struggling writers (See also Rønneberg, Johansson, Mossige, Torrance & Uppstad, this volume).

The Control Level

Hayes and Berninger (2014), in their framework, also detail a control level that draws together a task initiator and planner with a bank of writing schemas that feed down, control, and constrain how the specific writing processes operate (see Figure 2.1). Writing schemas "represent the writer's beliefs about the properties that the text to be produced should have (genre knowledge) and also beliefs about how to go about producing that text (strategic knowledge)" (p. 9, Hayes & Berninger, 2014). These schemas largely determine how the processes at the process level are used, and how they interact with the task environment.

The control level draws upon the attention process from the resource level (see Figure 2.1 for relative hierarchy of levels), and this allows the writer to develop a focus on a writing task in the face of distraction and to maintain motivation. Thus, the development of control processes with writing schemas allows the writer to modulate the writing processes involved in text generation with the task environment through the application of appropriate schemas while drawing upon, where necessary, the general cognitive resources level. This integration of levels and processes produces fast, cascading, and parallel functioning across the framework and so allows a system that is greater than the mere sum of parts.

There are many unanswered questions regarding the control level and how indeed processes are controlled and co-ordinated across writing (Olive, 2014). There are also questions about the extent of the role of working memory as either a domain general or domain specific function and whether executive

functions nested within working memory are part of or overlap with the control level hypothesised by Hayes and Berninger (2014). There is evidence that, as individuals with writing difficulties progress, they can develop sufficient function across processes to allow for some cascading and parallel processing. As discussed, individuals with dyslexia in Higher Education can produce writing with ideas comparable to their peers and are as fluent at writing, but at a cost of lower levels of spelling, grammar, and punctuation (Connelly et al., 2006; Sumner et al., In Press). Thus, these individuals may be showing evidence of their mastery of control processes by allocating cognitive resources to ensure that the translation of text is appropriate and that difficulties in transcription processes are more limited in impact. Further work regarding this hypothesis will be required.

Development of appropriate writing schemas at the control level may provide a way to circumvent some of the difficulties experienced by individuals with SLD when coordinating the processes involved in fluent writing vis-à-vis Hayes and Berninger (2014). It is noticeable that the largest effect sizes in studies examining writing interventions have been seen for those studies where explicit writing schemas were learnt by children as part of the intervention (Graham & Perin, 2007). Building on this evidence, Hayes & Olinghouse (2015) recommend that teachers should ensure that writing schemas are a key part of the writing curriculum. Schemas to develop knowledge of genre, structures and formats, strategies for producing text, and task and audience influences should be taught so they are available for conscious use by children when writing. Children should be able to draw upon a bank of explicit and well-practiced writing schemas that they can verbalise and use in the appropriate writing situations. However, Hayes and Berninger have suggested that some advanced writing schemas are only developmentally possible once language and executive functions are well advanced (Hayes & Berninger, 2014). Thus, there is still work to do here for children with writing difficulties, as these children often do not develop language or executive functions as quickly as other children, as reflected in the lack of progress many of these children make despite interventions and practice at writing (Dockrell et al., 2009).

Conclusions

The framework proposed by Hayes and Berninger (2014) suggests a complex and highly interactive writing system that can be influenced and developed in many different ways. The precise nature of how the different levels develop and interact is not yet specified in detail in this or, in fact, in any similar

recent model (Olive, 2014). However, using this framework, we can surmise that children who have difficulties learning to write may need support in a number of different areas. For example, they may need to be taught explicit strategies to help develop their writing processes through the development of writing schemas (Hayes & Olinghouse, 2015), and they may require support to more effectively use their cognitive resources to support writing. (For a meta-analysis review of successful teaching strategies, see Graham & Perin, 2007).

The framework can also help us understand that difficulties in co-ordinating or using cognitive resources such as reading will impact on the development of writing processes such as transcribing and evaluating (See Shanahan, 2006, 2015, for more details on interactions of reading with writing, and Graham & Hebert, 2010, for evidence about successful classroom interventions to promote both). How the control level factors interact with resource level areas such as attention in order to drive the motivation to write will also be important in understanding the poor writing of those with difficulties. It seems that the "Matthew Effect" of the poor writer getting poorer over time in comparison to peers who constantly get "richer" in writing is similar to that found in reading (Connelly & Dockrell, 2016; Puranik & Logan, 2012). Children who struggle with writing will not get better by themselves and may begin to avoid writing altogether, without a sense of themselves as "becoming a writer" (Connelly, 2014). Stigma around writing difficulty and labels such as "dyslexia" can have a long-term impact on individuals, spurring them to even avoid help where it is offered. One student who had successfully made the entry into Higher Education, despite writing difficulties, reported not seeking advice at the university help centre to avoid being labelled (Mortimore & Crozier, 2006). Thus, very early intervention for children with writing difficulties should be a key aim. (See Gillespie & Graham, 2014, for a recent meta-analysis of writing interventions for students with learning disabilities.) However, such intervention development should be guided by an appreciation of writing development as illustrated by the cognitive models of writing currently available. Simply relying on diagnostic categories (dyslexia, LLD, etc.) to inform writing remediation for children who struggle, based on the surface characteristics of these diagnoses, can provide some guidance for interventions. However, a framework such as that of Hayes & Berninger (2014) will allow teachers to identify and understand the specific areas in the writing process that are challenging the child so that targeted remediation can be developed.

The current cognitive models of writing have been useful for identifying components of the writing process, but not so useful for understanding how these components interact and how the interactions lead to change in writing development. The cognitive model of writing proposed by Bereiter and Scar-

damalia (1987) attempted to explain development and identified when a writer had moved from less skilled to more skilled writing, likely through a series of intermediate stages (Hayes, 2011). The advent of new and more accurate writing measurement tools, automatic text analysis, and other technological tools can perhaps now help us understand these interactions, and chart writing development more finely. It also can allow us to question current theory in ways we have not been able to achieve till now (Connelly, 2014; Dockrell, Connelly, Walter & Critten, this volume). Over and above this, studying how children learn to write with the assistance of cognitive models of writing will highlight where children are struggling with learning to write within the larger scope of all that goes into writing development, and so further inform interventions that can help overcome writing difficulties.

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The Complementary Relationships between Reading and Writing in Children with and without Writing Difficulties

Åsa Wengelin and Barbara Arfé

Introduction

This chapter deals with the relations between the processes of reading and writing, and thus the relation between reading and writing difficulties. Whereas the onset of spoken language development is assumed to happen "naturally" and with little effort for most children, the onset of written language acquisition generally happens later, and for many children not until they have received instruction in school. Children in different countries start school at different ages and acquire orthographies of different complexities concerning phonology, orthography, morphology and syllable structure. Therefore, different language systems will pose different challenges to writers and readers at different stages of the developmental process (Arfé, Dockrell, & Berninger, 2014). For example, in shallow orthographies spelling and decoding will be mastered earlier than in deep orthographies (e.g., Babayigit & Stainthorp, 2011), and this might to some extent affect the development of higher level processes, such as meaning-making processes in reading and writing.

What seems to be relatively universal in languages with alphabetic orthographies is however, that whereas some children learn to read and write before they start school and some even appear to crack the code more or less overnight, many do not and therefore require more explicit instruction. The period before starting to read and write is generally known as the emergent-literacy period, during which the activities of reading and writing cannot always be disentangled from each other. Research on emergent literacy is a vast research field on its own that can likely offer explanations for some of the phenomena discussed in this chapter. While keeping this in mind, we have chosen to delimit our chapter to research dealing with the activities often described as "conventional" reading and writing, as defined by McGee & Richgels (1996):

> Conventional readers and writers read and write in ways that most people in our literate society recognize as 'really' reading and writing. For

example, they use a variety of reading strategies, know hundreds of sight
words, read texts written in a variety of structures, are aware of audience,
monitor their own performances as writers and readers, and spell conven-
tionally.

p. 30

This chapter focuses on such conventional processes at word and text level. We
present two different, but complementary, perspectives that exist in research:
One that considers reading and writing as two separate—though related—
processes (e.g., Berninger, Abbott, Abbott, Graham, & Richards, 2002; Juel, 1988;
Mehta, Foorman, Branum-Martin, & Taylor, 2005) and examines the concur-
rent and longitudinal relationships between these two literacy skills, and one
that considers reading as a component of the writing process, and examines
the contribution of reading-during-writing processes to children's and adults'
writing (e.g., Alamargot, Chesnet, Dansac, & Ros, 2006; Wengelin, Leijten, &
Van Waes, 2010). We will discuss both perspectives with reference to reading
and writing difficulties.

Reading and Writing as Separate Processes

In cognitive research, reading and writing have often been considered two
separate objects of inquiry, characteristic of two distinct research areas: reading
research and writing research (Connelly, 2014). The connections between these
two areas have long been limited and sporadic. This division has led to the
development of separate models accounting either for reading (see Gough &
Tunmer, 1986; Kintsch, 2004) or writing (Berninger, Vaughan et al., 2002; Hayes
& Flower, 1980), and attempts to integrate reading and writing processes—and
thus reading and writing difficulties—in a unitary cognitive model have been
very few to date (Kintsch & van Dijk, 1978). In the next two parts, we will take a
closer look at models that explain reading and writing difficulties at word level
and at text level.

Models That Explain Reading and Writing Difficulties at Word Level
The relationship between word reading and spelling is one of the most debated
issues in reading and spelling research (Tainturier & Rapp, 2002). One view is
that they are two distinct processes, with different components, with the only
exception being an a-modal semantic system (Caramazza, 1988). Another view
is that reading and spelling depend on shared processing components, with
the exception of their peripheral processes. The models that have been clas-

spoken word

acoustic-phonological analysis

phonological lexicon

semantic system

orthographic lexicon

graphemic buffer

phonology to orthography conversion

Letter-name conversion

Letter-shape

oral spelling

written spelling
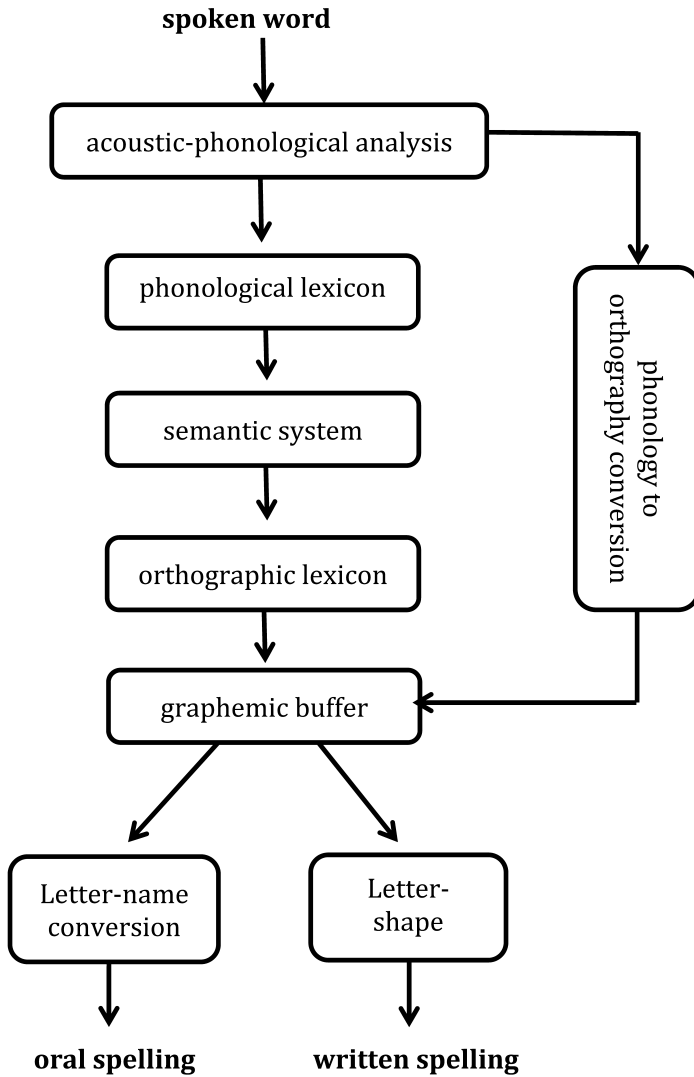
FIGURE 3.1 *A dual route spelling model*
BASED ON TAINTURIER & RAPP (2002)

sically used to describe the functional architecture of the reading and writing process at the word level—dual route models (e.g., Coltheart, 1978; Coltheart, Curtis, Atkins, Haller, 1993; Tainturier & Rapp, 2002)—view written spelling and reading as involving distinct processing components or modules, which are assumed to be selectively impaired in adults or children. However, they also describe components that are common to the two processes, albeit an explicit focus on these common modules is infrequent (see Figures 3.1 and Figure 3.2).

Printed word

visual

letters recognition

orthographic lexicon

semantic lexicon

phonological lexicon

grapheme to phoneme conversion

phonemic buffer

spoken word
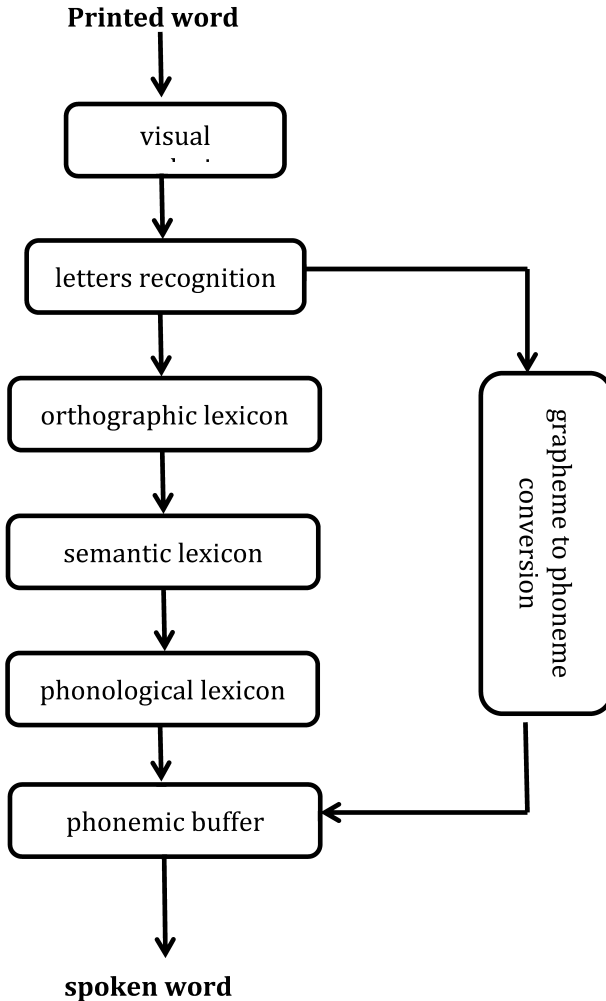
FIGURE 3.2 *A dual route reading model*
BASED ON WANG ET AL. (2014)

The classical dual route models (e.g., Coltheart, 1978; Tainturier & Rapp, 2002) describe reading and writing as processes consisting of sequential processing of visual/phonological, semantic, and orthographic information, supported by two different peripheral systems for the analysis of the input (auditory vs. visual). Both of these can temporarily store word representations to be produced by different output systems. Furthermore, both assume that word reading and word spelling can occur through two alternative processes or "routes": the lexical, where a word is read by retrieving it from a mental lexicon containing knowledge about the spelling and pronunciation of the letter

strings, and the sublexical, in which readers do not use their mental lexicon to read words, but make use of conversion rules relating segments of orthography to segments of phonology. Today, the independence of these two routes is debated (see Coltheart, 2005; Coltheart et al., 1993). However, in this chapter we focus more on the components described by this model than on the assumption of two independent routes for reading or spelling. In their more recent versions, dual route models (DRC: dual route cascaded) do not assume sequential processing mechanisms, but cascade mechanisms, that is, a system of spreading activation among different units of representations (e.g., words, letters; Coltheart et al., 1993; Coltheart, 2005). Nevertheless, the components are similar to those of the original models. According to both of the earlier-mentioned views on the relation between reading and spelling, some components of the dual route models are specific to only the reading or written spelling processes. Specific to the spelling system are the acoustic-to-phonological conversion component, that converts the auditory input into phonological representation; the phonology-to-orthography conversion system (POC) for conversion of the phonological units into orthographic units; and the graphemic buffer, a storage system where these units are assembled into sequences of abstract letters or letter strings (Figure 3.1). However, specific to reading are the components of visual analysis and letter recognition, and the grapheme-to-phoneme conversion system, based, as in the spelling process, on sublexical routines (Figure 3.2).

More debate exists around the status of the lexical representations involved in the reading and spelling processes. With the exception of the semantic system (a repository of word meanings), which, according to both views, is shared by oral language, reading, and spelling, the shared-components and distinct-components views make different hypotheses about the lexical representations involved in reading and spelling. The shared-components hypothesis assumes, for example, the existence of a single orthographic lexicon (a store of orthographic word forms) shared by the reading and spelling process, although the access procedures to it are considered to be process specific. By contrast, the distinct-components hypothesis distinguishes between an orthographic lexicon in input, which is necessary to recognize written words in reading (Figure 3.2), and an orthographic lexicon in output, used to produce written words by spelling (Tainturier & Rapp, 2002). The same could be assumed for the phonological lexicon (see Figures 3.1 and 3.2).

Connectionist models (e.g., Seidenberg & McClelland, 1989) and the more recent triple word form theory (Richards et al., 2006) emphasize the role of the interrelationships between the different word representations (phonological, orthographic, semantic, and morphological) in reading and spelling. Over-

coming the traditional separation between lexical and sublexical procedures and between components of reading and spelling in dual route models, connectionist models suggest that learning to read and write requires mapping orthographic representations of words onto phonological, morphological (and semantic) representations, which are the product of oral language development (similar to what is stated by the amalgamation theory of Ehri, 2005). The triple word form theory assumes, for example, that the quality of written-word spelling and reading may depend to a large degree on the child's ability to compute the interrelationships among the segments of phonological, morphological, and orthographic word forms. Hence, it is this amalgamation or cross-mapping of word representations that underpins reading and spelling. This view has recently received substantial support from behavioural and neuro-imaging studies conducted with individuals with dyslexia (e.g., Richards et al., 2006), and longitudinal studies conducted with typically developing children (e.g., Nunes, Bryant, & Bindman, 1997), for both reading and spelling.

Models That Explain Reading and Writing Difficulties at Text Level

At text level, probably the most widely used model to explain reading problems is the simple view of reading (e.g., Hoover & Gough, 1990). It depicts reading as consisting of two separate components: decoding (D) and linguistic comprehension (L), both necessary for reading texts and neither of them sufficient by itself. Reading comprehension (R) is seen as a product of these two components. Thus, the model is synthesized by the following formula: R= D X L. Progress in reading requires that both components be non-zero. However, assuming that the two components can independently contribute to reading, the model hypothesizes that poor reading comprehension skills can follow from one of these three conditions: (a) when decoding skills are adequate but linguistic comprehension is weak (poor comprehenders who are good decoders), (b) when linguistic comprehension is adequate but decoding skills are not (poor decoders who are good comprehenders), and (c) when both skills are compromised (poor decoders who are also poor comprehenders [Hoover & Gough, 1990]). This hypothesis is supported by empirical data (Juel, 1998).

Although the model assumes that the two components are equally important for the success of reading, decoding is hypothesized to contribute to reading comprehension more than linguistic comprehension until children acquire sufficient decoding skills to read fluently, then linguistic comprehension becomes more important (Hoover & Gough, 1990).

There has been an explicit attempt to extend the simple view of reading model to writing (Juel, 1988), although the reading and writing processes at

text level are assumed to rely on different components. Like the simple view of reading, the simple view of writing assumes that writing is the product of two components: transcription (or the ability to convert linguistic representations in written symbols) and text generation skills (i.e., the ability to generate ideas linguistically). As in reading, the two key components in writing can be impaired individually or in combination; that is, poor text generation skills are assumed to result either from a) selective problems with transcription (i.e., spelling and handwriting) in poor spellers with good text generation skills, b) selective text generation difficulties, in poor writers who have adequate transcription skills, or c) a combination of the two problems, in poor spellers who also are poor writers (see Juel, 1998). Studies on subtypes of writing problems seem to support this model (Wakely, Hooper, de Kruif, & Swartz, 2006). In addition, also similar to reading, writing transcription skills are assumed to contribute most to text production during the first years of school, and text generation is hypothesized to contribute more, once transcription has been automatized (Berninger, Vaughan et al., 2002). Indeed, spelling and handwriting problems seem to constrain text generation, requiring significant cognitive resources the writer needs to address higher level writing processes, such as idea generation and translation. Therefore, writers who are poor in transcription tend to be poor in text production too. However, unlike what emerged from reading, some research data suggest that in writing poor transcription skills do not always involve poor text production (e.g., Connelly, 2014), and that in highly regular orthographies, from early grades transcription contributes less to text production than do text generation skills (Babayigit & Stainthorp, 2011).

Despite the attempt to use the same types of models to explain reading and writing, models of reading and writing at the word and text levels have not yet been used to explain how these two processes can be interrelated.

Closing the Gap?

There is a long tradition not only of separation between the studies of reading and writing but also between the ways they are taught (Fitzgerald & Shanahan, 2000). A possible explanation for this could be that for a long time full participation in democratic societies required good reading skills but only limited writing skills. Over the past decade, however, with the rapid increase in the use of the internet, social media, and various portable communication devices, writing has become an everyday activity for most people around the globe. Brandt (2011) has even described this movement away from reading as

the main literacy activity, as a move from mass reading to an era of mass writing. Thus, both writing and reading processes are integrated in several everyday school activities, such as note taking and summary writing (Hebert, Gillespie, & Graham, 2013), or writing syntheses from sources (Boscolo, Arfé, & Quarisa, 2007), but they also play important roles in leisure activities such as the use of social media, narrative games, and blogging. Examining activities that combine reading and writing is important in understanding how children with reading and writing difficulties use writing functionally, i.e., to learn. In addition, despite the use of distinct clinical labels for reading and writing problems (e.g., dyslexia, dysgraphia, reading comprehension problems, problems of written expression), in reality, difficulties in learning reading and writing are often associated in the scholastic population: A number of children with dyslexia (i.e., word-level reading problems) experience writing problems at the word level (e.g., Angelelli, Marinelli, & Zoccolotti, 2010) and at the text level (e.g., Sumner, Connelly, & Barnett, 2014). Moreover, another group of children who consistently experience reading problems at the text level—poor comprehenders—appear to show similar problems in writing (e.g., Juel, 1988).

In the attempt to explain the association between reading and writing difficulties, cognitive and education researchers have elaborated three hypotheses. One is that in these children the same cognitive or language deficits might underpin the processing of written language in both reading and writing (Angelelli et al., 2010; Carretti, Re, & Arfé, 2013). A second hypothesis is that poor reading skills affect writing, because writing involves reading, whose mechanisms are impaired (Johansson, Johansson, Wengelin, & Holmqvist, 2008; Wengelin, Johansson, & Johansson, 2014). The third and last hypothesis is that reading and writing processes are related developmentally, and hence poor readers tend to become poor writers (see Juel, 1988) or, conversely, poor writing skills affect the development of higher order reading skills (see Berninger, Abbott, et al., 2002). These three hypotheses are not mutually exclusive. It is plausible to assume that the same underlying cognitive and/or language deficits hinder the development of both reading and writing (we will discuss how in the next paragraphs) and that thus these two processes are developmentally interconnected.

Separate, Though-Related, Processes

As the models of reading and writing presented in part 2 show, reading and writing processes appear to rely on different functional mechanisms. For example, from the lowest levels of elaboration, written words are first accessed

through the child's visual system in reading, through the hearing system, in dictation, or through the semantic system (i.e., long term memory) in written naming or written composition. Therefore, reading and writing could in principle pose different kinds of challenges to poor writers/readers in these initial stages of word elaboration (Tainturier & Rapp, 2002). In addition, reading is comprehension while writing is mainly production. That is, in reading the meaning-making process requires the child to follow text signals to reconstruct the meaning of a text, but writing requires the child himself or herself to generate meaning, its organization, and signals for the reader to connect information in the produced text, similar to oral language production. It is thus not surprising that the prevalence of writing problems greatly exceeds that of reading problems in the scholastic population (see Katusic, Colligan, Weaver, & Barbaresi, 2010). However, in many cases writing and reading problems are associated. In their population-based study, Katusic and colleagues found that cumulative incidence rates of writing disorders varied from about 7 to 15%. However, among all the written-language disorders they could identify, only 25% were not associated with a reading disability.

Hence, despite their differences, reading and writing cannot be studied in isolation if the aim is to explain how these processes work in the child's mind (Berninger, Abbott et al., 2002). They are two complex language phenomena that rely on a complex set of relationships between oral and written language, among visual, auditory, and phonological skills, and between receptive and expressive language mechanisms. Word recognition and written spelling processes are based on the use of the same word representations: orthographic, phonological, and morphological (and semantic). Problems in constructing or storing some of these word representations in memory would likely affect both reading and writing (Angelelli et al., 2010). On the other hand, developing these representations in one of the two can support their use in the other. Berninger, Abbott et al. (2002) found that word reading skills explained spelling and handwriting in typically developing children, but the reverse is also true. As spelling new words requires the writer to attend to the orthographic details (i.e., letter order) of words, and to sub-lexical sound-letter relationships in a comprehensive manner, spelling also influences reading by fostering the development of orthographic representations (Ouellette & Sénéchal, 2008). Evidence of such influence comes from longitudinal studies, showing that early writing during preschool has a predictive influence on first graders' reading (e.g., Shatil, Share, & Levin, 2000), and from experimental training studies on more and less shallow orthographies (e.g., Shahar-Yames & Share, 2008). Spelling, like decoding words, may act as a self-teaching mechanism (Shahar-Yames & Share, 2008): Each time the child attends to the orthographic details of a new word, recod-

ing the printed word to sound or the reverse, this specifies and consolidates its representation in memory.

As regards the production and comprehension of texts, these processes, though clearly different, involve similar communicative skills and linguistic resources. For example, knowledge of vocabulary, grammar, and discourse can be considered factors underlying both reading and writing (Babayigit & Stainthorp, 2011; Olinghouse, 2008). Also, the ability to relate pieces of information and represent their connections in a mental model is critical in both comprehending and producing a written text (Arfé & Boscolo, 2006). Finally, reading and writing involve similar cognitive skills, such as working memory (Cain, Oakhill, & Bryant, 2004; Swanson & Berninger, 1996), metaknowledge (Carretti et al., 2013), and monitoring abilities (Hayes & Berninger, 2014; Vorstius, Radach, Mayer, & Lonigan, 2013). Difficulties at one or more of these levels can likely affect both the reading and writing processes.

The relation between these higher-order processes has mainly been addressed in four different ways: (a) correlational studies of children's reading and writing skills, (b) studies that examine patterns of relations that exist between different aspects of reading and writing knowledge on the one hand and external variables on the other, (c) interventions of one of the two in order to improve the other (Fitzgerald & Shanahan 2000), and (d) longitudinal studies (e.g., Juel, 1989; Cain et al., 2004) which examine the developmental relationship between the acquisition of reading and writing skills respectively.

Due to space limitations, we do not focus on those but instead concentrate on two studies that explored the complex relationships between reading and writing processes by means of advanced statistical analyses. An important aspect of both these studies is that not only do they focus on the relation between reading and writing, but also on the relation between these literacy skills and other linguistic skills. The rationale behind this is to disentangle effects generated by linguistic modality (oral vs. written) from those of linguistic process (perception vs. expression). Figure 3.3 shows how the four linguistic functions, listening, speaking, reading, and writing, can be categorised across these two dimensions. It could for example be the case that reading and writing share more traits with their respective correspondents in the oral modality than with each other.

The first of the two studies in focus was carried out by Mehta et al. (2005) and investigated whether literacy could be described as a unitary construct, if so whether this construct could be distinguished from a more general language competence, i.e., whether written language skills are separable from a more general verbal ability, and finally the relative roles of teaching on the one hand and students' prior knowledge on the other in predicting literacy outcomes.

Linguistic modality

		Oral	Written
	Reception	Listening	Reading
Linguistic process	**Expression**	Speaking	Writing

FIGURE 3.3 *The four language functions distributed across the dimensions of linguistic modality and linguistic process*

They found that competencies in word reading, passage comprehension, and spelling could be adequately explained by a common factor that they named "literacy factor", which at the individual level was distinct from a more general language competence. Interestingly, text writing was less related to this factor. Their interpretation of this was that writing is influenced by more factors than word reading, spelling, and passage comprehension, and is therefore a more complex process. The latter was supported by a slightly disappointing result generated from classroom data that of five literacy outcomes measured in the study, the only one to be impacted by teaching quality was writing.

The second study in question was carried out by Berninger and Abbott (2010) and focused on the relations between higher-level processes in comprehension and expression of ideas in spoken and written language. They aimed at investigating whether the four skills of speaking, listening, reading, and writing are separate but interacting systems, or whether they draw on a single underlying system, independent of end organ (ears, eyes, mouth, and hand) and modality (oral vs. written language). A factor analysis of data generated by children in grade 1–7 revealed that a four-factor model of language by ear, mouth, eye, and hand fit their data better than a one-factor model for a single language system. Berninger and Abbott concluded that the functional systems that develop as children perceive language through their ears or eyes and express ideas in language through their mouth or hand may be separable and have distinct characteristics because "their unique histories in interacting with the world in contrasting ways create different paths to the higher order language skills in the mind" (p. 13).

This interpretation is further supported by additional data collected by the same authors, profiling children's language skills. These data showed that whereas most children's strengths and weaknesses in speaking, listening, read-

ing and writing changed over time, a small group appeared to retain stable dissociations between the four skills. Most frequent was stable weaknesses in writing, compared to the other three skills. This would not have been possible with a unitary language system.

Having drawn the conclusion that the four systems are separate, Berninger and Abbott (2010) set out to investigate whether and to what extent they are interrelated. Using regression analysis, they analysed to what extent skills related to three of the languages systems contributed uniquely to the fourth assuming that such unique contributions would indicate that they were separate but interrelated. Such relations could be expected to occur across any of the two dimensions, modality and linguistic process, i.e., horizontally or vertically in the table in figure 3.3.

Starting out with receptive processes, in both modalities, i.e., listening comprehension and reading comprehension, they found that both contributed unique variance to each other. This indicates that their measures of oral and written language comprehension do not assess a common core of receptive functions. These results were more or less consistent across school grade. Turning to expressive processes in both modalities, i.e., speaking and writing, they found similar—if not as consistent as across grade—results for oral and written expression. Their main conclusion of these results is that language functions in the two modalities—especially the receptive processes—do not share a common core.

As regards the relations between linguistic processes within each modality, they found that while reading comprehension and writing contributed unique variance to each other, speaking and listening comprehension did not. Viewed in isolation these results could indicate that while spoken language functions draw on a similar language core, their written correspondent does not. However, as the earlier mentioned profiling showed that oral skills were not completely identical, Berninger and Abbott rather concluded that they draw on a common language core *to a greater extent* than their correspondent written functions.

To sum up the results by Mehta et al. (2005) and Berninger and Abbott (2010), these authors suggest that we have separate language systems for the four functions speaking, listening, reading, and writing. Furthermore, to the extent that they are interrelated, these interrelationships seem to be modality dependent and stronger for the spoken modality than for the written. Writing is the most complex system and therefore most vulnerable to language disorders and developmental delays. These results support and explain studies on reading and writing difficulties which have shown that if and when oral language problems (Nauclér & Magnusson, 2002) or reading difficulties

(Hatcher, Snowling and Griffiths, 2002) are overcome, written production frequently continues to suffer.

The Reading Component in the Writing Process

So far we have dealt with relations between the reception of texts written by others on the one hand and the writer's own production of texts on the other. However, most models of writing assume that text production implies some amount of reading (see Hayes & Berninger, 2014; Torrance & Wengelin, 2010; Wengelin, et al., 2010). For example, revision typically involves reading the target sentences or text the writer has written (Hayes, Flower, Schriver, Stratman, & Carey, 1987; Kaufer, Hayes, & Flower, 1986). Hence, a reading component is considered in recent accounts of the writing process (Hayes & Berninger, 2014).

Hayes (1996) suggested that reading contributes to writing tasks in three distinct ways: reading for understanding, reading to define the writing task, and reading to evaluate. Reading for understanding and reading to define the task are, however, only considered when external sources are used (e.g., to provide the reader with content and a reason to write the text). Reading to evaluate, on the other hand, is considered when the writer is reading his/her own emerging text, for example in order to revise the text. This could take place either during the actual writing process, when the writer looks at his or her emerging text, or as a proof reading process after a first draft has been completed. Hayes (1996) argues that when reading to revise, people read not only to represent the text's meaning but to identify text problems like bad diction, wordiness, and poor organization.

Interestingly, errors may not be corrected immediately when they are detected, indicating that the interplay between reading and writing during text production is an intricate process in need of more research. For example, Van Waes, Leijten, and Quinlan (2010) showed that writers frequently detected errors in a sentence they were composing, but completed the partial sentence first and then corrected the error.

In addition to reading for revision, Hayes (1996) recognized that reading for evaluation may also be performed to facilitate other parts of the writing process (e.g., if communicative and rhetorical goals are achieved in the text, if the text conforms to a given text genre, and to spot general text improvements). Similarly, Holmqvist, Holsanova, Johansson, and Strömqvist (2004) have argued that writers frequently look back to refresh their memory, and Wengelin and colleagues (Wengelin et al., 2009) proposed that writers look at their emerg-

ing text to prompt content generation, to maintain cohesion, and to engage in meta-cognitive strategies.

Recently, questions have been raised about (a) the extent to which reading— or any type of feedback from the emerging text—is really necessary for text production (Torrance, Rønneberg, Johansson, & Uppstad, 2016) as suggested by others (e.g., Alamargot et al., 2006; Nottbusch, 2010; Torrance & Wengelin, 2010; Wengelin, et al., 2009) and (b) how reading during writing differs from reading a static text produced by someone else (Torrance, Johansson, Johansson, & Wengelin, 2016). Most likely, it depends on the writing task, but results from a study of blind writing (each character was represented on the screen by an x; Torrance et al., 2016) suggest that for shorter texts (≈ 300 words in the study by Torrance et al.) visual feedback may not be as necessary as previously thought for the production of a coherent text. Writers left more uncorrected errors in the texts produced in the blind condition than in the control condition, but no other differences were noted between the written products produced in the different conditions. These results are to a certain extent supported by Johansson and colleagues (Johansson, et al., 2008; Johansson, et al., 2010) who showed that writers read their texts surprisingly little and that there was no correlation between text characteristics such as lexical diversity or text length, and how much a writer reads the text produced to that point during the writing process. For longer texts, however, it appears very unlikely that access to the emerging text would not play a role; most likely it is not a question of a simple correlation between the amount of reading and text quality, but rather a question about what they look at and when they do it.

As regards proof reading, studies have found that participants read familiar texts more quickly (e.g., Levy & Begin, 1984) and corrected them more accurately (e.g., Levy, Di Persio, & Hollingshead, 1992), suggesting that reading one's own text for evaluation is indeed a different process from reading someone else's for understanding. In addition, Pilotti and colleagues (e.g., Pilotti, Maxwell, & Chodorow, 2006) showed that auditory feedback improved the accuracy of error correcting due to the proofreading, and thus suggested that for optimal proofreading performance writers should read aloud, indicating that not only written but also spoken language functions can play an important role in advanced text production. The term *reading* has in writing research been used to cover more or less everything that involves the use of visual feedback from the emerging and finished texts. In practice, however, this involves patterns such as following the cursor or the inscription point of the pen, quick scans to individual words earlier in the text, backtracking from the inscription point, and rereading words, sentences, or other parts of the texts; these patterns

can most likely have different functions in different contexts. It is important to examine how good and poor reading and writing skills may impact upon children's use of reading as an executive control device in writing. So far the empirical data on this topic are scarce both for the development of reading and writing and for reading and writing difficulties, but there are some interesting results. There seems to be little difference between age groups (Alamargot, Plane, Lambert & Chesnet, 2010) and between groups with and without reading and writing difficulties (Wengelin, Johansson & Johansson, 2014) in how much they read their emerging texts. However, writers with reading and writing difficulties do make significantly longer fixations than their peers when reading their own emerging texts, that is, they are slower readers than their peers even when it comes to reading their own texts. This pattern agrees with that of reading for understanding; Hutzler and Wimmer (2003) showed for example that German dyslexic readers made longer fixations than their peers when reading for understanding. Taken together these results indicate that reading difficulties could influence both reading for understanding and writers' reading for evaluation of their own emerging texts.

Implications for Assessment and Intervention

Significant implications for the assessment of writing problems and instructional intervention descend from our view of the reading-writing process interconnections. Our view of the developmental relationship between these two processes and of the nature of their relationship may influence important pedagogical decisions, such as whether to teach reading before writing or the reverse, or whether to adopt a holistic approach to the teaching of reading and writing or to teach critical reading and writing components separately. Already in 1985, Kucer (1985) stated that

> Recently a renewed interest in the nature of the relationship between reading and writing processes has emerged // Although the notion that reading and writing are related processes is not new, the fact that much of the current research is exploring commonalities, rather than differences, represents a departure from the past paradigms.
>
> p. 317

However, 30 years later we still have limited knowledge about how the different processes interact. Understanding this is essential for evidence-based intervention, and it is clear that research needs to address the more fundamental

questions about the relations between the cognitive, linguistic, and developmental processes of reading and writing. For example, Fitzgerald and Shanahan (2000) suggested that "If reading and writing really were identical and not just similar, then it may make sense to teach only reading or writing" (p. 43). We already know that this isn't the case, but the citation serves to illustrate that the way we model how reading and writing are connected will have implications for how we teach them.

On the plan of pedagogical intervention, since reading and writing require different abilities (e.g., different meaning-making processes), researchers and educators have developed separate curricula, instructional materials, and assessments for these two processes. This has led to instructional interventions addressed to improving reading skills (De Beni, Vocetti, Cornoldi, & Gruppo, 2004; Palmer, Boon, & Spencer, 2014) and writing skills (Berninger, Vaughan et al., 2002; Berry & Mason, 2012), but the focus has rarely been on their integration (but see Boscolo et al., 2007, and Miller, McCardle, & Long, 2014).

Moreover, despite the documented association between reading and writing problems in children (Katusic et al., 2009; Wakely et al., 2006) and the existence of research showing that some common cognitive and linguistic skills underpin the reading and writing processes (Carretti et al., 2013), relatively little effort is made in educational settings to support these underpinnings (e.g., memory skills, oral language skills, awareness of discourse rules) during reading and writing activities. Some studies have been carried out showing that proof reading can support the development of spelling (Martino, 1995; Torbe, 1977), and that the evaluation of the writer's own text is an important component in some approaches to strategy-based teaching (e.g., Graham & Harris, 2005). In addition, Graham and Hebert (2010) carried out a meta-analysis on the effects of using writing to enhance reading comprehension and reading skills. They showed that students' comprehension of science, social studies, and language arts are improved if they write about what they read, that students' reading skills are improved by learning the skills and processes that go into crafting text. However, we still have limited understanding of the mechanisms underlying these results.

Although considering the relationship between reading and writing is crucial in assessment and intervention, it is important to focus on different levels or different components at different ages. For example, whereas the research suggests that supporting reading skills in primary grades might also influence written production (e.g., Abbott & Berninger, 1993), earlier in the development of writing skills, oral language may play a more important role (Kim, Wagner, & Foster, 2011). Therefore, as suggested by Kim and colleagues, disproportionate attention to word reading and decoding skills at the expense of attention

to oral language skills may be a disservice to children's literacy development during the early phases of writing development.

Moreover, the lack of a significant relationship at a certain moment shouldn't lead to the assumption that either the reading or writing problem of the child are isolated areas of deficits, or that the deficit of the child in one system will not affect the development of his or her skills in the other system. Finally, even when problems are domain-specific, this does not mean that intervention on reading cannot affect writing or vice versa.

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PART 3

Writing Development

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The Multifaceted Development of Writing

Liliana Tolchinsky and Harriet Jisa

Becoming literate is part of an individual's linguistic development, and learning to write is an essential component of literacy. Children who have difficulties in acquiring writing are at risk in their linguistic and educational development. In this chapter, we review crucial landmarks in children's acquisition of writing in alphabetic systems, providing a developmental framework within which to characterize writing disabilities/difficulties, which may range from tracing a letter-shape to producing a coherent text. This diversity of areas of ability reflect the multiple meanings of writing, which can refer to the set of *graphic signs* used to represent an utterance, the method used for producing such signs (*mode of production*), or the *linguistic features* that characterize the resulting output. Each of these meanings corresponds to a domain of knowledge that children need to master in order to become competent writers: the forms and function of the signs of writing, the modality of production, and the written products. In the following, we discuss these and our developmental perspective on the evolving knowledge in each of these domains.

The Meanings of Writing

The Graphic Signs

Expressions such as *writing systems* illustrate the first sense of what we mean by "writing": symbol systems formed by a finite set of visible and enduring graphic elements that represent an utterance that can be understood without the intervention of the utterer (Daniels & Bright, 1996). Alphabetic, syllabic, or logographic systems are broad categories of writing systems; all represent language in an arbitrary and conventional way (i.e., without an iconic or direct resemblance between the graphic elements and the objects or events they refer to) (Sampson, 1985). Writing systems are realized in language-specific orthographies (e.g., English, French, or Spanish, all use the same set of graphic marks, letters, but obey different rules of pairing letters to sounds for representing utterances). Learners of writing must acquire not only the alphabetic principle—that individual signs represent categories of sound—they must also gain language-specific orthographic knowledge.

Some languages have a transparent orthographic system (have a regular sound-letter correspondence), while others have a more opaque (less regular) relation between phonemes and graphemes. Languages differ in their transparency/opacity (the way that phonemes and graphemes map to each other). Studies have shown that children learn to read and spell earlier in more transparent orthographies (e.g., Babayigit, 2009; Goswami, Gombert, & De Barrera, 1998; Kotoulas, 2004; Seymour, Aro, & Erskine, 2003).

The Mode of Production

Expressions such as *say it in writing* refer to the biomechanical mode of production (i.e., non-speech, non-signing) used for encoding utterances. Unlike speaking or signing that can only be produced by voice or manual gestures, many different tools can be used for writing: pens, pencils, brushes, keyboards and fingers. All leave visible, more or less permanent marks that can be scrutinized offline by the same producer/writer or any other reader. Writers must learn to handle the instruments skillfully so that they can focus on their intended message, and they must learn to take advantage of writing which, in contrast to speaking, allows them to plan, revise, and edit the message.

The Linguistic Features

Finally, writing may refer to a *discourse mode*, the written language register. The possible and probable planning, revision, and editing, plus the dissociation between the producer and the product, lead to the deployment of linguistic resources which insure interpretation in the absence of online feedback: lexical precision, reformulations, explicit references, and explicit linkage between utterances, that are not compulsory in the presence of interlocutors but are essential in their absence. In addition to specific features of language, writing as a discourse mode involves identifying the communicative situation, including text type, communicative purpose, and audience needs.

The several meanings of writing are used interchangeably in the literature. Our motivation for distinguishing among them is to show that the process of learning to write is truly multifaceted. It includes acquiring a system of signs/symbols, language-specific rules of use of these (orthographic knowledge), realizing the peculiarities of this mode of production (awareness of the writing process), and gaining a full command of the linguistic resources expected in the written products (lexical, morpho-syntactic, and discursive knowledge). In addition, the several meanings of writing may serve to typify different kinds of writing disabilities. In order to characterize and treat writing disorders, it is important to determine what aspect of writing is involved.

A Developmental Perspective on Writing

Learning to write is generally conceived of as highly dependent on formal teaching. Popular wisdom and linguistic textbooks usually contrast the natural acquisition of spoken language with the learning of written language (reading and writing), which requires specific instruction.

An alternative developmental view explores children's evolving knowledge prior to formal instruction, seeking to demonstrate that young children construct original and very precocious ideas about the practices of reading and writing. We view this perspective as useful for approaching writing disorders for two reasons: (1) it provides information crucial for distinguishing between those deviances that are part of writing development and those that are truly pathological, and (2) it provides invaluable details about pre-conventional writing behaviors. Most models of spelling (e.g., Ehri, 1982) refer to the period of initial development of writing (when children are not yet using conventional letters or even realizing that writing denotes spoken utterances) as pre-alphabetic. These models do not detail the specifics of the pre-alphabetic stage, as though the real thing starts only after children start looking for letter-to-sound correspondences. Nevertheless, the pre-alphabetic period might be more protracted in delayed development—and many disorders manifest initially as delayed development. Looking at this period through a developmental lens can enable detection of significant early differences.

The developmental approach to writing originated during the late thirties with the work of Vygotsky (1978) and Luria (1929), whose aim was to explore "the pre-history of written language". This approach, revived almost sixty years later by the groundbreaking work of Ferreiro tracing the *psychogenesis of writing*, was followed by a remarkable number of studies in different languages, orthographies, and cultural contexts (e.g., Ferreiro & Teberosky, 1979, in Spanish; Tolchinsky Landsmann & Levin, 1987, in Hebrew; Chan & Nunes, 1999, in Chinese). The basic idea is that, even when children have to incorporate knowledge of a conventional kind, they must make that knowledge their own and re-construct it in their own terms.

Another strand of thought is *invented spelling*, initiated by Read (1971). Based on his observations of pre-reading children who began writing, he viewed spelling as a linguistic process in which children attempt to map the sound structure of words. Read was also among the first to discover the important role of letter names in identifying phonemes and the importance of a child's own name in this discovery.

Finally, a parallel but more ethnographic, socio-cultural developmental perspective—emergent literacy—comes from the work of Clay (1982), McLane

and McNamee (1990), Teale and Sulzby (1986), and others, who argue that children's interest in the written word is triggered and enhanced by writing practices at home and at school. They stress the fundamental importance of family literacy practices for success at school (Heath, 1983).

Becoming a proficient writer may require formal instruction and many years of guided practice. Nevertheless, there is strong evidence suggesting that children acquire information about the features of written language through participation in writing practices and informal interactions with parents and other adults (Auerbach, 1989; Robins & Treiman, 2010; Weinberger, 1996). Moreover, there is increasing evidence that this informal information paves the way to further learning (Tolchinsky, Liberman, & Alonso-Cortés, 2015). In the next section, we present empirical evidence that knowledge about the three meanings of writing evolves from early childhood through adolescence.

Developing Knowledge of the Signs of Writing

The child is sensitive to the different verbal behaviors that literate adults perform with printed messages—naming, asking questions, describing, and speaking in a certain cadence. Affordances of printed materials lead to differentiating writing from drawing and to an increasing awareness of the relationship between written symbols and oral language (Graham & Winetraub, 1996; Traweek & Berninger, 1997). Informal and structured observations have revealed that 2-year-olds produce different kinds of markings for the two requests to draw and to write (Sulzby, 1985).

Very early, children from different languages and cultures display an understanding of the general surface characteristics of print in their own attempts at writing. Children first learn about the formal features common to all writing systems—linearity, presence of units, lack of iconicity—and only later learn about features that are specific to the particular orthography to which they are exposed, such as directionality. In a study with over 300 English-speaking children ages 3 to 5 years, Puranik and Lonigan (2011) showed that all 3-year-olds in the sample had acquired most of the universal writing features, while language-specific features could only be found in the writing samples of 4- and 5-year olds. Different writing tasks have been used to test the influence of task type in determining the conventionality of writing forms used by preschoolers. Results show that from a very early age, children use the more advanced writing forms (e.g., letter or letter-like symbols) for their own name, but use wavy scribble or long strings of letter-like symbols (Schickedanz & Casbergue, 2004; Vukelich & Christie, 2009) for other words. These studies confirm the salience of the global

visual pattern of writing, somehow extracted by the child from environmental print rather than resulting from a direct instructional strategy.

From this global pattern children will move to a focus on two levels of element, individual graphic signs and basic compounds. Two pieces of social information will help children in this task: learning to write their own names, and learning the names and sounds of letters. In literate communities, both parents and teachers tend to teach children how to write their own names before any other word; names constitute the first clearly meaningful text, resistant to being forgotten and stable in pronunciation. If a 3- or 4-year-old is told that a set of letters is his or her name, the child will remember it when presented with the same set at a later date, whereas for any other word this is not usually the case (Tolchinsky, 1992). After a pioneer study by Hildreth in the thirties (Hildreth, 1936), dozens of studies on early writing development have illustrated the crucial role of own-name writing in writing development (e.g., Bloodgood, 1999; Ferreiro & Teberosky, 1979; Tolchinsky, Landsmann, & Levin, 1987).

Also letters, their names and the sounds they stand for are meaningful pieces of knowledge children obtain from their environment. Children may at times acquire the letters from other words they have learned, but most frequently the child's name is the source and point of identification for the letters. As we shall see later, letter knowledge has been found to be a powerful preschool predictor of learning to spell across different spelling and educational systems (e.g., Cardoso-Martins, 1995; Levin & Ehri, 2009; Lonigan, Burgess, & Anthony, 2000; Tolchinsky, Levin, Aram, & McBride, 2011).

Parallel to learning the graphic elements of writing, children must discover the representational meaning of writing. Young toddlers, before age three, emit voices mimicking reading while gazing at a story book, showing their grasp of a link between verbal behavior and written objects.

In Luria's (1929/1978) pioneering study, he made the crucial observation that children began to introduce graphic differences into their writing, as some "scrawls" took on a longer or more rounded appearance mainly when the sentences referred to objects that differed in size. More recent research has shown that when recognizing words, children prefer more letters (longer words) to represent large objects (Lundberg & Tornéus, 1978), and that this preference also appears in their own attempts at writing. For example, Hebrew-speaking children use more symbols, or space their symbols farther apart, when writing *snake* because snakes are longer than butterflies (Levin & Tolchinsky Landsmann, 1990).

Luria (1929/1978) and Vygotsky (1978) both argued that from the moment children resort to referential devices, the natural development of writing has

become one of cultural development, because a symbolic relation has been established: children have grasped the fundamental relationship that something *stands for something else* (Luria, 1929/1978; Scinto, 1986). Yet, the idea that writing represents referential differences can be applied only in certain circumstances, when there is some kind of contrast between the words, such as words that contrast in size (e.g., *ant* vs. *elephant*) or color (e.g., *tomato* vs. *cucumber*). Children must realize that writing relates to the sounds of words in order to develop a general model suitable for every writing task, because every word and sentence has a phonic aspect.

Linking the Signs of Writing to Language

How do children come to understand that written marks represent the sounds of words rather than their content or meaning? Alternative and probably complementary explanations have been offered to this *phonetization* process. According to one account, the process of interpretation of one's own writing triggers phonetization in an individual's writing (Tolchinsky, 2003). A second account posits that adults provide the necessary cues to guide children in linking writing to language (Robins & Treiman, 2010), while a third attributes the development towards phonetization to children's increasing orthographic or orthotactic sensitivity.

Interpreting One's Own Writing Triggers Phonetization

Research has shown that whenever children are writing, either spontaneously or at the request of an adult (parent or interviewer), they can answer the question *What did you put here?* and interpret the graphic shapes they have produced. In experimental settings, they may reiterate verbatim the words the experimenter asked them to write (Tolchinsky Landsmann & Levin, 1985, 1987), but in contextualized tasks or real life situations, they may resort to other sources of information. If a text appears under a picture, they may use what they see in the picture to interpret the text, similar to children's early reading where they often take meaning cues from objects near the print. Thus, in studies where a puppet moves a card with a printed word nearer to one object (seemingly accidentally), 3-year-old children often change their reports of what the word says to reflect the object closest to the card (Bialystok, 2000; Bialystok & Martin, 2003). This mapping between a child's verbal interpretation of his/her own writing, irrespective of the source of information used, pushes them toward phonetization.

Adults as Guides Towards Phonetization

In a recent study, Robins and Treiman (2010) proposed that parent speech about writing helps move young children toward phonetization. They analyzed all of the transcripts that involved parent-child conversations in English (MacWhinney, 2000), with children between 18 months and 5 years of age, and found that parents do speak to even very young children about writing, and that they speak about speech and writing in quite similar ways: using the word *say* to refer to both speech and writing (e.g., *What did you say?* or *What does that sign say?*); using *name* and *word* interchangeably to refer to units of the written or spoken language (e.g., *I just wrote my name*, and *what's the name of that thing?*) (Robins & Treiman, 2010). The authors suggest that this use of similar terms for speech and writing may help children to realize that the two systems symbolize the same thing, language.

Orthographic or Phonotactic Sensitivity Helps Phonetization

A third explanation comes from increasing evidence of an implicit orthographic knowledge that may facilitate children's establishment of phonological links between written and spoken elements. In traditional models of spelling, the period of being unaware of the links between writing and speaking is referred to as pre-alphabetic (Ehri, 2005; Ehri & McCormick, 1998); children may recognize some sight words (thus Frith [1985] refers to this period of development as logographic) but no particular regularities are described. Children next move to partial correspondences between letter and sounds, then to exhaustive sound-letter correspondences. During these latter two stages, children's spelling decisions are basically phonographic, guided by phonological correspondences. Only during a fourth stage will children progress to an orthographic stage, which entails the ability to identify orthographic units without phonological analysis. Frith (1985) asserted that orthographic skills are mastered first for reading and later transferred to spelling. Others however have found that preliterate children develop crucial orthographic knowledge even before they are able to establish phonological links. Siegel and colleagues define orthographic knowledge as "both knowledge of the actual spelling of particular words and higher level conceptual skills, such as the recognition of the properties of words and sequences and typical positions of letters in English" (Siegel, Share, & Geva, 1995, p. 262). Kaefer (2009) observed pre-reading 3-year-olds; they found that although 3-year-old children did not significantly distinguish numbers from letters, they did look significantly longer at a number or symbol than at letters in the same position of a pseudo-word. This suggests early *implicit* orthographic knowledge in 3-year-olds. In addition, 5-year-olds identified letter strings as "words" although any combinations includ-

ing non-letters or repeated letters were identified as non-words. These findings are in line with previous studies showing that before looking for phonological links between letters and sounds, children have certain criteria about the *distinctive features* graphic displays must fulfill in order to be readable. The mere presence of letters is not enough for something to be readable; if there are very few letters, it is unreadable, and similarly if the same letter is repeated many times, it is also unreadable (Ferreiro, 1982). These criteria are manifest especially in sorting and writing tasks and seem to hold true across languages and scripts (e.g., Tolchinsky & Teberosky, 1998, for Spanish and Hebrew).

How are sound units mapped onto parts of the written string? Various studies suggest that syllables rather than phonemes are the first units of mapping letters to sound; the number of letters (or letter-like symbols) children use in writing words corresponds roughly to the number of syllables in the word they are attempting to write. Although evidence for the *syllabic hypothesis* is provided by case studies and in-depth longitudinal studies in Spanish (Tolchinsky, 2003), it is called into question mainly by studies carried out in English (e.g., Treiman, Tincoff, & Richmond-Welty, 1996), which suggest that children use alternative methods to understand the relation between written and spoken words. Treiman and colleagues (1996) suggested, in line with Ehri (1993), that children begin to create links between printed words and spoken words "by finding links between letters in printed words and the names of the letters in the spoken words" (Treiman et al., 1996, p. 512). Five year olds found it easier to say the initial letter of a word if it was the name of an English letter rather than its corresponding sound (e.g., *beach* vs. *bone* because the spoken form of *beach* starts with /bi/, the name of the letter b). Similar findings were reported for final letters, although letters at the end of words were more difficult to identify. In addition, children writing monosyllabic and disyllabic words in which the name of the letter coincided with part of the syllable showed no differences in the ease with which the initial letter of the bi-syllabic word or the first letter of the monosyllabic word were identified (*bead* vs. *beaver*), suggesting that children are not mapping at a syllable level but rather are using their knowledge of letter names. Success at spelling will vary according to the position of the letters (initial or final) in the word to be identified and whether or not the letter name fits the syllable or part of the word children are asked to spell.

In sum, children's discovery of links between letters and sound is a turning point in the conceptualization of writing. It means discovering a stable principle useful for representing any word. The first unit of letter-sound correspondence in certain languages is the syllable. The syllabic hypothesis seems to be language specific, emerging in certain languages but not in others, such as English.

It might be the case, however, that during this period of writing development, children do not have a fixed, stable unit of correspondence: depending on the structures of words, children may vary the unit of correspondence between letters and sounds. This instability would characterize children's letter-to-sound mapping until the *alphabetic principle* is established, the principle by which "usable knowledge of the fact that phonemes can be represented by letters, such that whenever a particular phoneme occurs in a word, and in whatever position, it can be represented by the same letter" (Bryne & Fielding-Barnsley, 1989, p. 313).

Although some children, even before being formally taught, discover the alphabetic principle, as a rule the transition to alphabetic writing is gradual. In this transition to alphabetic writing, the specific phonological and morphological structures of a language, and the way in which these characteristics are reflected in the script, play a crucial role.

Developing Knowledge of Writing as a Modality of Production

Very early, before age 3, children realize that writing means leaving visible marks that can be looked at. Later they become aware that those marks are linked to spoken utterances. Although closely related, the production of spoken and written language differs crucially. In principle, the writer has more time for deciding what to say, more time for producing what is said, and the possibility of going back to the written output for revising and editing. The main distinctions between producing language in the spoken versus the written modality have been reflected in the models of the process of production. Beginning with the classical model of Hayes and Flower (1980), every proposal has included three basic processes: planning, translation, and revision, and most of these processes occur in parallel and recursively, rather than linearly and successively. To what extent is children's early awareness of the specific characteristics of writing reflected in their managing of the process of production accurately depicted in these models? A crucial way of studying the cognitive processes at work during text composition is by studying the temporal characteristics of language production.

In adults, the dynamics of text composition have been studied using a variety of methods, including think-aloud and reaction time tasks used to gauge the cognitive cost of the writing activity. There are far fewer studies of how children manage time during composition or how time allocation varies with development and level of expertise (Fayol, Foulin, Maggio, & Lété, 2012). A common supposition is that children are so occupied with the mechanics of

writing and orthographic decisions that they have much less time to devote to planning and revising (Chanquoy 2001). Fayol and his associates (Fayol & Monchon, 1997; Fayol & Monteil, 1988), using a narrative completion production task (in French) with predictable vs. unpredictable endings, found 5th graders and adults had shorter clause-initial and medial pauses and faster writing rates than 3rd graders, whose attention was most likely devoted to transcription, leaving fewer cognitive resources available for managing higher dimensions. In an additional study, they found that consistent spelling also contributed to shorter pauses and faster rate, confirming earlier results obtained by Chanquoy and colleagues (Chanquoy, Foulin, & Fayol, 1991) that, beyond the predictable effect of content and syntactic complexity, orthography made a small but significant contribution to pause length. Fayol and Stephant (1991) also evaluated the specific weight of high-level dimensions on pause length and writing speed, and found that overall pause duration and transcription time were significantly longer for children than for adults, and the distribution of their pauses differed. They concluded that, while adults made use of subsequent pause durations and varying writing speed to manage other dimensions of the writing task, children began transcribing immediately and had to process all dimensions during production. One key difference between adults and children relates to the emergence of an initial pre-writing pause: adults strategically devote time to planning content and syntax before beginning to write, while younger writers start without devoting time to planning.

An interesting recent line of developmental work focuses on writing bursts (Alves, Branco, Castro, & Olive, 2012). Writers build up texts in a piecemeal fashion, with bursts of writing activity interspersed by production pauses (Chenoweth & Hayes, 2001, 2003); as they develop, children produce longer bursts. Alves and colleagues (Alves et al., 2012), studying Portuguese-speaking 9-year-old children with varying levels of transcription skills, found that faster transcription speed leads to longer language bursts and overall better text quality. On-line measures of writing efficiency are crucial for identifying individual differences in children's writing efficiency and for identifying those who struggle with writing fluency. The study of the dynamics of online text composing, comparing typical with atypical developing writers, may shed light on the extent to which individual differences are related to (1) the application of different writing strategies, (2) the different weight of transcription factors (handwriting and spelling), (3) linguistic factors related to syntax and vocabulary, or (3) higher level factors such as content or knowledge of task schemas.

Developing Knowledge about Written Language

Research on the development of awareness about writing as discourse has progressed along two distinct but parallel lines. The first concerns the development of the formal linguistic features of writing—learning to form letters, spell words, construct sentences, and use the written, more formal, language register. The second is concerned with the development of *task schemas* (Hayes & Flower, 1980) or *knowledge of specific genre constraints*. Largely corresponding to these two areas of development are two complementary bodies of research. The first supposes that children's knowledge of written language develops from low levels, such as handwriting or word spelling, and then proceeds to higher levels, such as overall text construction. This line of research argues that it is only after having gained control of handwriting and word spelling that children can develop knowledge about written discourse. A second line of research investigates what children know about written discourse well before they have mastered the signs of writing (Blanche-Benveniste, 1982).

The first line of research developed, in large part, in reaction to the model of writing proposed by Hayes and Flowers (1980), which involved three major components: the task environment (topic, audience, and writer's motivation), the writer's long-term memory (knowledge of the topic, language, and genre), and the writing process (planning, transcribing, and revision). This influential model was developed to capture the problem-solving nature of writing for adult writers. For researchers studying the development of writing, however, the role played by the transcribing component seemed to require further elaboration (Fayol, 2012), because handwriting and spelling can present major stumbling blocks to novice writers (Bereiter & Scardamalia, 1987; Graham, 1990). McCutchen (2012) introduced the capacity theory of writing which holds that, given limited cognitive resources, any variation in the processing cost of a given component will impact the use of other components, with either low level components (handwriting or spelling) affecting high level processes (planning content, creating a text) or vice versa. Lack of automaticity of transcription skills can severely interfere with the writing process, constraining content generation and fluency.

Text Knowledge and Familiarity with Writing Task-Schemas

In the second line of research, written language is conceived of first and foremost as a discourse mode. Written language development is seen as the acquisition of a repertoire of discourse modes that are socio-culturally bounded

(Berman & Nir-Sagiv, 2007; Dyson, 1983). The bulk of research from this perspective studies texts produced in different discourse modes, rather than only writing letters or words, and seeks to understand what children know about texts before gaining full command of spelling (Pontecorvo & Zucc.hermaglio, 1988; Sandbank, 2001). It has been observed, for example, that when 4- to 5-year-olds who do not yet know how to spell are asked to dictate stories that are meant to be written, they use linguistic forms typical of writing (Blanche-Benveniste, 1982).

By separating the transcriptional from the discursive aspects of written language, Pontecorvo and Zucc1hermaglio (1989) showed that before mastering the alphabetic code, children are aware of many linguistic features of written language. At the same time, full developments of the various aspects of oral language, such as complex grammar, definitional vocabulary, and listening comprehension, shown to have substantial predictive relations with later conventional literacy skills (Lonigan & Shanahan, 2009), are enhanced by children's experience with written language. In this sense written language functions as a device for developing knowledge (Galbraith, 2009), not just for translating existing knowledge from the spoken modality.

Support for this line of thought is provided by findings that very young children show no confusion between genres (e.g., they do not tell a story if asked to describe a house). Preschoolers distinguish between the modes of discourse to be expected from different printed materials (e.g., 4- to 5-year-olds hearing a food recipe from a storybook or a typical fairy tale from a newspaper react with surprise); they are able to produce different graphic layouts for writing shopping lists, newspaper news, advertisements, and poetry (Pontecorvo & Zucchermaglio, 1989), before attaining full command of the phonographic conventions of the written system.

These facts are an indication that preschoolers differentiate among genres. It is obvious, however, that children must also learn to produce cohesive and semantically rich texts for each of these purposes. Evidence shows that this ability is attained in some genres before others. Bereiter and Scardamalia (1987) propose that young writers use a knowledge-telling strategy in which content is retrieved in memory and written down as it comes to mind. More expert writers use a knowledge-transforming strategy by elaborating the communicative problem to be solved and setting goals built upon this elaboration to guide the generation and the evaluation of content. This difference in writing strategy helps us understand why narrative texts, which depend largely on temporal and causal relations, are among the first text types to be mastered by children, both in the spoken and written modalities (Berman, 1988, 1995; Fayol, 2012; Jisa, 2000). Children can retrieve the isolated events from memory and write them

down in the order that they occurred. The global structure of narrative texts is familiar to young children: they know that stories have a beginning, chronologically ordered events, and an ending. Thus, the cognitive cost of retrieving the narrative script in long-term memory is lower than for other text types. Argumentative or expository texts depend crucially on the elaboration of communicative goals and the planning of ideas (Boscolo, 1990; Britton, 1994; Ravid & Berman, 2010). The global structure of an expository text is less familiar to children and, thus, the cognitive costs are higher than those associated with narrative. Thus, while a knowledge-telling strategy is sufficient for writing a minimal narrative text, a knowledge-transforming strategy is required for writing an expository text.

Vocabulary choices are also intricately related to text genre (Biber, 1988; Olinghouse & Wilson, 2013). In comparisons of narrative and expository texts, Berman and Verhoeven (2002) observed that the adults' and children's expository texts had longer and more Latinate words than the narrative texts, even for the youngest writers (9-year-olds), and Gardner (2004) found that 5th graders' narrative texts contained more frequent words while their expository texts had higher lexical diversity.

Beers & Nagy (2011) compared narrative, descriptive, compare/contrast, and persuasive texts written by children and adolescents. They found both strong developmental differences and genre differences. Persuasive texts had longer clauses than the descriptive, compare/contrast, and narrative texts. In comparisons of narrative and expository texts, the expository texts showed more nominalizations (Ravid, van Hell, Rosado, & Zamora, 2002), infinitives, participles, and gerunds (Berman & Nir-Sagiv, 2007), clause-lengthening constructions that are not common before high school age (Berman, 2009). With development, writers create more adequate mental representations of the discourse genres and of the linguistic constructions which characterize them (Berman & Nir-Sagiv, 2007).

Syntactic density has long been used as a yardstick for measuring clause connectivity in children's written discourse. The number of clauses per sentence, or the terminal unit (t-unit), increases gradually from elementary to high school (Hunt, 1970; Crowhurst & Piche, 1979; Scott & Windsor, 2000). Over the course of schooling, new grammatical constructions gradually come into use in children's written texts, such as nominalizations (*the destruction of the city*), adverbial complements (*because, while, when*), relative clauses (*the mountain that we visited*) and discourse connectors (*nevertheless, however*).

Both the lexicon and syntax contribute to tighter packaging in written discourse. Becoming a proficient writer involves gaining mastery over more compact means of establishing the flow of information, resulting in texts that show

more densely integrated packages of information. Once children are over the major hurdles of letter formation and spelling, it has been argued that writing may actually facilitate the use of less frequent and more complex grammatical constructions.

Form and Function: From Emergence to Divergence in Usage

During the process of "growing into academic language", children encounter texts that contrast in genre. While exploring new text genres, children not only encounter new grammatical constructions, they also acquire new functions for the grammatical constructions that they already use (Jisa, 2004). Learning to produce contrasting text types is invaluable for children to capture the relationship between form and function of a given construction.

Berman (1987) introduced a useful distinction between a native language user and a proficient language user, which captures how children's language is impacted by becoming literate. Native language users produce fully grammatical structures in everyday conversation, and this use characterizes children's early language. Exposure to and use of written language in knowledge-based school activities challenges the children to expand vocabulary, syntactic repertoire, form-function mappings, and more importantly, to use language which is appropriate in register. Adults know how to fine tune language to fit the situation (e.g., when using *medical practitioner* or *physician* is more appropriate than *doctor*). Important aspects of register variation are revealed to children through their school-situated literacy activities.

Conclusion

Our goal in this chapter was to offer a developmental framework to guide the characterization and timing of writing difficulties. We have attempted to illustrate how learning to write involves development at many levels, ranging from low-level aspects (handwriting and spelling) to higher levels (syntax and semantics) marshalled during planning of different types of texts. Understanding how these different levels emerge and develop is crucial to informing clinical practices directed to children with motor or language difficulties. Struggling with writing is a barrier to educational progress (Connelly, Dockrell, & Barnett, 2012). Understanding exactly where the child is struggling is critical for designing remediation.

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Empirical Studies on the Writing Abilities of Adolescents and Adults with Learning Difficulties

Noel Gregg and Jason Nelson

Scholarship from the fields of sociolinguistics, cognitive psychology, and neurolinguistics influence our understanding of the development of written expression across the lifespan. Neurolinguistics and cognitive psychology research provide evidence of the many different cognitive and language processes influencing writing tasks (Berninger & Winn, 2006; Torrance & Galbraith, 2006). Understanding how specific processes (e.g., working memory, executive functioning, orthographic awareness) influence different aspects of written expression performance directly informs our intervention and accommodation decision-making (Gregg, 2009). Strategic learning relies not only on the cognitive abilities of writers, but also their experiences, self-efficacy beliefs, and motivation for writing (Pajares & Valiante, 2006). Researchers applying sociolinguistic models lend verification of the affective, situational, and social variables influencing written expression (Prior, 2006), yet the boundaries between cognitive, linguistic, affective, and social processes are ambiguous. It is critical for professionals interested in the abilities of the adolescent and adult population struggling with written expression to remain informed by research from several theoretical perspectives.

Definition of Written Expression

Vygotsky (1986) wrote extensively about the complex process of writing and postulated that learning to write involves the mastering of cognitive skills within the development of new social understanding. To transform inner language to written text requires stepping outside of thought to the social context of the reader. Building upon Vygotsky's pioneering work, we recognize the significant influence of social context on individual achievement; he suggested that learning is situated in and mediated by (a) the cultural practices of the group, (b) the available tools for sense-making (whether physical/material, linguistic, discursive, or conceptual), and (c) the particular activities and activity systems in which learning occurs.

Written expression and the tools we now use to communicate written text are being redefined in the twenty-first century digital, multi-networked, and multi-tasking world of information data collection and ever changing communication platforms (National Research Council [NRC], 2012). Online writing competencies, such as proficiency with a variety of virtual platforms and social media tools, are essential for success in school, social life, and the workplace.

Adolescent and Adult Writers

Adolescents and adults may struggle with written expression dependent on shifting contexts or the demands posed by different discourse communities (NRC, 2012). Observed differences vary by individual profile and/or the text demands. Adult writers with specific cognitive processing disorders often demonstrate difficulties with written expression (Gregg, 2009), and insufficient writing instruction early in their schooling causes many low literacy adults to be unprepared for the demands of work situations (MacArthur, Greenberg, Mellard, & Sabatini, 2010). While some individuals master out-of-school writing literacies (e.g., Facebook, Twitter, texting), they still could be lacking the writing proficiency necessary for success in higher education (NRC, 2012). This chapter integrates the research addressing these often-overlapping groups of struggling writers while recognizing that adults/adolescents who appear to struggle in one context may be adept in another.

Persistence and Written Expression

Contemporary researchers of motivation recognize the importance of a learner's cognitive profile, environment, and broader social and cultural experiences that affect persistence to complete writing tasks (Anderman & Anderman, 2010). Motivation, persistence, and engagement with writing are defined differently depending upon a researcher's theoretical perspective and are at times used interchangeably. We chose to use the term "persistence", as it best describes the act of writing required of adolescents and adults. Many writers demonstrating learning disorders (LD) want to become proficient in writing, but often do not persist due to lack of opportunity and/or effective interventions. Some adults with literacy difficulties are less motivated to engage in writing tasks as a result of their histories with academic learning and social stereotyping (Guthrie & Wigfield, 2000). However, it was not until the 1990s that motivation began to be integrated as a key component into cognitive mod-

els of writing (Hayes, 1996; Zimmerman & Risemberg 1997). More recently, the Hayes and Berninger (2014) writing framework (summarized in O'Rourke, Connelly, & Barnett, this volume) identifies a few of the motivational factors closely associated with the language and cognitive processes critical to written expression. Persistence in developing writing skills is a continuous and complex learning process that significantly influences the educational and career aspirations of an individual.

Researchers provide evidence that skilled writers are more motivated to engage in writing tasks than less skilled individuals (Vrugt, Oort, & Zeeberg, 2002), and often demonstrate more positive attitudes toward writing and greater belief in their ability to succeed on written expression tasks (Bandura, 1997; Pajares, 2003). Several specific aspects of persistence have been identified as critical to writing performance, including self-regulation (Butler & Winne, 1995), self-efficacy (Bandura, 1977), and goal orientation (e.g., Pintrich & Garcia, 1991). All of these constructs are interrelated factors influencing writing performance. It is critical to remember that the influence of each of these factors may be experienced differently depending on the individual's cognitive profile, experience, context, and activity demands. Writing demands vary from composing academic papers to Twitter tweets, requiring the individual to call upon different affective and cognitive abilities depending on the text requirements, which can either facilitate or constrain performance. Persistence with writing tasks is inter-related with an individual's affective response and cognitive processing abilities. Writing experiences may help to build an individual's identity as a writer, thus increasing self-confidence, self-efficacy and motivation to engage with new and unique writing activities (Dweck, 2002; Meyer & Turner, 2006).

Self-Regulation

Difficulty self-regulating the demands of writing appears to be a significant risk factor for many adolescents and adults with LD (Gregg, 2009). In particular, these individuals often do not appear to maximize the skills and knowledge gained from past academic experiences. Pintrich (2000) defined self-regulated learning as "an active, constructive process whereby learners set goals for their learning and then attempt to monitor, regulate, and control their cognition, motivation, and behavior, guided and constrained by their goals and the contextual features in the environment" (p. 453). Many writers with LD apply restricted approaches to planning, producing, and revising text. Such writers often demonstrate difficulty accessing strategies and knowledge that can be coordinated and regulated to reach the writer's goals (Graham, 2006). An increasing body of research is providing evidence that when struggling adoles-

cent and adult writers are taught specific strategies to increase their knowledge about writing, their writing performance improves (Graham & Perin, 2007).

Self-Efficacy

Self-efficacy beliefs are integral to one's ability to self-regulate behavior and learning. The type most related to writing competence is referred to as academic self-efficacy, which refers to an individual's ability to manage and master academic expectations. Academic self-efficacy is a strong predictor of writing performance (Pajares, 2003); weaker writers possess a lower sense of self-efficacy than stronger writers (Vrugt et al., 2002).

Specialized Writing Knowledge

Empirical research provides evidence that adult knowledge of specialized features of written expression (e.g., sense of audience and genre structures) improves the quality of writing performance (NRC, 2012). In addition, writers using online context draw upon not only the specialized knowledge of traditional written text, but also of online structures such as hyperlinks, websites, and search engines (Zhang & Duke, 2008).

Sense of Audience

Writers experiencing problems producing quality text often differ from their higher-achieving cohorts in the degree and manner in which they consider their audiences (Rubin & Looney, 1990). Struggling writers tend to think infrequently of potential readers, and fail to use information about their readers even when it is available. The problems adolescents and adults with LD experience in revision and audience awareness are interdependent. To investigate a writer's sense of audience requires evaluation of the writer's voice, perceptions of the audience, and the context in which the writing occurred (Gregg, Sigalas, Hoy, Weisenbaker, & McKinley, 1996). The writer, audience, and context are all involved in the dynamic creation of text and this leads to choices regarding concepts, vocabulary, style, and text organization.

Researchers have identified a number of social cognition skills required for developing sensitivity to audience in written language including content, execution, perspective taking, differentiation of voice, and organization of text (Gregg, 2009). Deficits in any one (or more) of these areas have been shown to impact a writer's ability to identify and remain sensitive to a specific audience. Perspective-taking requires social inferencing and the ability to perceive or express various traits in others; deficits in perspective-taking are often char-

acteristic of struggling writers. In a study exploring the relationship between sense of audience and LD among young adults, Gregg and McAlexander (1989) emphasized that certain cognitive profiles are more likely than others to cause problems with sense of audience. Interestingly, students with more severe linguistic deficits demonstrated greater sensitivity to sense of audience. However, their spelling and syntax errors often masked this strength in writing. Students with processing disorders impacting social cognition demonstrated the most difficulty with demonstrating sense of audience across writing tasks.

Types of Text Structure

Researchers provide evidence that increasing a struggling adult writer's knowledge about text structure can improve writing (Traxler & Gernsbacher, 1993). Text structure refers to the means by which individuals organize their ideas in writing. Word and sentence structures, as well as function (purpose), can be very different depending on the chosen mode of writing (e.g., narrative, expository, persuasive). Complementing our chapter, O'Rourke, Connelly, & Barnett (this volume) and Wengelin and Arfé (this volume) both explore the cognitive and linguistic relationships between reading and writing activities at the text level. From a very different orientation, Myhill and Jones (this volume), discuss the complementary dimensions of language process and social contexts influencing text construction. For our discussion, we draw upon the work of Halliday (1973) as a means of investigating text structure at the adult level. Halliday discussed three functions of adult language: *ideational*, *interpersonal*, and *textual*. The ideational function relates to the content or knowledge of what the writer is expressing. Usually, the more knowledge one brings to the writing task, the more fluent the writer. Interpersonal functions involve the writer's relationship to the audience (sense of audience). It is the textual function of writing that incorporates both the ideational and the interpersonal in order to construct meaning for the reader. Researchers examining the written text of adolescents and adults with LD note that these writers often demonstrate difficulty with executive processes, such as planning, monitoring, evaluating, and revising text structures (Graham & Harris, 1999). Hayes and Berninger's (2014) writing framework discussed in O'Rourke et al. (this volume), identifies what they call a control level that allocates attention to planning, monitoring, evaluating and revising and also coordinates the use of writing schemas.

Digitalk

Researchers exploring the relationship between digital online reading and reading printed text emphasize that the processes are not isomorphic (Zhang

& Duke, 2008). The prior knowledge, inferential reasoning, and self-regulation strategies are different and often more complex with online reading. Evidence indicates that online reading requires flexible deployment of appropriate strategies, depending on purpose and stance, that vary from print reading (Cromley & Azevedo, 2009). Therefore, it is not surprising that research on multimodal composing processes suggests that such writing requires new strategies to handle the increasing textual complexity (National Council of Teachers of English, 2008). Writers must now manage information presented and required for composing across a range of modes—audio, video, graphic, and with multiple new contexts and audiences (Ranker, 2008). Some have suggested that digital online composing might encourage new revision and self-monitoring strategies (Li, 2006). Some research suggests that self-efficacy and self-determination influence the use and persistence of specific communication platforms (Coryell & Chlup, 2007; Jacobson, 2008; NRC, 2012). The long-term action research writing program, *Read to Learn* (see Rose, this volume), is designed to increase the writing potential of struggling writers. It is an example of a writing model that focuses on learning as a social process. Use of this model provides an excellent framework for addressing many of the research questions exploring the relationship between digital reading and writing across a variety of learning environments adolescents and adults daily face.

Many adolescents and adults spend a great deal of time writing outside of the classroom, posting messages to social networks, chatting via instant messaging, and communicating by text messaging (Lenhart, 2010). Such digital writing requires the combination of written and conversational language and is referred to as digitalk (Turner, 2010, 2011). The features of linguistic structures demonstrated by those using digitalk do appear to reflect the ideational, interpersonal, and textual functions of traditional written language (Turner, Abrams, Katic, & Donovan, 2014). The relationship between digitalk and literacy patterns appears to provide some interesting insight into writing abilities. Examining the relationship between texting and literacy skills in adolescents with and without specific language impairments (SLI), Durkin, Conti-Ramsden, and Walker (2011) found that adolescents with SLI wrote shorter text messages and used less digitalk in their messages. Normally-achieving readers and writers demonstrated greater use of digital language than adolescents with SLI, suggesting that digital linguistic growth appears to mirror standardized writing patterns.

Powell and Dixon (2011) investigated the relationship of textisms (the language used in text messages—abbreviations, single letters, or symbols) and spelling ability. They found that adults' exposure to misspellings had a negative impact on spelling ability, but their exposure to textisms had a positive effect.

Their findings suggest that textism fosters metalinguistic awareness of how words are spelled. In addition, researchers have found that poor readers spent more time on their phones per day than strong readers, but strong readers used more textisms in their messages and were faster at reading a variety of different types of messages (Durkin et al., 2011). Research on the relationship between texting, textisms, and literacy skills of college students provides evidence that usage patterns vary across contexts (Drouin, 2011). In addition, Drouin found significant, *positive* relationships between text messaging frequency and literacy skills (spelling and reading fluency), but significant, *negative* relationships between textese usage in certain contexts (on social networking sites such as MySpace™ and Facebook™ and in emails to professors) and literacy (reading accuracy). This suggests that college students demonstrating more advanced reading and spelling abilities may be using text messaging more frequently than young adults with less literacy proficiency. Crystal (2008) suggested that text messaging might not be an appealing medium for those with deficient literacy skills.

The relationship of textese usage across contexts appears to reflect the difficulty adults with low literacy demonstrate with code switching using traditional print formats. Drouin (2011) found that young adults who reported using more textese on social networking services and those who reported using more textese in emails to professors demonstrated lower reading decoding skills (Drouin, 2011). Similarly, Wood, Kemp, Waldron, and Hart (2014) found an association between young adults' tendency to make capitalization and punctuation errors in textese and their ability to select grammatically correct word representations (even after controlling for IQ and spelling ability). More research is certainly needed to examine the relationship of digital voice, sense of audience, and code switching abilities to literacy proficiency.

Adult Literacy Research and Writing Performance

U.S. federal agencies signaled a concern over the lack of research specific to the adult population with literacy challenges by increasing funding opportunities to investigate the barriers of this group of individuals. For example, in 2001, the National Institute of Child Health and Human Development, the National Institute for Literacy, and the Office of Vocational and Adult Education published a research solicitation committing a total of $18.5 million over the 5-year period from 2002 to 2006 to support adult literacy research (Miller, McCardle, & Hernandez, 2010). While these agencies primarily funded research specific to reading in this population, they did encourage further empirical studies

focusing on writing in adults. In addition, several federal agencies directed researchers to investigate the performance of learners in a range of settings not limited to formal adult basic education programs, but also to high school graduates enrolled in developmental college courses, and/or workplace literacy settings (Miller et al., 2010).

In the area of written expression, U.S. federal funding has primarily supported researchers investigating the instructional needs (i.e., face-to-face and virtual) of this diverse group of adult learners. Writing in community college has received some attention over the last few years as the retention and graduation rates for this population continue to be serious problems; from 40% to 60% of new community college students are required to take developmental writing courses and few reach the criteria to take credit-bearing courses (Bailey, Jeong, & Cho, 2008). The majority of the research investigating underprepared writers has focused on strategy instruction rather than the exploration of the cognitive and linguistic processes involved in different writing areas (MacArthur & Philippakos, 2013; Perin, 2013). Researchers advocating strategy instruction draw their support on the close relationship between the constructs of persistence and academic performance discussed earlier (i.e., self-regulation, self-efficacy, goal setting) as essential to improving writing (MacArthur & Philippakos, 2013). While researchers have investigated additional cognitive and linguistic processes influencing adult populations demonstrating problems in reading decoding and reading comprehension, there continues to be less examination of the processes influencing adult writing. The one exception to this point pertains to the adolescent and adult population with documented LD, with most studies examining college students with LD.

Empirical Studies on the Writing Performance of Adolescents and Adults with Learning Disorders

In this section, we review empirical studies in which various aspects of writing have been explored with samples of adolescents and adults with documented LD. It should be first noted that the term *learning disorders* (i.e., learning disabilities, LD) is used generally here to encompass a variety of more specific forms of disorders that often impact writing. These more specific forms include dysgraphia, dyslexia, and oral and written language learning disability (Berninger, 2009). In our review, we default to using the term *learning disorders* in a general way but highlight subtype issues when relevant for deepening understanding of specific writing issues. We structure our review according to the following four areas of writing: (1) handwriting, (2) spelling, (3) punctua-

tion, grammar, and syntax, and (4) discourse. When relevant we also discuss the specific cognitive and linguistic processing abilities that may be disrupted, leading to problems in the specified aspect of writing. We also highlight how problems in each may cause difficulties in other aspects of writing and within the broader information processing system.

Handwriting

Adolescents and adults with LD have been found to have poorer handwriting legibility and slower handwriting speed than individuals without LD (Berninger, Nielsen, Abbott, Wijsman, & Raskind, 2008; Hatcher, Snowling, & Griffiths, 2002; see Tops, Callens, Van Cauwenberghe, Adriaens, & Brysbaert, 2013, for a contrary finding). When adults with dyslexia in particular have been examined, their handwriting fluency has been shown to be lower than that of age-matched but not spelling-matched controls (Connelly, Campbell, MacLean, & Barnes, 2006). Problems with handwriting are particularly characteristic of individuals with dysgraphia (Mather & Wendling, 2011) and have been found to be more severe in men with LD than in women with LD (Berninger et al., 2008).

Problems with orthographic processing (i.e., awareness of and sensitivity to the visual representations of language) have been found to have a direct, negative effect on handwriting, whereas graphomotor planning difficulties indirectly influence handwriting via orthographic processing (Abbott & Berninger, 1993). Orthographic processing difficulties are common among adolescents and adults with LD (Gregg, Bandalos, Coleman, Davis, Robinson, & Blake, 2008); therefore, these may be key underlying processing issues leading to their handwriting problems. Problems with handwriting have been found to further disrupt information processing by consuming resources within the limited-capacity working memory system, leaving fewer cognitive resources for meeting the higher-level demands of generating written text (Peverly, 2006). This disruption of working memory is particularly concerning because of the preexisting working memory deficits of many individuals with LD (Swanson & Siegel, 2001).

Handwriting difficulties have been described as negatively impacting other aspects of writing for adolescents and adults with LD. Gregg (2009) stated that handwriting difficulties often lead to decreased written productivity and ideation. Handwriting difficulties have been shown to negatively influence overall essay quality ratings for adolescents and adults with LD (Connelly et al., 2006; Dockrell, Lindsay, & Connelly, 2009; Gregg, Coleman, Davis, & Chalk,

2007). Such difficulties have been shown to have a greater effect on quality ratings on timed essay exams than on formative class essays (Connelly, Dockrell, & Barnett, 2005). Although it is clear that overall quality ratings are negatively affected by handwriting difficulties, further research is needed to determine the degree to which lower quality ratings are due to the effect of handwriting on raters' perceptions of competence versus its effect on higher-level processes influencing discourse complexity. Connelly and colleagues' (2006) study provides some insight into this issue. In this study, the handwritten essays of adults with dyslexia were typed up (spelling errors and cross-outs were preserved) prior to being rated for quality to reduce potential rater bias due to poor handwriting. They found that the overall essay quality scores of adults with dyslexia were lower than the scores of an age-matched control group but not lower than the scores of a spelling-skill-matched control group. Multiple regression analyses indicated that handwriting fluency was positively associated with overall essay quality ratings for the adults with dyslexia and the spelling-skill-matched, but not for the age-matched control group.

Spelling

Spelling is the aspect of writing that has received the most research attention in the adolescent and adult learning disorder literature. The majority of this research has used samples of adolescents and adults with reading disabilities (RD) or dyslexia, likely because word-level decoding (the core problem associated with dyslexia) and encoding are supported by similar underlying processing abilities (e.g., phonological and orthographic processing). In their meta-analysis of the adult RD literature, Swanson and Hsieh (2009) found large effect sizes for both spelling (encoding) problems (d = 1.57) and word reading (decoding) difficulties (d = 1.33). More recently, Tops, Callens, Bijn, and Brysbaert (2014) found effect size differences of greater than 2 when comparing the spelling skills of college students with and without dyslexia indicating that the spelling scores of adults with dyslexia were substantially lower than those of adults without dyslexia. Comparing samples of adults with LD in college or rehabilitation settings to adults without LD, Gregg et al. (1996) found that both LD groups possessed lower spelling skills than the group without LD and, surprisingly, that the spelling skills of college students with LD were *lower* than the skills of their counterparts in rehabilitation settings. Spelling differences among these groups have been found on both constrained, isolated word spelling tests and unconstrained, spontaneous writing samples, despite the ability of the writer to choose only words they know how to spell on the latter

type of task. Within unconstrained writing samples, Coleman, Gregg, McLain, and Bellair (2009) found that adults with LD made spelling errors in 1 of every 40 words, compared to 1 in 143 for those without LD. Similarly, Leuenberger and Morris (1990) found that adults with LD made twice as many spelling errors in spontaneous writing samples compared to those without LD.

Spelling issues among adolescents and adults with LD negatively impact others' opinions of their writing in addition to causing difficulties in other aspects of writing. As noted by Gregg, Hoy, and Sabol (1988), mastery of the conventions of written language is perceived as a basic skill that indicates intellectual fitness for postsecondary education. Spelling errors by college students with LD have been shown to strongly influence raters' perceptions of these students' overall writing quality (Gregg et al., 2007). The spelling difficulties of adolescents and adults with LD may also impact overall writing quality via their influence on other aspects of writing. As an example, Cowen (1988) found that college students with LD often use simpler words in their writing to avoid spelling errors. Similarly, Tops et al. (2013) found these students avoid writing words longer than six letters. This strategy is problematic because vocabulary complexity has been shown to be the single best predictor of overall writing quality for adolescents and adults with LD (Gregg et al., 2007). Poor spelling among adults with dyslexia has also been shown to be associated with pausing and dysfluent writing (Wengelin, 2007).

Regarding processing issues associated with the spelling skills of adolescents and adults with LD, early research indicated that these individuals may draw upon orthographic knowledge to compensate for phonological processing problems influencing spelling (Pennington et al., 1986). More recent research has indicated that adolescents and adults with LD have been found to experience the most difficulty with orthographic exception words and to struggle to memorize orthographic patterns (Kemp, Parrila, & Kirby, 2008; Meyler & Breznitz, 2003). Both Coleman et al. (2009) and Tops et al. (2014) found that adolescents and adults with LD make more phonological, orthographic, and morphological errors in their spellings than do those without LD, suggesting that underdeveloped abilities in all three areas of processing tend to disrupt their spelling. These processing differences were found using both constrained and unconstrained tasks, although orthographic errors were found to be more common on word dictation tasks and morphological errors were more prevalent on sentence dictation tasks (Tops et al., 2014).

Punctuation, Grammar, and Syntax

Punctuation and Grammar

Minimal research has been conducted in the areas of punctuation and grammar with adolescent and adult learning disorder samples. Of the studies that have been conducted, most have found that adolescents and adults with LD make more punctuation, capitalization, and grammatical errors (e.g., subject-verb and pronoun-antecedent agreement errors) than to do those without LD (Duques, 1989; Gregg, 1986b; Morris-Friehe & Leuenberger, 1992; Tops et al., 2013; Vogel & Moran, 1982). Because of these difficulties, adolescents and adults with LD have been described as prone to using punctuation sparingly (Vogel, 1985) and using less sophisticated grammatical structures and punctuation (Gregg, 2009). Additionally, nearly 80% of these individuals rely on others to proofread their written work (Smith, 1993).

Minimal research has also been conducted on the underlying processing issues that may lead to difficulties with punctuation and grammar for adults and adolescents with LD. In one of the only studies addressing this topic, Duques (1989) found that grammatical errors were prominent in both the spoken and written language of adults with LD, but more pronounced in written language. She concluded that adults with LD often experience difficulties with general language production and that grammatical acceptability in written language is additionally influenced by the orthographic processing skills of adults with LD. Furthermore, Duques (1989) found that as the level of writing demand became more complex, grammatical acceptability decreased, leading her to speculate that short-term memory weaknesses may also play a role in their difficulty in producing more complex grammatical structures.

Syntax

Most of the research on syntax has focused on the syntactic maturity of adolescents and adults with LD. Although syntax is influenced by punctuation and grammar, it is thought to be a broader construct, referring to the ways in which words are assembled to create individual sentences (Gregg, 2009). Most studies on syntax have incorporated thematic or terminal unit (T unit) analysis. A T unit, a single independent clause that may include dependent clauses, is mainly used to analyze syntax without consideration of punctuation and capitalization errors. No differences have been found in adolescents and adults with and without LD for length of T units (Gajar, 1989; Vogel, 1985; Vogel & Moran, 1982). However, differences in complexity of syntactic structure have been found; adolescents and adults with LD have been found to use less complex syntactic structures (e.g., fewer subordinate clauses per T unit and fewer

words per main clause) than their peers without LD (Vogel, 1985). Additionally, syntactic difficulties appear to be more problematic for some adolescents and adults with LD than others. Puranik, Lombardino, and Altmann (2007) found that adolescents and adults with language LD demonstrated more severe syntactic problems than did adolescents and adults with dyslexia, suggesting that individuals with broader oral language difficulties are more susceptible to experiencing syntactic problems in written language. Interestingly, participants with dyslexia in this study did not differ from participants without LD on any of the indicators of syntactic maturity.

Discourse

Although incorporating T unit analyses to examine syntactic maturity has been useful, these analyses have tended to treat writing as the expression of independent ideas rather than a combination of ideas expressed in a meaningful way (Gregg, Coleman, Stennett, & Davis, 2002). Several studies have addressed the shortcomings of this approach by examining higher-level aspects of written expression at the discourse level; the majority have examined the cohesion and coherence of discourse-level written text produced by adolescents and adults with LD relative to their peers without LD. Additionally, total verbosity at the discourse level beyond simple T unit length has been examined.

Cohesion

Cohesion refers to the structure of written text beyond the sentence level (Gregg, 1986a). Gregg (1985) compared the written discourse of college students with LD to that of basic writers (i.e., individuals with writing difficulties who did not meet the criteria for LD) and writers without LD, to determine each group's use of cohesive ties (e.g., grammatical, transitional, and lexical ties). Results indicated no significant differences between the groups on either frequency or accuracy of any of the cohesive ties investigated.

In a follow-up study, Gregg and Hoy (1990) examined the use of cohesive referencing in the written discourse of college students with LD compared to underprepared writers and writers without LD. The authors defined cohesive referencing as skill at assigning roles to the speaker and the addressee in written discourse. Results indicated that college students with LD did not differ on this measure relative to college students without LD and that both of these groups demonstrated more sophisticated cohesive referencing than did the underprepared writers. They argued that college students with LD often possess strengths in the higher-level aspects of writing despite their

problems with lower-level aspects of writing, citing observations that such writers generate ideas that are sophisticated in both meaning and structure. This argument was demonstrated by Connelly et al. (2006). In contrast, Gregg et al., (2007) found that the overall written discourse quality scores of college students with LD were lower than their peers without LD even when lower-level difficulties (e.g., spelling, handwriting, and grammar) were controlled; this difference manifested despite a structural equation analysis indicating that the dimensions of writing represented in expository discourse was similar for both groups. More research is needed to better understand these inconsistent findings.

Coherence

Coherence refers to the macrostructure of written discourse and is an indicator of how well written text comes together as a meaningful whole. In the only study examining this aspect of written expression with adults with LD, Gregg and Hoy (1989) compared college students with LD to underprepared writers and normally achieving writers. They also compared these groups on their comprehension of coherence (how well they comprehended logical verbal relationships, e.g., between words and sentences). Results indicated no differences between college students with LD and their normally achieving peers on comprehension of coherence measures, although both groups performed better than the underprepared writers without LD. The groups differed on their production of coherent text, with the normally achieving writers performing better than the other groups and the college students with LD demonstrating better coherence than the underprepared writers. Interestingly, college students with LD demonstrated the largest discrepancy between their comprehension and total coherence scores, leading the authors to conclude that these students possess strengths in their comprehension of coherent text structure but experience disruption in the processes necessary for producing coherent text.

Verbosity/Fluency

A final aspect of written discourse that has been examined with adolescent and adult LD samples is verbosity, or the total number of words used in written discourse. Verbosity has also been used as an indicator of the fluency of written discourse production, particularly under timed conditions. In a study of the timed essay writing of college students with LD, Gregg et al. (2007) found that these students wrote significantly shorter expository essays than did their peers without LD. Nearly 30% of individuals with LD were unable to complete their essays within the allotted time limit, whereas less than 10% of those

without LD had such difficulty. Gregg et al. (2002) found that verbosity was one of the best discriminators between college students with and without LD and was strongly correlated with overall writing quality. They speculated that underlying cognitive and linguistic processing weaknesses of those with LD likely negatively impacted their access to words and syntactic structures, thus reducing their verbosity. Likewise, Coleman et al. (2009) found lower verbosity in expository writing in college students with LD and argued that orthographic and morphological processing weaknesses, slowing access to spelling patterns and vocabulary, were the likely mechanisms.

Discussion

Many theoretical arguments have been made relating various cognitive, affective, and linguistic processing issues to problems with written discourse; however, minimal empirical investigations have been conducted, particularly using adult samples with and without learning difficulties. Illustrative of this is McGrew and Wendling's (2010) recent review of the research on the relations between academic achievement and cognitive abilities delineated by the Cattell-Horn-Carroll (CHC) theory. The CHC is a hierarchical taxonomic conceptualization of cognitive abilities according to nine broad cognitive abilities (e.g., fluid reasoning, long-term storage and retrieval, auditory processing) and a plethora of narrow abilities (e.g., inductive reasoning, naming facility, and speech sound discrimination) that influence these broader abilities (see Schneider and McGrew, 2012, for a comprehensive discussion of CHC theory). In this review, empirical studies examining the relationship between math, reading, and CHC abilities, but not writing and CHC abilities, were reviewed (presumably due to the paucity of empirical research available for review on the latter relationships). In the few studies that have been conducted, both processing speed and crystallized knowledge have been consistently found to be significantly related to written expression across the lifespan (Floyd, McGrew, & Evans, 2008; McGrew & Knopik, 1993), and working memory has been shown to moderate structural complexity in writing in adulthood (Hoskyn & Swanson, 2003). Although executive processes have been described as highly important for the higher-level aspects of written discourse (see Dehn, 2014, for a review), the relationship of these processes to the written expression of adolescents and adults underachieving in writing remains unexplored. This is extremely important to consider, because a great deal of instructional research focused on writing strategies is based on the assumptions (both theoretical and inferred) that these interventions on enhancing the executive processing skills of writers (e.g.,

self-monitoring, self-efficacy, self-regulation) are effective across the majority of individuals underachieving in writing (MacArthur & Philippakos, 2013).

Vygotsky (1986) encouraged scholars to explore the importance of understanding the relationships between cognitive development and the current technological tools that mediate learning. The digital, multi-networked, multitasking, and constantly changing world of information and communication is placing even greater demands on literacy across social, school, and work situations. It is clear from recent research investigating adolescent and adult writers underperforming in written expressions that identifying effective strategies to enhance digitalk is an essential catalyst for better digital writing. Unfortunately, the emphasis in understanding digital writing has often focused on familiarity and/or access to the technology tools or communication platforms, rather than investigating effective digital writing strategies across different learners. Individuals underprepared in written expression often demonstrate some of those same problems with digital formats as they do with print (e.g., fluency, metalinguistics). Empirical research investigating strategies, interventions, and electronic mentoring models, focusing on enhancing access for adolescents and adults with literacy barriers to gain greater digital writing skills, is critical to furthering educational and career success for this population. There is evidence that socially and academically isolated individuals are often less likely than other adults to use new communication technologies (Bryant, Sanders-Jackson, & Smallwood, 2006). Therefore more research focused on the usage patterns and strategies effective for accessing and enhancing the use of information and communication technologies for the adolescent and adult population underprepared in writing is of critical importance for their advancement in our global environment.

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Instructional and Intervention Approaches

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Language Bases of Spelling in Writing during Early and Middle Childhood: Grounding Applications to Struggling Writers in Typical Writing Development

Elaine Silliman, Ruth Huntley Bahr, William Nagy and Virginia Berninger

Introduction

A major aim of this chapter is to frame writing as a multidimensional language process for which spelling is fundamentally important. Although our main focus is on English spelling, issues related to spelling systems in other languages are also mentioned. We address the linguistic bases of spelling in morphophonemic orthographies by going beyond the transparent vs. opaque notion to an expanded perspective that emphasizes the concepts of shallow and deep orthographies and their application to spelling. For a cross-language study involving two morphophonemic orthographies on this topic, see Abbott, Fayol, Zorman, Casalis, Nagy, and Berninger (2016). Our underlying principle is that individuals access more than the alphabetic principle in learning how to spell. Indeed, they rely on multiple linguistic cues when spelling. For example, Pacton and colleagues have demonstrated the importance of orthotactics (e.g., Pacton, Borchardt, Treiman, & Lété, 2014; Pacton, Fayol, & Perruchet, 2005; Pacton, Perruchet, Fayol, & Cleeremans, 2001), which refers to permissible and probable spelling patterns in written words, including letter positions and letter sequences (Berninger & Fayol, 2008). Nunes and Bryant (2006) demonstrated the importance of morphology, which includes affixes that transform root words using suffixes and prefixes. Inflectional suffixes mark tense, number (e.g., *runs, run, ran*), or comparison (e.g., *green, greener*) , while derivational suffixes often alter part of speech, and create new word meaning (e.g., *person, personable*). Prefixes modify meaning (e.g., *justice, injustice*). Hence, in learning to spell, English is a morphophonemic orthography that requires understanding not only of the alphabetic principle in learning to spell words but also the patterns of orthography and morphology and the interrelationships among phonology, orthography, and morphology and the semantic and syntactic cues that the morphology provides (Tyler & Nagy, 1989).

In cognitive models of writing, spelling is both a translation process for converting the thought world (semantics) into written language and a transcription process for recording the written language. Research has shown that spelling is both a window into the concepts underlying words in the writer's mind (word meaning; see Richards, Berninger, & Fayol, 2009; Stahl & Nagy, 2006) and a means of translating those concepts into transcribed forms (word units comprised of letters). Thus, spelling is neither a purely motor act nor purely mechanical process but rather draws on translation and transcription processes. In this chapter, we draw on interdisciplinary research evidence from speech and language sciences, psycholinguistics, and neuroscience (Bahr, Silliman, & Berninger, 2009; Bahr, Silliman, Berninger, & Dow, 2012; Garcia, Abbott, & Berninger, 2010; Nagy, Berninger, & Abbott, 2006; Richards et al., 2006) that demonstrates that English draws on three linguistic codes or word forms: phonology (P), orthography (O), and morphology (M). These three codes or word forms and their interrelationships are referred to as POM throughout the chapter.

This chapter covers three main aspects. First, factors that influence learning to spell in a morphophonemic orthography are explained. Second, an evidence-based model is described that integrates POM (Bahr, Silliman, Berninger, & Barker, 2014)—with concepts and their semantic meaning and syntactic roles (Stahl & Nagy, 2005). The result is the creation of conventional, word-specific spellings, which are acquired in small steps across time. Lastly, because learners who struggle with writing and spelling in grade 1 typically continue to struggle in grade 3 (Costa et al., 2014) and beyond (Maughan et al., 2009), we make the case in the final section that this model of typical spelling development is useful in the assessment and instruction of students with persistent spelling difficulties, including those with language learning difficulties (Nagy, Carlisle, & Goodwin, 2014). We also address unmet research needs for further understanding the individual needs of struggling spellers.

The Importance of Spelling for Writing Development

Cross-sectional assessment studies of typically developing writers in early and middle childhood (grades 1 to 6, ages 6 to 12) documented that transcription skills (both spelling and handwriting) are related to the quality and length of composing (translation of thinking and concepts into written language) (for a review see Berninger, 2009). A 5-year longitudinal study of spelling (grades 1 to 5 or 3 to 7) beginning in grade 1 or 3 showed that only spelling consistently predicted other writing skills and often, reading skills, in the next grade

(Abbott, Berninger, & Fayol, 2010). Thus, even in the computer era, spelling is an important transcription skill, as well as translation skill. (Trans)scribing through handwriting and spelling enables recording in writing the outcomes of translating concepts into written language (see Hayes, 1996; Hays & Berninger, 2014; Hayes & Olinghouse, 2015).

Two Myths Interfering with Implementation of Evidence-Based Spelling Instruction

The first persisting myth is that spelling is just a mechanical skill and handwriting just a motor skill. For recent reviews of interdisciplinary research evidence that refutes this myth, see James, Jao, and Berninger (2015) and Longcamp, Richards, Velay, and Berninger (2017). One reason that the linguistic foundations of spelling are not widely recognized is that, historically, linguistics focused on oral language. Increasingly linguists are interested in written language, including spelling (e.g., Harris & Perfetti, 2017; Neef, 2012; Perfetti, Rieben, & Fayol, 1997). However, translation science is needed to implement this research, as the psycholinguistics of written spelling lags behind other efforts to implement evidence-based practices in schools, for example, in reading. Research has shown that learning to spell, that is, the word level of written language, is acquired in developmental steps across time. It may take years of formal instruction to coordinate the translation of cognitive processes into written language with the spelling of word-specific vocabulary across curriculum content areas (for a review of evidence organized by developmental stepping-stones, see Berninger, 2015).

The second myth relates to the opaqueness of morphophonemic orthographies. Although some orthographies do have consistent letter-phoneme relationships for pronouncing words (i.e., they are more transparent), the transparency of English spelling becomes evident when its foundations in morphology, as well as phonology and orthography, are understood (Nunes & Bryant, 2006; Rueckl, 2016). For example, the same spelling unit may or may not function as a true morpheme—*ful* is a true morpheme in *hopeful* but not *awful* (see Stahl & Nagy, 2006; Tyler & Nagy, 1989). Also, *height, sight*, and *bite* are spelling alternations (Venezky, 1995, 1999) for the long *i* sound, which become transparent to students once they become familiar with word families. To learn word-specific spellings, developing spellers therefore need the ability to analyze POM relationships at the word family level combined with morphemes and semantics at the lexical level (Ehri, 1980a, 1980b, 2014; Olson, Forsberg, Wise, & Rack, 1994). Moreover, interrelationships among POM codes vary with word origin in English: Anglo-Saxon, Romance (French and Latin), and Greek (Henry, 1990, 2010). In fact, English is not hopelessly opaque if its POM regularities are

taught for the grade-appropriate written spellings developing writers are likely to encounter and have opportunity to use in their writing at school.

The Relevance of Word Origins to Word-Specific Spellings
Anglo-Saxon Origin

Words of Anglo-Saxon origin tend to be one or two syllables long. Not only the alphabetic principle (e.g., phonemes to one-letter spelling units, *c-a-t*; phonemes to two-letter graphemes, at word beginning and end *th-i-ng*) but also phonological and orthographic onset-rimes (*th-ing*) contribute to the phonological-orthographic relationships in spelling. Inflectional suffixes that mark number, tense, and comparison and derivational suffixes that mark part of speech, and prefixes that affect meaning of root words are also relevant to spelling. For example, one phoneme /ng/ corresponds to a 2-letter spelling unit in *singing* in the root and the other in the suffix. Hence, to correctly spell a specific word linked to a specific meaning, a speller must pay attention to each linguistic cue in POM and coordinate all three sources of linguistic cues. If, for example, an act occurs in the present and the subject who performs it is singular, *sing* can be transformed to *sings*, or if the subject is plural, it is left as *sing*. If the action occurred in the past, sing can be altered to *sang*, illustrating that not all transformations involve adding affixes—sometimes they involve transforming the spelling and pronunciation of the root word. In the case of a derivational suffix that marks part of speech, the root word *sing*, a verb, might be transformed to a noun *singing*.

Romance (French or Latinate) Origin

Words with Romance origins (French or Latin) tend to be three to five syllables long. The final morpheme with a derivational suffix may not only create a transformed word with a new part of speech but also a phonological shift in the root word. For example, adding *al* to the root word, *nation*, not only transforms it from a noun to an adjective but also changes the pronunciation of the root word. Also, the alphabetic principle for words of Romance origin may be different from words of Anglo-Saxon origin (e.g., compare *ti, si*, or *ci* for the Romance words and *sh* for the Anglo-Saxon words). In addition, many words of French origin have a schwa (unstressed vowel) for which the spelling depends on the specific word spelling context in which it occurs (e.g., first *e* in av*e*nue and the *o* in purp*o*se). Again, a writer must pay attention to the POM features of specific words and link them to meaning for a word-specific spelling that is used appropriately in specific syntactic contexts (see Altemeier, Abbott, & Berninger, 2008).

Greek Origin

For Greek origin words, the alphabetic principle may differ from words of other origin (e.g., *ph* for /*f*/ as in *phone* or *ps* for /*s*/ and *ch* for /*k*/ as in *psychology*). Moreover, words of Greek origin often have bi-morphemes in which both contribute equally to creating the new word (e.g., *biosphere, geography*) rather than an affix transforming the root word. Such bi-morphemes of Greek origin may occur more frequently in content areas of curriculum, especially math and science.

Changing Models of Spelling in a Morphophonemic Orthography

Research evidence is mounting that spelling acquisition does not rely solely on the alphabetic principle for encoding written forms from spoken words, which is but one way of mapping phonological (phoneme) and orthographic (one-letter or two-letter graphemes) patterns to a specific unit of language. Instead, in both monolingual (e.g., Anglin, 1993; Carlisle & Fleming, 2003; Nagy & Townsend, 2012; Nagy et al., 2006) and bilingual children (e.g., Bahr, Silliman, Danzak, & Wilkinson, 2015; Goodwin, Huggins, Carlo, August, & Calderon, 2013a; Wolter & Dilworth, 2014), spelling also depends on other processes.

1) *POM coding* (Bahr et al., 2009) *or storing and processing POM word forms*. The storage and processing also involves abstracting *phonological regularities* (Bourassa & Treiman, 2014), *orthographic regularities* (e.g., Apel, Wolter, & Masterson, 2006; Pacton et al., 2001), and *morphological regularities* (e.g., Apel, Wilson-Fowler, Brimo, & Perrin, 2012; Deacon & Bryant, 2006; Pacton et al., 2005).

2) *Cross-code mapping of interrelationships between two (P-O, O-M, P-O) or all three of the POM codes* (e.g., Bahr et al., 2009, 2012; Berninger & Fayol, 2008; Sangster & Deacon, 2011). Since more than 50 % of English words are morphologically complex (Stahl & Nagy, 2006), the relevance of cross-code mapping for new word learning is important for at least two reasons. First, the status of a word as one morpheme (*caution*) or more than one (*action*; root = *act*, derivational suffix, *ion*) despite a common spelling unit within each word (*-ion*) affects the ease or difficulty of word learning (Carlisle & Katz, 2006). Second, morphologically complex words are integral for effective academic writing in school (Silliman, Wilkinson, & Brea-Spahn, in press). In sum, learning to spell in a morphophonemic orthography represents a developmentally complex process in which the POM features and their interrelationships are integrated over time into specific spellings that are also linked to specific word meanings (Stahl & Nagy, 2005).

Factors Influencing Learning to Spell in a Morphophonemic Orthography

In this section, critical components of the spelling process are first addressed: the level where the mapping of sound to meaning occurs through general versus word-specific knowledge, and variables influencing the depth of morphological analysis, which influences new word learning. The Word-Specific Continuum of Derivational Complexity is then introduced which integrates these three critical components: P-O, M-O, P-M, and P-O-M.

Factor 1: Level in System Where Mapping Occurs

A critical issue to consider is the level in the system where mapping occurs. The concepts of shallow and deep offer a more meaningful distinction than transparent versus opaque because the latter distinction implies less grapheme-phoneme predictability, when in fact, regularities among orthographic and morphologic patterns render seemingly opaque relationships transparent. Consider these transparent relationships when morphology as well as phonology and orthography are considered: *sign—signature, distinct—distinguish*. Newman's (2010) framework for contrasting shallow and deep orthographies in alphabetic and alphasyllabary languages focuses on mapping: a) *granularity* (the linguistic grain-size at which phonology is mapped to the orthography, e.g., phoneme, onset-rime, syllable); b) *stability* (regularity) of the mapping across P-O relationships; and c) *accessibility* of the mapping level in the structure of the spoken language (e.g., the extent to which phonological features are sufficiently salient for transcription into word forms). Omitted from the Newman framework, however, is the role of morphology, especially in deep orthographies such as English and French, which become shallower when morphological constancy operates (Bahr et al., 2009; Bourassa & Treiman, 2014; Nunes, & Bryant, 2006). That is, adding a suffix to a root word does not significantly alter the root spelling or pronunciation, such as *argue—argument* or *magic—magical*, but rather makes it shallower or closer to the surface in its accessibility (Perfetti & Harris, 2013).

Factor 2: General versus Word-Specific Knowledge
General Word Knowledge

General spelling knowledge progresses from smaller to larger units: phoneme-grapheme (1 or 2 letter) connections, phonological and orthographic onset-rime correspondences within syllables, and morphological analyses of root words and affixes (Davis & Drouin, 2010). The comparative frequency of legal letter groups (orthotactics) (Conrad, Harris, & Williams, 2013) may affect accessibility. Even children's early (prephonological) misspellings show unspoken

sensitivity to orthotactic patterns and the relative statistical frequency of co-occurring grapheme patterns (Treiman & Kessler, 2013). As an illustration of this general sensitivity, data from an analysis of superior, average, and poor spellers (Silliman, Bahr, & Berninger, 2013) revealed that a poor speller in grade 1 spelled the compound *careless* as *ckault*, which shows the child is struggling with two critical aspects involving the grain-size of the compound. First, the child appears to parse the compound inappropriately, representing it as a single syllable. Second, it is orthographically plausible to represent the *k* sound with *ck*; however, in American English, *ck* can only occur after a short vowel; hence, this child's misspelling represents an implicit awareness of permissible orthotactic sequences, but not their constraints on word position. Statistical learning manifests early in learning French as well. In French, like English, consonants cannot double in word-initial position. Research showed that children recalled items without doublets better than they recalled those with doublets (Pacton et al., 2014).

Word-Specific Knowledge

Multiple encounters with word forms and their meaning relations evolve through reading and writing (Davis & Drouin, 2010; Pacton et al., 2014) and oral language experiences (Wang, Nickels, Nation, & Castles, 2013). These experiences result in item-specific spellings represented in a lexicon (the mental dictionary) that can be accessed during spelling and word reading. The lexical quality hypothesis (Adolf & Perfetti, 2014) provides a framework for linking the vocabulary storehouse to the multiple sources of linguistic knowledge that underlie word-specific spelling. First, a word-specific spelling consists of phonological form/code (pronunciation), orthographic form/code (spelling), and morphological form/code (root and affixes) linked to semantics (word meaning). Second, completely specified representations are of higher lexical quality than are representations with incomplete or inaccurate linguistic features. Third, individual differences affect all aspects of learning word spelling. A larger vocabulary of familiar meanings results in more word-specific spellings of higher lexical quality (Harris & Perfetti, 2017).

Factor 3: Variables Affecting the Depth of Morphological Analysis

The research literature has identified three variables that may contribute to deeper morphological analysis for both good and poor writers (and readers): (a) familiarity, so words are more available for analysis (Carlisle & Fleming, 2003; Goodwin, Gilbert, & Cho, 2013b; Treiman, Seidenberg, & Kessler, 2015); (b) word family size for derived words generated, for example, *intense—intensive, intensively, intensifiers*, etc. versus those that do not generate as many, such as

seldom—seldomly (Carlisle & Katz, 2006); and (c) average family frequency (AFF) for derived words. Carlisle and Katz found that derived words with higher AFF and family size were often read more accurately than were derivations from smaller and less common families.

A fourth significant variable influencing the depth of morphological analysis involves the clarity of the semantic relationship between the root word and its derived form. In a word reading study, Goodwin et al. (2013b) selected low frequency derivations based on their likely content-specific occurrence in middle school textbooks. These low frequency derivations varied as to the transparency of their meaning; for example, *amazement* is a lower frequency derivation and is transparent (from *amaze*) contrasted with *spatial*, which is also lower frequency but has a less transparent relationship with *space*. The more transparent the meaning relationship between the root word and the derivation, the larger was the effect of the word root on reading accuracy. It appears, therefore, that the morphological complexity of particular derivations can influence the stability of word-specific knowledge (Bourassa & Treiman, 2014). It may be that morphotactic regularities compensate in learning to spell words where the semantic derivational relationships are less transparent.

Given the factors that can influence general and word-specific knowledge beyond grapheme-phoneme correspondences, the question arises how learners assemble and combine POM and integrate these systems with syntax in their construction of word-specific spellings of varying derivational complexity. The model depicted in Figure 6.1, the Word-Specific Continuum of Derivational Complexity, offers a template for how misspellings over time may provide insight into the eventual development of derivational complexity. In addition, the model takes into account that morphological constancy functions to make a "deep" orthography, like English, more accessible (or shallower) to writers navigating the complexities of English expression.

The Word-Specific Continuum of Derivational Complexity

Suffixes can have ambiguous meanings (Stahl & Nagy, 2005), especially for less frequent suffixes (Bourassa & Treiman, 2014), such as *-ious*. Tyler and Nagy (1989) found that knowledge of the syntactic role of derivational suffixes increased through grade 8, whereas awareness of a suffix's statistical constraints remained challenging to master beyond grade 6. Difficulty was attributed to the necessity for integrating morphemic with syntactic knowledge; for example, *-ness* attaches to adjectives (*still/stillness*), *-ize* attaches to nouns (*locale/localize*), and *-ity* attaches to Latinate adjectives (*human/humanity*).
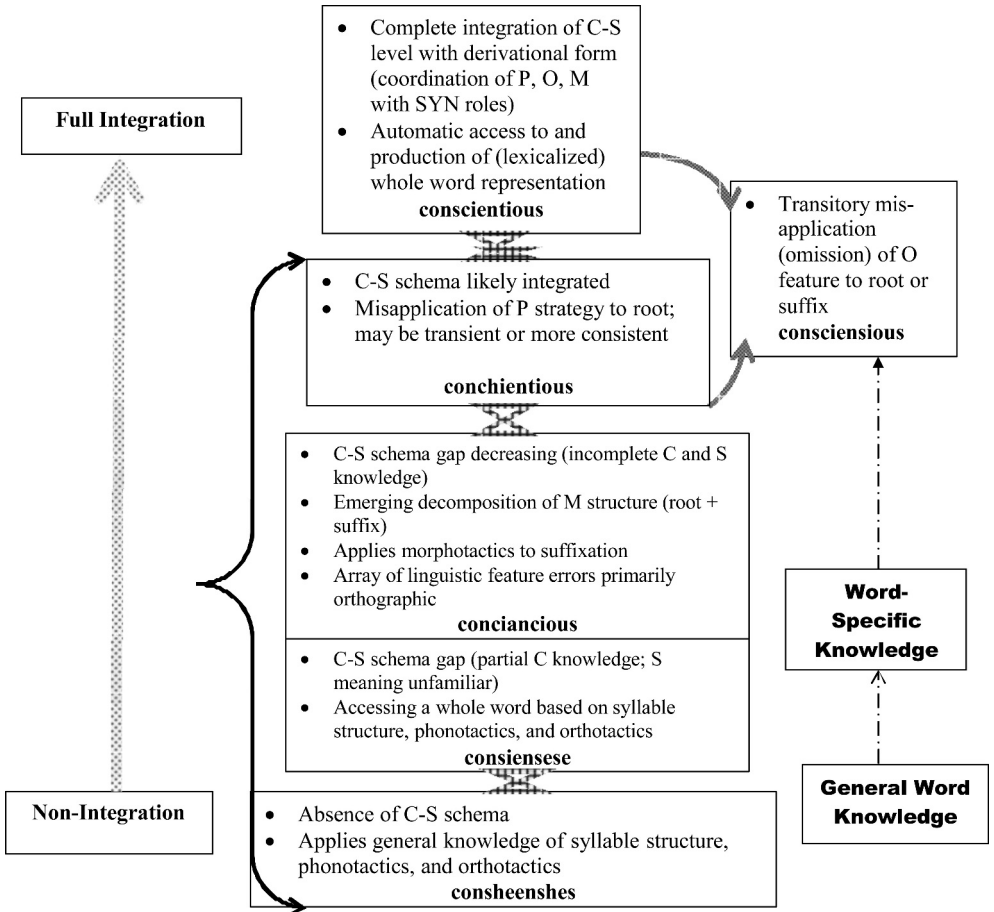
FIGURE 6.1 *Emerging word-specific spelling of a complex derivation. Evolving word-specific fitting of root word and suffix relationships into the conceptual (C)-semantic (S) schema, the morphological (M), orthographic (O), phonological (P), and syntactic (SYN) domains for the more complex derivation 'conscientious.' Bracketed arrow indicates recursive strategies; shaded and curved gray arrows designate recursive P or O strategies.*

Figure 6.1 depicts *conscientious*, a derivation that occurs on the Wechsler Individual Achievement Spelling Test-II (Wechsler, 2001) and one with which even superior spellers in grade 7 continued to struggle (Bahr et al., 2014). *Conscientious* is less frequent than *conscience* but both words occur infrequently. The suffix is ranked as common by Fry (2004) but in the first percentile of all affixed words in printed school English by Stahl and Nagy (2006, p. 166). The difficulty that even superior spellers encountered with this derivation is certainly heightened by the disassociation between the variable pronunciations

of this suffix and other orthographic alternations, such as *-ous* (*religious*) and *-eous* (*courteous*). The challenges these transformations present for rapid lexical access are explained by Hay's (2002) dual-level model of suffix complexity. According to this framework, which draws on derivational frequency (both root and suffix), when a root word, like *conscience*, occurs more frequently than the derived meaning, *conscientious*, then the likelihood is that the derived word will be accessed through decomposition (morphological analysis). In contrast, if a derived word (*government*) is employed more frequently than the root word (*govern*), then the meaning is likely lexicalized and the whole word then facilitates retrieval (Hay, 2002), making it shallower. Lexicalization does appear to influence how suffixes are processed in adults (Bozic, Szlachta, & Marslen-Wilson, 2013).

The dotted arrow on the left side of Figure 6.1 indicates the process of integrating conceptual and semantic knowledge about derivational meaning with phonological, orthographic, and morphological knowledge, from non-integration to full integration. The outcome is a unified representation in which form-meaning relations, including syntactic relations, are fused (Carlisle & Goodwin, 2014; Tyler & Nagy, 1989) and automatically accessed due to complete lexicalization. The right column with the dashed arrow shows transitions from general word knowledge to increasingly refined word-specific knowledge. The points on the continuum (the stacked boxes in the middle) show this transformational process in the learner's formulation of more accurate fittings of the conceptual-semantic schema with the complex morphophonemic and syntactic representations.

The misspelling, *consheenshes* (grade 1 superior speller) (Bahr et al., 2014) indicates the application of general word knowledge, including syllable structure, phonotactics, and orthotactics. The initial syllable, *con-*, is spelled accurately as held true for all misspellings by all participants (superior, average, and poor spellers). Moreover, all four syllables are present (*con-she-en-shes*), showing awareness that writing patterns can be syllabic and represented phonologically (Treiman & Kessler, 2003). The suffix (*shes* for *tious*) reflects the application of a phonological strategy (sound-letter correspondences).

The next two misspellings, *consiensese* (grade 2) and *conciancious* (grade 3), share commonality as indices of emerging conceptual and semantic knowledge, and more refined applications of metalinguistic and word consciousness that continually evolve (Apel et al., 2012; Nagy, 2007). In the lower box, the child continues to utilize a syllabic strategy, while the upper box illustrates an attempt to access a whole word. Here, the *conciancious* misspelling demonstrates a decomposition of the word into its root and suffix, indicating growth in the grain size selected for analysis, along with application of morphotactics and orthotactics, *ci-* for *she* and *-an* as an alternate spelling of the schwa vowel.

The next point on the continuum (*conchientious*; grade 4) represents initial integration of the conceptual and semantic levels. The morphological ending is represented accurately, while the child continues to struggle with the linguistic features that govern the correct spelling of the root. Other orthotactically permissible misspellings of the suffix may occur as the child strives to merge conceptual and semantic knowledge with knowledge about alterations in syntactic role (e.g., *consciensious*; grade 6).

The last level represents complete integration of the conceptual and semantic levels with the accurate integration of phonological, orthographic, morphological, and syntactic relations. The result is automatic access to and production of the lexicalized representation (i.e., *conscientious*).

Thus, for typically developing writers, small steps over time result in integration of many linguistic cues into a word-specific spelling that also reflects the journey taken for learning a deep orthography with transparent relationships at a word-systems level, drawing on multiple linguistic codes (see Abbott et al., 2010, 2016). The specific nature of this journey warrants further research given the finding that the level of morphological analysis entailed in a particular task influences how a specific suffix is applied across multiple linguistic levels (Goodwin, Petscher, Carlisle, & Mitchell, 2015).

For struggling writers, including those with language learning difficulties, this journey may be complicated, if not protracted, by the reduced quality of their lexical representations and knowledge of the relations among POM and syntactic roles. One possibility deserving further investigation is that general word knowledge is less constricted than is word-specific knowledge. On the one hand, the finding that elementary age students with language learning problems were sensitive to the morphological constancy of simple inflections and derivations (Deacon et al., 2014) suggests general word knowledge assisted them in applying the written suffix. On the other hand, when word-specific knowledge was required (e.g., spelling of *wink* vs *win*, *wins*, *winner*), they were less accurate. The word-specific model of derivational complexity would predict this pattern, suggesting that the model may be relevant for informing educational assessment and instruction. In the final section, we address how struggling writers can be supported by approaches that emphasize the systematic and explicit integration of POM. Of note, POM synthesis has not been a feature of typical spelling instruction.

Applications to Struggling Writers

Developing writers may struggle in spelling for varied reasons. Some may fall at the lower end of the normal range in their spelling ability; that is, they are at risk by virtue of being low achievers compared to age or graded peers. Others may struggle because of biologically based specific learning disabilities involving language learning. Yet others may struggle with spelling because their first language is not the same as the language of instruction used at school or they speak a dialect of that language not used in instruction at school. Or, they may be from a culture with an oral tradition and thus may not be exposed to written language in the home environment.

Regardless of why they struggle, meta-analyses have shown the benefits of explicit spelling instruction for facilitating spelling development (Graham & Santangelo, 2014). For example, in one programmatic line of research, multiple classrooms in multiple schools and school districts were screened and children who were the lowest in spelling were randomly assigned to alternative treatments or a contact control group that received only phonological training. The results for second grade showed that the spelling instruction that taught multiple connections between phonological units and orthographic units of different grain size was most effective (Berninger et al., 1998). The results for third grade showed that the spelling instruction that taught multiple strategies for analyzing P and O units of both content and function words, which varied in syllable length, was most effective (Berninger et al., 2000). In another study that randomly assigned schools to before or after school writing clubs for low achieving writers in grade 4, results showed that adding explicit instruction in M with that for P and O was effective in raising writing achievement on the state assessment compared to schools that did not participate in the clubs (Berninger, Fulton, & Abbott, 2001). However, all of these instructional studies also included activities for transferring spelling skills to composing at the syntax and text levels and taught to all levels of language close in time to create functional writing systems (Berninger. 2009).

This approach that taught P-O, M-O, P-M and their interrelationships was also effective in teaching students in grades 4 and above with specific learning disabilities, such as dyslexia with or without co-occurring dysgraphia (impaired handwriting) (Berninger et al., 2008). Both behavioral and brain imaging data before and after instruction for children in grades 4 to 9 who met evidence-based criteria for dyslexia, characterized by spelling as well as reading disability, showed significant gains in spelling achievement and brain normalization during spelling tasks (Berninger & Richards, 2010). This occurred after receiving instruction in P, O, and M awareness and their interconnections (e.g., through

word sorts, Bear, Ivernezzi, Templeton, & Johnston, 2015; see Berninger et al., 2008, Study 1) and/or orthographic patterns in word-specific spellings (see Berninger et al., 2008, Study 2). In both studies, instructional activities also facilitated transfer of ideas and word concepts through spelling to composing. Thus, POM instruction can improve idea expression in written language (Bahr et al., 2009; Carlisle & Goodwin, 2014; Nagy et al., 2014).

However, more research is needed on effective interventions for spelling in students who have disabilities such as sensory disorders (deafness) or other kinds of specific learning disabilities, such as oral written language learning disability (Silliman & Berninger, 2011), that may involve morphological and syntactic processing more than do dyslexia and/or dysgraphia (Arfé, Dockrell, & Berninger, 2015). In addition, the influence of dialectal variations, second language use, and cultural traditions (see McCardle & Berninger, 2015) also affect the acquisition of academic writing skill. The role of spelling as an instructional framework for improving the process of transcription across the range of cultural and linguistic diversity merits more in-depth investigation.

Finally, we consider how the model presented in the second section of this chapter and Figure 6.1 might inform spelling instruction for struggling writers. To begin with, teachers should give careful attention to selection of words whose spelling should be taught for learning vocabulary specific to the content areas of the curriculum (see Nagy & Hiebert, 2011). Three suggestions for accomplishing this goal based on the POM model presented in this chapter are illustrated with teaching the spelling for *conscientious* (see Figure 6.1). First, engage students with new word meanings in the oral domain to teach the concept underlying the word. These practices involve the use of student-friendly definitions to strengthen conceptual—semantic connections (e.g., *to get good grades, you need to put great effort in and be very careful* (*conscientious*) *about details when you study*); student demonstrations of appropriate word use in varied situations, and student applications of new word meanings in unique contexts (see Beck, McKeown, & Kucan, 2013). These activities should also focus on morphological awareness by identifying word roots through morphological analysis, demonstrating how prefixes and suffixes influence word meaning, and how derivational suffixes change syntactic roles.

Second, to build precise orthographic patterns tied to specific word positions in memory, ask students to attend visually to each letter of the word while naming each letter aloud, and then take a mental picture of all the letters in that written word, then close their eyes and "see" the written spelling in their mind's eye (Berninger et al., 2008). Next, have students look at the mental photograph in their mind's eye with their eyes closed, name letters in specific word positions selected by the teacher while the students' eyes remain closed,

and then have them open their eyes and check those letters in their designated positions with the target written spelling. For instance, for *conscientious*, the teacher might ask them to name, with eyes closed, letters in the 4th to 6th word positions and then the last five letter positions. In another learning activity, POM interconnections can be facilitated with word sorts (Bear et al., 2015; see also Berninger et al., 2008, Study 1). Sorts can be designed to call attention to P-O, M-O, M-P, and P-O-M interrelationships, such as sorting words with similar vowel spellings into stacks representing long and short vowels (i.e., *reef, beam* vs. *been*, *death*). For other examples, see Berninger et al. (2008) and Goodwin et al. (2013b).

Conclusions

In summary, not only the P-O, M-O, and P-M connections and their interrelationships in POM but also semantics (vocabulary meaning) contribute to learning correct word-specific spellings. However, morphology is not synonymous with semantics. Morphology is a word that means to transform (to morph or change) a root word using affixes that result in a change in word structure (Anglo-Saxon or Romance word origin) or to transform by combining two separate words to create a new one (Greek word origin). Semantics is a bridge between the two worlds of language and thought that gives word structure to vocabulary in the language domain and meaning to vocabulary in the cognitive domain (see Stahl & Nagy, 2006). Learning to spell so that the P, O, & M are interrelated and linked to semantic meaning for a specific syntactic context requires knowledge of word-specific spellings. With a systems approach to assessment and instruction that takes into account POM interconnections and their links with semantics for a specific content area of curriculum, a morphophonemic orthography becomes more transparent. However, even in the computer age, explicit instruction is needed to learn this system, and it is developed over time as the nature and complexity of words students encounter in the curriculum change. Current spell checkers detect typos but do not provide appropriate cues to correct spellings (see Rønneberg, Johansson, Mossige, Torrance, & Uppstad, this volume). Moreover, the act of producing the letters to spell the words during the translation of thought into written words engages the mind and facilitates the thought-language translation process (James et al., 2015; Longcamp et al., 2017). As we trust this chapter has made clear, both struggling and typically developing writers benefit from systematic and ongoing spelling instruction throughout schooling.

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Why Bother with Writers? Towards "Good Enough" Technologies for Supporting Individuals with Dyslexia

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Introduction

Existing technological solutions to aid writing do not consider *how* the text is produced. Most available tools are targeting a final product and the correctness of this product, and often fail to support the production of the text. Popular alternatives such as LaTeX may help the writer to focus on the text, and are one step towards separating writing and formatting. However, there is no explicit support for writing flow. The system needs to consider *when* a writer needs feedback. No writer likes to be interrupted when searching for an expression, or finishing a sentence or a phrase. However spell checkers do not wait until a writer has finished a sentence before a spelling error is underlined with red. This is related to another problem; the abundance of negative feedback and a matching scarcity of positive feedback given by spell checkers. We argue that the potential for development of writing skills is not currently supported by existing tools, and this may be a serious shortcoming for people with Specific Learning Disabilities (SLD) associated with reading and writing.

In a broad sense, writing always has involved technology. The term technology—originating from the Greek word Techne, "craftsmanship"—has been applied to historical phenomena that span from the introduction of the alphabet to digital solutions that underlie writing tools. The digital age has put forward new possibilities for the support of writing, mainly through options linked to digital word processors. Word processing makes changing and revising text a much easier and less costly activity. However, there has been a tendency for the design and development of digital writer-support tools to be driven by what technology permits rather than what writers need. Dixon et al. (2004, chapter 4) discuss this in relation to computer interfaces for text production. The WYSIWYG has become the model for direct manipulation interface that arguably has design advantages as well as psychological advantages, but for text production it puts quite high expectations on the user for understanding and handling the

full complexity of text production in a simplistic model based on direct manipulation. The system could arguably do more to help the writer to express ideas through words, but such a model would incorporate the system as a writing partner.

In this chapter the short history of digital writing technology is described as having a focus on getting single words written in a correct manner. Providing a full menu of visible choices (for the writer to read) and showing the writer what the end product will look like throughout the whole writing process have been guiding principles for human-machine interaction since early graphical interfaces became widely available (most notably through the first Macintosh computers), but there were earlier attempts at a "writer's workbench" (cf. de Smedt, 2009). This design principle is often abbreviated as WYSIWYG—*What you see is what you get*. Typical of the tools that have emerged during the digital shift is the spell checker, with its focus on detecting spelling mistakes and giving choices regarding revision.

We approach the issue of how technological aids can meet the needs of writers with Specific Learning Disabilities (SLD) and writers with dyslexia in particular by asking *what is wrong with WYSIWYG*, in order to pinpoint challenges related to overarching ideas in the field. Our intention with the chapter as a whole is to draw the contours of a different principle for future technological tools for writers with SLD as well as ordinary writers, who need to improve their writing fluency: We propose *what you get is what you need— WYGIWYN*.

Before we discuss WYSIWYG as being the dominant premise provider for text tools, let us highlight some of the challenges people with dyslexia face every day. First, they struggle with spelling: their written texts in general contain more spelling errors than texts written by typical writers (Coleman, Gregg, McLain, & Bellair, 2009; Tops, Callens, van Cauwenberghe, Adriaens, & Brysbaert, 2013) and their struggling with spelling seems to persist (Bruck, 1993). However, this might not be their most persistent problem. Tops and colleagues (Tops et al., 2013) find that the overall *text quality* of students with dyslexia is generally poorer. Moreover, as a group, people with reading and writing difficulties write more slowly than typical writers (Wengelin, 2002; Wengelin & Strömqvist, 2000). Their writing behaviour is characterized by an attention towards the word currently being written or just written (Wengelin, 2007). This focus on single words might distract writers from focusing on other parts of text production. To write a coherent and fluent text implies that you are able to remember what you have written and plan ahead, while simultaneously dealing with the current situation. Confident writers know that they can handle the situations that are likely to emerge, and they spend their effort on planning ahead rather

than worrying about what can go wrong. For some writers, fluency is limited by focusing on single words and the possibilities and choices that follow.

A substantial aspect of writing is conveniently switching between focus on a larger plot or meaning, where one is heading, and monitoring what is about to be produced here and now. The alternation between looking ahead and monitoring what is close can be described as a ground-breaking hermeneutic for considering a whole, while continuously checking whether this whole is challenged by the evolving parts. There are reasons to believe that individuals with dyslexia face problems in such switching of focus, as detected by for example Rapid Automatic Switching (RAS), (Berninger, Abbott, Thomson, & Raskind, 2001, as reported in Berninger, Nielsen, Abbot, Wijsman & Raskind, 2008).

We know that persistent problems are intensified by lack of experience with text, i.e., problems in decoding orthography make those with SLD read less than readers without difficulties. We also know that the grand leap in reading development comes when children start to read a lot—input matters. It is possible to reason in similar ways regarding writing, which makes extensive writing both a goal and a means to the goal. A possible pathway to support this development is a theory that supports the development of concrete procedures or tools that value writing fluency. Following this line of arguments, we argue that better timed, more focused and positive feedback may give the writer the option of choosing more convenient paths, paths that give the writer new and richer experience with writing a text. The effect of actually enjoying the activity should not be underestimated as it is beneficial on many levels, not least in making the writer seeking out more opportunities to write rather than avoid them.

What is Wrong with WYSIWYG

WYSIWYG imposes large cognitive demands on the writer to take control of the final output. This involves identifying what action to take or tool to use and then, often non-trivially, navigating the systems menus to make this happen. The interface affords in this way a situation where the writer is expected to produce a text that is simultaneously correct, coherent, and aesthetically presented. The number of choices provided during writing may be a challenge to both working memory and visual capacity of the typical writer, and even more so for a challenged writer. On top of this is the substantial number of tools in typical word processors that are devoted to revision and correction. However, writers with SLD face difficulties at a more basic level; to get their thoughts

and ideas down on paper in an understandable manner. The problem is not primarily that their texts are not understandable to readers—the problem is that the writer may experience uncertainty, stress and lack of self-confidence when faced with written tasks (Mossige, Rønneberg, Johansson, Uppstad, & Torrance, n.d.). While there are few investigations on the relation between stress, self-confidence and outcome on writing performance, Alexander-Passe (2006) discuss this in terms of coping mechanisms. Because of the focus on the final product, the design principle for text tools runs the risk of being more concerned with the needs of the readers than the needs of the writer.

Word processing programs are used extensively in Norwegian schools and work life, and writers use word processors from an increasingly younger age. In addition to producing legible letters and allowing for easy revision, most word processors today include some sort of a spell checker. Three meta-studies have found that use of word processors improves writing quality for students, compared to writing by hand (Bangert-Drowns, 1993; Goldberg, Russell, & Cook, 2003; Graham & Perin, 2007).

Because writers with SLD struggle with transcription and revision, word processors and spell checkers should prove to be advantageous for this group in particular. However, the spell checkers typically integrated in word processors may trigger more uncertainty by only providing negative feedback, which makes it hard to see what is good enough. Morphy and Graham (2012), in a meta-analysis of the effects of word processing for students who were weak writers, weak readers, or both, in grades 1–12, found that overall word processors had a positive effect on the quality of the produced texts. Comparing different kinds of word processors, they found that those that included additional support in *planning, drafting*, and *revision* showed significant gains in writing quality. Morphy and Graham conclude that weak writers/readers should use word processing as their primary tool when composing, especially those word processors that provide feedback on the quality of the text, or support planning, drafting and revision.

Although word processors and other computer tools have their limitations, MacArthur (2006) argued that all transcription tools remove one burden, but add a burden on working memory, or require training. Typically, the spell checker gives immediate and frequent feedback about errors. Uncertainty comes when the writer's attention is guided away from meaning production to a focus on a word's orthography. MacArthur argues that although spell checkers may help struggling writers correct more errors than they do with no such help, struggling writers are not always able to recognize the correct spelling. Having to read and choose from a list of alternatives that typically differ by only one or two letters might impose a new burden for struggling writers (MacArthur,

2006; MacArthur, Graham, Haynes, & De La Paz, 1996) and severely misspelled words may not even be listed (which occurred in 42% of cases). The difficulty of choosing the right word is rather evident, giving what we know about poorer reading skills on average for individuals with dyslexia. Another limitation is that homonyms or other real words that are the result of spelling errors are not detected (which occurred in 37% of cases).

It is striking how *phonologically close* some severe misspellings may be (cf. *fernitcer / furniture* (MacArthur, 2006), which is close if pronounced but far in edit distance, meaning that several operations must be done to the misspelling in order to reach the target word), in light of many students being diagnosed with dyslexia on the basis of difficulties with phoneme-grapheme mapping or other phonological deficits. We find many similar examples in our Norwegian data, although there are other error types as well. This highlights the fact that sound coding, rather than orthographic coding, may help catch some errors. More advanced word prediction may help here, by predicting the intended word based on context words to the left and right, as well as the characters in the word to be corrected. Additionally, the likelihood of the correct word is affected by topical context words in the text to be corrected.

Some word prediction programs incorporate phonetic spellings of words in their algorithms, and these could be helpful for struggling writers. However, research on early word prediction programs shows that these slow writers down (Lewis, Graves, Ashton, & Kieley, 1998). Also in using these programs, as with spell checkers, writers do not always recognize the correct spelling, unless the system also provides speech synthesis to help writers read the text. The solution to the limitations, especially the demand on reading skills, of word prediction has been to implement text-to-speech synthesis, where the writer may listen to the words in the list in order to decide the right one. Speech synthesis reads the written text aloud, and can therefore support students, with or without reading disabilities, when they revise their texts. Writers get helpful auditory feedback on misspelled words, as the program attempts to pronounce the words phonetically. If a pronunciation seems strange, it is an indication that there is a spelling error. However, using speech synthesis to correct individual words is time consuming and imposes the burden of listening for misspellings, and if done while producing text may interrupt the flow of writing.

Still, research supports the use of word prediction programs (referred to as "word completion" by MacArthur) for students with spelling difficulties. MacArthur (2006; pp. 17–18) reports some positive results, although when the algorithm used a larger vocabulary, the complexity of selecting the correct word completion increased to a level that was difficult for students with reading difficulties. Matching the active vocabulary to the immediate needs of the

students seems to be a key ingredient in making word completion work. We argue that the task of predicting a word can be saved until an editing stage where more restrictive context is available. The aim is to be able to either determine the intended word or provide very few, but highly likely, alternatives, to make the correction procedure less demanding of reading and monitoring skills. Recently, word completion and word prediction programs have benefited from using extremely large data sets and machine learning algorithms (van den Bosch 2005, 2006, 2011). The task of predicting the intended words using cues that are available from either the product (e.g., the lexical material around the word in focus) or the process (e.g., keystroke latency intervals) is intrinsically a task within the scope of computational linguistics and natural language processing.

Current solutions to word completion and speech synthesis can be considered unfortunate if the goal is to help the writer focus on developing content. Word completion can be challenging in that it forces writers with dyslexia to consider orthography, while speech synthesis is time consuming. Both solutions are, in accordance with the WYSIWYG-principle, in guiding the writer to correct here and now, using all means possible to get the text looking perfect. They can however block the writer from completing the meaning that is under construction.

WYGIWYN—What You Get is What You Need

When we here suggest a new standard—WYGIWYN (*what you get is what you need*), we claim that the writer, and the writer with SLD in particular, needs *less* rather than more information. A writing tool that emphasizes fluency therefore needs to find ways of reaching this goal that are in line with a WYGIWYN philosophy.

As stated earlier, we aim to draw the contours of a principle that differs from the way in which writer support is currently typically conceptualised. Figure 7.1 shows the shift in emphasis from correction to fluency achieved by WYGIWYN. This might appear at first sight as splitting hairs, but the consequences of the perspective shift become evident if we think of how a technological aid would have to be different if it were built so that fluency were prioritised over correction. Even though word processors today have a WYSIWYG design with a focus on correcting rather than supporting fluency, the field is aware that a more cognitively motivated design is desirable, as noted by de Smedt (2009, p. 4): "[A] holistic approach to writing is needed, where NLP [Natural Language Processing] research better interacts with the study of cognitive aspects of the

WYSIWYG	CORRECTION	fluency
What you see is what you get		
WYGIWYN	correction	FLUENCY
What you get is what you need		

FIGURE 7.1   *Schematic presentation of two principles which differ qualitatively in the accentuation of fluency versus correction. Capital letters indicate the main element of the principle.*

writing process (including first and second language learning and language disorders)". There is still much work to be done to understand how a writing tool can interact better with the writer.

Why Fluency?

In accordance with theories of flow (Csikszentmihalyi, 1997), we consider fluency as a span, in which there is a threshold that needs to be passed to be fluent. This is different from the idea that fluency equals speed. Fluency has to do with the efficiency of coding and decoding. The threshold can be defined as a point where the thought moves from being delayed or interfered with by various constraints (e.g., on coding and decoding, or confidence) to being pulled ahead by the semantic networks the current words activate. The act of writing, accompanied by formal instruction, typically involves writing down an idea. However, writers soon experience that the words they write lead their thought onto new tracks, often ending up somewhere else than initially planned. Hecht-Nielsen (2007) presents a model called Confabulation Theory, where the activation of knowledge links may create similar stories that are spun out from seed concepts, and this may also explain how false memories are created through activation and co-activation of knowledge links. This kind of progress in terms of words following words, where interpretations continuously are challenged by new meanings, is a common denominator for both reading and writing. Still, the elements that hamper this kind of progress in writing are different from reading. Although a reader manages to decode a word, there is no guarantee the words are already in the reader's lexicon. In writing it is first and foremost *spelling a word that is already in your lexicon* correctly, and then *recognizing* the written words as if they were old friends when you see what you wrote. Therefore, in reading, the problem involves lack of access to the word and concept; in writing, however, it is about knowing the orthographic representation of a word for which the writer already has an active phonological representation

and semantic associations (i.e., the writer knows what he or she wants to write). Given this, we can investigate it experimentally by having individuals write in a blinded condition where the visual feedback is degraded by having the letters of the words crossed out before presented to the screen.

Text linguistics (e.g., Halliday & Hasan, 1976) focuses on how activation of semantic fields contributes to text cohesion. A central insight is that one word activates a whole field of new words which are rooted in a variety of contexts and as parts of different expressions. Activation effects are also investigated using priming with related words or pictures, and effects of both semantic and phonological priming are robust (cf. Levelt, Roelofs, & Meyer, 1999; Levelt 2001, inter al.).

Research exploring how words cue or prime meaning has to a large extent been focused on readers or listeners, and less on speakers or writers. In focusing on writers we link these effects to the notion of fluency. In the literature on teaching writing, these aspects are essential in the approach termed *free writing* (Elbow, 1973). According to Elbow, free writing is writing without stopping, editing, worrying about grammar, thinking, or rushing. Free writing is a technique extensively used to overcome writer's block, and appears as an element in many approaches to writing instruction. From our point of view free writing is useful because it allows the writer to follow the emergent properties of words, to follow new paths of meaning, without the heavy burden imposed by the WYSIWYG interface.

Flower & Hayes' (1981), and later Hayes' (2012) model of writing both emphasize that writing takes place in distinct processes, that is, that planning takes place in sentence boundaries, during longer pauses. Further, the execution of what is planned takes place in separate sequences, called bursts. To a large extent, this model is in line with common sense about the writing process, particularly a production model that assumes that we plan first, then translate/transcribe our thoughts into the written mode. Ofstad Oxborough, in her doctoral research, shows that a large part of the planning activity happens in parallel with the writing bursts (Ofstad Oxborough, forthcoming; Torrance, 2015). The competent undergraduate students in her samples wrote coherent text with remarkable fluency, with average pauses of two seconds followed by writing 13 words, on average, before pausing again (and for 25% of two second pauses, a mean of 18 words). Pauses at the start of sentences were, on average, around 2.5 seconds long. Other researchers report similar values (Schilperoord, 1996), with only marginally longer times for younger writers (Wengelin, 2002), suggesting that a large part of planning happens concurrently with output rather than during pauses, and that this planning is a largely implicit, low level process (rather than explicit thinking and reasoning). Two or three sec-

onds is not sufficient time to engage in any but the most rudimentary higher-level processing. At minimum, the surface form of the emerging text must be planned incrementally, in parallel with output. Even if 13 or more words can be phonologically encoded in two or three seconds, retaining these during output would be substantially beyond working memory capacity.

These kinds of findings suggest, therefore, that an essential part of meaning construction takes place *during* writing, word by word. In writers whose output is fluent, unhindered by the need to attend to spelling, central long term memory retrieval processes remain available for meaning making (i.e., for activation to spread from what is currently being expressed to associated semantic content). This is, however, a demanding, focussed and precarious process. If retrieval processes are demanded by the need to spell the current word, meaning-related processing immediately grinds to a halt, and must be picked up again once the spelling problem has been resolved (probably with recourse to some deliberate cue-searching, which further disrupts flow). If there are sufficient interruptions to the parallel output / meaning making processing, the writer loses the plot (quite literally, if the task is to write a narrative).

Supporting writing fluency therefore requires maintaining, as much as is possible, the dual meaning making and output processing that occur when writing is flowing. Help with spelling that interrupts writers mid-sentence is likely to achieve correctness at the expense of meaning making. There are, however, points during production where the writer would naturally stop to take breath—when the ongoing flow of the composition would naturally be halted while the writer considers what has already been written, or just has a bit of a rest. This is more likely to occur at sentence boundaries than within sentences (Wengelin, 2006), and much more likely to occur at paragraph boundaries. If a writer support tool must interrupt the writer, these contexts are likely to be much less disruptive points at which to do so.

Preventing Reading during Writing

In a recent study (Torrance, Rønneberg, Johansson, & Uppstad, 2016) we asked upper secondary school writers with dyslexia to write—by keyboard—short argumentative essays under each of two conditions: Blind Writing, in which reading was prevented by displaying Xs on the screen for each letter keystroke (the actual text being stored for analysis), and Normal Writing, in which they could see what they were writing. The writers with dyslexia (N = 26) were compared with a group of students without dyslexia (N = 26) matched on age and math performance (as a measure of non-verbal ability).

As might be expected, the individuals with dyslexia made substantially and significantly more spelling errors than the students without dyslexia, in both

conditions. The extent to which the spelling for a particular word deviates from correct spelling can be assessed in terms of Levenshtien distances (Levenshtein, 1966), sometimes called *edit distance* as measured by the minimal edit operations on characters necessary to go from one word to the other. Preliminary analysis of the data indicated that for the writers with dyslexia this distance was not larger than for the control group, indicating that the individual errors are not generally more severe, only that there are more of them. This is partly good news in terms of correcting the spelling mistakes, but since there are more word errors there is a challenge for automatic correction procedures: if we use local lexical context for correction, there is an increased probability that the context is degraded. Writers with dyslexia also tended to write fewer words, although this difference was not statistically significant.

The most surprising finding, however, was that in the blind condition both groups managed to produce coherent text despite not being able to read what they had written. Final texts contained more spelling errors, as might be expected given that preventing reading prevents both error monitoring and error correction. However, there were only small differences between conditions in holistic quality, and texts were longer in the blind condition. This increased length can most easily be explained by time saved both in error correction and by the fact that they could not spend the last few minutes of the writing period reading what they had written. Note, though, that preventing this final read-through did not adversely affect quality. The net result of preventing reading, therefore, was to improve productivity, with no substantial detrimental effects to quality. This at minimum suggests the feasibility of a tool helping writers with dyslexia which involves them writing, for some of the time, without being able to monitor what they are producing.

One possible conclusion from the fact that preventing reading did not seem to impair writing in either group is that writers do not tend to perceive, or at least process to any depth, the words that they are currently typing. This is possibly because their attention is directed to something else. This could be very literally the case; if writers look at the keyboard while typing, they will not read the words currently being typed. However, even if students in our study did fixate on the screen when typing (which is anecdotally increasingly the norm for a generation for whom keyboarding is a common, highly practiced activity), it may be that attention was not focussed on the emerging word: writers' focus on what to write next means that they do not monitor what is currently being written. This is probably an adaptive and desirable state of affairs. Once text has been written, there is no particular benefit to revisiting it and flow is partly achieved by attention always being ahead of what is appearing on the screen. In studies exploring writers' eye movements, we have observed, informally, that

some writers tend to habitually fixate slightly above or below the text that they are typing, a markedly different pattern from reading eye movements, where fixation is directly on the word being read. One possible explanation is that writers degrade visual input from the words as they appear on the screen, thus reducing the chances that these words will steal attention that is better focused on what is to come next. The blind condition in our study simply takes this situation one step further.

How to Create a Better Writing Tool

Most of the ideas here are intended as ideas for a general writing tool, and not only for individuals with dyslexia. The idea is to work with feedback to the writer, and help motivate the writer to write more and to rehearse, rather than avoid, difficult words.

So far in this chapter we have identified some of the ways in which writers with dyslexia might struggle, relative to peers without dyslexia and made the following arguments: Aiming to promote fluency rather than complete accuracy will benefit both written products and the writers' learning. "Good enough" is an appropriate fluency-maintaining attitude toward the emerging text, and WYNIWYG is a design principle that can facilitate delayed error-correction. We have shown that preventing revision during writing did not adversely affect quality. By separating revision from transcription, we argue that writers are better able to plan in parallel with writing. Still, writers with dyslexia make many errors that need to be corrected. For a spell checker these errors need to be detected and feedback should be given to the writer at a point where the writer is ready for feedback. In this section, we suggest features that might be present in more effective writer-support tools for writers who struggle with spelling.

Timing of Feedback

The timing of feedback from a writing tool depends on where the writer is in the writing process. Feedback should aim at being nonintrusive; disturbing the writer can distract from other goals in the writing process. The writing tool has information about the typical writing speed and pause pattern, and may use machine learning techniques to find out when it is safer to provide feedback, with different thresholds for positive and negative feedback. Not giving immediate feedback on spelling errors will have positive consequences for the writer as well as the writing tool.

Interviews with individuals with dyslexia (Mossige, Johansson, Rønneberg, Torrance, & Uppstad, in preparation) show that this group is aware of negative

feedback during writing, and this is often reported as being overwhelming. Many also report that they try to correct as soon as they get the red underline for misspelled words. However, this may in fact disrupt the writing process, and should therefore be avoided; in addition, there are cases where the currently-written error is unlikely to be identified, because the material is too far off from known words. These cases may benefit from the tool asking for a second or third try at the word. Such tries are likely to circle around the intended word even if the intended word is still elusive. Extra tries give valuable information about what the writer is more certain about, for example, that some letters should be near the beginning of the word, which is the kind of simple information that would help an automatic correction procedure to restrict the search space.

Positive learning happens when the learner enjoys the activity. Positive feedback is one way to enhance the experience, so it is surprising that there is scarcely any positive feedback in writing tools although negative feedback is abundant. There is little reported research on positive feedback, but teachers who work with students with dyslexia are commonly advised to give positive feedback to encourage the students to write, learn, and not give up. This may also be good advice for computational writing tools, although we find very little research that systematically evaluates outcomes. Most of the writing aids are aimed at helping students correct errors, rather than encouraging them to write and focus on the important tasks of planning, structuring, presenting and arguing in the text. For a hesitant writer it would be reassuring to get feedback that indicated that the written words are good enough (see also Serlin & Lapsley 1985), meaning that the written words are either correctly spelled or can very likely be corrected by a spell-checker (i.e., they are close enough to existing words).

There is very little evidence that individuals with dyslexia benefit from immediate correction. This supports an idea of having them write in stages that separate text production from editing, to wait and edit in a second stage. Thus, when it is time for editing, the mechanism has access to a *history* of how the text was produced. In much of mainstream Natural Language Processing the text (input) appears as if it just materialized. However, as we have argued, the text is produced over time, and has gone through a process where the writer has stopped and paused at various points, and where words have been written and rewritten as the writer has struggled to find the right expression or spelling. This information can be used to aid detection of problems in the product (the text to be edited). It can also be argued that it is a simpler task to provide correction assistance for a text after it has been written, rather than while it is being written, because we have access to more information, such as information about the user behaviour while writing. We would also have access

to the words in the entire text, which could be used to detect more higher-order information (topic, semantic relatedness between words) and to restrict the search space of words to consider when alternatives have to be determined.

Another reason to edit in a second stage is that the text could be read out by text-to-speech software, and the user could be asked to press a key when a problem is detected. This will give a search range for detecting problems. All hearing users will be able to interact with the program in this way, and problems such as confused words will be easier to detect when read aloud than when visually scanning through the text, as even when scanning we typically read for meaning. One common error, familiar to most writers, is that it is hard to detect duplicated unstressed function words (e.g. the the) by scanning or reading, but more easily detected if read aloud by automatic text-to-speech software.

The use of context words is highly likely to positively influence automatic word prediction, which is the useful task of predicting the intended word given textual input from the writer. We will look at some common types of lexical errors later in the section. There are many statistical techniques for finding out which words are correlated in usage. The challenge is to weigh correlations from large general text sources together with the individual preferences of the user. For example, writing the word "dog" will influence, or prime, the use for other words for domestic animals such as "cat".

Spelling errors can be separated into two categories, non-word errors and confusables (Reynaert 2009; Stehouwer & van Zaanen, 2009). In addition to spelling errors, we need to handle out-of-vocabulary words (OOV) in a graceful way, e.g., through using the internet. Try googling "she bought two books" and "she bought too books". You find significantly more documents with "two" than "too"; the same technique is useful for OOV.

The advantage of the internet is that popular names (artists, etc.) and new words are available more quickly than in edited word lists and dictionaries. The idea is also to use context words to see how alternative words behave in the given context. Web material can have reasonable coverage for words in context, simply because there are such vast amounts of data. Rømcke & Johansson (2008) solved a classification of named entities task using frequency ranking of web queries such as "his name is x" vs "her name is x" vs "hotel in x" etc., where x is replaced by the item to classify for a large proportion of cases. Our largest corpora cannot compare in size with having the entire web to search, and as mentioned the web will be more up to date on recent events and the associated lexical material.

Non-word errors are easy to detect since they are not in the vocabulary. However, they are not always easy to correct, as this depends on how different the input is from the correct word, i.e., how many simple edit operations are

needed to correct the input: such simple edit operations can be classified as *transpositions, *deletions, *insertions, and *substitutions (cf. Damerou, 1964; Reynaert, 2004).

Confusables are errors that result in existing words, and are often difficult to detect, e.g., homonyms (words with similar sound; e.g., two, too, to). If one imagines utilizing the internet to identify a likely error and constrain the appropriate choice, the same first letter will be particularly important for lexical search. However, these words often occur in very different lexical contexts, as if the homonymy is preserved because the lexical context provides enough information to choose the right word. However, not all confusables are homonyms. We will consider any error that leads to a real word as a confusable (e.g., from, form). Fortunately, confusables can often be detected using lexical context without full parsing (e.g., "She bought too books", "I think so to", "Two think is too do"), especially if we can predict the alternative. Kukich (1992) mentions that of all errors in documents 25–50 % are confusables.

Compounding
A problem in Scandinavian languages is separating compound words into two words (e.g., "sær skriving"). Reynaert (2004) introduced the idea of a Zipf-filter to identify divided compounds. One corpus-based solution is to detect that the frequency of the compound in a large corpus (e.g., Norwegian Newspaper Corpus) is significantly higher than the frequency of finding the first and the second word together; this is a signal that we might have an error and the user could be alerted to the possible problem.

Once a possible error has been identified, we need to suggest corrections, i.e., to find the closest attested match. The alternatives are commonly ranked by their Levenshtein distance (cf. Reynaert, 2009). A common OCR error is "m" instead of "in". Correcting this takes two operations: substitute "n" for "m" and insert an "i". For practical reasons most spell checkers do not consider Levenshtein distances above 5, since the number of possible candidate words increases significantly with each operation. In Norwegian, there are two written norms that sometimes produce problems for form based correction; for example when looking for the Nynorsk word "forespurnad" (request) and writing the bokmål word "forespørsel" (request) the alternative "fårepølse" (sheep sausage) was suggested, which looks far from both original words but contains the same first letter, the same consonants (f, r, s, p, l) and the same vowels (o/å, ø, e) illustrating that sound coding may indeed find unexpected alternatives. As illustrated here, the task of Norwegian spelling correction might need to include translation between spelling norms. Reynaert (2004, 2009) uses a numeric anagram to code word sequences for look-up, the idea being to repre-

TABLE 7.1   *One or two words? Frequencies and estimated effect size in each cell.*

	One word	Two words
tooth brush	33,100,000 / (+0.80)	4,240,000 / (-0.06)
is there	158,000 / (-0.07)	430,000,000 / (+0.01)

sent the group of letters (or bigrams or trigrams of letters) in the input, and then look up all attested word sequences (n-grams) having the same code. The list of alternatives is then ranked by their Levenshtein distance to find the closest match. It is possible to weight the choices, so that frequent patterns take precedence over less frequent ones, and choices that are in the vocabulary used in the current text could rank higher for that reason.

Reynaert's approach has proven effective at detecting and correcting spelling errors, especially confusables. He gives comforting statistics on error types and edit distances: most errors are corrected in less than three edits. Deletions are the most common error. Context-sensitive matching produces better texts, i.e., more errors are corrected than (re-) introduced by the algorithm. Reynaert (2004) reports a fitness value of 3.89 (for each erroneously corrected error there are 3.89 correct corrections) for Dutch text and 1.49 for English text. The commonly used ISPELL and Microsoft Proofing Tools both have scores under 1, i.e., they make the text worse if you trust their first suggestion.

Frequency counts, especially Google frequency estimates, can be very useful for deciding between alternatives. Johansson (2013) suggests a simple measure for calculating effect size, and this can be generalized to give the effect size contribution in each cell of a contingency table. The effect size is a relevant measure for ranking alternatives on higher or lower frequencies than expected. Each cell is marked positively for cells with a higher observed frequency than expected and vice versa (positive for lower than expected). One example is choosing between compounding or not between two words. Table 7.1 shows an English example, the choice between "tooth brush" or "toothbrush". According to Google frequencies, the choice is quite clear. The cell containing toothbrush in one word is indicated by a positive effect size of 0.8, and the other cells are more or less as expected: frequencies lower than expected would be alternatives to avoid given a better choice. The lexical sequence "is there" is indicated as two words that are occasionally mistakenly written as one word, a fact we use to estimate how often people slip up and fail to type a space between two words.

TABLE 7.2 *Effect of context words. Frequencies and estimated effect size in each cell.*

	Word	+Fruit +Banana
kiwi	71,200,000 / (0)	9,220,000 / (0.21)
wiki	905,000,000 / (0)	6,720,000 / (-0.02)

Table 7.2 shows an example where two real words ("wiki" and "kiwi") might have been confused. Here the challenge is to decide if "wiki" or "kiwi" is the intended word. If we only have the word without context, we do not have any evidence for either word, although "wiki" is by far the most frequent alternative. Context words, content words that are generally infrequent but are overrepresented in the text at hand, may change preferences. For example if relevant context words (such as "fruit" and "banana") were detected, the effect size indicates that "kiwi" might be the intended word—it occurs more frequently than expected and with an effect size nearly ten times larger than "wiki" in this context.

Access to frequency count estimations with good coverage is essential for this simple measure, and the frequencies estimated by Google have the advantage of high coverage and the capability of using lexical correlations and other information to estimate useful numbers for co-occurrence of lower frequency words and misspellings. However, frequency estimation is a challenge that can be tackled by many different methods; machine learning techniques combined with very large corpora may provide frequency estimates that do not depend on access to the internet or a search engine.

Gaming

When a writer has written a word incorrectly, what does it mean from a learning perspective? It could mean that this is a word that the writer is likely to use in the near future. That is, it is a word that it is worth putting some extra effort into, apart from just correcting it. This is valuable information for a writing tool with a goal of helping the writer learn to write better. For example, the word can be added to a set of practice words. A program could also award points when difficult (for example, low frequency) words are written correctly, or even close to correctly, and in that list of difficult words would be words that have been written incorrectly previously. The game aspect would have some chance of maintaining interest by encouraging writers to use words they have misspelled before, and thus may tend to avoid in writing.

Conclusion

Why bother with writers? One answer is that writers provide much more information than what one gets from just looking at their final products. We have shown that simple behaviour measures such as keylogging can give some information about where the writer is in the writing process. Long pauses before starting a sentence might be a good time to present feedback. The writer also continuously updates the vocabulary that is used in the document, and an intelligent writing aid would use these words to activate semantically related or frequently co-occurring words. The writer is a great source of information.

The second part of the answer is that an intelligent mechanism could figure out from the writers' activity what they need. Often writers only need a bit of positive feedback (that the text so far is good enough). The aim is to improve the writers' flow of writing by encouraging them to plan forward rather than worry about already-produced text. Not only is this a valuable addition to a text tool, it can make writing an enjoyable learning experience. There are several ways of achieving this, and one that we have discussed is to keep track of the vocabulary and provide positive feedback when previously hard items are produced correctly or closer to the correct word. Making part of this a game activity, where writers are awarded points for correctly writing "difficult" words, also would encourage the writer to spend time writing. Writers with SLD have great potential to learn and improve, and spending more time writing would certainly help, and this is likely if the activity is enjoyable.

Existing technological solutions to aid writing do not consider *how* the text is produced. Since tools target a correct final product, they miss supporting the writing process. We have argued that such goals should be rethought. The writer provides information that can be utilized. This has consequences for *how* and when a writing aid should interact with the writer. The writing flow and experience of the writer should have higher priority.

We have also argued that separating writing and editing may both support text flow and provide a better chance for semi-automatically correcting the product. Correction processes are supported by recent developments in the availability of extremely large collections of text, possibly through the internet, together with the availability of user-provided behaviour data and data on the vocabulary used in the document. An automatic correction procedure does not have to consider all possible words and word forms in the language (or languages), just those likely to occur in the document at hand and the contexts it provides.

This chapter has outlined some solutions within reach for current technology. Increasingly large amounts of text available via the internet can be used for word prediction in context, to determine co-occurrence patterns, and to activate words often found together. The writing process can thus be supported by building up expectations tailored to the needs of the writer.

A shift in design philosophy is relevant because it will allow the writer to focus more on producing text, learning to produce better texts, and becoming a better editor rather than worrying about often minor mistakes, which often can be more or less automatically corrected by a context sensitive editing mechanism.

Producing a readable text is hard; making a text readable, even enjoyable, for another human is a process that involves many steps of editing and reviewing. In addition, it is often necessary to have other people read and comment on the text; we are not arguing that we can eliminate readers from the writing process. However, when the writer enjoys the activity and seeks more of it, they are also more likely to adapt to their readers and with time and practise to produce even more readable texts.

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Lost for Words: Instructional Approaches to Support Older Struggling Writers

Debra Myhill and Susan Jones

Mastering the art of writing is an essential pre-requisite for social and economic well-being in twenty-first century Western society. New digital technologies, including social media, have vastly increased the significance of writing as a mode of communication, both socially and in the workplace. Twitter can start revolutions, WikiLeaks can expose criminals and, at a more mundane level, emails are now the ubiquitous form of communication within most institutions. Perhaps more significantly for this chapter, writing remains stalwartly the gatekeeper to educational success: almost all examinations are required to be handwritten, and in England, revisions to public examinations have generated an increased emphasis on terminal written examinations. In this context, any child or young person who is unable to communicate effectively in writing is disadvantaged.

Yet research repeatedly tells us how difficult writing is to master. The National Commission on Writing in America's Schools and Colleges (2003) maintained that "writing is best understood as a complex intellectual activity that requires students to stretch their minds, sharpen their analytical capabilities and make valid and accurate distinctions" (2003, p. 13). This complexity is multi-layered. From a cognitive perspective, writing is a costly activity (Alamargot & Chanquoy, 2001; Kellogg, 1994), making high demands on working memory, and tying up mental resources (Sharples, 1999). Indeed, Kellogg (2008) has argued that writing is more cognitively demanding than playing chess. Linguistically, writing is more complex than speech: it contains more subordination, greater lexical density, more embeddedness, more passives, and demands a wider range of vocabulary than speech (Czerniewska, 1992); young writers have to learn the differences between writing and spoken language. Furthermore, writing is a social practice (Prior, 2005), where what is valued in writing and how written texts are shaped varies from community to community and by situation. Young writers have to learn the social and cultural aspects of texts, as well as simply being able to reproduce them (Kress, 1994). Finally, the nature of the writing task itself can affect its demands: a transactional note to a friend reminding him or her to feed the cat is less complex and demanding than writ-

ing an argument about a topic which requires both knowledge and control of topical information, and the ability to express intellectual reasoning in written form. And as Nelson and Gregg note in Chapter 5, struggling to master school writing may be paralleled with success in out-of-school literacies.

On one level, then, all writers struggle with writing. Expert writers do not necessarily find writing easy, and as proficiency in writing grows, so too do writers' expectations of their text. Whilst very young writers are struggling with the most basic acts of motor control of a pencil, letter shaping and word spacing, mature writers are battling with shaping the text to fit sophisticated rhetorical intentions. In a recent interview with Booker prize winner, Hilary Mantel, for a study on the composing processes of professional writers, she explained her sense of what she could or could not write well:

> I think I am always trying new things, but the reason for that is that that's a very powerful question to me, and I think to be honest there probably are things I really can't do. I remember having this conversation with a writer long ago and I said to her 'I need to write a battle' and she said 'I need to write a dinner party'. ((Laughter)) You know, her object, was to have eight people on the page, mine was to have eighty thousand but I still haven't written a battle, and I am very conscious that despite what people call the epic scale of my fiction I do tend to push it into holes and corners. I write the head-to-head and I write the smoky back room. I can write the arena but I've not taken it outdoors, and I am more at ease with the peopled world than with the natural world. I am working on that. So you're conscious of your limitations and pushing against them.

This chapter, however, is specifically concerned with that group of writers in secondary schools who would be regarded as struggling when compared with typically developing writers. This includes children with specific language impairments (SLI) and those with no identified special need but whose attainment in writing is significantly below the average for that age group. In this chapter we will first offer an overview of what existing research has revealed about struggling writers. We will then consider evidence-based instructional approaches deemed to support struggling writers, with a particular focus on two studies we have conducted which resulted in improved student outcomes in writing. Finally, the chapter concludes with a consideration of implications for further research.

The Characteristics of Writing in Struggling Writers

Empirical understanding of writing development (the process of writing and how writing is mastered) remains dwarfed by the much more substantive parallel body of work on reading (Myhill & Fisher, 2010). Nevertheless, there is a well-developed, albeit small, body of research about children who struggle with writing (see also Chapter 5 of this book for a discussion of some of these difficulties in adolescents and adults). There seems to be general agreement on the characteristics of texts from children with writing difficulties: Typically they are short and not confidently organised (Garcia & Fidalgo, 2008; Hooper, Swartz, Wakely, de Kruif, & Montgomery, 2002; MacArthur & Graham, 1987); likely to contain a substantial number of errors in spelling, punctuation and grammar (Graham, 1990); and the handwriting is likely to be only poorly legible and executed slowly (Graham & Weintraub, 1996). In addition, De Milliano, van Gelderen, and Sleegers (2012) found that struggling writers are more likely to exhibit the kind of writing consistent with the knowledge-telling phase, as described by Bereiter and Scardamalia (1987). These characteristics point to writers who developmentally appear to be hampered by the need to focus on transcription of ideas in the head to words on the page. Bereiter and Scardamalia (1982) argue that the capacity to think globally about the text as a whole is constrained by the local demands of transcription and generating the next sentence and that "until such co-ordination of goals and composing strategies is achieved, we suspect children cannot do much to shape or improve their compositions at the 'macro' level" (p. 6).

The importance of metacognitive knowledge as an enabling factor in writing is signalled many times in the literature (Alamargot & Chanquoy, 2001; Hayes & Flower, 1980; Kellogg, 1994; Martlew, 1983). Metacognitive knowledge supports the writer in managing the writing process strategically and in decision-making during writing. A subset of metacognition is metalinguistic knowledge, and this plays a key role in writing in facilitating lexical, syntactic and pragmatic choices about the emerging text. It seems, however, that struggling writers are less strong in these areas. Both Troia (2006) and Garcia and Fidalgo (2008) found that writers with learning difficulties had less metaknowledge than their peers. Drawing on Bialystok and Ryan's (1985) conceptualisation of metalinguistic knowledge as *analysis* and *control*, where analysis represents the ability to represent explicit, conscious linguistic knowledge and control is the ability to selectively attend to and apply that knowledge, Lum and Bavin (2007) conducted a study which found that children with SLI had more difficulty with metalinguistic tasks requiring analysis and control than did their typically developing peers.

However, the research considered thus far is predominantly conducted with younger writers in the primary phase. There is a dearth of research which addresses struggling writers in the adolescent stage, or older. A small-scale study by Sawyer, Francis and Knight (1992) investigated special arrangements at General Certificate of Secondary Education (GCSE) for candidates with specific learning difficulties, and the basis upon which extra time is given. The study examined the predictive validity of short tests as an alternative assessment model. A more substantive study by Dockrell, Lindsay & Connelly (2009) tracked the writing performance of 58 students with SLI, collecting assessment data over five time points from age 8 to age 16 years in order to determine longitudinal trajectories in writing performance and to investigate the relationships between written and oral language, reading and handwriting fluency. They found that at age 16, this group of struggling writers presented writing with short texts, poor sentence structure and poor organisation. Weaknesses were also evident in handwriting fluency, vocabulary and spelling. What is perhaps surprising about these results is that the characteristics of a struggling writer at age 16 mirror very closely the characteristics of struggling writers in the primary school.

Commonalities and Differences between Specific Language Difficulties and General Delay in Writing

In addition to research which investigates the characteristics of writing produced by struggling writers, there is a small body of research which explores similarities and differences between writers with SLI and those who lag behind the norm of achievement in writing for their age group. Mackie and Dockrell (2004) analysed the writing performance of three groups: an SLI group of 11-year-old students and two comparison groups, one matched for attainment (language attainment of age 7.3 years), and one for chronological age. On writing assessment, the SLI group produced more syntactic errors than the two comparison groups and wrote shorter texts than the chronological age matched group. However, they did not differ in terms of spelling errors or content of written language from the language attainment group. Mackie and Dockrell (2004) concluded that the inter-relationships between oral language, reading and writing differed for the three groups.

Puranik, Lombardino, and Altman (2007) focus specifically on investigating differences in written production among students with and without dyslexia and those with language-impairment. Examining the writing of expository text in students aged 11–21, they analysed language performance at text, sentence

and word levels. Their results showed that, as might be expected, students without dyslexia performed better than both students with dyslexia or SLI on all measures. Students with dyslexia outperformed those with SLI on a number of variables including the number of T-units (usually defined as a main clause plus any subordinate clauses linked to it), the number of ideas, text length, and lexical variety, although both of these groups performed similarly in spelling and grammatical correctness. Puranik et al. argued that these results support the view that students with dyslexia and SLI differ principally in the non-phonological dimensions of language. Another study comparing students with and without dyslexia (Kinder & James, 2012) considered authorial identity in university students. Kinder and James adopted a mixed-methods approach. A questionnaire measured self-rated confidence in writing; understanding of authorship; knowledge to avoid plagiarism; top-down, bottom-up and pragmatic approaches to writing; and deep, surface and strategic approaches to learning. They also conducted qualitative interviews with students with dyslexia. The results indicated that students with dyslexia were less strategic in their approach to writing, more likely to adopt surface approaches, less confident about their writing, and less assured in their understanding of authorship. The interviews revealed students' perceptions that being dyslexic made writing more difficult and reduced their sense of confidence in being writers.

This small body of research is both patchy and inconclusive and often conducted with very small samples. Thus, it is hard to determine whether differences between writers with SLI and those who are developmentally delayed are substantive or consistently realised. This leaves open to further empirical investigation the question of whether teaching interventions need to be specifically designed for different groups of struggling writers or whether common approaches can be used. Santangelo and Olinghouse (2009), in a review of research on effective instructional strategies for students with writing difficulties, argue that their concluding recommendations about effective practices are relevant to all students, not just those with writing difficulties. It is beyond the scope of this chapter to address in depth the equally important issues of motivation and self-efficacy (this is addressed by Nelson and Gregg in Chapter 5). Nonetheless, it is clear that by the time struggling writers are in their teen years, they are likely to have experienced several years of "failing" as writers and a growing awareness of the gap between their own writing competence and that of peers, with consequential impact on self-efficacy and motivation. De Milliano et al.'s study (2012) showed that struggling writers who put more effort into their writing achieved more highly than those who were less effortful—an unsurprising finding, perhaps, but one which underlines the importance of considering motivation in this particular age group. It is clear that there

is potential for substantially more research which focuses on writers in the secondary phase, and which considers not only developmental trajectories in different groups, but also how those trajectories are influenced by changing motivation levels and sense of self-efficacy.

Instructional Approaches to Support Adolescent Struggling Writers

There have been several substantial reviews or meta-analyses which synthesise research on effective instructional strategies to support struggling writers. Santangelo and Olinghouse (2009) conducted a narrative review, synthesising contemporary qualitative and quantitative research related to effective writing instruction. The Department for Education (DFE) in England (2012) commissioned a review of research evidence on writing, which included a section on approaches for struggling writers and students with Special Educational Needs or Disabilities. More recently, Gillespie and Graham (2014) conducted a meta-analysis of 43 studies, which comprised 35 studies involving students in upper elementary and middle grades, 5 high school studies, and 3 of students in primary grades. Ebbels (2014) considered specifically the effectiveness of interventions to support grammatical competence in school-aged children with language impairments. Inevitably, all of these studies tend to draw on the same body of research and draw broadly similar conclusions. One is that the evidence base is limited, particularly for older school students. The DFE (2012) review noted that "there is little evidence on specific interventions to help pupils with writing, and little evidence on interventions for secondary school pupils" (2012, p. 6), whilst Gillespie and Graham (2014) raise important concerns not simply about the quantity of research, but also its quality and limitations on its generalizability. What is evident, however, is that struggling writers need direct and specific teaching support. Table 8.1 summarises the key conclusions from these reviews.

Considering all these reviews, three instructional approaches do appear to stand out as particularly salient: first, the need to support understanding and skills in managing the writing process; second, the efficacy of strategy instruction; and finally, the value of direct and explicit instructional approaches. It is also important to note that there is considerable overlap among these three categories; for example, one explicit approach might be providing clear prompts for how to revise a text, which overlaps with the writing process.

Troia (2006) notes that children with language difficulties frequently have problems managing the writing process, a point reiterated by Mason, Harris, and Graham (2011). Writing is a complex act, and even when transcription and

TABLE 8.1   *Summary of recommendations for effective writing instruction for struggling writers*

Author/s	Conclusions/recommendations
Santangelo & Olinghouse (2009)	– establishing a context for effective writing instruction; – the use of research-based instructional methods and practices; – teaching strategies in writing; – teaching level skills such as word, sentence, and paragraph.
Department for Education (2012)	– cognitive strategy instruction; – explicit, interactive, scaffolded instruction in planning, composing and revising strategies; – one-to-one tutoring; – cross-over effects from national interventions on reading and formative assessment.
Gillespie & Graham (2014)	– strategy instruction; – dictation; – goal setting; – process writing.
Ebbels (2014)	– implicit methods for younger children; – explicit methods for older children.

orthography have become reasonably automated, young writers still need to attend to both the content of their intended text and how best to communicate that content in written form. One element of this is understanding that the process of writing incorporates planning, drafting, revising and proof-reading, and being able to co-ordinate these processes over a span of time. Gillespie and Graham (2014) found an effect size of 0.43 for interventions which supported management of the writing process. In their analysis, process writing "consisted of students engaging in cycles of planning, drafting, revising, editing, and publishing their writing, sustained time for writing for authentic purposes and authentic audiences, and instruction conducted in mini-lessons to target students' writing needs as they arose" (Gillespie & Graham, 2014, p. 457). Their finding that dictation was also a positive strategy (effect size 0.55) may well also link to the writing process. By having a scribe who captures the dictated text, a struggling writer is freed from the cognitively costly demands of transcription and orthography and may be more able to allocate cognitive attention to drafting and to evaluating the text.

The value of strategy instruction recurs throughout the research, and it demonstrated the highest effect size (1.09) in Gillespie and Graham's meta-analysis. Many of the studies providing strategy instruction are about helping writers to manage the writing process (Danoff, Harris, & Graham, 1993; Kiuhara, O'Neil, Hawken, & Graham, 2012; Mason et al., 2011), and Garcia de Caso-Fuertes, Fidalgo-Redondo, Arias-Gundin, and Torrance (2010) argue that students with learning difficulties "can show marked improvements in the quality of texts they produce if they learn to strategically regulate the writing process" (2010, p. 77).

The third strand of instructional approaches, explicit and direct approaches, appears to draw on a differing body of research focused on supporting grammatical competence. These studies are not always focused on writing, however. What they have in common is direct instruction in aspects of expressive language where specific needs or weaknesses have been identified. Leonard, Camarata, Brown, & Camarata (2004) designed a successful intervention to help children with SLI use third person singular or auxiliary *is/was/are*. Ebbels, van der Lely, and Dockrell (2007) targeted verb argument structure in students with SLI through direct instruction and achieved a greater rate of improvement in the intervention than in the control group.

Similarly, the use of visual strategies in the form of shapes, colours and arrows proved effective in helping older children master grammatical structures such as past tense formation (Ebbels, 2007). Saddler and Graham (2005) evaluated the efficacy of peer-assisted sentence-combining instruction on weaker writers, and concluded that this form of explicit instruction has a moderate impact on improving writing outcomes in adolescent students. Pertinent to the focus of this chapter, Ebbels (2014) suggests that whilst implicit approaches might be most effective for younger children, explicit approaches seem to be more effective in older children.

Supporting Metalinguistic Development in Writing

Explicit approaches which foster metalinguistic understanding about writing have formed the locus of two of our own studies, both with older adolescent writers. Whilst almost all language users develop a substantial body of implicit understanding of talk through their natural, everyday social interactions, metalinguistic understanding about writing may not develop so naturally. Although all writers draw on their social and reading experiences in order to write, specific metalinguistic understanding of how written texts are crafted and how metalinguistic choices at word, sentence and text level shape meaning

seems less well-understood. Writing itself, of course, is an enterprise which is taught, and the research reviewed earlier in this chapter reiterates the importance of direct instruction. Our particular interest is in the potential value of developing students' explicit grammatical knowledge about writing, opening up for them access to a repertoire of possibilities for writing. Our theorisation of grammar as a tool for writing is not one which conceptualises grammar as a mechanism for error remediation, but one which conceptualises grammar as fundamentally about linguistic choice. Thus, explicit grammatical metalinguistic knowledge can be viewed not as "an end in itself, but a means of developing our awareness of the expressive richness of 'language in use'" (Crystal, 2004, p. 10). Therefore, our goal is to support writers in developing explicit metalinguistic knowledge of grammatical choices available to them, and to be able to select from this repertoire in their own written texts.

The first study (Jones, Myhill, & Bailey, 2013; Myhill, Jones, Lines, & Watson, 2012) used a mixed-methods design, including a randomised controlled trial with complementary qualitative data collection. Thirty-two mixed comprehensive schools, including children across the ability range, in the South-West of England and the Midlands were recruited and in each school, a class of Year 8 students, aged 12–13, formed the sample for the randomised controlled trial. Sixteen of these schools were randomly assigned to the intervention group and sixteen to the comparison group, thus there were no cases where an intervention class and a comparison class were from the same school. Baseline data relating to the school and teacher demographics, student performance data, and teacher grammatical subject knowledge were also collected. Qualitative data was collected each term of the three-term project and included classroom observations, teacher and student interviews, and writing samples from the project lessons. The purpose of this qualitative data was to provide a richer contextual understanding of *how* the intervention was employed by the teachers, experienced by the students and realised in classroom writing, to complement the statistical analysis which would indicate *whether* the intervention had any effect.

The study ran for one year and in each of the three terms, the intervention group taught a unit of work, running for three weeks, each focusing on a specific written genre (narrative fiction, argument, poetry). These units incorporated explicit teaching of grammatical constructions relevant to the genre being addressed: For example, how first and third person can alter viewpoint in narrative fiction, or how modal verbs can differently position the writer in an argument text. The comparison group taught the same three genres of writing, addressed the same teaching objectives, elicited the same written products, and had access to the same set of stimulus materials and resources. However,

the intervention group had detailed teaching units, planned at the lesson level, in which grammar identified as relevant to the genre being addressed was explicitly taught.

A pre- and post-test design was adopted to determine the efficacy of the intervention. Using a cross-over design to reduce any possible test effect, two writing tasks were created, one inviting students to write about a personal fear, the other about a personal challenge. At the pre-test, half wrote about a personal fear and the other half about a personal challenge, and this was reversed for the post-test. Both tests were independently scored by a national assessment agency (Cambridge Assessment). The difference between the pre- and post-test at the end of the intervention showed that both groups had improved over the year, but that the intervention group had made significantly greater improvement. Overall, a two-sample t-test indicated a highly significant ($p < 0.001$) positive effect for the intervention in terms of improvement in writing attainment. Further multiple regression analyses suggested that the positive effect was mitigated by teachers' grammatical subject knowledge: an important finding given the new emphasis on grammar in the revised National Curriculum in England. In order to handle students' questions and to make meaningful connections for learners between grammatical choices and their effects in writing, teachers need confident grammatical subject knowledge.

A further finding was that able writers appeared to have benefitted more from the intervention than weaker writers. However, data analysis also indicated that able writers in the comparison group did not improve over the year, whereas the weaker writers in the comparison group did, albeit not at the same rate as those in the intervention. Thus, it is unclear from the data whether the intervention was better suited to the needs of able writers or whether the stronger positive effect was simply an artefact of the data and the limited improvement of able writers in the comparison group. Alternatively, able writers might be more capable of handling the grammatical metalanguage and the conceptual understanding underpinning them, and/or they may be better at transferring that knowledge into their own writing. The ambivalence of this finding that the intervention might be more beneficial for able writers led to the design of a follow-on study, specifically addressing whether this intervention, supporting the development of metalinguistic understanding of writing, was helpful for struggling writers. This study is described below.

Supporting Metalinguistic Development in Struggling Writers

The key principle informing the first study was to develop metalinguistic understanding of writing by making explicit how particular linguistic structures supported particular writing genres. The aim was not to teach grammar, but to teach writing, and to equip young writers with metalinguistic understanding which supported linguistic decision-making and authorial control. The teaching materials were designed to meet the generic needs of year 8 writers, and although they did include both stretch and support activities to account for the differentiated needs of this group, they may have met the needs of more able writers more effectively than those of struggling writers. The follow-on study, therefore, focused more on learners' identified writing needs than on the genre demands of the writing task. The research design for this second study mirrored that of the earlier study, adopting a mixed methods approach including a quasi-experimental design and complementary qualitative data collection.

The follow-on study began with the systematic analysis of fifty writing samples of narrative writing graded as Level 3 or below in order to establish the writing needs of this group of struggling writers. Level 3 in England is a national achievement level and at age 11 the expectation is that students will achieve Level 4. Thus Level 3 represents a significant lag in writing attainment for a 13-year-old. The narratives were analysed both for their linguistic characteristics and for their overall composition and effect. Seven key writing needs were identified through this analysis:

- Limited use of internal sentence punctuation;
- Frequent omission of full stops or inaccuracy at sentence boundaries;
- Limited description through noun phrase expansion;
- Limited variety in sentence structure or length with a preponderance of long, complex sentences;
- Very plot-driven writing, with little establishment of character or setting;
- A tendency toward writing which reflected visual modes;
- A tendency to use language patterns reflecting oral rather than written genres.

In the light of this diagnostic analysis, an intervention was planned to cover approximately four weeks of teaching and designed using the pedagogical principles underpinning the earlier study. A key feature of this intervention was that it explored how a narrative was conveyed in a visual text and how this might transfer to the written mode. The aim was to show how detail in a visual

mode might be made explicit in the written medium, particularly through the use of the noun phrase, the purpose being to appropriately target the linguistic features of text in a way that directly addressed the writing needs of these struggling secondary-aged writers. The visual resources used included videos depicting urban myths and a Bart Simpson graphic narrative. Through the use of these visual texts, students were supported in discussing how information, particularly in relation to how character is inferred through visual details in an image, needs to be conveyed through well-chosen words in writing. At the same time, the intervention highlighted how writers purposefully vary sentences; drawing attention to sentence length and purpose created an opportunity to focus on sentence boundary punctuation as part of the effective crafting of text. Finally, the intervention made explicit how a clear narrative structure can help young writers manage the relationship between the local and global elements of a text.

Seven schools were recruited to the study and two classes of students aged 12–13 from each school formed the sample. The groups were selected to represent low-attaining writers, typically attaining level 3 or low level 4 in the national assessment scales used in England at the time. Baseline data was collected to establish the similarity of the two groups: this comprised the writing level achieved by the students at age 11 (Key Stage 2) in the national tests of writing. Analysis of this data indicated that the intervention and comparison groups were well-matched at the start of the study, with both groups having a mean of Level 3.7 in the Key Stage 2 writing tests.

The pre- and post-test data shows a high attrition rate across the study, resulting from a fairly high rate of absenteeism amongst this group of weaker students both for the pre- and post-tests and during the taught elements of the intervention. This is an important point to note, not simply because of its potential effect on the statistical analysis, but because it is a reminder that this group of students are not homogenous in their profiles. Some of the struggling writers in these classes are students who struggle to master writing and may have learning difficulties; others are students whose poor attendance and disaffection with school limits their opportunities to learn. It is also impossible to tell from our data whether poor attendance and disaffection have developed from a sense of failure and increasing demotivation, or whether the poor attendance leads to failure and demotivation. Nonetheless, it is a reminder of the point noted earlier—that few studies, including our own, have taken sufficient account of the influence of motivation on the writing performance of struggling writers.

The pre- and post-data for the two groups reveals that, despite the very similar Key Stage 2 results, the comparison group scored more highly in the pre-

TABLE 8.2   *The mean scores of the two groups' pre- and post-test*

Group	Number	Pre-test score: mean	Post-test score: mean
Comparison	116	5.4	5.9
Intervention	127	4.6	5.4

test than the intervention group. However, the gain for the intervention group was higher at 0.8 compared with 0.5 for the comparison.

Because the data represents students "nested" in classes who could not therefore be randomly assigned to comparison or intervention groups, an analysis of covariance (ANCOVA) was deemed most appropriate. When ANCOVA controls for the covariate it also removes some of the treatment effect, reducing the likelihood of obtaining a significant result. Before undertaking the ANCOVA to establish the statistical significance of this outcome, checks were made to ensure the relationships between the dependent variable and the covariate were the same for each group. A test of linearity indicated the relationship was linear and Levene's test of equality of error variances did not violate the assumption; but the test for homogeneity of the regression slopes showed a result that was just significant (p= 0.047), thus marginally violating the assumption. Overall, however, these checks indicate no significant unequal relationship between the two groups. The subsequent ANCOVA test indicated that the different outcomes of the intervention and comparison group were just statistically significant when adjusted to two significant figures (p < 0.05). This suggests caution should be exercised in claims made on the data, but that nevertheless there is a positive effect of the intervention on these struggling writers. This result may be influenced by the higher pre-test scores of the comparison group, by a teacher effect, or by the brevity of the intervention. To confirm these results, further studies are needed which address these issues in a larger scale study. Nonetheless, this study suggests that explicit instruction, drawing on grammatical features of writing, matched to learners' identified needs, may be an effective strategy to support writing development in struggling writers.

Conclusions

Reflecting on the implications of the Common Core State Standards (NGA/ CCSSO, 2010) for students with learning disabilities, Graham and Harris (2013)

argue that these standards are advantageous for this group of learners in establishing expectations of what should be achieved. In light of this, they offer clear recommendations for professional practice. They draw attention to the limitations of teachers' professional knowledge of writing development and recommend that teachers increase this knowledge. They also recommend that thought be given to establishing a classroom environment for writing which allows students with learning disabilities to flourish. Finally, they recommend that teachers draw on research evidence to inform their teaching of writing, both for students whose writing is developing along age-related trajectories and for students with learning disabilities (i.e., specific learning disorders).

However, perhaps the most salient point made in this chapter is that there is a real paucity of research evidence regarding the needs of older struggling writers, in the secondary phase of schooling, on which teachers can draw (a conclusion also drawn by Nelson and Gregg in Chapter 5). This probably reflects the fact that research in writing is itself still a maturing research field, particularly when compared with the very substantial and well-established field of research in reading. And within this, research in writing addressing adolescent or secondary-aged writers is a far smaller body of work than the research into how writing develops in the early years. More research is needed to determine whether there are particular differences between older students with SLI and those who lag behind age-related expectations in writing, and whether there are distinct instructional strategies or interventions which help these students. Future research, as noted earlier, should also investigate more thoroughly the issue of motivation in these older writers who are likely to have experienced a sense of their own "failure" at writing within the school system, particularly in jurisdictions with high-stakes assessment regimes.

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Assessment: Perspectives on Assessing Learning and Performance

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Evaluating the Task of Language Learning

David Rose

Introduction

This contribution is concerned with the needs of students who are struggling with school, particularly with regard to literacy, but discusses their difficulties in relation to wider issues in education. The discussion emerges from the experience of a long-term action research project known as *Reading to Learn* (Rose, 2017; Rose & Martin 2012, 2013). *Reading to Learn* is a methodology that supports learners to read with comprehension and engagement, and then to use what they have learnt from reading to write coherent texts. It is also a professional learning program designed to provide teachers with skills in the methodology, and associated knowledge about pedagogy and language. The *Reading to Learn* methodology is not a literacy "program"; rather it is set of resources for teachers to meet the needs of their students. The resources consist of knowledge. The professional learning program includes an assessment designed to track students' literacy growth, as teachers develop their skills. In this respect, it evaluates the tasks of both language learning and language teaching, both discussed in this paper.

The methodology had its roots in the genre-based approach to writing developed from the 1980s in the "Sydney School" (Christie, 1999; Cope & Kalantzis, 2014; Martin, 2016; Rose, 2008, 2015), and scaffolding approaches to reading (Axford, Harders, & Wise, 2009; Gray, 1987). These approaches were brought together in the late 1990s for an initial research project with Indigenous Australian children (Rose, 2011; Rose, Gray, & Cowey, 1999). These students' literacy levels were on average 4–8 years behind their non-Indigenous peers; none were reading independently before the end of grade 3, and all secondary students were reading at junior primary levels. By the end of the project's first year, most of these students were reading at age appropriate levels, and independent evaluation showed average literacy growth at a rate normally expected over four years (McCrae et al., 2000).

Over two decades since, *Reading to Learn* has grown in scope as a classroom methodology and professional program for primary, secondary and tertiary teachers, and in scale across Australia (Rose & Acevedo, 2006; Rose, Rose, Farrington, & Page, 2008), Asia (Lin, 2016; Shum, Tai, & Shi, 2016), Africa (Lucas,

McEwan, Ngware, & Oketch, 2014; Makathini, 2015), and western Europe (Coffin, Acevedo, & Lövstedt, 2013). The results of up to four times typical literacy growth rates have been consistently replicated (Culican, 2006; Rose, 2015, 2016; Rose & Martin, 2013). Significantly for the focus of this volume, this includes many students diagnosed with learning difficulties or special needs, who on average attain acceptable writing standards for their grade levels, within one year in the program.

This chapter outlines how this growth is achieved and evaluated, but it is also concerned with why these students do not ordinarily achieve success in school. In doing so, it seeks to relate evaluation to language, language to knowledge, knowledge to pedagogy, and pedagogy to social justice. The starting point is theories: a social theory of knowledge in schools, in which students are more or less successful; a social theory of learning, in which learning emerges from the teacher/learner relation; and a functional theory of language, in which people exchange meanings through speaking or writing. The functional language model is applied to designing a writing assessment, illustrated with a student diagnosed with learning difficulties. This student's difficulties are then contextualised in a discussion of literacy development through the stages of school, and how this development differs between more and less successful students. This is followed by an examination of evaluation and pedagogy in learning theories that are focused on individual development or social learning. The chapter concludes with a brief description of the *Reading to Learn* pedagogy, and assessment of the same student's literacy growth following its application.

Behind each evaluation can be found a theory of learning, a theory of knowledge, and a theory of language, whether these theories are explicit or tacit. But to be clear about the evaluations we use, we do need to be explicit about the theories that inform them. Theories of learning can be contrasted between those that construe learning as intra-individual processes modelled on biological development, and those that construe learning as a social process between teachers and learners. Theories of language can be contrasted between those that focus on forms of words and syntactic rules for combining them in sentences, and those that focus on the social functions of meanings exchanged by speakers. Theories of knowledge can be contrasted between those that view knowledge as constructed by the individual and social realist theories such as that of Bernstein (2000), that view learning as an exchange of knowledge between learners and teachers. In this chapter I present an approach to evaluation based on a realist model of knowledge, a social model of learning, and a functional model of language.

Knowledge

Bernstein's theory of knowledge is embedded in an analysis of education as a social institution in which knowledge is produced and exchanged. In this model, knowledge is understood as an evolving social resource that includes both knowledge about the natural and social worlds, and skills for acting in those worlds. Cultures can be understood as reservoirs of these resources, accumulated over many generations, from which each member gradually builds his or her own repertoire, and exchanges it with others. School knowledge is a particular reservoir of resources, from which each student builds a repertoire through education. Bernstein's theory further links pedagogic evaluation to the social distribution of resources, including knowledge. It helps to explain the tendency of schools to reproduce social inequalities, as students from lower socio-economic groups are likely to be evaluated as less successful, and given access to different kinds of knowledge than more successful students. For example, while the latter may study sciences and calculus in preparation for university, less successful students may study "life skills" and "functional maths". While the most successful may study literary criticism, the least successful may be given remedial literacy lessons.

Learning

Evaluation can also be located in a social theory of learning, in terms of the teacher/learner relation unfolding in time. Rose & Martin (2012) propose that learning occurs through activity, that a learning task is the core element of the activity, and that only the learner can do this task. Two core roles of teachers in a learning activity are to specify the learning task (e.g., with a spoken or written question), and to evaluate its performance. What learners demonstrate in performing the task is the knowledge they have acquired; the evaluation tells them how well they have learnt. As far as we can tell, this is a fundamental structure of learning activities, in all pedagogic contexts, no matter what the learning theory. The task is the core phase. It may be done independently without any specification or evaluation, but in formal education it is usually specified and evaluated by teachers. Furthermore, a teacher may prepare learners for a task, by providing the knowledge required to do it successfully, and successful performance of a task provides a platform of understanding on which knowledge can be elaborated.

Teachers' roles in preparing, specifying, evaluating and elaborating learning tasks require a detailed understanding of the nature of the task. This is

apparent in manual activities, in which the teacher is an expert, and guides the learner to do the activity in steps. Such modelling and guidance may be a fundamental pedagogic pattern across human cultures. But in the school, most learning activities involve language, and more often than not the task is constituted entirely in spoken or written language. Hence teachers' understanding of learning tasks in school must involve some model of language.

Language

Frequently, the model of language applied in pedagogic activities, including assessments, is the "bricks-&-mortar" model of formal and traditional school grammars, in which words (bricks) are combined into sentences by grammatical rules (mortar), and words are composed in turn of letters representing sounds (bricks) combined by spelling rules (mortar). In various forms, this model has dominated European linguistics for two and a half millennia. The functional model of language takes a different perspective, in which language is defined as a resource for meaning, as in Bernstein's model of knowledge as reservoir and repertoire. Speaking, reading and writing involve exchanging meanings with each other. Language and its social contexts are complementary dimensions of the process of making meaning, in which language enacts relations between interactants, and construes their experience.

The language system is immensely complex, but we can describe its outlines with a few basic dimensions, highlighted in bold as follows. We can distinguish general dimensions of the social contexts of language, including the **tenor** of social relations, **fields** of social activity, and the **mode** of language, as dialogic or monologic, spoken or written. These three dimensions are known in systemic functional linguistics as **register**. A culture consists of a huge variety of options in tenor, field and mode, but these options are woven together in consistent configurations that are recognisable to members of the culture. These recognisable configurations of tenor, field, and mode are known as **genres.** Each genre goes through predictable stages to achieve its social purposes. For example, a narrative may expect a complicating event and a resolution, a debate expects one side to be argued, and then another side, and so on (Martin & Rose, 2008).

A genre is realised by patterns of tenor, field, and mode, which are realised in turn as patterns of language. But language does not consist merely of words in sentences; rather social contexts unfold as text. Patterns of unfolding meanings in texts are referred to as **discourse**. Tenor is realised as patterns of interpersonal meaning (such as moves in a dialogue), field as ideational meaning
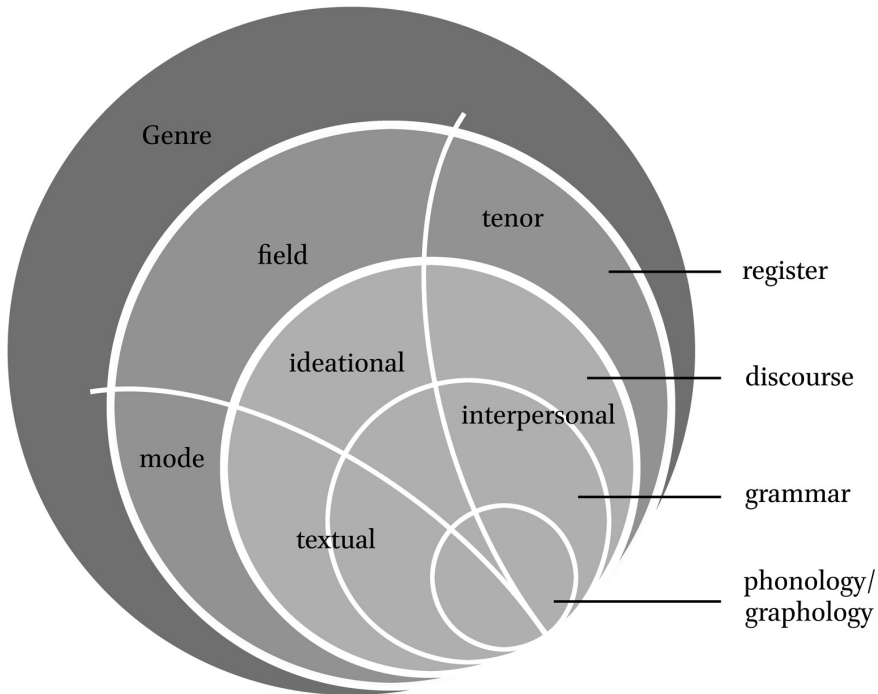
FIGURE 9.1 *Language in social contexts*

(such as sequences of events), and mode as textual meaning (how information is organised). These patterns of meaning in texts are realised as patterns of wording in sentences, or **grammar**, which are realised in turn as patterns of sounds (**phonology**) or letters (**graphology**). The whole model is illustrated in Figure 9.1.

Evaluation of Language Resources

This language model enables us to interpret learning tasks in school in terms of genre, register, and the language patterns that realise them, and to evaluate tasks in the same terms. Based on this model, a writing assessment was designed in the *Reading to Learn* program, to accurately analyse the language resources that each student brings to the writing task (Rose, 2015, 2016, 2017).

Teachers identify these language resources in students' writing, using 14 criteria. At the level of genre, evaluation focuses on the global social purpose of the text, and its organisation into stages, and phases within each stage. (A phase of meaning is typically expressed as a paragraph in writing.) At the level of

register, it focuses on the text's field, tenor, and mode. At the level of discourse, interpersonal, ideational and textual features are identified. Ideational features include **lexis** or "content words", and **conjunctions** that link sequences of events. Interpersonal features include **appraisal** (evaluative items). Textual features include **reference** items (pronouns, articles). At the level of grammar, the variety and accuracy of grammatical resources are evaluated. At the level of graphic features, spelling, punctuation and graphic presentation are marked. The sequence of analysis is thus from the "top-down", from genre to register, to discourse, to grammar, to graphology. Questions are used to interrogate each of these criteria, summarised in Table 9.1.

Each criterion is scored 0–3: 0 = no evidence; 1 = present but weak; 2 = good but could be improved; 3 = excellent for the student's grade level. The assessment thus gives equal weight to each component of the writing task. Like all assessments it involves teacher judgements, but they are constrained to a 0–3 choice within each criterion.

We can use the criteria to assess the following Text 9.1, written by a 14 year old Indigenous student in Year 9. The writing task asked students to write about themselves.

In the following transcript, appraisals are underlined.

> d[*avid*] *the <u>best makin poeple laugh</u>*
> *<u>very cheeky</u> when <u>want to</u>*
> *<u>can</u> get <u>loud and quiet</u>*
> *I am <u>short temperd</u>*
> *david <u>rules</u> at chess*
> *<u>good at</u> making plans*

From a glance at Text 9.1, this very low assessment is intuitively predictable, but the criteria make specific weaknesses apparent. After nine years in school, this student appears to have learnt very little about written language. He is apparently unable to form legible letters, or structure and punctuate simple sentences. He apparently only has words to express simple evaluations of his personality traits. His written language resources are so far behind his grade level that mode is scored at 0.

TABLE 9.1   *Writing assessment criteria*

GENRE	[Genre stages and phases can be marked and labelled.]
Purpose	*How appropriate and well-developed is the genre for the writing purpose?*
Staging	*Does it go through appropriate stages, and how well is each stage developed?*
Phases	*How well organised is the sequence of phases in each stage?*
REGISTER	[Quick judgements are made about these register criteria.]
Field	*How well does the writer understand and explain the field in factual texts, construct the plot, settings and characters in stories, or describe the issues in arguments?*
Tenor	*How well does the writer engage the reader in stories, persuade in arguments, or objectively inform in factual texts?*
Mode	*How highly written is the language for the school stage? Is it too spoken?*
DISCOURSE	[Discourse criteria are marked in the text, to give an accurate measure.]
Lexis	*What are the writer's lexical resources? How well is lexis used to construct the field?*
Appraisal	*What are the writer's appraisal resources? How well is appraisal used to engage, persuade, evaluate?*
Conjunction	*Is there a clear logical relation between all sentences?*
Reference	*Is it clear who or what is referred to in each sentence?*
GRAMMAR	[Quick judgements can be made about grammar.]
	Is there an appropriate variety of sentence and word group structures for the school stage? Are the grammatical conventions of written English used accurately?
GRAPHIC FEATURES	
Spelling	*How accurately spelt are core words and non-core words?*
Punctuation	*How appropriately and accurately is punctuation used?*
Presentation	*Are paragraphs used? How legible is the writing? Is the layout clear? Are illustrations/diagrams used appropriately?*

TEXT 9.1   *Year 9 student*

TABLE 9.2   *Assessment of Text 9.1*

Criteria		Comments
Purpose	1	personal description—very simple
Staging	0	no stages
Phases	0	no phases
Field	1	brief personal knowledge
Tenor	1	simple personal evaluations
Mode	0	far too spoken for Year 9—Year 1 standard
Lexis	1	only two items—*chess, plans*
Appraisal	1	simple judgements (underlined)
Conjunction	0	no conjunction—simple list
Reference	1	only two personal references—*I, david*
Grammar	0	very simple, many missing items
Spelling	1	most common words correct, some errors
Punctuation	0	no punctuation or letter cases
Presentation	0	very poor handwriting
Total	7/42	well below grade standard

Evaluation and Literacy Development through School

This student's apparent inability to learn basic components of written language led to classifications of "learning disabilities" and "special needs", for which he has been prescribed remedial literacy programs throughout his schooling. As he has been unable to read curriculum texts independently, most school knowledge has been closed to him. As he lacks such knowledge, he has been unable to participate actively in classroom learning. Years of continual failure contributed to behaviour problems that led to his placement in a special program for such students, in which he was subject to further remedial literacy programs. His attempt in Text 9.1 illustrates the educational outcome of this nine year history.

These types of remedial literacy interventions tend to be informed by the reductive model of language as bricks-&-mortar. They "dis-integrate" the language learning task, isolating low level grammatical and graphological components from the higher strata of meaning making. Struggling readers and writers tend to experience these activities as meaningless drills, with little discernible relation to meaningful communication. Indigenous and other children struggling to read and write can be seriously disadvantaged by these approaches (Rose et al., 1999). Such students may appear to teachers and specialists to lack perceptual, cognitive, and motor skills, but these may be merely symptoms of problems that originate with ineffective teaching.

The sequence of development in reading and writing skills through each stage of school has been referred to as a "hidden curriculum" (Rose, 2004). For successful students, each stage prepares them for the reading and writing tasks of the next stage. But as these tasks become more and more elaborate, there is less and less explicit teaching of the literacy skills involved. Indeed, it is only in the junior primary that foundation skills in reading and writing are explicitly taught. If children do not adequately acquire these skills in this initial stage, they will not be prepared for the next stage. They may be given remedial literacy activities in subsequent stages, but they are unlikely to catch up to their more successful peers. While each stage prepares successful students for the next, all students are evaluated on how well they acquired skills in the preceding stages.

In this hidden curriculum, successful students tacitly acquire skills in each stage, building on skills they acquired in preceding stages. One outcome is that the gap between most and least successful students is maintained throughout the whole of schooling. This pattern is graphically illustrated in Figure 9.2, which aggregates writing assessments from teacher training in the *Reading to Learn* program. Teachers are asked to assess writing samples from students in top, middle, and bottom groups in their classes, before implementing the
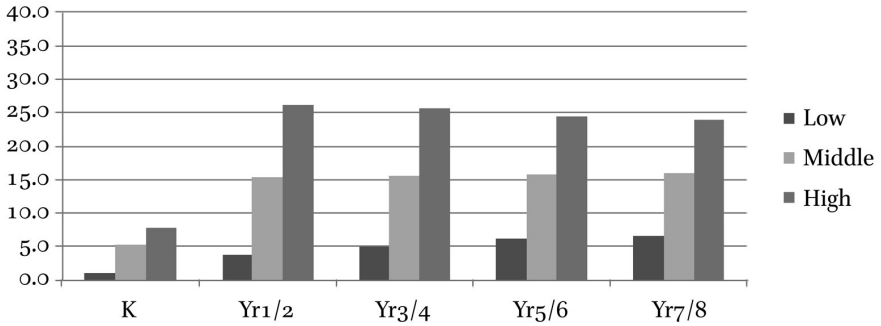
FIGURE 9.2   *Pre-intervention scores show gap between student groups before* R2L *teaching. Figure 9.2 represents students' average writing skills without receiving Reading to Learn strategies. These pre-intervention results function as the 'control' for measuring the effectiveness of the intervention. Results are shown for each stage of school, from kindergarten through junior, middle and upper primary to junior secondary school. For each school stage, results are averaged for students in lower, middle and upper achievement bands. Results are measured on 14 criteria covering knowledge and language skills, each scored 0–3, giving a possible total of 42 represented on the* Y-axis.

Reading to Learn literacy strategies. Figure 9.2 shows results for these "pre" samples, averaged across assessments by 400 teachers in one training program in 2010, representing at least 10,000 students (Rose, 2015, 2016; Rose & Martin, 2012, 2013).

Figure 9.2 is useful because it shows the mean differences in written language resources of high, middle and low achieving student groups in each school stage. As this is a large sample across classes and schools, it may be read as approximating differences in the Australian and similar education systems. What is particularly interesting is that the gap between top and bottom groups is comparatively narrow at the start of school, labelled K for kindergarten, but after a year or two the gap has tripled, and remains steady through each following school stage. The top group has clearly benefited from the literacy practices of their early-years teachers, as their average results have shot up to the median standard for the school stage. These children are now reading and writing independently, and are likely to be actively engaged in learning from reading. The middle group has also obtained some benefit, but the bottom group appears to have received very little benefit from these literacy practices; their results are still near zero, and improve only slightly through each subsequent stage. The children who were failing at the start of primary school are still failing at the start of secondary, despite all the interventions prescribed by various literacy theories. These large-scale data confirm what teachers know intuitively, that the gap between the top and bottom students in their classes

and schools will essentially be the same at the end of each year, and each student's school career, as it was at the start.

Evaluation in a Social Learning Theory

Vygotsky's famous zone of proximal development (ZPD) refers to a contrast between two modes of evaluation, independent or guided. He defines ZPD as "the distance between the actual development level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers" (1978, p. 86). Assessment of actual development is of course what most school assessments are concerned with, in order to rank students and determine their education programs, pathways and outcomes, as discussed above. Concomitantly, independent problem solving is the ideal learning activity in individuated pedagogies.

In these theories and practices, the ideal learning activity is one in which students are doing learning tasks (solving problems) individually. As the task is done independently, its difficulty must be close to students' assessed learning abilities. As they complete each task, their performance may be evaluated. If they are successful, they may be deemed ready for a further learning task that is just beyond their new competence, and the cycle continues for that task. High achieving students are given more complex tasks at each step, and low achieving students are given simpler tasks. In addition, the pacing of the high group's learning may be faster, and the pacing of the lower group's learning slower. This is the trend we see demonstrated statistically in Figure 9.2. The gap is maintained through each year, each school stage, and the whole sequence of schooling. It is reproduced by constraining students' development to their assessed ability levels. It is simultaneously legitimated by these assessments, as though "ability" was a natural explanation of unequal outcomes. Bernstein for one does not accept this explanation:

> The school must disconnect its own internal hierarchy of success and failure from ineffectiveness of teaching within the school and the external hierarchy of power relations between social groups outside the school. How do schools individualize failure and legitimize inequalities? The answer is clear: failure is attributed to inborn facilities (cognitive, affective) or to the cultural deficits relayed by the family which come to have the force of inborn facilities.
>
> 2000, p. xxiv

Bernstein's conclusion proposes a radically different explanation: rather than inborn facilities, the cause of failure and inequality is "ineffectiveness of teaching". This explanation shifts the focus of evaluation from the individual learner onto the teaching practice, in other words, onto the pedagogic relation between learner and teacher. This is Vygotsky's second option for evaluation, the learner's potential development as determined through problem solving under adult guidance. This potential development is the knowledge/skills that are possible for a learner to acquire with effective teaching. From the perspective of knowledge and pedagogy, the ZPD is the difference between what a learner already knows, and the knowledge he or she could be taught. This is a radically different view of knowledge and pedagogy from individualist theories. Vygotsky is quite explicit about this:

> Any function in the child's cultural development appears twice, or on two planes. First it appears on the social plane, and then on the psychological plane. First it appears between people as an inter-psychological category, and then within the child as an intra-psychological category.
>
> 1981, p. 163

In other words, the notion of learners constructing knowledge individually is an illusion. All cultural development, i.e., knowledge, begins with the pedagogic relation between learner and teacher. It is through this relation that the culture's reservoir of semiotic resources is negotiated, in order to build the learner's repertoire.

From Evaluation to Pedagogy

If we can accept Bernstein's and Vygotsky's propositions, then any assessment is not merely an evaluation of individual learners' abilities; what it actually evaluates is the effectiveness of teaching that learners have experienced. If students are failing in school, such as the writer of Text 9.1, then their teaching has been ineffective. This is not to say that the teaching is ineffective for all, but that it is less effective for some students than for others, creating and reproducing inequalities. The important question for evaluation of struggling students is then not what skills the learner lacks, but what factors make teaching ineffective. Clearly if the role of the teacher is constrained, as in some constructivist pedagogies, this would be one factor. Where the teacher does have a clear authoritative role, another potential factor is a failure to understand the learning task, and another is a failure to design effective preparations for learners to do the task successfully.

As all learning tasks in school involve language, particularly reading and writing, and language is such an immensely complex phenomenon, it is hardly surprising that learning tasks are often poorly understood and their preparations often poorly designed. The problem is compounded by the bricks-&-mortar language model that often informs both assessments and remedial interventions, divorcing language learning from curricular learning. An alternative is provided by the *Reading to Learn* methodology, which is informed by the functional model of language and social learning theory (Rose & Martin, 2012). In this approach, learning language is integrated with curricular knowledge, reading is integrated with writing, and teachers design preparations to enable all students to do the same tasks successfully.

Effective design of preparations can support students to succeed with learning tasks that are well beyond their independent capacities. Supported success with high level tasks can accelerate learning faster than independent practice with lower level tasks, as it targets learners' potential development, systematically guiding them to acquire new skills. The ZPD is larger for some students than others. If they are then assessed, the performance of both groups will be lower than the supported task level, but the growth will be greater than with independent practice. If students are then supported with a further high level task, their following assessments will again fall below the supported level, but will be higher than their previous assessments. As cycles of supported tasks are repeated, the skill levels of weaker students accelerate faster than those of stronger students, and the gap between them narrows.

In *Reading to Learn*, students are supported with tasks that may be well beyond their independent competences, through a carefully designed sequence of reading and writing activities informed by the functional language model. The first activity, known as *Preparing for Reading*, supports students to follow a text with general comprehension as it is read aloud, by the teacher orally summarising the sequence in which it unfolds, in terms that all students can understand. As the field of the text is prepared, all students know what to expect and need not struggle to comprehend as it is read. Because it is read aloud, they need not struggle to decode unfamiliar written words. This massively reduces the load of the reading task, enabling even the weakest students to focus on the unfolding meanings in challenging texts. The next activity, *Detailed Reading*, supports all students to visually read passages of the text with detailed comprehension, by guiding them to identify wordings in each sentence, highlight them, and discuss their meanings. As they already have a general understanding of the text, the load of recognising words is reduced, enabling all students to comprehend their meanings in detail, and read the passage fluently.

To provide more support, *Detailed Reading* may be followed by *Sentence Making*, in which the teacher writes sentences from the *Detailed Reading* passage on cardboard strips, and guides students to cut them into chunks of meaning and manually manipulate them. This manual practice gives students total control over words and meanings. It is particularly effective for young or struggling students. *Sentence Making* then leads to *Spelling*, in which individual words are cut into their letter patterns, which students practise writing on small whiteboards. They then practise using these words in *Sentence Writing* on their whiteboards. *Sentence Making*, *Spelling*, and *Sentence Writing* are key strategies for students diagnosed with special needs. Rather than drilling foundation skills in isolation, they are practised in the meaningful context of texts, passages, and sentences that students understand and are engaged in, which rapidly accelerates their learning.

In the next activity, *Joint Rewriting*, students are guided to write a new passage, using what they have learnt from *Detailed Reading*. For stories, rewriting follows the precise language patterns of the reading passage, but changes the plot, setting, and characters. This supports students to use the language resources of accomplished authors in their own writing. For factual texts, rewriting begins by students writing notes on the class board from the information that has been highlighted in the reading text. The teacher then guides the class to use this information in a new passage. Finally, after building knowledge and language resources through this sequence of activities, the teacher guides students to construct whole new texts, in the activity known as *Joint Construction*. The sequence thus follows the functional language model, focusing on each component of the language task from the top down, beginning with genre and register in *Preparing for Reading*, followed by discourse and grammar in *Detailed Reading*, then graphology in *Sentence Making, Spelling*, and *Sentence Writing*. It then builds back up through the model, through grammar and discourse in *Joint Rewriting*, to genre and register in *Joint Construction*. Relations between levels of the language task and the teaching sequence are illustrated in Figure 9.3.

These activities are repeated through daily, weekly and monthly cycles, as the school program permits, embedding literacy learning in curriculum teaching. Students' literacy growth can be extremely rapid with consistent practice. Text 9.2 was written by the same student as Text 9.1, after a few weeks of these activities. It is a brief biography of the Indigenous Australian leader, Shirley Smith, or "Mum Shirl". It was written independently, following a series of whole class activities, studying biographies of Mum Shirl, and practising writing.
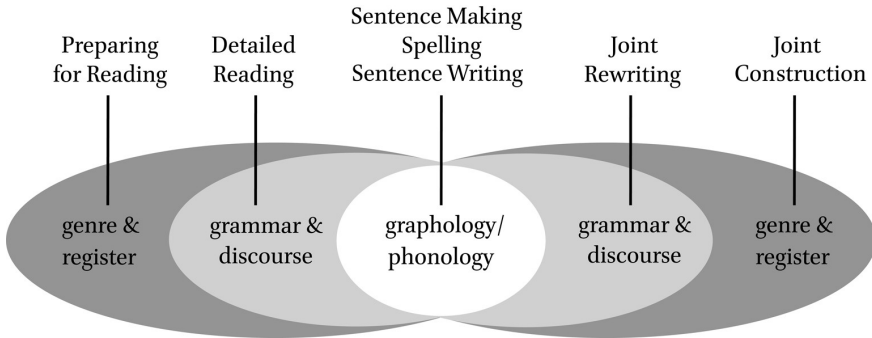
FIGURE 9.3 *Reading to Learn sequence and language levels*

TEXT 9.2   *Same student following intervention*

TABLE 9.3   *Assessment of Text 9.2*

Criteria		Comments
Purpose	1	biography—simple
Staging	1	brief Orientation, no Life stages
Phases	1	clear phases—identity, early life, social context, life work
Field	1	Mum Shirl's work, early life, social context, but no detail of life
Tenor	1	objective evaluations
Mode	1	written language—middle primary standard
Lexis	1	builds simple field—*prisoners, education, epilepsy, schooling, Aboriginal people*
Appraisal	1	positive judgements of Mum Shirl, evaluates problems of Aboriginal people
Conjunction	1	reasons—*because*, historical sequence—*back then, after it*
Reference	1	keeps track with pronouns—*she, her, it, their*, and comparison—*others*
Grammar	1	appropriate but relatively simple
Spelling	2	variety of words correct
Punctuation	2	correct punctuation and letter cases
Presentation	1	legible handwriting, no paragraphs for phases
Total	16/42	below grade standard

> *Shirl Smith was also know as "Mum Shirl". Mum Shirl was <u>famous</u> for <u>helping people</u> who were <u>needy</u>, and prisoners. Her education was <u>difficult</u> because of her illnes (epilepsy). Her schooling <u>failed</u> because she <u>couldn't</u> go to school. Back then times were <u>difficult</u> for aboriginal people. They <u>took away your children</u>. It was <u>hard to trust</u> anybody after it. Mum Shirl <u>helped people</u> become <u>happy and comfortable</u>. She <u>fought for others</u>. She <u>helped others</u> get on with their lives.*

The assessment in Table 9.3 shows consistent improvements in all areas of genre, register, and language. A glance at the text shows that grammar and performance on graphic criteria are vastly improved compared to Text 9.1. This is not a result of drilling these features, as in remedial literacy programs.

Rather it is an effect of gaining control of higher level features—genre, register, discourse—and practising grammar and graphic features in this meaningful context. However the student's language resources are still weak in most areas, below the standard expected for middle secondary school. This is not surprising, considering how much further Text 9.1 was below the standard. What may be surprising is the extraordinary gains this student has made in just a few weeks, after nine years of failure. Crucially these gains were not achieved by the student alone, but with the support of the teacher with the whole class. Text 9.2 demonstrates growth after one or two iterations of supported practice with high level tasks.

Figure 9.4 shows results for the same teachers and students as Figure 9.3, after 6–8 months of *Reading to Learn* training and classroom practice. Comparing results between Figures 9.3 and 9.4, post-intervention scores show average growth in kindergarten to be 70% above pre-intervention scores; all groups are now scoring in the high range, and the gap between low and high achieving groups is halved. In the other year levels, growth is 30–40% above the pre-intervention scores, and the gap has halved from 50% to around 25%. These results were achieved after three or more iterations of supported practice, as outlined above. Crucially they were achieved mainly by teachers working with whole classes. Although *Reading to Learn* can be used for additional support with groups or individual students, Culican (2006) reported that the whole class model of delivery produced better outcomes than were obtained using withdrawal groups. While the ZPD is much larger for weaker than for stronger students, the *Reading to Learn* strategies support all students to do the same high level tasks together.

Conclusion

There is no question that a proportion of school students diagnosed with learning difficulties may have significant neurological impairments that constrain their capacity to develop as readers and writers. But in my experience working with teachers of Indigenous and other groups of students diagnosed with learning difficulties, the problem is overwhelmingly not neurological but pedagogic; the failure is not in the student but in the effectiveness of teaching. I have argued in this paper that such ineffective teaching practices stem from an individuated view of learning that fails to properly analyse the nature of learning tasks, and hence fails to design effective preparations for learners to succeed with tasks. These failures in analysis and design are partly the result of a reductive bricks-&-mortar model of language that "dis-integrates" the lan-
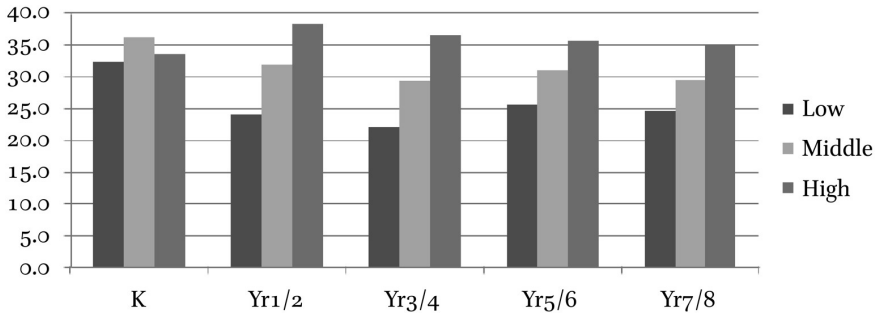
FIGURE 9.4 *Post-intervention scores show gap between student groups after R2L teaching.*
Figure 9.4 shows results for the same students as represented in figure 9.2 and the
same teachers as they trained and applied the strategies for about 6 months, with
their whole classes. Results are measured on 14 criteria covering knowledge and
language skills, each scored 0–3, giving a possible total of 42 represented on the Y-
axis and are shown for each stage of school, from kindergarten through junior,
middle and upper primary to junior secondary school (X-axis).

guage learning task, and focuses on the lowest levels of language, prescribing remedial literacy activities that are unlikely to ever enable struggling students to catch up with their more successful peers.

The evidence of assessments presented in this chapter indicates that such remedial interventions have minimal effects on the inequality of learning and outcomes in schools. Students who are evaluated in the failing range at the start of school are likely to remain in this group through each stage of primary and secondary, despite incremental improvements that may be attributed to remedial activities. With regard to the so-called "gold standard" of education research using randomised trials with control groups (Mertens, 2014), the pre-intervention assessments shown in Table 9.2 function as the counterfactual in the *Reading to Learn* research. These pre-intervention results represent the sum of the effects of prior literacy teaching and remedial interventions for the top, middle and bottom cohorts in each stage of schooling, using a sample of over 10,000 students. Although this data is cross-sectional, this data gives the reader a sense for the expected learning gains experienced by similar peers. As such, they are proxy measures of the average effectiveness of teaching practices other than the *Reading to Learn* methodology. Their persistence year-after-year correlates with Bernstein's interpretation, that continual failure is an endemic pattern of the school, which "necessarily produces a hierarchy based on success and failure of students" (Bernstein, 2000, p. xxiv).

If the problem lies with the school, the solution cannot be found by attempting to remediate the difficulties of individual students. If we are serious about solving these difficulties, we must look to teaching practices of the school that

create and maintain inequalities, and re-design these practices. This has been the approach of *Reading to Learn*, which uses a functional model of language to integrate language learning tasks in carefully designed sequences of activities, and uses a social model of learning to guide all students in a class to practice high level reading and writing tasks, no matter what their assessed "abilities". The writing assessment, which is integral to the professional learning program, shows the full range of language resources that students bring to the writing task. It also shows the power of the methodology to narrow the achievement gap between the most successful and least successful students, including those diagnosed with learning difficulties. Since it is their teachers who have enabled students to achieve these gains, it evaluates success, not only with the tasks of language learning, but with the tasks of language teaching.

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CHAPTER 10

The Role of Curriculum Based Measures in Assessing Writing Products

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The Challenge

Literacy, including writing, is a key gateway skill (Buchanan & Flouri, 2001). Failure to produce text quickly, legibly, and accurately results in poor educational achievements, reduced job opportunities, and reduced earning potential. Thus, the ability to produce written text, either manually or electronically, is a key transferable skill. The heightened awareness that "writing today is not a frill for the privileged few, but an essential skill for the many" (The National Commission on Writing, 2003, p. 11), coupled with the numbers of students challenged by writing and the complexity of the writing process, has called attention to the importance of using reliable and valid assessments of written text production (Bew, 2011).

These assessments should capture the key components of written text production as children are learning to write (Berninger et al., 2002). Arguably such assessments should be timely and lead to targeted teaching or specific interventions that can be monitored (Saddler & Asaro-Saddler, 2013). Teachers need to be able to profile pupils' developing writing skills so appropriate action can be taken (Fuchs & Fuchs, 2009). To date, studies of writing development and the ways in which writing products are assessed have been relatively neglected (Miller & McCardle, 2011). This chapter considers the assessment of children's written texts by exploring the use of curriculum-based measures of writing (CBM-W). We draw on data from children in English primary schools (Dockrell, Connelly, Walter & Critten, 2015) to consider the extent to which such measures capture developmental differences and changes in writing skills over time (Fewster & MacMillan, 2002). Using these data, we also assess whether the CBM-W can accurately reflect the performance found on more time-consuming and complex standardized measures of written text, and finally, we consider if CBM-W can identify struggling writers.

Assessing Writing

In England, National Curriculum (NC) assessments have provided teachers with a framework from which to evaluate children's written text products (Qualifications and Curriculum Authority—QCA 1999; Department for Education, 2013). The NC set out both the programme of study that schools needed to follow and the attainment targets that pupils were expected to achieve. However, the use of NC assessments for writing has not gone unchallenged. There is substantial variation in the marks assigned to the same script by trained markers, with evidence of regression to the mean at both ends of the distribution (He, Anwyll, Glanville, & Deavall, 2013). This has implications for teachers' assessment of writing and the extent to which the tests are "fit for purpose" (Bew, 2011). In addition, teachers have found the assessment schemes overly bureaucratic, with English primary teachers devoting, on average, 5 hours a week to assessing and marking pupils' work (Deakin, James, Tickner, & Tidwell, 2010). Teachers comment on the perceived heavy workload and complexity of current writing assessments, mirroring earlier comments on this particular assessment of writing drawn from a large-scale research review (Stanley, MacCann, Gardner, Reynolds, & Wild, 2009). Therefore, there is scope for exploring less complex and less time-consuming alternative forms of assessment for writing and establishing whether adequate levels of reliability, sensitivity, and acceptability can be established for such measures.

Written texts can be evaluated in a number of different ways and assessments can be made of single or multiple texts. Often summative assessments are made from single texts; this type of assessment is typical in research studies. By contrast, formative assessment is more likely to involve tracking performance over time to identify both progress and the child's strengths and needs (Mansell et al., 2009). Irrespective of the approach taken, writing assessments are needed to provide information about the pupils' current level of performance and future teaching and learning needs, and the teacher or the researcher is required to make explicit decisions about the dimension(s) of the text which are to be evaluated.

Various approaches to evaluation of written composition have been used by researchers and teachers, including holistic scoring, analytic scoring, quantitative scoring, and curriculum based measures (Abbott & Berninger, 1993; Dockrell, Ricketts, Charman, & Lindsay, 2014; Lee, Gentile, & Kantor, 2010; Mackie & Dockrell, 2004; McMaster & Espin, 2007; Puranik & Al Otaiba, 2012; Scott & Windsor, 2000; Wagner et al., 2011). These various evaluation approaches differ in purposes and in the underlying assumptions about the dimensionality of written composition that are made.

Holistic scoring measures have been used in research, psychometric assessments, and in practice. Global quality of the text is rated on a single ordinal scale (see, for example, Weschler, 2005) rather than on any specific dimensions of the text produced. Holistic measures have the advantage of providing a single score with relatively little time involvement, but they are limited in their ability to reliably differentiate among writing levels, monitor change over time, or capture differential performance on the key components of writing (Espin et al., 2000; Kim et al., 2015). In younger children and those with learning disabilities, the short amount of text often written by these children can also reduce the validity of a holistic approach to evaluation (McMaster & Espin, 2007).

More recent work has attempted to identify specific dimensions of children's written text products, providing guidelines of where and how to evaluate children's written compositions. Sometimes these dimensions are considered together to create a single score, such as in the Wechsler Objective Language Dimensions of writing or UK writing Key Stage 2 SATs assessment scores (Department for Education, 2013; Rust, 1996). Other times the hypothesized dimensions are scored separately and profiles of writing are produced in terms of analytic or quantitative scoring schemes (Huot, 1990). However, all these approaches require the assessor to have specialized training to reliably identify the target dimensions, and the construct validity of the various analytical dimensions is often lower than for holistic scoring schemes (Espin, De La Paz, Scierka & Roelofs, 2005; Gansle, Noell, VanDerHeyden, Naquin, & Slider, 2002).

The number of dimensions thought to underpin written text production has been a matter of debate. Earlier studies of composition identified two dimensions in written texts: quality and productivity (Berninger & Swanson, 1994; Graham, Berninger, Abbott, Abbott, & Whitaker, 1997; Olinghouse & Graham, 2009). Recently researchers have refined these dimensions by including factors related to text complexity and organization (Wagner et al., 2011). Although these dimensions vary by age and population tested, they all capture dimensions of productivity (e.g., numbers of words generated), and accuracy (Puranik, Lombardino, & Altmann, 2008; Wagner et al., 2011).

Text genre is an added consideration when evaluating written texts. Most research assessments of pupils' writing rely on single transcripts and single genres and, as such, may not be consistent with children's writing competence. Because children need to learn to write for multiple purposes and multiple audiences, assessments which only examine a single writing product may fail to capture the demands of different types of writing tasks (Scott & Windsor, 2000). For example, narrative and expository writing are common school tasks, but expository texts which involve conveying facts or describing procedures take longer to master (Berman & Verhoeven, 2002), and differences identified

in students' performances are evident in their texts (Beers & Nagy, 2011; Koutsoftas & Gray, 2012). Thus, a tool that can be used for different text types and can differentiate among them has advantages in supporting teaching and learning. Currently, it remains to be established whether measures of text production can reliably differentiate across genres and whether any differences identified should inform the assessment of writing.

Overall, assessing writing is challenging. Arguably assessments of pupils' written text should capture dimensions of productivity and accuracy without placing undue demands on staff training and time. In addition, the ability to distinguish across text types would provide teachers with a flexible approach to the assessment of writing.

Formative Assessment

Timely sensitive assessment of students' writing competencies is a key step to monitoring progression (Nelson, 2014), but students need to be assessed on reliable and valid measures; frequently high stakes national tests do not provide this information (Graham, Hebert, & Harris, 2011). Thus, it becomes important to examine the ways in which formative assessment can drive writing development for students. Formative assessment produces a picture of learners' strengths and needs in terms of their writing skills. It requires professional judgment, something that is often challenging without objective and measurable benchmarks (Marlow et al., 2014).

Writing needs to be evaluated at the word, sentence, and text levels, capturing the key dimensions of both productivity and accuracy for pupils and examining different phases of writing development (Connelly & Dockrell, 2015; Dockrell & Connelly, 2016). Monitoring change is a key component in that activity, one which requires two basic elements to be effective: first students need to be assessed over time, and second, the writing task needs to be tailored to the competencies that are being examined. In addition, where possible, comparisons should be made across different writing genres (Berman, 2008; Olinghouse & Wilson, 2013). Curriculum based measures (CBM) offer one solution to these challenges.

CBMs offer a way of measuring a child's academic progress through direct assessment of specific academic skills and have been well established for reading and numeracy (Stecker, Fuchs, & Fuchs, 2005). They are also argued to be a sensitive index of pupils' productivity and accuracy of written text production (Espin et al., 2000), and have been successfully used to examine the skills of English language learners (Campbell, Espin, & McMaster, 2013). These assess-

ments involve pupils writing for short periods (between three and seven minutes) in response to a probe and have been shown to be valid and reliable measures of writing proficiency for students aged between 7 and 12 (Weissenburger & Espin, 2005). Thus, they provide a potentially quick and reliable assessment of younger school children's writing products. Given their dual focus on productivity and accuracy, CBMs also reflect current models of the writing process.

A variety of different text measures have been used to evaluate productivity, including numbers of words written, correct word sequences (CWS), punctuation marks, and words spelled correctly, and the appropriateness of these measures varies with the pupil's age. (See McMaster & Espin, 2007, for a review of the technical features of the measures). Although productivity measures such as total words written has often been considered the hallmark measure of CBM-W tasks, there is increasing evidence that inclusion of other quantitative measures in combination with qualitative measures provides a more comprehensive assessment of a complex skill such as writing (McMaster & Espin, 2007; Ritchey & Coker, 2013). The inclusion of correct word sequences and measures of spelling may also provide more face validity for teachers (Coker & Ritchey, 2010; Gansle, Noell, VanDerHeyden, Naquin, & Slider, 2002).

The measures of the writing product vary in their scoring reliability. Interrater reliability can be high, with 80–90% agreement (Gansle, VanDerHeyden, Noell, Resetar, & Williams, 2006; Graham, Harris, & Hebert, 2011; Weissenburger & Espin, 2005). There is also evidence of validity where some elements are correlated with standardized assessments (.69 for TOWL) and with teacher ratings (.76) (Parker, Tindal, & Hasbrouck, 1991). For example, Espin and colleagues (Espin et al., 2000) confirmed the validity and reliability of the number of CWS as an indicator of general writing performance. In general, validity is higher when the CBM-W is being examined in relation to a writing task rather than more general performance across the curriculum (McMaster & Espin, 2007). Simpler measures such as total words written have lower criterion-related coefficients than more complex measures, such as correct word sequences or measures reflecting spelling and word choice. Narrative probes have demonstrated the best technical adequacy to date (see McMaster & Campbell, 2008).

The use of a CBM has also not gone unchallenged. There are a number of significant criticisms of the use of such measures, criticisms which relate to scoring, the extent to which these measures are valid across different populations, and their sensitivity in capturing text quality. Despite the challenges of some children's handwriting, good inter-rater reliability has been achieved following training for numbers of words and words spelled correctly, but other measures are not so straightforward and require a more subjective judgment. Moreover,

only modest criterion-validity coefficients have been achieved, although this may be a more general problem of writing measures (Huot, 1990).

Of particular concern has been the identification of more sensitive indicators of early writing. Work by McMaster and colleagues has begun to systematically address these issues with children below the age of eight (McMaster, Ritchey, & Lembke, 2011). Most work using the CBM-W has examined static scores, and evidence examining growth trajectories has been contradictory. McMaster and colleagues found stable and valid growth curves for children between the ages of eight and nine. However, Costa and colleagues (Costa, Hooper, McBee, Anderson, & Yerby, 2012) concluded that only the CBM-W variables of total words written, words spelled correctly, and correct word sequences showed clear developmental trends and argued that CBM-W be used in combination with other forms of assessment. A final limitation rests in the paucity of research on CBM-W in educational contexts outside North America. Given the interaction between teaching and learning and the different pedagogical approaches used outside North America, the utility of CBM-W to evaluate writing performance and progress for children at similar stages of learning to write remains limited. It therefore becomes important to consider whether CBM-W can be used to complement current writing assessments in, for example, the current English Key Stage 2 (age 7–11 years) where children are expected to make much progress as young writers. As yet we do not know which, if any, CBM-W elements differentiate pupils' writing performance or whether these are sensitive to change over time (Ritchey & Coker, 2013).

Our Study

To further examine the potential use of a writing CBM (CBM-W), we studied 263 pupils who were 8, 9, and 10 years old (English school Years 3, 4, and 5). We used both a narrative and an expository probe to examine genre effects on performance and examined changes over a five-month period to track developmental trajectories. (For full details of the study, see Dockrell, Connelly, Walter & Critten, 2015.) We scored the texts for productivity (total words produced, correct word sequences (CWS), number of punctuation marks, and sentences produced) and accuracy (proportion of words spelled correctly, CWS, and punctuation marks).

For all productivity measures, except sentences produced, we found significant age trends and genre effects, with narrative genre resulting in increased productivity. In Figure 10.1 the changes for total numbers of words produced are presented. As Figure 10.2 shows, there were also clear and significant differ-
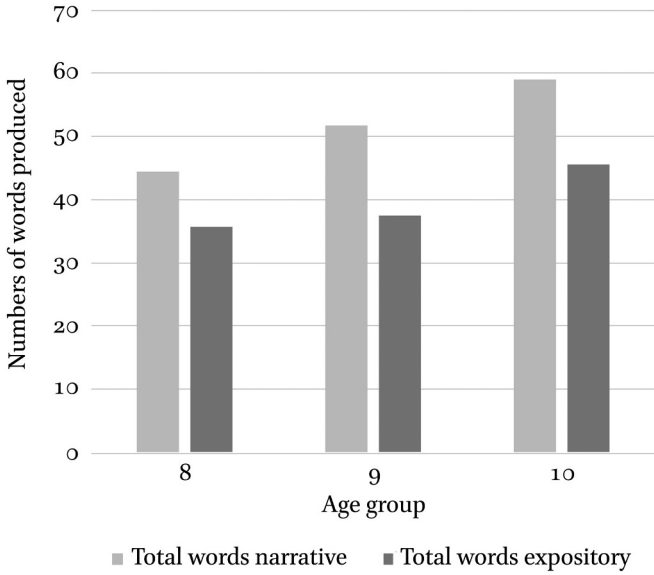
FIGURE 10.1   *Mean numbers of words produced in five minutes in typically developing children*
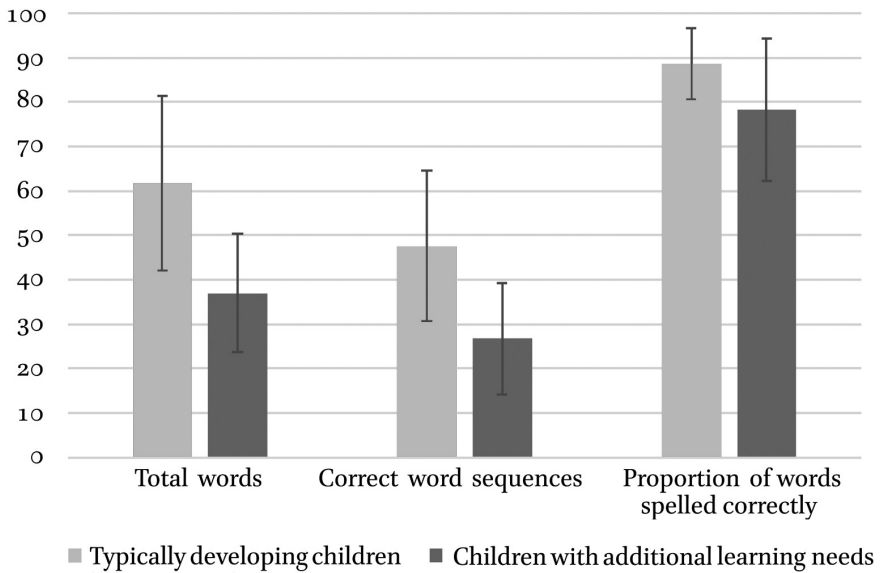
FIGURE 10.2   *Mean (SD) on CBM productivity measures for children typically developing children and those with special educational needs*

ences between children who had additional learning needs and their chronologically age-matched typically developing peers. The differences were large and significant for all measures of productivity and showed little overlap between the two groups as illustrated by the standard deviations.

Overall the results were consistent with other reports in the literature. The different elements of the CBM-W were differentially sensitive to development with clear age trends. We also found good construct validity as evidenced by their significant association with the norm-referenced test measuring writing quality, the Wechsler Objective Language Dimensions (Rust, 1996), that had been standardized in the UK against an age range from 8 to 16 years of age. All the different elements of the CBM-W (for both narrative and expository texts) correlated significantly with the overall quality scores from the norm-referenced test measuring writing quality. Furthermore, a principal components analysis demonstrated that both the norm-referenced test and the CBM tasks loaded onto two constructs of writing which represented measures of productivity and measures of accuracy. Change over time was also evident, and significant differences between narrative and expository texts were found. Pupils with special educational needs scored significantly less well on the CBM-w, demonstrating the sensitivity of the measure to identify struggling writers.

There was also evidence of more complex patterns across the different measures of accuracy and productivity. For example, while numbers of sentences produced failed to discriminate by age and genre across the sample, it was an important factor for the older children. Developments in writing for older competent writers may be more evident if detailed assessments of sentence structure at the clausal level are used (Berman, 2008). However, such analyses are not compatible with rapid assessment. As yet there are also no data suggesting that such sentence structure measures change reliably with development at this age.

In contrast to some previous work (McMaster & Espin, 2007), the only accuracy measure that discriminated between age groups was the proportion of words spelled correctly. This result replicates that of Costa and colleagues (Costa et al., 2012). Transcription skills, both handwriting and spelling, account for the majority of the variance in writing quality for both children developing typically and those with developmental difficulties learning to write in English (Berninger, Nielsen, Abbott, Wijsman, & Raskind, 2008; Graham et al., 1997; Olinghouse, 2008). Our data suggest that a short (five-minute) text written to a writing probe can effectively capture these differences.

It is important to note that despite the statistically significant differences, and in many cases the large effect sizes, found in our study, there was marked heterogeneity within the age groups. Ninety-five percent confidence inter-

vals revealed little overlap between the year groups, but variation within year groups was often large. This variation was also evident in gains that pupils made in each measure over the five-month period. While this variation deserves further investigation, similar heterogeneity was found in the standardized Wechsler Objective Language Dimensions (Rust, 1996) scores for the sample; the national data on writing tests for England also show similar patterns of heterogeneity within year groups (Department for Education, 2011, 2012). In fact, despite this heterogeneity, there was little overlap between the scores for pupils with Special Educational Needs and those with no recorded special needs, suggesting that CBM-W may be a useful objective measure for children who are struggling to develop writing skills. The variance in children's scores at this stage in writing development can thus serve as a sensitive marker for monitoring progress and identifying pupils struggling with writing.

Sensitivity to growth was evident for two productivity measures (CWS and total words written) and for proportion of words spelled correctly, a measure of accuracy. Effect sizes for both CWS and total words written were large. This is a promising finding, as teachers may be able to track progress using these more objective measures, which also provide for the detailed monitoring of children, especially those who struggle with writing. Information can then be used to inform decision-making about the need for further support and, by corollary, the subsequent effect of that support on pupils' writing.

Performance on CBM-W also reliably differentiated between narrative and expository texts. This confirms previous work examining these genre differences (Koutsoftas & Gray, 2012; Scott & Windsor, 2000) and provides a further source of information about the validity of the CBM-W. Pupils produced less text and less accurate text to the expository probe. In contrast, more punctuation marks were used than in the narrative texts, perhaps indicating the more list-like nature of narrative texts at this point in development. There were large effect sizes for these differences, as would be expected when children are new to writing in a genre. This raises an important caveat in using these assessments. In order to differentiate between pupils across time, comparisons need to be made using similar types of probes.

Overall, we were able to identify a number of strengths in the CBM-W we used for children with this range of ages and educational needs. Good reliability of the scoring was established and there was validity with a UK nationally-standardized measure. The CBM-W differentiated across year groups and for pupils with and without special educational needs. It was also sensitive to change over the five-month period of the current study, providing a sound basis for formative assessment. Together these data suggest that the CBM-W can be used across the primary years from age 7 to age 11 for both typical and atypical

writers and can chart change over periods of time within those years. There is more work required to see if CBM can be reliably administered more frequently than the current 5-month period validated here. However, other work on CBM-W would suggest that more fine-grained administration periods with weekly administration are common (McMaster & Espin, 2007).

There is still much to investigate around CBM-W and more specific research is required to specify the utility of CBM-W at various ages and to identify which measures best reflect the underlying strengths or weaknesses in the children's written products. For example, the utility of CBM-W may change depending on the macro-structural dimensions of the text that are assessed. This future work will be important for demonstrating if CBM-W can be used to support directly the development of specific skills in writing through interventions. Similarly, it may be that a different measure of text complexity at the word and sentence level would provide more sensitive indicators of change. It is likely that the nature of analysis will need to consider both the children's ages and their writing skills.

In our work we examined children up to age 11 but there is currently limited data on CBM-W in older children's writing and in advanced older writers in post-school education. More detailed validity profiles, for example, examining informational validity for instructional actions are also lacking. It may be the case that CBM-W may be more useful in older writers for tracking struggling pupils as the higher-level components of writing such as ideation or narrativity may be more difficult to measure with a CBM approach. However, some recent research has shown that linguistic-based automated text analysis can detect complex differences in narrativity in written texts between children at U.S. High School and this may provide a fruitful avenue for research on older writers' more complex texts (Allen, Snow, & McNamara, 2016).

In terms of our own data presented here, there are also limitations. For example, we were unable to control for potential teacher effects across the study and we did not have detailed data on the nature of the children's learning difficulties. Trained graduate assistants coded the texts, so it is not yet possible to generalize the findings to other assessors. Research in other domains has indicated that generalizing from research studies to conventional practice in schools raises additional challenges (McCartney, Boyle, Ellis, Bannatyne, & Turnbull, 2011). CBM-W only provide partial information on writing as they assess the product but not the process of writing. However, further research tackling these issues may, in turn, help enhance the face value of CBM-W. Some teachers and researchers remain to be convinced that the complex set of processes represented in writing can be adequately measured by seemingly simple measures such as the number of words and spelling errors.

Implications and Future Research

It is clear from the above limitations that there is more work to be done to establish the potential uses of the CBM-W. Nonetheless the current study suggests that the CBM-W is a useful tool among a repertoire of methods of assessing pupils writing. It has the potential to be used for targeting intervention goals and as a screening tool to identify those children struggling to write. Furthermore, given the high levels of reliability and the relatively straightforward scoring system, it is likely to be appealing to researchers and educational practitioners alike. Of course the availability of CBM-W data alone does not lead to changes in instruction or better outcomes for struggling writers (McMaster et al., 2011). Professionals using such measures will need to ensure that pupils are supported with effective, targeted teaching to develop their writing skills, but we hope that CBM-W can be a useful tool to assist them in this process.

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PART 6

Conclusions

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Approaches to Improving Writing Research, Instruction, and Performance

Peggy McCardle, Brett Miller and Vincent Connelly*

Introduction

To understand the writing process, one needs to understand its developmental origins and progression, the malleability of its component skills, and the socio-cultural value and role of the activity itself. The field of writing research is in the early stages of incorporating developmental insights into theorizing and conceptual development. Hayes and Berninger (2014) offer a developmentally sensitive cognitive model of the development of writing processes, which recognizes three major, highly interactive yet parallel "levels": resource (including attention, working memory, long-term memory, and reading skill), process, and control, all constrained by difficulty level. Rose (this volume) also cites a resource model (that of Bernstein, 2000), where resources are more social and interpersonal, highlighting the critical role of the teacher and the teacher-student relationship in the context of knowledge construction, and where levels of difficulty will depend on individual differences and change over time with development, invoking Vygotsky's zone of proximal development (Vygotsky, 1978). Both models emphasize the need to examine writing development as a dynamic activity that changes with both growth and experience.

Viewing reading and writing through a developmental, longitudinal lens will be critical, as both reading and writing develop and require instructional support well beyond the early grades. Relations, i.e., correlations between component skills and related processes, change over time, and this change must be considered when planning and implementing instructional support or interventions. Careful examination of these correlations should lead to experimen-

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tal and quasi-experimental studies to determine how best to support learners' current needs as they progress in becoming skilled readers and writers, which can take many years of support and sustained effort. We must not forget that one of the key roles that models play in this research field is to continue to go beyond describing the writing processes per se and illustrate how, and why, development in writing skill occurs over time. The modeling of the writing process can become so complex that future models may risk becoming more descriptive than developmental. Some of the classic models of writing development, while lacking some of the complexity of later models, are very useful for driving forward our questions about how writing develops in children from less skilled to more skilled (e.g., Bereiter & Scardamalia, 1987). We can then begin to more clearly understand when and where things can go wrong in writing development and so help predict and prevent failure.

The Overall Need for Research

Understanding how children develop knowledge prior to reading and writing is essential to building an understanding of pre-writing behaviors and can facilitate efforts to distinguish atypical behaviors and thus guide early preventive interventions. Early development of writing builds on foundational oral language, literacy experiences, and activities in the home and community. Early writing-related behaviors provide critical information for understanding the writing development of children with and without later difficulties. Children develop an early recognition of text in the environment and gain knowledge and understanding of surface level characteristics of writing in their language system (e.g., directionality, linearity), and acquire an awareness of discourse through early interactions with parents and caregivers (see Tolchinsky & Jisa, this volume, for a review of early writing development). Before entering primary school, children often are taught to write their names and learn the names and sounds of letters; these skills are strong predictors of later literacy development (for a review, see National Early Literacy Panel, 2008). An area in need of additional research in early development is our understanding of the emergence of early writing skills; this includes especially how lower level and higher level features of writing are integrated developmentally as children's writing products become increasingly complex as they grow and develop, and as they begin to learn about more complex written products and genres. Some research has suggested that struggling writers fail to integrate lower level and higher level processes (e.g., Dockrell, Lindsay & Connelly, 2009) and that this failure

to integrate leads to a "stop-start" dysfluent style of writing where processes are not conducted in parallel but serially (Olive, 2014).

Adolescents and young adults who struggle with writing face diverse challenges of a different sort from younger students just learning to read and write: they are generating more complex written products, using more complex syntax and more sophisticated vocabulary, and are often involved in diverse discourse communities (see Gregg & Nelson and Myhill & Jones, this volume, for discussions of older struggling writers). Text generated by older struggling writers tends to be shorter, not as well organized, and contains a greater number of spelling, punctuation, and grammatical problems; these writers often use comparatively simpler words and less sophisticated punctuation and grammar and they often have poorer handwriting, which can affect both the reality and perception of the quality of their writing. They tend to focus on local rather than more global aspects of text, at the expense of overall quality, and are less likely to engage and persist with writing due in part to fewer opportunities to write, or avoidance of such opportunities, and less access to effective instructional practices. The body of research on older struggling writers is smaller than that addressing younger writers, is less definitive regarding whether individualized (or standardized by subgroup) intervention approaches are necessary; there are few samples of adults (with and without learning difficulties) and those few samples tend to consist of university or college students. Additionally, research conducted particularly on subsets of struggling writers often involves smaller samples with frequently inconclusive findings, such as is the case with specific language impairment (see Myhill and Jones, this volume).

Assessment is a key issue for writing across all ages. Scoring written text has been a challenge historically for the field, including in classroom settings, where rubrics are generally used (see for review Jonsson & Svingby, 2007). Some scoring systems have included more holistic approaches that often give a single ordinal score, but these approaches are less useful with short texts, differentiating learners (because of the gross scaling), and are less sensitive to change over time. Conversely, analytic approaches can provide more complex and detailed information about the individual learner, but often involve more complex training and the development of psychometrically sensitive and reliable subscores. If we focus on what to measure, ideas have also evolved over time with an increased focus on quality, productivity, text complexity and organization, and genre.

Dockrell and Connelly (this volume) discuss the potential of curriculum based measurement (CBM) of writing for providing timely information to monitor progress and to inform targeted instruction. CBM can potentially provide information over time to capture developmental changes, relate these to more

complex aspects of written text, and identify children who struggle in the acquisition of writing. To generate a comprehensive picture of the writing skills of any individual, Dockrell and Connelly argue, we need comprehensive data collection, rather than focusing on production (often number of words written) in isolation. However, CBMs are not without their own challenges: validity of use across populations of interest, difficulties in scoring, and sensitivity to detecting differences in the quality of text. Despite these challenges, it is feasible to develop and implement specific CBMs and obtain valid information. For CBMs to have a broader impact, research is needed on their utility across age and developmental ranges, to determine when specific measures are most sensitive to performance changes. One key role of CBMs is to guide instructional practice; however, more research is needed to inform their use and interpretation, as well as to guide changes in practice within various instructional contexts. Other research on CBM for assessment in other fields, such as reading or math, have shown that classroom educators can often be unconvinced about the validity of CBM tools and that this remains a key barrier to use.

Future Research Directions

While the chapters in this volume offer a variety of views of writing development, instruction, intervention and assessment, all agree that we should view the field with a broad developmental lens, as in the models of Hayes and Berninger (2014) and Bernstein (2000). O'Rourke et al. (this volume) call for research to enhance our understanding of the development of the individual processes or skills within levels (e.g., the resource level, including attention, working memory, long-term memory, and reading skill in Hayes and Berninger's (2014) framework) and in the integration across levels. Especially for individuals with language-learning and attentional difficulties, understanding the role of resource-level activities and how these may play out in complex non-linear or cascading fashions can provide insights for both the foundational understanding of writing and its relation to reading, but also for the design and implementation of intervention.

Assessment too is essential to not only documenting and tracking growth and progress but also can and should inform instruction and intervention. As noted earlier, research is needed on the utility of CBMs across age and developmental ranges, to determine when specific measures are most sensitive to performance changes, and such information can guide changes in both instruction and intervention. It could also help convince classroom educators of the utility of CBMs in their daily practice. From a research perspective, an enhanced

focus on assessment can also inform foundational science by further specify-
ing and refining how we define and operationalize core constructs related to
writing development. These refinements can lead to improved specification in
our theories and precision of measurement of our constructs.

Reading is a key resource constraint on the development of efficient writing
(Hayes & Berninger, 2014) and a critical functional part of the writing pro-
cess itself, yet the interaction between reading and writing skills has been little
studied (e.g., Miller, McCardle, & Long, 2014; Wengelin & Arfé, this volume).
Relatedly, there has been some work on the relationships between handwriting
and composing (e.g., Kent & Wanzek, 2016; Limpo, Alves & Connelly, 2017), such
that handwriting could be included as a resource for writing, but additional
exploration and replication are needed. Spelling is a key component of tran-
scription and a key constraint on writing from the primary grades through to
adulthood for poor spellers; it affects both accuracy and fluency (Sumner, Con-
nelly & Barnett, 2014; Tops, Callens, van Cauwenberghe, Adriaens & Brysbaert,
2013). Yet, the complex interactions demonstrated in some recent experimen-
tal work (e.g., Kandel & Spinelli, 2010) are still poorly understood. In addition,
language skills are a foundational resource that undergirds both reading and
writing, and these skills themselves change developmentally as a key part of
literacy mastery. What follow are a few targeted research areas that could indi-
vidually and collectively contribute to a much richer and deeper understanding
of writing development, difficulties, and intervention.

The following are areas drawn largely from the context of the chapters in this
volume, in which it is clear that additional research is needed, whether to break
new ground or more thoroughly explore areas where some research has been
initiated or is ongoing. In addition, there are clearly areas where we need to
examine current or recommended practices, either to document their effects
or to explore the mechanisms that underlie those effects in order to more thor-
oughly understand how typically developing writers become successful and
why and how some children do not. Such knowledge can lead to better screen-
ing and early identification of spelling and writing difficulties, curricula and
intervention design, and should lead to changes and enhancements in teacher
education and professional development in order for teachers to fully under-
stand children's development in these areas and through that knowledge more
effectively educate all children—and enable all children to become effective
writers.

The Underpinnings of Reading and Writing Difficulties

In seeking to examine the underpinnings of reading and writing difficulties, again a developmental approach holds promise. Perhaps the same or overlapping cognitive or language deficits could underlie both reading and writing problems: for example, poor reading impacts writing because of its key role in the writing process (reading written text and revising) and both processes may be related developmentally. However, several authors have noted the implications of the potential separability of disorders of reading and writing (e.g., see Berninger & Abbott, 2010; Mehta et al., 2005; see also Peterson, McGrath, Willcutt, Keenan, Olson, & Pennington, under review, Wagner et al., 2011). Viewed through the lens of practice, in education settings, relatively little support is given for the underpinnings of reading and writing processes (e.g., oral language skills and meta-linguistic awareness, including discourse rules) and the supports that do exist are generally not well integrated.

Meta-Linguistics

Myhill and Jones note that adolescent struggling writers possess less metacognitive knowledge of the writing process and are less successful in utilizing what they know; they need support for comprehension and to increase their skills in managing the writing process. Noting the importance of the role of teacher knowledge, Myhill and Jones imply that limitations in the teacher's own knowledge may negatively impact struggling writers. In fact, a study of sixth grade teachers' speech (Lesaux & Gamez, 2012) showed that the quality of teacher language (but not the quantity) had a positive effect on the reading development of native-English speaking and language minority students, supporting the notion that indeed teachers' language can affect learning. At minimum, there is a need for better understanding of the role of teachers' knowledge and ability to demonstrate meta-linguistics in mediating students' development of meta-linguistic knowledge; thus it will also be important to examine the development of these skills in teacher preparation programs.

Morphology

Morphology, a specific area of metalinguistic awareness, has historically been underrepresented or not included in models of reading and spelling (e.g., Coltheart, Rastle, Perry, Langdon, & Ziegler, 2001; Seidenberg & McClelland, 1989; although see for example Taft, 1979; for discussion in the context of connectionist models see Rueckl, 2010, and Gonnerman, Seidenberg, & Andersen, 2007). Enhancing such integrative accounts could advance theoretical understanding of reading development, spelling and reading for those who struggle in these areas, and especially of normative spelling (which is and instructionally

should be far more than a mechanical rote-memory task; see Silliman, Bahr, Nagy, & Berninger, this volume). In addition, better integrative explanations could provide important tests and potential constraints on morphology's role in literacy development. Spelling depends upon the interconnections between phonology, orthography, and morphology and the mapping among these factors. Silliman et al. highlight that the relative frequency of legal (within the orthography) letter groupings may affect their accessibility; this is consistent with general learning principles from statistical learning models (e.g., see Harm & Seidenberg, 1999), which offer an opportunity for deeper exploration.

   We need an enhanced understanding of the basic development of morphological knowledge and its interconnectedness with other forms of lexical information. Some recent work in this area shows potential promise with both typical (McCutchen, Stull, Herrera, Lotas & Evans, 2014) and struggling writers (Critten, Connelly, Dockrell & Walter, 2015), but much remains to be explored. This is true not only for English, a morphophonemic morphologically rich language, but also for the full range of languages and orthographies. Silliman et al. argue that through the lens of morphology, English becomes more transparent, and a cogent presentation of this is made by Henry & Calfee (2003) and Moats (2005). But the discussion of possible inter-language differences in the balance or level of transparency at different levels of analysis extends to many languages, informed by linguistic analyses (e.g., Kieffer & Lesaux, 2012; McBride-Chang et al., 2005; Schiff, Schwartz-Nahshon, & Nagar 2011; Wang, Ko, & Choi, 2009). However, the implications for struggling writers and spellers is less clear and likely complex, particularly when we think about the dynamics of the developing writing (cognitive) system for struggling writers, vis-à-vis Hayes and Berninger (2014), and how it varies by writing system. Research on the role of morphology in designing interventions for struggling readers and writers within and across languages, and in teacher education, is an important area for future exploration.

Self-Efficacy and Executive Functions

While terms like self-efficacy, motivation, executive function or executive control are much discussed, research to focus on the specific behaviors they encompass and their impact on literacy—both reading and writing, is sparse (e.g., see though Berninger, Abbott, Cook, & Nagy, 2017). Key components of persistence, including self-regulation, self-efficacy, and goal orientation, relate both directly and indirectly to an individual's general cognitive processing abilities and affective response to the task of writing (e.g., see Santangelo, Harris, & Graham, 2016). Individuals with specific learning disorders (SLDs) have an increased likelihood of difficulties with self-regulation in the context of writ-

ing, which can interfere with the planning, production, and revision processes. Struggling writers have lower reported self-efficacy for writing and are less likely to think of and/or utilize information about the audience for the written product (Troia, Shankland, & Wolbers, 2010). Within the research on struggling readers, especially adolescents and adults, there is also a general lack of attention to motivation and its role in writing and to the intersection of writing and executive function.

Digital Literacy

With the increased need to write in digital environments, there is a need to focus on digital writing strategies for diverse learners so that struggling writers can more effectively produce text appropriate for the "genre" constraints of those environments. Rønneberg, Johansson, Mossige, Torrance, and Uppstad (this volume) present a practical view for how technology could support struggling writers by adopting an alternative, writer-centric perspective. They call for a move from the current largely negative feedback system that writing technologies provide (e.g., indicating misspellings, focus on grammar) to a more optimally timed, focused, positive feedback. Current feedback mechanisms are at best difficult for struggling writers to fully utilize, and at worst detract from production. For example, in the case of spelling feedback, it is generally assumed that the writer can identify the correctly-spelled word if presented, which unfortunately is often not the case for struggling writers (See Sumner, Connelly & Barnett, In Press). Rønneberg and colleagues (this volume) suggest that delaying this type of feedback could not only allow the struggling writer to focus on writing production/fluency but also provide additional information from the text that would constrain later-presented word candidates for misspelled items. More holistically, technology solutions need to be reoriented away from WYSIWYG (*what you see is what you get*) to WYGIWYN (*what you get is what you need*). The key distinction here is to emphasize writing fluency over correction; this approach could enhance text generation for struggling writers by de-emphasizing correction and focusing activity (and attention) on production. Consistent with this argument, individuals with dyslexia can produce text comparable to those without dyslexia when the text is hidden after it is written, i.e., not allowing for revisions.

Rønneberg et al. (this volume) highlight an intelligent writing tool that detects the use of difficult items for a struggling writer based upon previous experience and gives positive feedback, encouraging and motivating the writer. At this point, these concepts are largely not instantiated in current tools and vary in their complexity of implementation—e.g., delaying feedback on possible errors until a later revision phase would be straightforward to implement,

whereas identifying areas of difficulty and providing positive, timely feedback based upon future use is feasible but more complex.

To fully realize the potential of technological tools to improve writing fluency and quality for struggling writers, the research community will need to creatively combine and flexibly utilize a range of methodological approaches to keep up with the pace of technology development. Given the time required to obtain efficacy data, the delay from conceptualization to funding to research to publication, technology will have already advanced in ways that may make the work less relevant. These challenges are not insurmountable, but necessitate nimble and creative research methodologies to collect timely data that can meaningfully inform practice while maintaining high evidentiary standards. Schools and classrooms are already incorporating technology, largely with little to no data to inform its efficacious use, and will likely continue as new technologies and additional technology vendors enter the education space.

Teacher Education

Several of the authors in this volume join the plea for improvements in teacher education to prepare these professionals to effectively instruct and intervene in the areas of reading and writing. They decry the paucity of research on struggling writers that teachers can directly utilize, and recent reports show that classroom teachers feel less well prepared when teaching struggling writers (e.g., Dockrell, Marshall & Wyse, 2016). We have noted specifically the need for greater depth of knowledge in specific areas of linguistics (metalinguistics, and in particular for English, morphology and its importance in spelling, and the impact a teacher's language can have in building student language skills). For example, explicit instruction to facilitate metalinguistic awareness of word forms and their interconnections may be beneficial for those individuals with and without spelling difficulties, and supporting awareness of the connections among phonology, orthography, and morphology and semantics (word meaning) can be an effective tool for enhancing idea expression in struggling writers. While the efficacy of specific interventions to accomplish this should be studied, its implementation and corresponding fidelity can only happen if teachers are knowledgeable about those connections and how best to present them.

In addition, there are other areas of human development about which teachers must have some depth of knowledge—motivation, executive function, cultural differences. While many teachers are aware of these areas and seek additional education about them, courses in child or human development should be a standard part of teacher preparation.

We call for an increase in research on the impact of digital writing, and this too should be a focus of ongoing teacher preparation and professional development, as the digital world changes rapidly and teachers must somehow keep pace, not an easy task. We ask much of today's (and tomorrow's) teachers—the demands of their job and time will likely only increase. The least we can do is provide the supports necessary such that they, like their learners, can thrive. Literacy training (pre- or post-service) does not occur in a vacuum; teachers need the opportunity to plan, practice, and reify their teaching practices, and administrators and schools need to enhance systemic and systematic supports for system-wide improvements in writing instruction in their schools.

Conclusion

In conclusion, this volume aimed to provide insights into the state of science and practice for writing development in struggling learners. The paths to becoming a struggling writer are heterogeneous, with individuals possessing primarily language, reading, or writing impairments, (or combinations of these), which may be biologically based, environmentally induced through disadvantage and poor quality instruction, or from other potential etiologies. Models of writing development must become increasingly sensitive and specific, to account for the spectrum of writers that appears in classrooms around the world. This necessitates a better understanding of the developmental trajectories for normative and atypical writing, with an eye toward rich phenotypic data that could more fully inform our understanding of risk in a way that might allow us to proactively address potential problems before they manifest. Normative data also could inform classification and identification approaches to writing disabilities and their potential separability from reading disability or language impairment in a clinical diagnostic context.

This in turn hinges on our ability to successfully measure written products with assessments that are sensitive to developmental differences and changes over time. If we are to see improvements in learners' performance, we must continue to focus on strengthening the power of writing instruction and interventions across the developmental span, on optimizing content and dosage for those at-risk or with demonstrated difficulties, and on more systematically describing the nature of the counterfactual in efficacy studies. At one level, the hope is that effect sizes for our interventions will in fact decrease in the near term due to enhancements in the nature of the writing instruction (and outcomes) in the counterfactual, particularly in a business-as-usual context; in

other words, one hopes that the quality of writing instruction in public and private education will improve to such an extent that it will be hard to develop substantially better instructional writing programs (and that such programs would no longer need to be developed!). Unfortunately, we are currently far from that as a reality.

Additionally, there is a paucity of long-term outcome studies for writing interventions; we largely do not know the long-term impact of interventions (e.g., 2–4 years after they have ended). Such data will be critical in factoring out changes attributable to development itself and the influence of accumulation of background knowledge, so that we can more clearly examine concepts of instructional dosage, intensity, and grouping moving forward.

In short, the field has made substantive progress, but the road is long and will likely be rough and winding as we move forward to improve outcomes for struggling writers. Significant research attention is needed for these understudied groups if we are to enhance instructional approaches with the goal of substantive, sustained long-term gains in performance. Coherently connecting different lines of research on writing from basic foundational conceptualizations of the writing process through to intervention and measurement, and back to foundational research will be critical to advancing both science and practice. Although difficult, such an integrated research endeavor is within our reach and capabilities!

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