Inattention and Written Expression Difficulties in Children with Normal and Poor Word-Reading Skills

by

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ABSTRACT

This study examined written expression skills in children with attention problems with and without word reading difficulties. The sample consisted of 28 children with attention problems (AP) only, 18 children with coexisting attention and reading problems (ARP), and 34 children without attention or word reading difficulties (TYP). Curriculum-based measurement (CBM) indices of accuracy and fluency, plus teacher ratings of handwriting, spelling, and overall writing skills were used to assess children’s written expression skills. The analyses indicated that the AP and ARP groups received significantly lower scores on all measures of written expression than the TYP group. The ARP group scored significantly lower than the AP group on the teacher ratings of writing and spelling. These findings suggest that inattention is significantly related to written expression difficulties independent of word-reading skills.
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CHAPTER ONE

INTRODUCTION
1.1 Background and Overview of the Present Study

Children with a clinical diagnosis of attention deficit hyperactivity disorder (ADHD) are at high risk for academic impairment, special education, grade repetition, and high school dropout (Biederman et al., 2004; Currie & Stabile, 2006; Deshazo-Barry, Lyman, & Klinger, 2002; DuPaul et al., 2004; Rapport, Scanlan, & Denney, 1999; Spira & Fischel, 2005). Children with ADHD display developmentally inappropriate symptoms of inattention and/or hyperactivity in more than one context (American Psychiatric Association, Diagnostic and Statistical Manual, 4th ed., TR, 2000). Prior research has demonstrated that written expression disabilities are twice as common as learning disabilities (defined as an IQ-achievement discrepancy) in reading or math among children with a clinical diagnosis of ADHD (Mayes & Calhoun, 2006; 2007a; Mayes, Calhoun, & Crowell, 2000). Specifically, 65% of children with ADHD have been found to meet criteria for a learning disability in written expression relative to 33% for reading and 26% for math (Mayes & Calhoun, 2006; 2007a; Mayes et al., 2000).

Despite the higher prevalence of written expression disabilities relative to reading and math disabilities among students with ADHD, there is considerably more research concerning the reading skills of children with ADHD than there is for written expression (Berninger, Mizokawa, & Bragg, 1991; Elbert, 1993; Mayes & Calhoun, 2007a; Mayes et al., 2000). Furthermore, previous research concerning ADHD and written expression has not typically examined the specific role of inattention, nor has it explicitly tested and controlled for co-existing reading difficulties. This thesis focuses on the inattention dimension of behaviour, rather than ADHD per se, because a growing body of research indicates that symptoms of inattention, but not symptoms of hyperactivity-impulsivity are associated with academic underachievement in reading and mathematics in both clinical and community samples of
Children with attention problems may be more likely to have written expression difficulties than children without attention problems because they often exhibit weaknesses in executive function (EF) and working memory (WM) (Barkley, 1997; Gathercole et al., 2008; Lui & Tannock, 2007; Martinussen & Tannock, 2006; Pennington & Ozonoff, 1996; Westerberg, Hirvikoski, Frossberg, & Klingberg, 2004). Developing writers need high levels of attention and memory resources, as well as linguistic and transcription skills in order to hold thoughts about content in mind while remembering and writing letter forms, identifying correct spellings, and thinking of suitable words and phrases (Berninger, 1999; Berninger et al., 1996; Graham & Harris, 2003; McCutchen, 1996). Specifically, the writing process draws heavily on EF and WM to coordinate, execute and regulate a number of component writing skills all at once (Altemeier, Abbott, & Berninger, 2007; Berninger, 1999; Bourke & Adams, 2003; Hayes, 2005; Hooper, Swartz, Wakely, de Kruif, & Montgomery, 2002; Kellogg, 1996; McCutchen, 1996; Vanderberg & Swanson, 2007). Weaknesses in EF and WM have been found to be associated with poor writing outcomes in children (e.g., Altemeier et al., 2007; Hooper et al., 2002; Swanson & Berninger, 1996).

Furthermore, research has shown that weak readers generally become poor writers (Juel, 1988). Specifically, difficulties with the sub-skills that underlie spelling and early word level reading are likely to produce writing difficulties at the level of transcription (Berninger, Abbott, Abbott, Graham, & Richards, 2002; Berninger et al., 2006; Berninger, Cartwright, Yates, Swanson, & Abbott, 1994; Berninger, Yates & Lester, 1991; Shanahan & Lomax, 1986; 1988). Considering that attention problems have been found to predict poor reading skills (Dally, 2006; Rabiner & Coie, 2000), it is possible that at least some of the writing difficulties demonstrated
by children with ADHD in previous studies are due to coexisting weaknesses in reading skills. Hence, it is important that research studies examining the written expression difficulties of children with attention problems control for co-existing reading problems in order to verify whether symptoms of inattention are related to difficulties with written expression independent of weak reading skills.

Determining whether children with attention problems demonstrate significant weaknesses in written expression independent of coexisting word-reading weaknesses has important implications for understanding, preventing and re-meriating written expression difficulties among these children. Although inattentive behaviour was found to be related to word-level reading and writing skills in a sample of children with dyslexia (Thomson et al., 2005), no previous research could be found that specifically assessed whether inattentive behaviour is associated with written expression outcomes in a community sample of English-speaking children. In summary, there is a conspicuous gap in the research regarding the role of attention in children’s writing ability and whether attention problems are related to writing difficulties independent of reading difficulties.

Epidemiological studies indicate that written expression difficulties are one of the most common and impairing academic problems for all school-aged children (Hooper et al., 1993; Hooper et al., 2002; Mayes & Calhoun, 2006). The ability to produce quality written work plays an important role in academic success. Teachers often evaluate student knowledge via written expression. Also, writing is a means for communication, self-regulation, problem solving, and idea generation (Graham & Perin, 2007). Thus, it is important to identify factors that contribute to writing difficulties in children. The primary objective of the present study was to determine whether children with attention problems, with and without co-existing word reading difficulties, exhibit weaknesses in written expression related to handwriting quality, spelling,
compositional fluency and accuracy relative to children without attention and word reading problems. Thus, in order to isolate and examine the specific effects of attention problems on children’s written expression skills, the present study differentiated between children with attention problems only and children with coexisting attention and word reading problems.

1.2 Literature Review

The theoretical rationale underlying the present investigation of written expression difficulties in children with attention problems is comprised of four main sections. In the first part, empirical evidence concerning the academic outcomes and cognitive characteristics associated with attention deficits and ADHD is summarized to demonstrate a gap in the literature regarding the relationship between inattention and written expression outcomes. The second section consists of a review of the literature concerning children’s writing development to provide a framework for understanding written expression difficulties in children with attention problems. A gap in the literature is identified regarding the role of inattention in children's written expression skills. The third section discusses the assessment of written expression and describes the advantages of curriculum-based measures (CBM) of written language, the tool that was used to assess children’s writing in the present study. Finally, the literature review will be concluded by a summary of the key findings of prior research and the questions which remain unanswered.

1.2.1 Academic and Cognitive Weaknesses Associated with ADHD

Attention Deficit Hyperactivity Disorder (ADHD) is a common behavioural disorder that affects 3% to 7% of children (5.3% worldwide; Polanczyk, de Lima, Horta, Biederman, Rohde, 2007). Children with ADHD exhibit developmentally inappropriate symptoms of inattentive behaviour, and/or hyperactivity-impulsivity that cause significant impairment (American Psychiatric Association, Diagnostic and Statistical Manual, 4th ed., TR, 2000). Children with a
diagnosis of ADHD have been reported to experience poor psychiatric, social, and academic outcomes (Barkley, Fischer, Edelbrock, & Smallish, 1990; Biederman et al., 2006; Biederman et al., 2004; DuPaul et al., 2004; Hart, Lahey, Loeber, Applegate, & Frick, 1995). Symptom intensity on the hyperactive-impulsive dimension of ADHD tends to be associated with oppositional behaviour and poor social outcomes (e.g., Chhabildas, Pennington, & Willcutt, 2001; Weiss, Worling, & Wasdell, 2003). In contrast, symptom intensity on the inattentive dimension of ADHD has been reported to be associated with cognitive deficits in executive function (EF) and working memory (WM) (Barkley, 1997; Chhabildas et al., 2001; Martinussen & Tannock, 2006; Westerberg et al., 2004; Willcutt, Doyle, Nigg, Faraone, Pennington, 2005; Wilding, 2003; 2005), academic underachievement (DuPaul et al., 2004; Loe & Feldman, 2007; Mayes et al., 2000; Spira & Fischel, 2005), and comorbid learning disabilities (Mayes et al., 2000; Weiss et al., 2003; Willcutt & Pennington, 2000).

The symptoms of ADHD have been found to occur along “a continuum of risk” (Levy, Hay, McStephen, Wood, Waldman, 1997; Loe & Feldman, 2007; Merrell & Tymms, 2001; Mayes et al., 2000; Rodriguez et al., 2007). Children who exhibit mild and moderate levels of inattentive behaviour have been found to be at risk for academic under-achievement (Currie & Stabile, 2006; Todd et al., 2002). It follows that there may be several students in any class who exhibit mild to moderate symptoms of ADHD and experience academic risk; however, these students would not meet the diagnostic criteria for ADHD.

1.2.1.1 General Academic Underachievement and Learning Difficulties

Children with a clinical diagnosis of ADHD often score below average on standardized achievement tests (Barkley, DuPaul, & McMurray, 1990; Hinshaw, 1992, 1994) and the rate of comorbid LD (as defined by IQ-achievement discrepancy) is particularly high (Barkley et al., 1990). Reports of comorbid LD in children with ADHD range from 25% to 70% (Barkley, 1994;
Mayes et al., 2000). Estimates of reading disorder in ADHD range from 15% to 50% (August & Garfinkel, 1990; Barkley 1990; Mayes et al., 2000; Semrud-Clikeman et al., 1992; Willecutt & Pennington, 2000). Approximately 24% to 60% of children with ADHD have a LD in math (Barkley, 1990; Mayes et al., 2000; Semrud-Clikeman et al., 1992), and about 24% to 60% have a spelling disorder (Barkley, 1990; Elbert, 1993; Mayes et al., 2000). Although research concerning comorbid written expression disorders in children with ADHD is limited, data suggest that the prevalence of LD in written expression among children with ADHD is higher than is found in the non-ADHD population (Elbert, 1993; Mayes et al., 2000; Mayes & Calhoun, 2006; 2007a). For example, 65% of children with ADHD were found to have a comorbid LD in written expression compared to only 27% of non-ADHD children in a sample of clinic-referred subjects (Mayes et al., 2000).

The relationship between the core symptoms of ADHD and academic risk has been confirmed by a number of studies (Deshazo-Barry et al., 2002; DuPaul et al., 2004; Hinshaw, 1992; 1994; Merrell & Tymms, 2001; Rapport et al., 1999; Rodriguez et al., 2007). For example, ADHD symptom severity has been found to predict academic and learning outcomes over and above intelligence (DuPaul et al., 2004; Rapport et al., 1999), executive function (Deshazo-Barry et al. 2002), and conduct problems (Frick et al., 1991). Inattention (as opposed to hyperactivity-impulsivity) has been found to be a particularly strong predictor of academic and learning outcomes among both clinical samples of children with ADHD (DuPaul et al., 2004; Spira & Fischel, 2005) and community samples of children (Merrell & Tymms, 2001; Rabiner & Coie, 2000; Rodriguez et al., 2007; Todd et al., 2002). Furthermore, Mayes & Calhoun (2007b) found that weaknesses in attention, graphomotor skills, and processing speed were associated with lower levels of academic achievement of children with ADHD.

Attention appears to be a major mediator in academic performance and learning.
disabilities (Mayes et al., 2000). Children with learning disabilities are often rated by their teachers as exhibiting inattentive behaviour (McConaughy, Mattison, & Peterson, 1994; Speece, McKinney & Applebaum, 1985), which has been supported by psychometric measures of attention (Copeland & Wisniewski, 1981; Richards, Samuels, Turnure, & Ysseldyke, 1990; see Soo & Bailey, 2006 for review; Swanson, 1983; Tarnowski, Prinz, & Nay, 1986). Furthermore, inattentive behaviour has been found to be related deficits in EF and WM in both clinical (Martinussen & Tannock, 2006; Westerberg et al., 2004) and community samples of children (Gathercole et al., 2008; Lui & Tannock, 2007). Deficits in WM are also commonly found among individuals with learning difficulties (Alloway et al., 2005; Gathercole, Alloway, Willis, & Adams, 2006; Pickering & Gathercole, 2004; Swanson, Ashbaker, & Lee, 1996). In general, data suggest that attention problems and learning problems are “overlapping, interrelated spectrum disorders” that may require intervention even if diagnostic criteria for ADHD or LD are not met (see also Levy et al., 1997; noted by Mayes et al., 2000; Merrell & Tymms, 2001; Rabiner & Murray, 2002; Rodriguez et al., 2007).

1.2.1.2 Inattention and Reading Difficulties

Inattentive behaviour in the classroom has been reported to play a critical role in the development of children’s reading skills (Dally, 2006; Rabiner & Coie, 2000; Rabiner, Malone & CPPRG, 2004; Rabiner & Murray, 2002; Thomson et al., 2005; Warner-Rogers et al., 2000). Data from longitudinal studies has demonstrated that attention problems in kindergarten are predictive of reading difficulties in later grades (Dally, 2006; Rabiner & Coie, 2000). Moreover, data from intervention studies indicate that attention plays a significant role in learning outcomes (Chenault, Thomson, Abbott, & Berninger, 2006; Rabiner et al., 2004). For example, Rabiner et al. (2004) found that students with coexisting attention and reading problems who received reading remediation showed no improvements in reading relative to students with
either attention or reading problems alone.

1.2.1.3 ADHD and Writing Difficulties

Existing data suggests that children who exhibit clinical levels of ADHD symptoms demonstrate difficulties with handwriting legibility, spelling, compositional fluency, planning and organization, sentence construction, and story composition (Adi-Japha, Landau, Frenkel, Teicher, & Shalev, 2007; Elbert, 1993; Imhof, 2004; Mathers, 2006; Mayes & Calhoun, 2006; 2007a; 2007b; Re, Caeron, & Cornoldi, 2008; Re, Pedron, & Cornoldi, 2007). Difficulties with handwriting have been well documented among children with ADHD (Adi-japha et al., 2007; Imhof, 2004; Mayes & Calhoun, 2007b; see review by Racine, Majnemer, Shevell, & Snider, 2008; Schoemaker, Ketelaars, Zonneveld, Minderaa, & Mulder, 2005; Tucha & Lange, 2004). Imhof (2004) reported that children with ADHD performed significantly below typical peers on a copy task in terms of letter formation, alignment and neatness. There is some evidence that weaknesses in fine motor control are related to symptoms of inattention, but not hyperactivity-impulsivity (Fliers, Rommelse, Vermeulen, & Atlink, 2008; Martin, Piek, & Hay, 2006; Pitcher, Piek, & Barrett, 2002; Pitcher, Piek, & Hay, 2003). These weaknesses may account for some of handwriting difficulties among children with ADHD.

Although significant difficulties with handwriting quality are documented among children with ADHD (see Racine et al., 2008 for a review), evidence suggests they are not impaired in terms of handwriting fluency (i.e., speed) (Ross, Poidevant, & Miner, 1995; Re et al., 2007). For example, no significant differences were found in handwriting fluency between 48 students with ADHD and a matched control group (Ross et al., 1995). It is important to recognize that handwriting fluency is typically evaluated in isolation from the overall process of composing. Thus, it is distinct from compositional fluency which is considerably more complicated because it requires the fluent integration and execution of transcription skills
together with higher level composing skills.

Children with ADHD have also been reported to exhibit difficulties with spelling, both when writing compositions (e.g., Elbert, 1993; Re et al., 2007) and when completing context-free tasks (i.e., dictation: Elbert, 1993; Kroese, Hynd, Knight, Meimez, & Hall, 2000; Mayes & Calhoun, 2006; 2007a). In brief, children with ADHD symptoms appear to demonstrate transcription difficulties related to handwriting quality and spelling, but not necessarily handwriting fluency (Adi-japha et al., 2007; Re et al., 2007; Ross et al., 1995; Racine et al., 2008).

Children with ADHD have also been found to exhibit written expression difficulties at the level of composition. Relative to peers without ADHD symptoms, they exhibit weaknesses in compositional fluency (e.g., story length under time constraints), punctuation, sentence construction, planning and organization, and story composition (Mathers, 2006; Mayes & Calhoun, 2007b; Re et al., 2007; 2008; Reid & Ortiz-Lienemann, 2006). For example, Re et al. (2007) found that Italian children who exhibited elevated levels of ADHD symptoms in the classroom had difficulties on all qualitative and quantitative measures of writing compared to controls; specifically, they produced shorter texts with more spelling, grammar and punctuation errors. In addition children with ADHD symptoms received significantly lower scores for adequacy of product relative to task assignment, organization of text, and variety of words (Re et al., 2007).

Similarly, another study that compared the writing skills of 21 boys with ADHD or attention deficit disorder and 11 matched controls across three essays reported that boys with ADHD performed significantly below controls on word complexity, written language, productivity, and general writing ability (Resta & Eliot, 1994). Mathers (2006) reported that children with ADHD produced more spelling and punctuation errors in writing compared to
typical peers when required to produce three types of written text (i.e., story, recount, and procedural). In summary, these studies indicate that children with ADHD symptoms exhibit written expression difficulties related to spelling, compositional fluency (i.e., they tend to write shorter stories under time constraints), and compositional accuracy (produce more errors with punctuation, grammar, and sentence construction in their stories).

1.2.1.4 Summary and Implications of ADHD Section

Overall, these findings demonstrate that children with ADHD, and those with high levels of ADHD symptoms, have significant difficulties with written expression related to transcription (i.e., handwriting and spelling), compositional fluency (i.e., rate of text production), and compositional accuracy (i.e., proportion of errors). Some critical issues however, remain unexplored. Specifically, few of these studies examined the role of inattention, and none of these studies explicitly tested and controlled for comorbid word level reading problems. As such it is unclear whether inattention symptoms or comorbid word reading difficulties are associated with the poor writing outcomes demonstrated by children with ADHD. Furthermore, previous studies have examined handwriting fluency, but not handwriting quality, together with compositional skills (e.g., Re et al., 2007) among children with ADHD or attention problems. Studies examining written expression skills of children with ADHD provide a useful background for examining the role of inattention in written expression difficulties; however, it is also necessary to understand the developmental constraints that influence children’s writing. The next section describes an influential model of writing development and outlines the key developmental factors that influence children’s writing proficiency in order to provide a framework for understanding and assessing written expression difficulties in children with attention problems.

1.2.2 Children’s Writing Development

“The physical act of transcribing written text is a major drain on cognitive resources of
beginning writers, and text generation itself is also less fluent for younger writers.”
-McCutchen, 1996, p319

Children's writing differs in many ways from adult writing, and thus some models are more applicable to understanding early writing development than others. For example, Hayes and Flower’s (1980) influential model of adult writing emphasizes the cognitive processes involved in planning and revising rather than the processes involved in translating ideas into written text. However, during the early elementary years, writing development consists mainly of translating. Children must develop basic writing skills such as learning to print and spell (i.e., transcription skills) so that they can translate their ideas into written words, sentences and discourse (i.e., text generation) (Berninger, Cartwright, et al., 1994; Berninger et al., 1996; Berninger et al., 1992). In view of the fact that children’s writing tends to be focussed on transcription and text generation rather than high levels of planning and revising (as does adult writing), Berninger and colleagues (1996) modified Hayes & Flowers (1980) influential model of adult writing to reflect the developmental constraints of children's writing. Subsequently a developmental model of writing known as the Simple View of Writing was established (Berninger & Amtmann, 2003; Berninger, Vaughn, et al., 2002).

1.2.2.1 Theoretical Framework for Writing Development

The Simple View of Writing (Berninger & Amtmann, 2003; Berninger, Vaughn, et al., 2002), provides a developmental framework for understanding children’s writing that corresponds to the key constraints (i.e., linguistic, neuro-developmental and cognitive) that influence early writing development (Berninger et al., 1996). This developmental model of writing consists of the following three key components: (a) text generation; (b) transcription, including spelling and handwriting; and (c) executive function (EF) including attention control and self regulation skills. With the support of working memory, these three key components
interact throughout the composing process. Text generation involves producing ideas and
converting them into language (e.g., words or sentences) (Berninger et al., 1992; Berninger et
al., 1996; Berninger, Vaughn, et al., 2002). Transcription is the physical act of translating and
recording those language representations into decipherable text on the page. Transcription skills
depend upon orthographic motor integration and phonetic skills for handwriting and spelling.
According the model, EF is involved in regulating the overall writing process, and WM is
related to the efficiency of each component process; thus EF and WM correspond to cognitive
constraints of writing development. Schematically, the Simple View of Writing represents the
components of children’s writing in a triangle (see Figure 1). Transcription and EF are the
foundation of children’s writing. In the model, EF and WM support the goal of text generation.
WM has a central position in the model as it connects to and facilitates each component. As
depicted in the model, writing proficiency corresponds to the text generation component
positioned at the apex of the triangle and is enabled by available WM resources and the
transcription and self regulation components at the base.

The components in the Simple View of Writing are all engaged and interacting together
throughout the composing process. However, the relative influence of each component may
vary across development and across individuals. For example, the transcription component
tends to exert a strong influence on the early acquisition of writing because the low-order neuro-
developmental skills which underlie transcription are just emerging. Specifically, low-order
neuro-developmental skills such as the speed of sequential finger movements, rapid coding of
orthographic information, and rapid automatic production of alphabet letters have been shown to
be good predictors of beginning handwriting and composition skills (Berninger et al., 2006;
Berninger et al., 1992; Ritchey, 2008). Weaknesses in these low-level neuro-developmental
skills may constrain the development of proficient transcription skills. In turn, poor transcription
skills can act as a major barrier to the text generation and fluent composing of beginning writers during the translation process (Berninger et al., 1992). According the model, as the children’s transcription and EF (e.g., attention regulation) skills become increasingly developed and effortless, more WM resources become available for the text generation component of writing and the fluency and quality of children’s writing improves (Berninger, 1999; Berninger & Fuller, 1992; Berninger et al., 1996; Berninger, Mizokawa, Bragg, Cartwright, & Yates, 1994; Berninger, Vaughn, et al., 2002). Thus, children’s ability write fluently and proficiently depends on automatic transcription skills, strong EF abilities and available WM resources.

In summary, this model illustrates that the children’s writing proficiency is strongly influenced by the development of text generation and transcription abilities as well as the ability to effectively regulate their attention (EF) between the demands of transcription and text generation during the translating process (Berninger et al., 1996; Berninger, Vaughn, et al., 2002). The Simple View of Writing provides a theoretical basis for the main hypothesis tested in the present study as well as a framework for assessing children’s writing. The present study tested the hypothesis that children with attention problems (poor attention-control) with or without poor word reading skills would demonstrate written expression difficulties. Although the role of inattention in children’s writing has not been explicitly examined in previous studies with typically developing children; the role of specific cognitive processes such as WM, and EF, as well as the role of transcription and reading skills in children’s writing have been demonstrated in number of studies. Evidence for the relative roles of EF, transcription and word-reading in children’s writing is reviewed in the next sections.

1.2.2.2 The Role of EF and WM in Writing Acquisition

Successful writing requires the effective allocation of a number of resources such as attention, memory, organizational, and problem solving (Berninger, Vaughn, et al., 2002;
Executive function and WM processes, sometimes referred to as attention control and self-regulation (SR), are attributed a central role in several descriptions of writing for both adults and children (Berninger & Amtmann, 2003; Berninger, Vaughn, et al., 2002; Graham & Harris, 2000; Hayes, 2005; Hooper et al., 2002; Kellogg, 1996; McCutchen, 1996; Swanson & Berninger, 1996). In these descriptions of writing, EF and WM are generally responsible for planning and revising, maintaining the goals of the specific writing task, managing the writing environment, and coordinating and executing the component skills involved in composing all at the same time (see Berninger et al., 1996; Graham & Harris, 2000; Hayes, 2005; McCutchen, 1996). Research has confirmed that EF and WM measures contribute to overall writing proficiency, as well as planning, translation, revision and many sub-measures of written output such as punctuation and grammar (Altemeier et al., 2007; Altemeier, Jones, Abbott, & Berninger, 2006; Berninger, 1999; Bourke & Adams, 2003; Graham & Harris, 2000; Hooper et al., 2002; Swanson & Berninger, 1996; Vanderberg & Swanson, 2007). Evidence suggests that the controlled attention component of WM is intricately tied to writing in school students (Vanderberg & Swanson, 2007). As children’s writing does not typically involve high levels of planning and revising, EF skills and WM resources are primarily responsible for controlling attention and efficiently coordinating component writing skills during the translating process in children’s writing.

Furthermore, individual differences in WM capacity are suspected to influence the acquisition and fluency of early transcription skills (Berninger, 1999; Graham & Harris, 2000; McCutchen, 1996; Swanson & Berninger, 1996). Transcription skills consume most of the attentional resources of beginning writers (Berninger, 1999; Berninger et al., 1992; McCutchen, 1996). Limited attentional resources are thus likely to slow or impair the acquisition of fluent transcription skills; in turn less attentional resources are likely to be available for higher level
text generation processes (Berninger, 1999; Berninger & Amtmann, 2003; Graham & Harris, 2000; McCutchen, 1996).

Although it is generally accepted that the ability to control and sustain attention is important for the efficient execution of quality written expression (Berninger & Amtmann, 2003; Berninger, Vaughn, et al., 2002; Graham & Harris, 2000; Hayes, 2005; Hooper et al., 2002; Kellogg, 1996; Vanderberg & Swanson, 2007), the relationship between inattentive behaviour and written expression outcomes has not been explicitly explored in a community-based sample of English-speaking children. However, behavioural measures of attention were found to play a significant role in the sentence and word writing skills of English-speaking children with dyslexia in one study (Thomson et al., 2005). Furthermore, in another study of English-speaking children with dyslexia - prior attention training was reported to improve the effects of composition instruction (Chenault et al., 2006). Children with attention problems are likely to demonstrate weaknesses in writing relative to children without attention problems because the ability to control and sustain attention is essential in written expression. Furthermore, given the domain-general role attributed to attention and related constructs (i.e., EF and WM) for regulating the writing process, the writing difficulties associated with attention problems are also likely to be domain-general (Hooper et al., 2002; McCutchen, 1996; Swanson & Berninger, 1996). As such, many aspects of writing may be undermined by problems with attention such as compositional fluency and accuracy on a timed writing task as well as transcription skills.

1.2.2.3 The Role of Transcription in Writing Acquisition

Children’s overall writing ability is strongly influenced by basic transcription skills which consist of both handwriting and spelling skills (Berninger, 1999; Berninger et al., 1996; Berninger, Vaughan, Abbott, Abbott, & Woodruff, 1997; Berninger et al., 1992; Graham, 1990;
Graham et al., 1997; McCutchen, 1996). Orthographic (letter) knowledge, orthographic-motor integration for letter writing, and phonemic segmentation support transcription skills (Abbott & Berninger, 1993; Berninger, Cartwright, et al., 1994; Berninger et al., 1996; Berninger, Yates, et al., 1991). Together handwriting and spelling draw on orthographic (letter) knowledge (Berninger, Cartwright, et al., 1994; Berninger et al., 1992; Berninger, Yates, et al., 1991). Since orthographic knowledge represents children’s internal representation of letter shapes, deficits in this area may manifest themselves in both handwriting and/or spelling weaknesses. Handwriting also draws on orthographic-motor integration skills to physically translate these orthographic forms into written text (Berninger et al., 1992; Berninger, Cartwright, et al., 1994); whereas spelling also draws on phonemic segmentation skills to sound out and identify letters and letter clusters within the word being spelled. Although spelling generally draws on the same subskills involved in word-level reading (Berninger, Abbott, et al., 2002; Berninger, Cartwright, et al., 1994), it has been argued that learning to spell is generally more difficult for children than learning to read (see Berninger, 1999 for discussion).

Both handwriting and spelling skills have both been reported to predict children's compositional fluency and quality at the elementary level (Abbott & Berninger, 1993; Berninger, 1999; Berninger et al., 1997; Berninger et al., 1992; Graham, 1990; Graham et al., 1997; Graham, Harris, & Fink, 2000; McCutchen, 1996). Handwriting skills have been found to contribute directly to compositional fluency (Berninger et al., 1997; Graham et al., 2000) and quality in both the primary and intermediate grades (Berninger, Cartwright, et al., 1994; Berninger et al., 1992; Graham et al., 1997). Graham et al. (1997) found that spelling contributed directly to compositional fluency and indirectly – through handwriting – to compositional quality in the primary grades. In the intermediate grades (i.e. grade four through six), spelling was found to contribute to both compositional fluency and quality indirectly.
through its correlation with handwriting. Furthermore, the treatment of handwriting problems has been found to transfer to improved compositional skills in elementary level students (Berninger et al., 1997; Graham et al., 2000; Jones & Christensen, 1999).

Consistent with Berninger, Vaughn, et al.’s (2002) Simple View of Writing, the evidence reviewed demonstrates that transcription skills play an important role in children’s writing ability during the elementary years. Difficulties with basic handwriting and spelling skills, particularly weaknesses in handwriting fluency, are often related to problems with text generation such as poor compositional fluency and quality (e.g., Berninger et al., 1992; Rosenblum, Weiss, & Parush, 2003). When letter production is not fully automatic, the act of handwriting may place increased demands on memory and attentional resources, which, in turn, may constrain the higher level cognitive processes required for composition (Graham & Harris, 2000; Jones and Christensen, 1999). Furthermore, it may be that children with limited attentional resources are slower to develop automatized transcription skills, and thus experience an elevated risk for transcription related writing difficulties.

1.2.2.4 The Role of Word-Reading Skills in Writing Acquisition

Early reading and writing development is closely tied because reading and writing acquisition involve many of the same preliminary sub-skills (Berninger, Cartwright, et al. 1994; Berninger, Yates, et al., 1991; Shanahan, 1984; 2006; Shanahan & Lomax, 1986; 1988). In particular, transcription and word-reading skills draw on many of the same sub-processes including orthographic (letter) and phonological (letter-sound) coding (Berninger, Cartwright, et al. 1994; Berninger, Yates, et al., 1991; Shanahan, 1984; 2006; Shanahan & Lomax, 1986; 1988). Evidence shows that early word reading skills and related processes (e.g. orthographic knowledge and phonological awareness) are strongly related to the acquisition of the ability to write letters and spell words at the elementary (Abbott & Berninger, 1993; Berninger, Abbott, et
al., 2002; Berninger et al., 2006; Berninger, Cartwright, et al., 1994; Olinghouse, 2008) and kindergarten levels (Berninger et al., 2006; Ritchey, 2008). Deficits in word-reading or the component processes of word-reading are thus likely to manifest themselves as spelling and handwriting difficulties.

The relationship between word reading skills and various aspects of writing, including transcription, compositional fluency and quality has been demonstrated in a number of studies (Abbott & Berninger, 1993; Berninger, Abbott, et al., 2002; Berninger et al., 2006; Berninger, Cartwright, et al., 1994; Olinghouse, 2008; Ritchey, 2008, Shanahan, 1984; 2006; Shanahan & Lomax, 1986; 1988). At the elementary level, correlation coefficients reported between word reading and writing skills range from .36 to .76 for spelling, .21 to .32 for handwriting, and .14 to .52 for compositional fluency or quality (Berninger, Abbott, et al., 2002; Berninger, Cartwright, et al., 1994; Berninger et al., 1992; Olinghouse, 2008). Evidence suggests that word-reading is directly related to transcription and indirectly related to compositional fluency and quality through transcription (e.g., Berninger, Abbott, et al., 2002; Berninger, Cartwright, et al., 1994; Olinghouse, 2008). Accordingly, weak word reading skills may contribute to written expression difficulties at the level of transcription; in turn, difficulties at the level of transcription may have a negative impact on children’s fluency and quality of writing.

1.2.2.5 Summary of Children’s Writing Development Section

The Simple View of Writing (Berninger & Amtmann, 2003) identifies text generation, transcription and EF skills as key components that each draw on WM resources to varying degrees at different stages of writing development. Empirical evidence confirms the importance of WM and EF processes, as well as transcription skills in children's writing. Weaknesses in EF and WM may result in written expression difficulties related to compositional fluency, accuracy and quality as well as transcription (Bourke & Adams, 2003; Hooper et al., 2002; McCutchen,
Poor handwriting or spelling skills may also influence weaknesses in compositional fluency and quality during the elementary years (Berninger, Cartwright, et al., 1994; Berninger et al., 1997; Berninger, Vaughn, et al., 2002; Berninger et al., 1992; Graham et al., 1997; Olinghouse, 2008). Furthermore, weak word-reading skills may impact compositional fluency and quality indirectly through problems with transcription skills since word level reading skills are closely related to spelling and handwriting skills (Berninger, Abbott, et al., 2002; Berninger, Cartwright, et al., 1994).

Children who exhibit inattentive behaviour have been found to have weaknesses in EF and WM (Gathercole et al., 2008; Lui & Tannock, 2007) as well as reading (Dally, 2006; Rabiner & Coie, 2000), all of which are important to developing writing proficiency.

The Simple View of Writing provided the theoretical basis for the main hypothesis tested in the present study. Specifically, children with attention problems (poor attention-control) with or without poor word reading skills were expected to demonstrate written expression difficulties. Children with coexisting attention and word-reading problems were expected to be even more impaired than those with attention problems only. Given the general importance of controlled attention and EF in the Simple View of Writing, and the EF and WM weaknesses associated with inattentive behaviour, children with attention problems were expected to demonstrate poor compositional fluency, quality and accuracy (i.e., text generation skills) on a timed writing task as well as poor transcription skills.

Children with coexisting attention and word-reading problems were expected to be more impaired than children with attention problems only on all these measures since transcription and word-reading skills are closely related (Berninger, Cartwright, et al., 1994; Berninger, Abbott, et al., 2002; Shanahan, 1984; 2006) and weak transcription skills tend to contribute to higher level written expression difficulties (Berninger et al., 1992; Graham et al., 1997).
Previous research has shown that children with ADHD symptoms have significant writing difficulties (e.g., Re et al., 2007). However, the role of inattention in children's writing ability has not been explicitly examined in previous studies with typically developing children. The present thesis study therefore addresses a significant gap in the writing development literature. The next section addresses issues and considerations relevant to assessing and understanding children’s written expression and explains the advantages of employing objective Curriculum-Based Measurement (CBM) of written expression for present study.

1.2.3 Assessment of Written Expression Skills

“…writing disabilities may be rarely identified but they certainly are not rare.”
-Mayes & Calhoun, 2007a, p. 443

Despite the fact that written expression difficulties are one of the most common and impairing academic problems for all school-aged children (Berninger, Mizokawa, & Braggs, 1991; Cobb-Morocco, Dalton, & Tivnan, 1992; Hooper et al., 1993; Hooper et al., 2002; Mayes & Calhoun, 2006; 2007a; Mayes et al., 2000), many standardized tests of academic achievement tend to be insensitive to writing disorders because they only assess written expression at the word or sentence level (Berninger, Mizokawa, et al., 1991; Mayes & Calhoun, 2007a; Mayes, Calhoun & Lane, 2005; Sandler et al., 1992; Wiener, 1986). In fact, specific writing difficulties often are not identified and children may not receive interventions for these difficulties (Berninger, Mizokawa, et al., 1991; Berninger et al., 2008a; Mayes et al., 2005; Mayes & Calhoun, 2007a; Sandler et al., 1992; Wiener, 1986). Understanding and identifying those factors that differentiate good writers from poor writers has important implications for developing effective instructional practice, as well as for recognizing, preventing and remediating written expression difficulties.
1.2.3.1 Issues and Considerations in Writing Assessment

The assessment of written expression is a particularly challenging area of academic assessment. In contrast to assessments of reading and math which typically require individuals to respond in a way such that a correct response is easily evident, assessments of written expression do not tend to have a single correct answer (Gansle, VanDerHeyden, Noell, Resetar, Williams, 2006). Such responses are considerably more complicated to evaluate objectively and efficiently. For example, as pointed out by Gansle et al. one student may write a text that is clear and well-organized, but with many spelling errors; whereas another student may write a text that lacks coherence, but with few spelling or punctuation errors. In addition to a writer’s writing proficiency, several other factors may influence an individual’s score on a writing assessment. Schoonen (2005) noted that various aspects of writing assessment such as which traits were assessed (e.g., content or conventions) and the way in which these traits are scored (e.g., a holistic rating scale or analytically) may influence the outcome of the assessment.

Furthermore, it is important to consider that different standardized achievement tests of written expression have been found to yield different results regarding the presence or absence of a writing disability depending on the specific skills measured (Mayes et al., 2005; Mayes et al., 2007). For example, the reported rate of written expression disabilities identified is twice as high when employing the written expression subtest of the Weschler Individual Achievement Test (WIAT) (Psychological Corp., 1992), which assesses compositional writing skills, compared to the written language subtests of the Woodcock Johnson, Psycho-Educational Battery-revised (Woodcock & Johnson, 1989) in which the ability to produce individual words and sentences is evaluated (e.g., see Mayes et al., 2005). This discrepancy in outcomes across different tests suggests that assessments which involve composition writing are more sensitive measures of writing ability than are assessments that require writing words and sentences in
isolation (Berninger, Mizokawa, et al., 1991; Mayes et al., 2005).

Furthermore, evidence suggests there are considerable intraindividual differences in terms of word, sentence and paragraph level writing skills (Berninger, Mizokawa, et al., 1994). Thus, the assessment of written expression difficulties is further complicated by the considerable variability that exists regarding individual strengths and weaknesses in writing subskills (Berninger, Mizokawa, et al., 1991). Struggling elementary level writers tend to produce written compositions with poor handwriting legibility, fewer words and sentences, higher percentages of spelling, capitalization and punctuation errors, and less sensitivity to text structure compared to proficient elementary writers (e.g., Graham, 1990; Graham, 1999; Graham, Harris, MacArthur, & Schwartz, 1991; Graham & Harris, 2003; Houck & Billingsley, 1989; Thomas, Englert, & Gregg, 1987). However, the specific type or pattern of writing errors and the underlying causes of writing problems may vary considerably among these students (Berninger, Mizokawa, et al., 1991; Berninger, Mizokawa, et al., 1994; Mayes et al., 2005).

Cluster analysis techniques have been used to empirically identify a variety of written expression subtypes that reflect distinct patterns of skills and impairment (Roid, 1994; Sandler et al., 1992; Wakely, Hooper, de Kruif, & Swartz, 2006). For example, Sandler et al. (1992) found that some children exhibited writing difficulties because of poor visual-spatial skills; whereas other students had attention and memory problems. Because writing involves a diverse array of multi-level skills, a variety of developmental dysfunctions (e.g., linguistic, neuro-motor, cognitive) may contribute to a child’s written output (Berninger, Mizokawa, et al., 1991; Berninger, Mizokawa, et al., 1994).

1.2.3.2 Key Assessment Components According to Simple View

It is important that assessments of written expression include measures of multiple skills across levels because written expression is a multifaceted ability involving several high- and
low-level subskills (Berninger, 1999; Berninger et al., 1996; Berninger, Mizokawa, et al., 1991). Measures of transcription for example, (i.e., spelling and handwriting) assess low-level skills.

Measures of compositional fluency (i.e., rate of text production) and overall compositional accuracy (i.e., correct use of grammar, punctuation and capitalization) represent the higher-level text generation and EF skills as identified in the Simple View of Writing (Berninger & Amtmann, 2003; Berninger, Vaughn, et al., 2002). Furthermore, transcription skills, compositional fluency, and accuracy are strong predictors of overall writing proficiency at the elementary level (Berninger et al., 1992; Berninger, Cartwright, et al., 1994; Berninger et al., 1997; Brooks, Vaughan, & Berninger, 1999; Graham et al., 1997; Graham et al., 2000; Jones & Christensen, 1999) and are thereby important components to include when assessing of writing proficiency.

It is important to specifically evaluate spelling and handwriting because these may be the first signs of writing difficulties in primary grade children (Berninger, et al., 1992). It is also important to assess compositional fluency as poor compositional fluency is also one of the early indicators of writing disability in the primary grades (Berninger, Mizokawa, et al., 1991; Berninger et al., 1992). Although measures of compositional fluency (e.g., number of words produced) theoretically reflect how easily the writer can find words to express ideas (i.e., text generation), compositional fluency is also influenced by available WM resources, and the speed and efficiency of EF and transcription skills during the composing process (Berninger, 1999; Berninger et al., 1997; Berninger, Vaughn, et al., 2002; Berninger et al., 1992; Graham et al., 1997). In summary, previous research and writing theory suggest that assessments of written expression at the elementary level should specifically evaluate both text generation and transcription skills within the context of the composing process (e.g., Berninger, Mizokawa, et al., 1991; Mayes et al., 2005).
A variety of approaches may be employed by writing researchers, teachers and school psychologists to carry out the daunting task of objectively scoring written narratives or essays and assessing written expression skills. Some examples include: holistic scoring, which entails using an overall impression to rate a paper on a scale with anchor papers serving as scale examples (e.g., see Cooper, 1997); primary trait scoring, in which features of a particular genre are identified and rated; discourse scoring, in which T-units or other discourse units are counted (e.g., Houck & Billingsley, 1989); and objective analytic scoring, which involves counting micro-measures of writing (e.g., number of correct words, sentences, punctuation, etc., see Deno, Marston, & Mirkin, 1982; Parker, Tindal, & Hasbrouck, 1991b). In contrast to holistic measures of writing and subjective judgements of quality which may require specialized training in using a rating scheme, objective analytic measures of writing may be more useful for identifying specific areas of difficulty and they may be more reliable (Berninger et al., 1992). For example, holistic measures of writing may overlook specific deficiencies in handwriting or spelling and may be more vulnerable to producing inconsistent results due to the subjectivity of the scorer. Curriculum-based measurement (CBM) of written expression use standardized, objective analytic scoring procedures. This type of assessment was used to assess writing in the present study.

1.2.3.2 Curriculum-Based Measurement (CBM) of Written Expression

Curriculum-based measures were originally developed to provide an efficient and valid means for teachers to assess the effects of instruction in special education settings (Deno, 1992; Deno & Fuchs, 1987; Deno, Mirkin, & Wesson, 1984; Tindal & Parker, 1989). CBM assessments use brief tasks in which correct and incorrect student responses to the tasks are counted within a set time interval (usually in minutes). The CBM assessment system is built on a set of common principles such that assessments are administered and scored according to an
established set of rules (Hosp, Hosp, & Howell, 2006).

Curriculum-based measures of writing are useful because they provide objective measures of writing that focus on the curriculum (i.e., relevant material). CBM measures of written expression have been used to distinguish between skilled and poor writers and, to identify students who require extra support (e.g., Parker et al., 1991a; Watkinson & Lee, 1992). Furthermore, there is extensive empirical evidence supporting the reliability and validity of curriculum-based measures to effectively assess of written expression proficiency (Deno, Marsten, & Mirkin, 1982; Gansle et al., 2004; Gansle et al., 2006; Jewell & Malecki, 2005; Malecki & Jewell, 2003; for review see McMaster & Espin, 2007; Parker et al., 1991a; 1991b; Tindal & Parker, 1989; Weissenburger & Espin, 2005; Videen, Deno, & Marston, 1982). Curriculum based measures have been described as “academic vital signs” because they can be used as “general indicators” of student performance in an academic area (Gansle et al., 2006; Hosp et al., 2006).

The CBM writing assessment typically indexes children’s ability to produce a composition within a limited amount of time. Specifically, students are presented with a lined sheet of paper with a story starter prompt at the top and instructed to think for 1 minute about a possible corresponding story. They are then given 3 minutes (sometimes 5 minutes) to write the story. CBM writing samples can be scored in various ways. For example, CBM writing samples can be assessed for (a) fluency (total words written, words spelled correctly, correct writing sequences); (b) accuracy (percentage of words spelled correctly, percentage of correct writing sequences); and (c) accurate production indicator (correct minus incorrect writing sequences) (Hosp et al., 2006). The CBM writing sample collected for the present study was only scored on the first two indices (i.e., fluency and accuracy) as well as in terms of handwriting quality. Early research on CBM writing assessment focused on the identification of reliable and valid
indicators of written expression performance at the elementary school level (Deno et al., 1982; Deno, Mirkin, & Marston, 1980; Marston & Deno, 1981; Videen et al., 1982).

The CBM indices for fluency and accuracy utilized in the present study have been previously validated against standardized assessments of writing (e.g., SAT-9, Test of Written Language; Woodcock Johnson Revised: Writing subtests), language arts grades, and teachers’ holistic ratings of writing (Deno et al., 1982; Gansle et al., 2004; Jewell & Malecki, 2005; Malecki & Jewell, 2003; for review see McMaster & Espin, 2007; Parker et al., 1991b; Videen et al., 1982; Weissenburger & Espin, 2005). Initially, research on CBM indices of writing focussed on the fluency measures for total words written (TWW) and the number of words spelled correctly (WSC) and provided evidence that these measures are reliable and valid indicators of writing proficiency at the elementary school level (Deno et al., 1982; Deno et al., 1980; Marston, Lowry, Deno, & Mirkin, 1981; Shinn & Marston, 1985). Subsequent research concerning the reliability and validity of the fluency-based score for correct writing sequences (CWS) and accuracy-based scores (i.e., %WSC and %CWS) indicates that these measures correlate more strongly with criterion measures of writing and thus may be even more useful for assessing general writing proficiency in elementary students than the fluency-based measures for TWW and WSC (Jewell & Malecki, 2005; Parker et al., 1991b; Weissenburger & Espin, 2005; Videen et al., 1982). For example, among elementary level students the fluency score for correct writing sequences (CWS) has been found to correlate significantly with holistic ratings of writing, language arts achievement scores and the Test of Written Language (TOWL) (Hammill & Larsen, 1983) with correlations ranging from .51 to .85 (Parker et al., 1991b; Videen et al., 1982; Weissenburger & Espin, 2005). CBM accuracy-based measures for spelling (%WSC) and overall writing (%CWS) have also been found to correlate significantly with holistic ratings of writing, language arts grades, and standardized achievement tests in
elementary level students (i.e., %WSC, $r = .46 - .67$; %CWS, $r = .43 -.70$) (Jewell & Malecki, 2005; Parker et al., 1991b). Accuracy-based CBM writing measures have also been used to identify students at risk for writing difficulties (Parker et al. 1991a; Watkinson & Lee 1992).

In addition to the CBM indices of fluency and accuracy described above, the CBM writing samples collected in the present study were assessed for handwriting quality using a rubric. As well, each child’s classroom teacher was asked to rate the child’s writing skills and overall language competence. Teacher ratings provided an impression of overall academic functioning relevant to written expression and can provide information to confirm the validity of the direct measures of writing.

**1.2.4. Summary of Literature Review and Rationale for Present Study**

Written expression problems are reported to occur at twice the rate of reading and math difficulties among children with a clinical diagnosis of ADHD (Mayes & Calhoun, 2006; 2007a). Children who exhibit high levels of ADHD symptoms (including those with a clinical diagnosis) have been reported to have difficulties with written expression related to handwriting, compositional fluency, spelling, punctuation, grammar and vocabulary (e.g., Resta & Elliott, 1994; Re et al., 2007). The present study focused specifically on inattention symptoms because children with elevated attention problems (e.g., sub-threshold to clinical levels) were expected to be at high-risk for writing difficulties. For example, recent studies suggest that inattentive behaviour is associated with underlying deficits in EF and WM among both community (Gathercole et al., 2008; Lui & Tannock, 2007) and clinical (Chhabildas et al., 2001; Martinussen & Tannock, 2006) samples of children. These same EF and WM processes are specifically identified as key factors in children’s writing proficiency (Hooper et al., 2002; Swanson & Berninger, 1996a).

Additionally, inattentive behaviour in the classroom has also been found to be predictive
of weak reading skills among community samples of children (e.g., Rabiner & Coie, 2000). Word-level reading skills have been found to be strongly related to transcription skills in typically developing elementary level students (Berninger et al., 2002). Previous studies of written expression difficulties in children have not specifically examined the role of inattentive symptoms at the sub-threshold to clinical level and, explicitly tested and controlled for co-existing word level reading problems (e.g., Elbert, 1993; Re et al., 2007; Resta & Elliot, 1994). Therefore, research is needed to determine whether inattention is a risk factor for weaknesses in written expression skills, and whether an association between inattention and writing difficulties exists independent of co-existing reading difficulties. To address this gap in the literature, the participants in the present study were not restricted to students with a categorical diagnosis of ADHD. Rather, the present study examined writing skills in a community sample of children in grades 1 to 4 with and without moderate to severe attention problems as rated by their classroom teacher. Furthermore, the present study tested word-level reading skills and distinguished between children with attention problems with and without coexisting word reading problems.

The Simple View of Writing (Berninger & Amtmann, 2003; Berninger, Vaughn, et al., 2002) provided the theoretical framework for understanding and assessing written expression in the present study of elementary grade children with attention problems because it describes the key skills that influence the development of children’s writing proficiency. The Simple View of Writing identifies text generation, transcription and self-regulation skills as key components that each draw on WM resources to varying degrees at different stages of writing development (Berninger & Amtmann, 2003; Berninger, Vaughn, et al., 2002). In the present study, compositional measures of handwriting quality and spelling accuracy assess the transcription component, measures of attention in the classroom reflect the self-regulation/EF/WM component (see Thomson et al., 2005) and together, measures of compositional fluency and
accuracy as well as teacher ratings of written expression skills assess the text generation component.

1.3 Objectives and Hypotheses of the Present Study

(1) The primary objective of this study was to determine whether children with attention problems with and without co-existing word level reading difficulties exhibit weaknesses in the following written expression skills: i) direct measures of handwriting quality, spelling, compositional fluency, and compositional accuracy as well as ii) teacher ratings of writing skills and language arts competence.

(2) The second objective of this study was to explore whether children with co-existing attention and reading problems exhibit greater weaknesses in written expression skills compared to children with attention problems only.

(3) The third objective of this study was to explore whether writing outcomes (both direct measures and teacher ratings), were related to inattentive behaviour in the classroom independent of hyperactivity-impulsivity symptoms.

Hypotheses tested:

(1) Relative to children without attention or word reading problems, children with attention problems with and without word reading problems will exhibit significantly lower written expression scores on the objective measures of handwriting quality, spelling, compositional fluency, and accuracy, as well as on the teacher ratings of writing skills and overall language arts competence.

(2) Children with attention problems and coexisting word-reading difficulties will be significantly more impaired than children with attention problems only on all measures of writing. This hypothesis is grounded in evidence that word reading skills are closely related to transcription skills, and transcription difficulties have been found to negatively impact the
(3) It was predicted that poor writing outcomes would be significantly related to attention problems independent of (i.e., controlling for) hyperactivity-impulsivity symptoms. Hyperactivity-impulsivity was predicted to be indirectly related to writing outcomes through its correlation with symptoms of inattention; thus hyperactivity-impulsivity would not relate significantly to writing outcomes after controlling for inattention. These hypotheses are grounded in research documenting a relationship between inattentive behaviour and academic impairment (Dally, 2006; Dupaul et al., 2004; Frick et al., 1991; Fuchs et al., 2006; Rabiner & Coie, 2000; Todd et al., 2002; Warner-Rogers et al., 2000), as well as cognitive deficits in EF and WM (Gathercole et al., 2008; Martinussen & Tannock, 2006; Pennington & Ozonoff, 1996).
CHAPTER TWO

METHOD
2.1 Participants

Participants included 85 children in grades one through four from four schools in a rural Ontario school board. Their ages ranged from 6 to 10 years ($M = 8.2$, $SD=1.17$), with 18 students in grade one, 26 students in grade two, 21 in grade three, and 20 in grade four. The sample consisted of more boys (68%) than girls (32%). The average level of parental education reported for the majority of participants was some college or higher such that 36.5% (n=31) graduated from college or received some higher level education, 36.5% (n=31) graduated from high-school or attended some college, 12% of parents (n=11) attended some high school or less, and no parental education information was available for 15% (n=13).

Recruitment. Participants in this study were drawn from the baseline assessment pool of a larger intervention study examining the effects of a training package for teachers on instructional strategies for children with ADHD. For the larger study, each teacher identified six students in their classrooms based on criteria outlined by the researchers (two students with good attention skills; two average students, and two students with attention and academic difficulties). Parents of identified students were provided with an information package regarding the study including a consent form. Teachers completed the Strengths and Weaknesses of ADHD and Normal Behaviour (SWAN) rating scale and a brief academic rating scale for each selected and consenting student in their class. Consenting parents also completed the parental version of the SWAN and a brief questionnaire that was used to characterize the sample in terms of parental education and proportion of students with a designated exceptionality (e.g., learning disability) or diagnosis of ADHD.

Inclusionary criteria. Students were included in the larger study if they were attending a general education classroom and their parent or guardian provided informed consent. All
children with parental consent were also asked for their verbal assent to participate in the study. Students were included in the present study if complete data for them was available in terms of teachers’ assessment of attention, word reading skills, and curriculum-based measures (CBM) of writing. As long as these conditions were met, students with identified exceptionalities were included in the study.

*Formation of subgroups.* Participants were classified into subgroups based on the presence of mild to severe attention and/or reading problems. For the present study, attention problems were assessed with the SWAN teacher rating scale (Swanson et al., 2005). An average inattention score was created by averaging the ratings on the 9 inattention items on the SWAN rating scale. Children who had an average score on the inattention items that was greater than 0 were classified as inattentive. Reading problems were defined as a composite score of less than 90 on a standardized measure of word reading, the Test of Word Reading Efficiency (TOWRE) (Torgesen, Wagner, & Rashotte, 1999). Using these criteria, the sample was divided into four groups consisting of: (a) children with typical attention and reading skills (TYP group n = 34), (b) children with mild to severe attention problems only (AP group; n = 28), (c) children with coexisting attention and reading problems (ARP group; n = 18), and (d) children reading problems only (RP group; n = 5).

*Group characteristics.* As Table 1 illustrates, the groups were equivalent in terms of age, nonverbal intelligence, auditory short term memory, average parental education level, and gender distribution. By design, groups differed significantly on measures of attention and reading; significantly lower levels of inattentive behaviour were evident for the TYP compared to the attention problem groups (AP and ARP), and significantly lower reading scores were evident for the ARP group than the TYP and AP groups. Descriptive statistics across groups are presented in Table 1. The RP group was excluded from subsequent group analyses due to small
sample size.

2.3 Procedure

Each student completed brief measures of memory, nonverbal intelligence, word reading skills and written expression that were administered by trained research assistants in quiet rooms in their school in random order. The CBM writing probe was administered to small groups of two to five students from the same classroom, whereas the other measures were administered individually.

2.4 Measures

Inattentive behaviour. Teacher ratings of inattentive behaviour using the SWAN teacher rating scale were used to identify children with and without problems with attention (mild to severe) in the current study. The SWAN ADHD scale (Swanson et al., 2005) includes 18 questions that correspond to the ADHD symptoms (nine for inattention and nine for hyperactivity-impulsivity) listed in the Diagnostic and Statistical Manual of the American Psychiatric Association (DSM IV, 1994). Participants were rated on a scale of ‘-3 to +3’ for each question, such that a score of zero reflects average behaviour and values above zero indicate the presence of mild to severe attention problems (i.e., a score of +3 is rated as severe) while values below zero indicate the absence of attention problems and good attending behaviour (i.e., a score of -3 means above average levels of attention). Thus, unlike other ADHD symptom rating scales, such as the SNAP IV, or the DSMIV criteria, the SWAN is designed to assess the full range of attention skills (i.e., from strong to poor) (Swanson et al., 2005). Furthermore, a factor analysis of the SWAN scale in a Canadian community sample identified the expected two factors, inattention and hyperactivity-impulsivity (Lui & Tannock, 2007). The teacher ratings on the 9 inattention items were used to create an average inattention score and teacher ratings on the 9 hyperactivity-impulsivity items were used to create an average hyperactivity-impulsivity
score. These scores could range from +3 (“far below” average) to -3 (“far above” average behaviour).

Parent ratings of ADHD behaviours using the SWAN parent scale were also collected. Significant correlations between teacher and parent SWAN scores for inattention and hyperactivity (inattention rho = .56, \( p < 0.001, n = 69 \); hyperactivity rho = .42, \( p < 0.001, n = 69 \)) reflect the reliability of these measures across environments and raters.

Reading skills. The Test of Word Reading Efficiency (TOWRE) (Torgesen, Wagner, Rashotte, 1999) was used to assess word reading skills in the present study. Word recognition skills and nonword decoding skills were assessed with the Sight Word Efficiency and Phonetic Decoding Efficiency subtests of the TOWRE respectively. Children were required to read two lists of words (one for real words and one for nonwords). The score for the Sight Word Efficiency subtest is the number of real words correctly read in 45 seconds. The score for the Phonetic Decoding Efficiency subtest is the number of nonwords correctly decoded in 45 seconds. The TOWRE is a standardized, nationally (i.e., U.S.A) normed measure of word reading fluency and accuracy that assesses both word recognition and word decoding subskills. Measures of reading fluency are considered a more sensitive measure of reading ability than accuracy measures (Fuchs et al., 2002). The test developer reported that the test-retest reliability of the TOWRE is .95 and the criterion validity is .92 with WRMT Word Identification (Woodcock, 1998) for 8-year-olds. Raw scores were converted to age-based standard scores.

Auditory verbal short term memory. The Auditory Sentence Length (ASL) task utilized in the present study provides a quick and reliable assessment of auditory short term memory span. The ASL score is the number of words correctly recalled from orally presented sentences of increasing length (see Rowe, Pollard, & Rowe, 2005).
Non-verbal intelligence. The Matrices subtest from the Wechsler Abbreviated Scale for Intelligence (WASI) (Wechsler, 1999) measures nonverbal reasoning, abstract problem solving, and inductive and spatial reasoning. The correlation between the Matrices subtest and WISC–III Full Scale IQ reported by the test developer is $r = .66$.

Teacher ratings of writing related performance. Each student’s handwriting, spelling and written expression skills were rated on a scale of 1 to 5 by their classroom teacher using the Literacy Rating Scale (LRS) (see Fletcher, Tannock, & Bishop, 2001), a brief, non-standardized measure. In addition, teachers’ overall perception of student skills and achievement-related behaviours in language arts was assessed with the Reading and Language Arts subscale of the Academic Competence Evaluation Scale (ACES) (Diperna & Elliot, 1999a; 1999b). These measures provided an index of general language arts performance.

Curriculum-based measurement (CBM) of written language (Deno et al., 1982; Gansle et al., 2002; Malecki & Jewel, 2003). For this measure, children were asked to write a story in response to the written prompt “One day....” This prompt was both read aloud and typed at the top of a lined piece of paper. Students were first given one minute to think of a story they wanted to write and then three minutes to write their story. If a student stopped writing before the three minutes were over the examiner encouraged the student to keep writing until his or her time was up. Each child’s writing sample was scored for fluency, spelling, writing accuracy, and handwriting quality. These measures were selected on the basis of their utility, reliability and validity as reported in the literature (Gansle et al., 2004; Jewell & Malecki, 2005; Parker et al., 1991a; 1991b; for review see McMaster & Espin, 2007). The scoring procedure for each of the CBM writing measures utilized in the present study is briefly described here (see Appendix A for a more detailed description of scoring procedures).
Handwriting quality (HW). Quality of handwriting in the writing samples was evaluated along two dimensions: (a) the letter legibility, and (b) the uniformity of text on the page using a scale of one to five (1 = well below average, 5 = well above average). These two scores were averaged to provide a score for the overall visual presentation and readability of the writing sample. The development of this handwriting measure for the present study was informed by empirical findings and a literature review that identify aspects of letter legibility and the overall text as the best predictors of handwriting quality (see Graham, Struck, Santoro, & Berninger, 2006; Rosenblum et al., 2003). The scale and scoring instructions used to assess handwriting in the present study are included in Appendix A; examples of two scored writing samples can be found in Appendix B.

CBM measures of writing fluency. The total number of words written (TWW) during the 3-minute period, including incorrectly spelled words, was counted. TWW reflects compositional fluency. The total number of words spelled correctly (WSC) was counted irrespective of grammar or context, consistent with the rules reported by Gansle et al. (2002). The total number of writing sequences (TWS), considered as all separate writing units such as words and punctuation, was counted. The number of correct writing sequences (CWS) was calculated by counting each successive pair of correct writing units from beginning to end of the sample. To be counted as correct, writing sequences had to be correctly spelled and grammatically correct. Also, words at the beginning of sentences had to be capitalized, and correct punctuation had to be inserted at the end of a sentence. In contrast to the scores for TWW and WSC, which specifically reflect word writing and spelling fluency, the CWS score reflects many aspects of written expression, including fluency, spelling, grammar, capitalization, punctuation, and spelling.

CBM measures of writing accuracy. The percentage of words spelled correctly (%WSC)
was calculated by dividing the number of words spelled correctly (WSC) by total words written (WSC/TWW) to provide an index of spelling accuracy. The percentage of correct writing sequences (%CWS) was calculated by dividing the number of correct writing sequences (CWS) by the number of total writing sequences (CWS/TWS) to provide an index of overall writing accuracy including accuracy of spelling, use of grammar and writing conventions. The CBM measures %WSC and %CWS have been reported to correlate strongly with holistic ratings of writing (e.g., $r = .73$ for %WSC and $r = .75$ for %CWS, Tindal & Parker, 1989), thus providing evidence for their validity in evaluating students’ writing.

**Reliability and validity of writing measures.** Inter-scorer reliability of the CBM writing measures utilized in the present study was calculated for 30% ($n = 35$) of the writing samples. These samples were scored independently by two scorers and the inter-scorer reliability for each measure was computed by dividing the lower of the two scores by the higher score for each double scored sample (Powell-Smith, & Shinn, 2004; Weissenburger & Espin, 2005). The average inter-scorer reliability was 98.4% for TWW, 97.0% for WSC, 97.5% for CWS, 98.7% for TWS and 92.7% for handwriting. The scoring procedures utilized and examples of scored writing samples are presented in Appendix A. The CBM writing scores also correlated significantly with teacher ratings of student writing skills and overall language arts performance which provides further evidence of their validity in assessing written expression. The correlation coefficients between CBM writing scores and teacher ratings of writing are presented in Appendix B. The CBM scores for handwriting (HW) and overall writing accuracy (%CWS) correlated best with teacher ratings (i.e., HW, $r_s = .49$ to .59, $p < .001$; %CWS, $r_s = .40$ to .54, $p < .001$).
2.5 Statistical Analyses

The shape of the distribution for each variable was assessed statistically with the Kolmogorov-Smirnov (total sample) and Shapiro-Wilk (across groups, \( n < 50 \)) tests of normality, and graphically by inspection of histogram and normal Q-plots. A square root transformation was applied to WSC and CWS in SPSS to attain a normal distribution of scores for these variables across groups and total sample. Although the distributions for \%WSC and \%CWS were normally distributed across the total sample, these variables deviated from the normal curve across groups and could not be transformed to produce a normal distribution across groups. Consequently nonparametric tests were employed to assess group differences for these variables.

*Hypotheses 1 & 2:* To explore group differences in the handwriting quality and CBM fluency measures (Hypotheses 1 and 2), two multivariate ANOVAs were conducted. The CBM measures for handwriting quality and compositional fluency variables (HW, TWW, WSC, and CWS) were entered as dependent variables into one MANOVA with group as the independent variable. Follow-up univariate ANOVAs were conducted if the overall MANOVA was significant. Pillai’s trace statistic was used for interpretation of multivariate analyses as it is more robust to assumption violations than other statistics (Olson, 1976). Similarly the Bonferroni adjustment for multiple comparisons was used for post hoc pair-wise comparisons for all follow-up univariate analyses to control for type I error. A second MANOVA was conducted to examine group differences on the teacher ratings of handwriting, spelling, and written expression skills and teacher perceptions of overall language arts competence (ACES subscale). Non-parametric Kruskall-Wallis and follow up Mann Whitney \( U \) tests were conducted to compare groups on percentage scores for spelling accuracy (\%WSC) and overall writing accuracy (\%CWS).
Hypothesis 3: The hypothesis that inattentive behaviour is related to writing outcomes independent of its relationship with hyperactivity was tested using partial correlational analyses. The relationship between attention and writing outcomes controlling for hyperactivity and age was compared to the relationship between hyperactivity and writing outcomes controlling for inattention and age.
CHAPTER THREE

RESULTS
3.1 Group Differences in Written Expression

CBM writing scores. A multivariate analysis of variance was conducted to examine group differences (TYP, AP, and ARP) on handwriting quality and the CBM fluency variables (TWW, WSC, CWS). There was a significant overall effect of group, Pillai’s trace = .36, $F(8,150) = .41, p<.001, \eta^2 = .18$. Follow up univariate ANOVAs revealed significant differences between the groups on each variable with effect sizes ranging from $\eta^2 = .20$ for total words written (TWW), to $\eta^2 = .27$ for correct writing sequences (CWS). Table 2 presents the univariate ANOVA results and the means and standard deviations for each measure by subgroup. Pair-wise comparisons (Bonferroni adjusted) indicated that the AP and ARP subgroups scored significantly lower than the TYP group on all of the writing measures. There were no significant differences between the two attention groups (AP vs. ARP) on measures of handwriting quality (HW), or on any of the fluency measures (TWW, WSC, CWS).

Nonparametric analyses were also conducted for the accuracy scores for spelling and overall writing (%WSC and %CWS) due to the atypical distribution of these variables within each subgroup. Results of the Kruskal-Wallis k-independent samples test revealed a significant difference between subgroups on both %WSC, $\chi^2(2, N = 80) = 22.64, p <.001$, and %CWS, $\chi^2(2, N = 80) = 19.48, p <.001$. Mann-Whitney $U$ tests were used to examine differences between the subgroups. Three planned follow-up comparisons were conducted and a Bonferroni correction was applied for the three comparisons (i.e., a significance level of $p = .05/3 = .0167$) to minimize Type 1 error (see Field, 2005). Results of the Mann Whitney $U$ comparisons indicated that the TYP group scored significantly higher than the AP and ARP groups on %WSC (TYP vs. AP, $U = 253.50, p = .002$; TYP vs. ARP, $U = 76.00, p <.001$) and %CWS (TYP vs. AP, $U = 297.00, p = .011$; TYP vs. ARP, $U = 79.00, p <.001$). The Mann Whitney $U$ comparisons
for the AP and ARP groups were not significant for %WSC, \((U = 166.50, p = .05)\) or %CWS \((U = 169.00, p = .06)\). See Table 2 for means and standard deviations.

Teacher ratings of writing. A multivariate analysis of variance was conducted to examine group differences (TYP, AP, and ARP) on the teacher ratings of writing (handwriting, spelling, and written expression) and overall language arts competence. A significant difference was found between the groups, Pillai's Trace = .71, \(F(8,146) = 10.12\), with a moderate effect size of \(\eta^2 = .36\). Follow up post hoc univariate ANOVAs indicated that the subgroups differed on teacher ratings of handwriting, spelling, written expression, and overall language arts competence (see Table 3). Effect sizes were moderate to strong, ranging from \(\eta^2 = .47\) for handwriting skills to \(\eta^2 = .56\) for written expression skills. Post-hoc Bonferroni comparisons indicated that the AP and ARP subgroups scored significantly lower than the TYP group on the teacher ratings of handwriting, spelling, written expression, and overall language arts score (see Table 3). Children with coexisting attention and reading problems (ARP group) scored significantly lower than children with attention problems only (AP group) on teachers’ ratings of spelling and written expression skills as well as teachers’ perceptions of overall language arts competence. The two attention problem groups (AP and ARP) did not differ significantly on teacher ratings of handwriting skills.

3.2 Partial Correlation Analyses: ADHD Symptom Dimensions and Writing Outcomes

Zero-order correlation analyses revealed that the average scores for Inattention (SWAN-ATT) and Hyperactivity (SWAN-HYP) were highly correlated, \(r = .82, p < .001\) with each other. Both the Inattention average score and the Hyperactivity average score were significantly correlated with all measures of writing (see Table 4). After controlling for age and Hyperactivity, Inattention was still significantly related to all writing outcomes with the
exception of the direct measure of handwriting quality. After controlling for Inattention and age, Hyperactivity was no longer significantly correlated to writing outcomes, with the exception of the direct measure of Handwriting quality, \( r = .29, p < .05 \) (see Table 4). The lack of association between Hyperactivity and most writing outcomes after controlling for Inattention and age should be interpreted cautiously due to the high correlation between Inattention and Hyperactivity and probable suppression effects. Specifically, after the variance associated with Inattention and age is removed from the relationship between Hyperactivity and writing, the remaining ‘residual’ for Hyperactivity may not actually represent the construct of Hyperactivity very effectively because too much shared variance between Inattention and Hyperactivity has been removed.

3.3 Supplementary Analyses

**Gender Differences.** Several studies have reported that girls outperform boys on measures of compositional fluency (Jewell & Malecki, 2005; Malecki & Jewell, 2003) and handwriting and orthographic automaticity (Berninger & Fuller, 1992; Berninger, Nielsen, Abbott, Wijsman, & Raskind, 2008b). Although the subgroups did not differ in gender distribution (see Table 1), an additional exploratory analysis was conducted to assess whether boys and girls performed similarly within each group. Thus, gender differences in writing outcomes were examined within groups using Mann Whitney \( U \) tests for the accuracy measures (%WSC and %CWS) and t-tests for all other measures. Results of the within group tests indicated that boys and girls were equivalent on most measures, however girls did perform significantly better than boys on two measures: (a) handwriting quality within the TYP group, \( t(32) = -3.32, p < .01 \), and within the AP group, \( t(26) = -3.79, p < .01 \); and (b) teacher ratings of written expression skills in the TYP group, \( t(32) = .28, p < .01 \). No significant gender differences were found for direct measures of spelling, compositional fluency, and accuracy or for teacher
ratings of handwriting, spelling and language arts competence within any groups. Due to insufficient sample size for girls across groups, gender was not included as a factor in group analyses. The means and standard deviations by gender and group as are reported in Appendix C for the direct measures of writing and Appendix D for the teacher ratings of writing.

Group differences were examined separately for boys and girls for the two measures in which girls outperformed boys (i.e., handwriting quality and teacher ratings of written expression). Analysis of variance was used to examine group differences for the boys. Due to small sample sizes of girls across groups, nonparametric Kruskall-Wallis tests with Mann-Whitney $U$ post hoc comparisons were conducted for girls. All post hoc comparisons were Bonferroni adjusted.

Consistent with the overall group results, a significant group effect was found for handwriting quality when examined among boys only, $F(2,53) = 9.43, p < .001, \eta^2 = .26$. Follow-up comparisons between the groups indicated that the AP group scored significantly lower than the TYP group on the direct measure of handwriting quality; the ARP group also scored lower than the TYP group but the difference was not statistically significant. As with the total sample, there was no significant difference between the AP group and the ARP group for handwriting quality.

A significant group effect was also found among boys for teacher ratings of written expression, $F(2,53) = 27.14, p < .001, \eta^2 = .51$. Consistent with the results for the total sample, follow up comparisons indicated that both attention problem subgroups (AP and ARP) received significantly lower teacher ratings than the typical (TYP) group, and the ARP group scored significantly lower than the AP group.

For the girls, a significant group effect was also found among girls for handwriting quality, $\chi^2 (2, N = 24) = 9.21, p = .01, \eta^2 = .40$. Follow up Mann-Whitney $U$ comparisons
indicated that the ARP group received significantly lower scores for handwriting quality than the TYP group ($U = 4.00, p = .011$). Although the AP group also scored lower than the TYP group on handwriting legibility, the difference was not significant. There was no significant difference between the AP and ARP groups. These findings are similar to those reported for the boys and the total sample.

A significant group effect was also found among girls for teacher ratings of written expression, $\chi^2 (2, N = 24) = 17.04, p = .003, \eta^2 = .74$. Again, consistent with the results for the total sample, follow up group comparisons indicated that both attention problem subgroups (AP and ARP) received significantly lower teacher ratings of written expression skills than the TYP group (i.e., TYP vs. AP, $U = 2.00, p < .001$; TYP vs. ARP, $U = 1.00, p = .003$). However, no significant differences were found between the attention problem subgroups (AP and ARP) for girls ($U = 11, p = .51$). This finding may be due to the small number of girls within the ARP group.

In summary, the results of this study reveal that inattentive behaviour is significantly related to written expression outcomes independent of word reading skills and hyperactivity-impulsivity. Findings for teacher ratings of handwriting, spelling, and written expression were generally consistent with the outcomes for direct measures (CBM) of writing. Specific areas of difficulty that were significantly related to attention problems include handwriting, spelling, compositional fluency accuracy and quality. Although, there were no significant differences between the attention groups (AP and ARP groups) on direct CBM measures of writing, the group with coexisting attention and reading problems (ARP) had significantly lower teacher ratings of spelling and written expression skills as well as overall language arts competence than the comparison and AR groups. In conclusion, results of the present study suggest that inattentive behaviour is directly related to all writing outcomes (see Table 4) with the exception
of the direct measure of handwriting quality. Thus the results of the partial correlation analyses suggest that handwriting quality is indirectly related to inattention through hyperactivity-impulsivity.
CHAPTER FOUR

DISCUSSION
This chapter is divided into four main sections. First, the specific findings are summarized in terms of text generation and transcription level outcomes and discussed in relation to previous research and possible underlying mechanisms of effect. The practical and theoretical implications of these findings are discussed in the second section. The limitations of the present study and directions for future research are discussed in the third section. The conclusion is presented in the final section.

4.1 Summary and Discussion of Results

The purpose of this study was to examine the influence of inattention on children’s writing skills and to assess whether attention problems were associated with weak writing skills independent of reading difficulties and symptoms of hyperactivity-impulsivity. Three hypotheses were tested. First, children with attention problems were expected have significantly poorer writing outcomes independent of word-reading skills than those without attention and reading problems. Second, children with coexisting attention and word-reading problems were expected to be significantly more impaired than children with attention problems only. Third, poor writing outcomes were expected to be significantly correlated to attention problems independent of (i.e., controlling for) hyperactivity-impulsivity symptoms. Three key findings emerged from the results. First, children with attention problems with and without coexisting word reading difficulties performed significantly poorer on all measures of written expression than children in the typical group. Second, children with coexisting attention and word-reading problems were only moderately more impaired than children with attention problems only. Finally, attention problems were significantly associated with written expression skills after controlling for hyperactivity-impulsivity. Hyperactivity was only significantly associated with handwriting quality after controlling for inattention. The lack of significant correlations between
Hyperactivity and most writing outcomes after controlling for Inattention and age is likely due to a suppressor effect thus should be interpreted cautiously.

The results indicated that writing difficulties associated with attention problems tend to be pervasive or otherwise nonspecific, such that multiple aspects of writing were impaired across both transcription and text generation levels including measures of handwriting quality, compositional fluency, spelling and compositional accuracy. More specifically, relative to typically developing children without attention or reading problems, children with attention problems (with or without reading problems) had lower quality handwriting, produced written narratives that were shorter (lower TWW scores), with a higher rate of errors in spelling (lower %WSC scores) and compositional accuracy (lower % CWS scores). Children with attention problems (with or without reading problems) also received lower teacher ratings for writing skills in handwriting, spelling and written expression as well as overall language arts competence. The specific findings at the levels of (a) transcription and then (b) text generation and their relation to previous research are discussed more thoroughly in the next section.

4.1.1 Transcription Level Outcomes

**Spelling.** Consistent with the first hypothesis, children with attention problems with and without word reading problems scored significantly lower on the direct measure of spelling accuracy (%WSC). They also wrote significantly fewer correctly spelled words (WSC), and received significantly lower teacher ratings for spelling skills than peers without attention or reading problems. These results are consistent with previous findings that children with ADHD write stories with more spelling errors (Mathers, 2006; Re et al., 2007; Resta & Elliot, 1994). Although no statistically significant differences were found between the attention problem subgroups (AP and ARP) on the direct CBM measures of spelling, children with coexisting attention and reading problems tended to receive lower scores than the attention problem only
subgroup. This tendency was supported by significantly lower teacher ratings of spelling for children with coexisting attention and reading problems than for those with attention problems only. Thus, the second hypothesis that coexisting attention and word level reading problems would be associated with significantly poorer spelling scores than attention problems only was partially confirmed. Furthermore, inattention was significantly related to poor spelling outcomes after controlling for hyperactivity-impulsivity as predicted by the third hypothesis.

The finding that children with attention deficits demonstrate significant spelling problems in the written compositions despite normal word reading skills may be partially explained by the results of a recent study that analyzed the transcription skills of Hebrew-speaking children with ADHD (Adi-japha et al., 2007). Specifically, boys with ADHD, who had normal reading skills, were found to display a unique pattern of spelling errors known as graphemic buffer errors (e.g., letter insertions, substitutions, transpositions and omissions). Graphemic buffer errors are thought to be due to attentional problems, whereas phonological spelling errors are related to linguistic deficits (Adi-japha et al., 2007). According to this explanation children with coexisting attention and linguistic (i.e., word reading) deficits would be expected to produce more phonological and graphemic spelling errors relative to children with either attention or wording reading problems alone. Although the present study did not examine the types of spelling errors the children made in their compositions, children with coexisting attention and reading problems had a slightly higher rate of spelling errors and significantly lower teacher ratings of spelling skills than children with attention problems only. Considering the findings of Adi-japha et al. it may be possible that some of the spelling errors displayed by children with attention problems only in the present study were a product of “attention-related grapheme buffer errors” (i.e., difficulty correctly forming written letters) rather than “phonologically-related spelling errors”. Furthermore, children with attention
problems and normal word-reading skills may struggle more with spelling when they are coping with the demands of handwriting together with generating text due to the added strain on working memory.

Handwriting. In the present study, handwriting quality was evaluated in terms of letter legibility and overall uniformity of written text on the page. Handwriting skills in general were also rated by each student’s classroom teacher. Compared to the typical group, the attention problem subgroups (both AP and ARP) received significantly lower scores for handwriting (i.e., objective measures and teacher ratings) with no significant differences between the AP and ARP groups. These results indicate that poor handwriting quality is associated with attention problems independent of word reading difficulties. The present findings are consistent with previous research identifying problems with handwriting in children with ADHD (Adi-japha et al., 2007; see Racine et al., 2008 for a review, Schoemaker et al., 2005). For example, in a recent review of research concerning handwriting in children with ADHD, Racine et al. concluded children with ADHD have impaired handwriting characterized by poor legibility and inappropriate speed of execution compared to typical children.

Schoemaker et al. (2005) examined whether the handwriting difficulties associated with ADHD might be a result of impaired motor control processes, (i.e. motor planning and parameter setting). They had children with and without ADHD copy figures of increasing complexity under increasing accuracy levels on a digitizer. Although the motor planning performance of children with ADHD appeared normal, Schoemaker et al. found evidence for a specific deficit in parameter setting as well as a general fine motor control problem. Specifically, these children were unable to successfully adapt task performance when more accurate strokes were required (i.e., parameter setting). They also showed slower, more inaccurate goal-directed strokes with higher axial pen force across all graphic tasks (i.e., general
fine motor control). Poor inhibitory control (i.e., attention/EF weaknesses) and developmental delays related to fine motor control were proposed as possible explanations for the graphic output deficits displayed by children with ADHD (Schoemaker et al). None of the studies reviewed by Racine et al. (2008), nor Shoemaker et al., specifically explored whether the handwriting difficulties associated with ADHD were more associated with the inattentive or hyperactive-impulsive symptom dimension of ADHD or controlled for coexisting reading difficulties.

In the present study, the results of zero-order correlations initially revealed that poor handwriting was strongly correlated with both inattention and hyperactivity-impulsivity (i.e., $r = .60$ and $.61, p < .001$); however inattention was no longer significantly related to handwriting when the effects hyperactivity-impulsivity were controlled. These results suggest that handwriting quality may be indirectly related to inattention through symptoms of hyperactivity-impulsivity. The finding that poor handwriting quality is related to hyperactivity and not inattention is inconsistent with a recent study that reported that that inattention was more related to weaknesses in fine motor skills (as indexed by a parent rating scale) than hyperactivity (Fliers et al., 2008). This inconsistency in findings may be because the present study directly assessed handwriting quality, whereas Fliers et al. relied on a rating scale that addressed other skills. The results of partial correlation analyses in the present study should be interpreted cautiously considering that the zero-order correlations indicated that inattention and hyperactivity were highly correlated with each other, and with each of the writing outcomes. In summary, the poor handwriting quality demonstrated by children with attention problems in this study, and in previous studies of ADHD, may be a result of developmental delays or deficits in a range of processes including fine motor control, orthographic coding, or EF skills (see Schoemaker et al., 2005; and Racine et al., 2008 for review).
Few studies have examined the relationship between handwriting quality and composition skills among children with attention problems. Instead, previous studies have generally focused on the relationship between compositional quality and handwriting fluency as opposed to handwriting quality or legibility (e.g., Graham et al., 1997). For example, Re et al. (2007) examined handwriting fluency (i.e., a timed copy task) in youth with and without ADHD symptoms and found no significant differences on the timed copy task. However, the two groups differed on measures of writing fluency and accuracy. Research is needed to examine whether difficulties producing legible handwriting may influence other aspects of writing such as accuracy and handwriting fluency (e.g., Jones & Christensen, 1999), and may therefore account for some of the weaknesses in written spelling, compositional fluency, and accuracy demonstrated by children with attention problems in the present study. Furthermore, handwriting legibility and spelling can affect a teacher’s judgement about overall writing quality and a students’ ability to compose (e.g., Chase, 1986; Graham, 1999; Rosenblum et al., 2003). Research is needed to examine the relationship between standardized assessments of handwriting quality and handwriting fluency and compositional quality in children with attention problems; such research may help identify key areas to target for intervention.

4.1.2 Text Generation Level Outcomes

Compositional fluency and quality. In the present study, children with attention problems, with and without word reading problems (ARP and AP groups), wrote stories with significantly fewer words, and significantly more errors (including incorrect grammar and punctuation) than children in the typical group. Teacher ratings of written expression skills were also significantly lower for both attention problem groups (AP and ARP) than for the typical group (TYP). Children with coexisting attention and reading problems received significantly lower teacher ratings of written expression skills compared to children with attention problems
only. Although there was a tendency for children with coexisting attention and reading problems to have lower scores for compositional accuracy than the AP subgroup, these two subgroups did not differ significantly on direct measures of compositional fluency or accuracy. Additionally, attention problems were found to be significantly related to all measures reflecting text generation skills (i.e., direct measures of compositional fluency, quality, accuracy and teacher ratings of written expression skills) after controlling for the effects of age and hyperactivity-impulsivity through partial correlation analyses. Thus, the results of the present study suggest that poor written expression outcomes are directly related to attention problems independent of word-reading skills and hyperactivity-impulsivity.

These results are generally consistent with previous findings that children with ADHD write stories with fewer words and more errors (Re et al., 2007; Resta & Elliot, 1994); the present study however, provides further evidence concerning the relative influence of word-reading skills and ADHD symptom dimension. These results are also generally consistent with recent findings regarding the prevalence and co-morbidity of learning disabilities in written expression (defined using IQ-discrepancy) among children with ADHD (Mayes & Calhoun, 2007a). Mayes and Calhoun demonstrated that written expression disabilities frequently occur in students with ADHD without co-morbid reading disabilities. In a sample of 242 children with ADHD they found that almost 50% of the children demonstrated significant impairment in written expression alone; whereas only 14% presented with both reading and written expression disabilities, and 4% were identified with RD alone. Thus, even with average or better reading skills, children with attention-deficits appear to be at significant risk for written expression disabilities. Given the apparent prevalence of writing weaknesses in children with attention deficits, it may be beneficial to assess the written expression skills of students who exhibit inattentive behaviour and target this group for special instruction.
4.1.3 Language Arts Competence.

In present study the attention problem groups, both with and without reading difficulties (ARP and AP) received significantly lower scores for overall language arts competence compared to the typical group (TYP). Children with co-existing attention and reading problems scored significantly lower than children attention problems only. These results indicated that children with attention problems experience significant academic risk in overall language arts even when they have average or better word-reading skills. Poor overall language arts scores are likely a consequence weaknesses in written language skills, or perhaps higher-level reading skills (e.g., reading comprehension).

4.1.4 General Summary and Discussion

Importantly, the present findings indicate that even children who exhibit mild to moderate (subclinical) levels of inattention, and normal word-reading skills demonstrate significantly poorer written expression skills than children with normal levels of attention and word-reading skills. It may be that children with attention problems are particularly impaired when a timed measure of composing is used because it may place extra demands on their cognitive resources. However, it bears consideration that the group differences and effect sizes found for teacher ratings of writing skills were greater than those found for the timed measure of writing, perhaps because most classroom based writing activities also tend involve time constraints.

Furthermore, given that handwriting skills contribute to compositional skills (e.g., Graham et al., 1997; Graham et al., 2000; see Rosenblum et al., 2003 for review), the handwriting difficulties exhibited by children with attention problems may negatively impact overall written expression proficiency and academic performance of children with attention problems. Poor quality handwriting has also been shown to negatively affect teacher’s
perceptions of the content of written work (e.g., Graham & Perin, 2007). In general, difficulties with handwriting have been reported to cause a significant degree of impairment in academic life for children (Graham et al., 1997; see Rosenblum et al., 2003 for review). Future research is needed to clarify the mechanisms through which inattentive behaviour is related to poor written expression and identify target areas for intervention and accommodation.

4.2 Implications for Research, Theory and Practice

Implications for Research. The hypothetical inattention-writing model shown in Figure 2 attempts to represent and integrate the findings of the present thesis study together with the literature concerning written expression development, and the literature on writing difficulties and ADHD that was reviewed for this thesis. The purpose of the model in Figure 2 is to describe how inattention may be related to poor writing outcomes, and to pose questions for future research. Also, the figure identifies key areas to consider when assessing written expression difficulties in children with attention problems. The relationships between attention problems and writing outcomes illustrated in Figure 2 are not causal or exhaustive. The key point demonstrated by this diagram is that the relationship between inattention and written expression difficulties is likely multi-faceted and more research is needed to clarify this relationship.

For example, as shown in Figure 2, inattention may be indirectly related to poor transcription level outcomes either through coexisting reading weaknesses or coexisting symptoms of hyperactivity-impulsivity. Alternatively, inattention may directly related to poor writing outcomes independent of coexisting word reading weaknesses and symptoms of hyperactivity-impulsivity. Given that attention problems are often highly correlated with hyperactivity-impulsivity symptoms (e.g., A.P.A. DSM-IV, 2000) and poor reading skills (e.g., Dally, 2006), bidirectional arrows are shown in Figure 2 joining attention problems to
hyperactivity-impulsivity and reading weaknesses. In consideration of the evidence that word reading ability is related to transcription skills, particularly spelling (e.g., Berninger, Abbott, et al., 2002), Figure 2 also shows an arrow connecting reading weaknesses directly to written spelling and transcription level difficulties to indicate that poor spelling may be due to coexisting word reading weaknesses. Further research is needed to isolate and examine how word reading weaknesses and hyperactivity-impulsivity influence written expression in children with and without attention problems.

The results of the present study suggest that poor handwriting quality may be directly related to hyperactivity-impulsivity symptoms independent of inattention, and thus Figure 2 also shows an arrow connecting hyperactivity-impulsivity symptoms directly to handwriting quality and transcription level difficulties. However, Figure 2 also shows an arrow connecting attention problems directly to handwriting quality in consideration of conflicting evidence which suggests that symptoms of inattention and not hyperactivity-impulsivity are related to poor fine motor control (e.g., Fliers et al., 2008; Pitcher et al., 2002), which is important for handwriting (e.g., Feder & Majnemer, 2007). The arrow shown connecting handwriting quality to written spelling represents the untested hypothesis that poorly formed letters or otherwise illegible writing (e.g., poor letter spacing and orientation) may impair the written spelling accuracy of children with attention problems with or without underlying spelling difficulties. Further research is needed to clarify the relationship between inattention and handwriting quality and examine the extent to which handwriting quality contributes to written spelling and text generation skills.

Figure 2 shows a direct connection between attention problems and transcription level difficulties (e.g., difficulty producing correct letter forms, or poor spelling), as well as direct connection between attention problems and text generation level difficulties such as poor compositional fluency (i.e., writing little under time constraints), or poor compositional...
accuracy (i.e., producing careless errors in written work). However, it is unknown whether attention problems are related to text generation level difficulties (i.e., poor compositional fluency and composition accuracy) because of transcription level difficulties, or in addition to transcription level difficulties. Research is needed to examine the effects of transcription skill deficits on writing fluency and quality in children with attention problems. Such research has important implications for preventing and remediating written expression difficulties among children with attention problems.

Finally, weaknesses in attention, graphomotor skills, and processing speed have been reported to be associated with lower levels of academic achievement of children with ADHD (Mayes & Calhoun, 2007b). It may be that writing tasks require more time and effort for children who experience difficulties at the level of transcription (handwriting or written spelling) and/or problems with compositional fluency and consequently reduce the amount of written work completed relative to other children. This is reflected in Figure 2 by arrows connecting transcription level difficulties and compositional fluency to ‘time and effort to complete work’. Studies are needed to assess the contribution of writing proficiency to children's productivity and overall academic performance, particularly among children with attention problems. It is hoped that the Inattention-Writing model presented in Figure 2 may be useful to educators and researchers interested in understanding and assessing written expression difficulties in children with attention problems.

**Implications for Theory and Practice.** As predicted, based on the Simple View of Writing (e.g., Berninger & Amtmann, 2003), children in the present study who demonstrated poor attention control in the classroom demonstrated pervasive writing difficulties. The Simple View of Writing postulates that written expression performance at the level of text generation (see Figure 1) relies on high levels of WM, EF (attention-control), and transcription skills. Thus
weaknesses in attention control, or any of the other components, may impair written expression at the text generation level. Although the Simple View of Writing attributes an important role to attention-control in children’s writing development (Berninger & Amtmann, 2003), few studies have examined the role of inattention in children’s writing with English-speaking children. On the other hand, inattention, but not hyperactivity, was found to be related to writing outcomes in one study that examined reading and writing in a sample of children with dyslexia (Thomson et al., 2005). The results of the present study therefore make a novel contribution to the literature on children’s writing development by providing support for the role of attention in writing theory in a community-based sample of children.

The results of the present study also have important clinical and educational implications concerning the identification, prevention, remediation, and possible aetiology of written expression difficulties in children with and without poor word-reading skills. Previous research suggests that significant written expression difficulties frequently go “unrecognized and untreated” (e.g., Berninger, Mizokawa, et al., 1991; Berninger et al., 2008a), and that the prevalence of writing disabilities is particularly high in students with ADHD (Mayes et al., 2005; Mayes & Calhoun, 2006; 2007a). The present results suggest that inattentive behaviour, even at subclinical levels, may be an important predictor of written expression proficiency. Thus, to improve the rate of identification, prevention and remediation of written expression difficulties, it may be helpful to identify primary grade children with attention problems and screen them for written expression difficulties. In order to promote and support the academic success of students with attention problems and writing weaknesses, it may be helpful to develop targeted instructional strategies for this group to prevent further deterioration of written expression skills and academic impairments.

In view of the weaknesses demonstrated by children with attention problems in the
present study on measures of transcription, compositional fluency and accuracy, these students may benefit from targeted instruction to improve accuracy and automaticity of transcription skills including handwriting and/or keyboarding skills (Berninger et al., 1997; Berninger, Vaughn, et al., 2002; Graham, 1999; Graham et al., 1997; Jones & Christensen, 1999).

Instruction targeted to the accuracy and automaticity of transcription skills has been reported to improve composition fluency and quality (Berninger et al., 1997; Berninger, Vaughn, et al., 2002; Graham, 1999; Graham et al., 1997; Graham et al., 2000; Jones & Christensen, 1999). Additionally, adaptations and accommodations that reduce or remove the mechanical constraints of written expression may help to free up limited attentional and cognitive resources (i.e., EF and WM) and facilitate text generation at the word, sentence and discourse level of composing (Berninger et al., 1997; Berninger, Vaughn, et al., 2002; Cobb et al., 1992; Graham et al., 1997, 2000).

For example, students who are able to dictate their texts, or use technological assistance (e.g., word processor), may be able to focus more on higher level writing processes than transcription (Graham & Harris, 2003). Furthermore, prior research has shown that students with LD produce significantly longer and better quality stories when they dictate stories rather than write them by hand (Graham, 1990; MacArthur, & Graham, & Scarvold, 1987). However, children with ADHD have been found to exhibit significant deficits in producing coherent oral narratives (e.g., Flory et al., 2006; Purvis & Tannock, 1997; Tannock, Purvis, & Schachar, 1993), thus this strategy alone may improve their fluency, but not necessarily the quality of their writing. Additional support or training related to producing cohesive narratives may be needed.

Recently, Re et al. (2008) demonstrated that a guided facilitation intervention for composing a letter produced significant improvements in the length and quality of letters written by children with and without ADHD symptoms. However, the quality of letter writing by
children with ADHD symptoms was still significantly poorer than children without ADHD symptoms after the guided facilitation training (Re et al., 2008). Some additional tools and strategies that may be helpful include computer software for transcribing voice-to-text, reading back typed text, and correcting spelling. Research, however, is needed to assess the impact of these tools with children with attention problems (Berninger & Amtmann, 2003).

In addition, children with attention problems may benefit from direct instruction in metacognitive strategies, staging of writing, self-monitoring, and mnemonic devices for regulating the writing process and reducing memory demands during writing (e.g., De LaPaz, 2001; Graham & Harris, 2000, 2003; Graham, Harris, & Mason, 2005; Lienemann & Reid, 2008; Reid & Lienemann, 2006, Re et al., 2008). The effectiveness of self regulated strategy development (SRSD) (Graham & Harris, 2000) among students with ADHD has been demonstrated in small-scale intervention studies with moderate success (De LaPaz, 2001; Lienemann & Reid, 2008; Reid & Lienemann, 2006). The efficacy of SRSD for improving written expression of students with LD is widely documented (Graham & Harris, 2003; Graham et al., 2005). Attention training paired with writing instruction has been reported to improve the composition skills of children with dyslexia (Chenault et al., 2006). Research is needed to identify instructional strategies that support the written expression development of children with attention problems.

Finally, this study also has practical implications for assessment in both research and education. The findings of the present study provide further evidence that CBM assessment of written language is a valid measure of students' written expression performance (e.g., Weissenburger & Espin, 2005). Furthermore, the present findings also provide more evidence for the validity of CBM writing measures to detect differences in writing proficiency among at risk groups of children (e.g. Parker et al., 1991a). Also, teachers may be able to more easily
interpret and make use of the present findings because the present study utilized CBM measures of writing that can be easily administered and interpreted by teachers. Thus an advantage of the present study is that it utilized measures with ecological validity and obvious educational utility.

4.3 Limitations and Directions for Future Research

Findings of the present study must be considered in light of the following limitations. The first limitation of the study is related to the handwriting assessment. The direct measure of handwriting was assessed solely by analyzing the visual presentation of the text in the writing samples. Unfortunately, it was not possible to directly assess handwriting and its various dimensions of independent of the composing process. Independent, objective measures of handwriting subskills, such as orthographic coding and copy fluency, would have been useful to assess in order to potentially isolate, understand, or rule-out specific skill deficits underlying handwriting difficulties and attention problems. For example, difficulties with handwriting may arise from a variety of different underlying deficits including difficulty coordinating the overall writing process due to limited cognitive resources, poor fine motor control, poor orthographic coding, poor executive control or a combination of such deficits (Feder & Majnemer, 2007).

Along a similar vein, future studies should distinguish between phonological spelling errors and graphemic buffer errors to determine whether the transcription difficulties of children with attention problems are related to linguistic errors, attention problems or both (Adi Japha et al., 2007; Re et al., 2007).

A second limitation of this study was that due to insufficient sample size across groups (i.e., $n = 5$ for Reading Problems only group) and gender (i.e., $n = 4$ for girls vs. $n = 13$ for boys for ARP) it was not possible to: (a) assess the interaction between group and gender and (b) assess the characteristics of the reading problem only group (RP) relative to the attention problem groups (i.e., AP and ARP). A recent study examined gender differences and EF in
writing among children with dyslexia and reported that boys were significantly more impaired than girls with respect to both EF (i.e., sustained attention/switching tasks) and writing (Berninger et al., 2008b). Further research is needed to examine gender differences in written expression within samples of children with attention deficits or ADHD.

An additional limitation of this study was that only a single writing sample was collected from each child, and the writing samples were quite short (about 3 to 5 sentences on average). The brevity of the writing samples provided limited material to assess, and thus may have reduced the sensitivity of the measures to subtle group differences, for example between the AP and ARP groups. Furthermore, the use of more sophisticated writing measures (e.g., sentences, content, cohesion, overall writing quality, etc.) was impractical given length of the samples collected. It should be noted however, that CBM measures of writing have been found to effectively capture students academic functioning in written expression skills (see review by McMaster & Espin, 2007). Future research should consider obtaining multiple and/or longer writing samples in different genres to provide for a more in-depth assessment of writing ability in children with attention problems using a range of tasks (e.g., see Schoonen, 2005).

Furthermore, children with clinical levels of inattention (i.e., ADHD) often exhibit weaknesses in oral language skills related to EF deficits and difficulties producing coherent oral narratives (Flory et al., 2006; Purvis & Tannock, 1997; Tannock et al., 1993). Hence, it would be advisable to investigate EF-related language factors such as planning, goals, organization, cohesion, problem solving, and idea generation in writing among older students with attention problems.

Finally, it bears consideration that the students with attention problems were selected for the larger intervention study because they exhibited attention and academic problems; however, they did not have to exhibit writing difficulties. Also, for the present study, the relations between
reading and attention and writing within this sample were of particular interest, not just whether they had deficits. Furthermore, the subjective teacher ratings of attention (SWAN scale) used to differentiate the groups in the present study could have been confounded by students’ academic performance (or vice versa), thereby contributing to the strong relationship between attention scores and ratings of writing skills and language arts competence. However, the validity of these measures in the present study was supported because teacher ratings of inattention correlated significantly with parent ratings of inattention, and teacher ratings of writing skills were consistent with objective CBM writing scores. Future studies should consider inclusion of objective measures of attention (e.g., neuro-cognitive measures of WM, EF, and processing speed). Such measures would be useful to validate the teacher attention scores as well as to potentially isolate and explain the underlying mechanism through which inattentive behaviour is related to poor writing outcomes.

4.4 Conclusion

The present study illustrates that children with mild to severe attention problems exhibited weaknesses in all areas measured including handwriting quality, spelling, compositional fluency, accuracy, and general written expression across both direct measures and teacher ratings of writing. These weaknesses were evident even among those children with attention problems who did not have word-level reading impairments. This finding suggests that attention may be important in early written expression and it confirms the first hypothesis. The second hypothesis, that coexisting attention and reading problems would be associated with significantly greater impairment in written expression than attention problems alone, was only partially confirmed as there were no significant differences between the attention groups (AP and ARP groups) on the objective CBM measures of writing. However, children with coexisting attention and reading problems did exhibit significantly lower teacher ratings of spelling and
written expression skills as well as overall language arts competence compared to those children in the AP group.

Finally, the third hypothesis that inattentive behaviour would be directly related to all writing outcomes independent of hyperactivity-impulsivity was confirmed by for all but one outcome measure. After controlling for age and hyperactivity-impulsivity, inattention was still directly related all measures of writing except for direct measures of handwriting quality. Furthermore, handwriting quality was the only measure that continued to be significantly related to hyperactivity-impulsivity after controlling for age and inattention.

The results of the present study extend prior research concerning written expression skills of children with ADHD symptoms (Elbert, 1993; Mayes et al., 2000; Mayes & Calhoun, 2007a; Re et al., 2007; 2008) by demonstrating an association between inattention and written expression difficulties in a non-clinical English-speaking sample. It is hoped that the findings from this study may help to understand and prevent written expression difficulties in students with and without attention problems and encourage further exploration of this area.


Exceptional Children, 16, 99-104.


Rowe, K., Pollard, J., & Rowe, K. (2005) *Literacy, behavior, and auditory processing: Does teacher professional development make a difference?* Australian Council for Educational Research. (Background paper to Rue Wright Memorial Award presented at the Royal Australasian College of Physicians Scientific Meeting Wellington, New Zealand, 8-11 May 2005.)


Table 1.  

**Sample Characteristics across Groups**

<table>
<thead>
<tr>
<th></th>
<th>TYP (1)</th>
<th></th>
<th></th>
<th></th>
<th>AP (2)</th>
<th></th>
<th></th>
<th>ARP (3)</th>
<th></th>
<th>Differences</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
<td>n</td>
<td>M</td>
<td>SD</td>
<td>n</td>
<td>M</td>
<td>SD</td>
<td>n</td>
<td>F(2, 77)</td>
</tr>
<tr>
<td>Gender (%boys)</td>
<td>62%</td>
<td>75%</td>
<td>78%</td>
<td>na</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parent Ed. a</td>
<td>4.33</td>
<td>1.02</td>
<td>29</td>
<td>3.72</td>
<td>1.17</td>
<td>25</td>
<td>4.38</td>
<td>0.89</td>
<td>13</td>
<td>3.08</td>
</tr>
<tr>
<td>Age</td>
<td>8.25</td>
<td>1.27</td>
<td>29</td>
<td>7.99</td>
<td>1.19</td>
<td>25</td>
<td>8.63</td>
<td>0.87</td>
<td>13</td>
<td>2.43</td>
</tr>
<tr>
<td>WASI</td>
<td>51.62</td>
<td>8.74</td>
<td>29</td>
<td>50.44</td>
<td>9.61</td>
<td>25</td>
<td>49.15</td>
<td>9.34</td>
<td>13</td>
<td>.71</td>
</tr>
<tr>
<td>ASL</td>
<td>15.03</td>
<td>3.29</td>
<td>29</td>
<td>13.80</td>
<td>4.37</td>
<td>25</td>
<td>15.08</td>
<td>4.05</td>
<td>13</td>
<td>1.24</td>
</tr>
<tr>
<td>TOWRE</td>
<td>105.66</td>
<td>12.44</td>
<td>29</td>
<td>102.04</td>
<td>8.49</td>
<td>25</td>
<td>79.15</td>
<td>7.53</td>
<td>13</td>
<td>46.78***</td>
</tr>
<tr>
<td>SWAN Inattention</td>
<td>-1.33</td>
<td>0.97</td>
<td>29</td>
<td>1.10</td>
<td>0.61</td>
<td>25</td>
<td>1.25</td>
<td>0.51</td>
<td>13</td>
<td>102.89***</td>
</tr>
<tr>
<td>SWAN Hyperactivity</td>
<td>-1.09</td>
<td>1.12</td>
<td>29</td>
<td>0.52</td>
<td>0.97</td>
<td>25</td>
<td>0.93</td>
<td>0.89</td>
<td>13</td>
<td>25.26***</td>
</tr>
</tbody>
</table>

Note: TYP = Typical attention and reading, AP = Attention problems only, ARP = Attention and reading problems, WASI = Wechsler Abbreviated Scale for Intelligence-Matrices subtest measures nonverbal IQ, TOWRE = Test of Word Reading Efficiency; ASL = Auditory Sentence Length Task; SWAN = Strength and Weaknesses of Attention Deficit/Hyperactivity-Impulsivity Disorder and Normal Behaviour.

a Gender distribution was equivalent across groups: Pearson $\chi^2(2, N = 80) = 1.95, p > .05$

b Parent education values: 1 = Grades 0-8, 2 = Grades 9-11, 3 = High school/GED, 4 = Some college, 5 = College graduate, 6 = Post-college degree, value presented is the average

*p<.05, **p<.01, ***p<.001
| Group Differences on Handwriting Quality and the CBM Assessments of Written Expression |
|---------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
|                                 | 1. TYP           | 2. AP           | 3. ARP          | df             | F^b             | Post hoc^d       | η^2b            |
|                                 | \( (n = 34) \)   | \( (n = 28) \)  | \( (n = 18) \)  |                |                 |                 |                 |
| \( M \)                         | 1.33             | 2.39            | 2.39            | 2, 77          | 13.35***        | 1 > 2, 3        | .26             |
| \( SD \)                        | .83              | .81             | .63             |                 |                 |                 |                 |
| *Handwriting quality*           |                 |                 |                 |                 |                 |                 |                 |
| HW                              | 3.31             | 2.39            | 2.39            | 2, 77          | 9.33***         | 1 > 2, 3        | .20             |
| Fluency scores                  |                 |                 |                 |                 |                 |                 |                 |
| TWW                             | 32.03            | 20.07           | 20.28           | 2, 77          | 11.68***        | 1 > 2, 3        | .23             |
| WSC\(^a\)                       | 28.47            | 15.75           | 13.94           | 2, 77          | 14.21***        | 1 > 2, 3        | .27             |
| CWS\(^a\)                       | 25.47            | 12.21           | 10.00           | 2, 77          |                 |                 |                 |
| *Accuracy scores*               |                 |                 |                 |                 |                 |                 |                 |
| %WSC                            | 86%              | 76%             | 66%             | 2, 80          | 22.64***        | 1 > 2, 3        | .29             |
| %CWS                            | 68%              | 54%             | 43%             | 2, 80          | 19.48***        | 1 > 2, 3        | .25             |

*Note:* TYP = Typical attention and reading, AP = Attention problems only, ARP = Attention and reading problems, HW = Handwriting, TWW = words written, WSC = words spelled correctly, CWS = Correct writing sequences, %WSC = WSC/TWW, %CWS = CWS/total writing sequences.

\(^a\) Square root transformation applied to normalize distribution but raw scores are presented to facilitate interpretation.

\(^b\) F values and effect size are for follow-up univariate ANOVAs.

\(^c\) Reported results for group differences in the accuracy scores were computed using nonparametric Kruskal-Wallis tests; Mann Whitney U were employed for post hoc pair-wise comparisons.

\(^d\) Bonferroni adjusted for multiple comparisons.

*p < .05, **p < .01, ***p < .001*
Table 3.

*Group Differences on the Teacher Ratings of Written Expression Skills and Language Arts*

<table>
<thead>
<tr>
<th></th>
<th>1. TYP (n = 34)</th>
<th>2. AP (n = 27)</th>
<th>3. ARP (n = 16)</th>
<th>Differences</th>
<th>( F^{b} )</th>
<th>Post-hoc (^{c} )</th>
<th>( \eta^{2} ) (^{b} )</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Literacy Rating Scale</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Handwriting</td>
<td>3.71 0.84</td>
<td>2.33 0.83</td>
<td>1.81 0.75</td>
<td>33.64***</td>
<td>1 &gt; 2, 3</td>
<td>.47</td>
<td></td>
</tr>
<tr>
<td>Spelling</td>
<td>3.76 0.89</td>
<td>2.48 0.85</td>
<td>1.44 0.63</td>
<td>46.36***</td>
<td>1 &gt; 2, 3; 2 &gt; 3</td>
<td>.55</td>
<td></td>
</tr>
<tr>
<td>Written expression</td>
<td>3.56 0.82</td>
<td>2.26 0.66</td>
<td>1.56 0.73</td>
<td>48.28***</td>
<td>1 &gt; 2, 3; 2 &gt; 3</td>
<td>.56</td>
<td></td>
</tr>
<tr>
<td><strong>Academic Competence Evaluation Scale</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Language Arts</td>
<td>40.26 7.77</td>
<td>28.52 6.45</td>
<td>22.69 5.55</td>
<td>44.35***</td>
<td>1 &gt; 2, 3, 2 &gt; 3</td>
<td>.54</td>
<td></td>
</tr>
</tbody>
</table>

Note: TYP = Typical attention and reading, AP = Attention Problem only, ARP = Attention + Reading Problems.

\(^{a}\) Teacher rating data was unavailable for 3 children.

\(^{b}\) \( F \) values and effect size are for follow-up univariate ANOVAs, \( df = 2, 77 \).

\(^{c}\) Bonferroni adjusted for multiple comparisons.

\(* p < .05, ** p < .01, *** p < .001\)
Table 4.

Zero-order and Partial Correlations for Inattention and Hyperactivity across Writing Variables

<table>
<thead>
<tr>
<th></th>
<th>Zero-order Correlations</th>
<th></th>
<th>Partial Correlations</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Age</td>
<td>Inattention</td>
<td>Hyperactivity</td>
<td>Inattention b</td>
</tr>
<tr>
<td>Age</td>
<td>_</td>
<td>.04</td>
<td>.06</td>
<td>_</td>
</tr>
<tr>
<td>Inattention</td>
<td>_</td>
<td>_</td>
<td>.82***</td>
<td>_</td>
</tr>
<tr>
<td>CBM writing variables</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HW</td>
<td>.28*</td>
<td>- .60***</td>
<td>- .61***</td>
<td>-.21</td>
</tr>
<tr>
<td>TWW</td>
<td>.58***</td>
<td>-.43***</td>
<td>-.33**</td>
<td>-.30**</td>
</tr>
<tr>
<td>WSC</td>
<td>.59***</td>
<td>-.48***</td>
<td>-.37**</td>
<td>-.33**</td>
</tr>
<tr>
<td>CWS</td>
<td>.57***</td>
<td>-.50***</td>
<td>-.37**</td>
<td>-.38***</td>
</tr>
<tr>
<td>%WSC</td>
<td>.36**</td>
<td>-.46***</td>
<td>-.39***</td>
<td>-.27*</td>
</tr>
<tr>
<td>%CWS</td>
<td>.36**</td>
<td>-.44***</td>
<td>-.33**</td>
<td>-.30**</td>
</tr>
<tr>
<td>Teacher ratings of writing skills</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Handwriting</td>
<td>-.06</td>
<td>-.78***</td>
<td>-.63***</td>
<td>-.59***</td>
</tr>
<tr>
<td>Spelling</td>
<td>-.14</td>
<td>-.75***</td>
<td>-.58***</td>
<td>-.59***</td>
</tr>
<tr>
<td>Written Expression</td>
<td>-.10</td>
<td>-.80***</td>
<td>-.62***</td>
<td>-.65***</td>
</tr>
<tr>
<td>Language Arts</td>
<td>-.08</td>
<td>-.77***</td>
<td>-.56***</td>
<td>-.65***</td>
</tr>
</tbody>
</table>

Note: HW = Handwriting, TWW = Total words written, WSC = Words spelled correctly, CWS = Correct writing sequences, %WSC = WSC/TWW, %CWS = CWS/Total writing sequences, Inattention = teacher ratings on Inattention Subscale of the Strength And Weaknesses of Attention Deficit/Hyperactivity-Impulsivity Disorder And Normal Behaviour (SWAN) scale, Hyperactivity = teacher ratings on Hyperactivity-Impulsivity Subscale of SWAN.

a Square root transformed.
b Covarying age and hyperactivity-impulsivity.
c Covarying age and inattention.

*p<.05, **p<.01, ***p<.001
APPENDIX A

Scoring procedures and examples of scored writing samples
Scoring Procedures for CBM Writing Samples in Present Study

Note: scoring procedures used in this study were compiled by the author based on published studies that utilized CBM measures or analyzed handwriting (e.g., Jewel & Malecki, 2005; Parker et al., 1991; Gansle et al., 2004; Rosenblum et al., 2003; Wright, 1992)

Directions for scoring
Children's writing samples are to be scored using procedures described below to provide an index of children's writing fluency (production dependent scores), accuracy (production independent scores), legibility (handwriting scale), and overall quality (CWS). Score samples from the same grade at a time. Start with the fastest and easiest measures: 1) Handwriting, 2) Total words and 3) Total words spelled correctly, 4) Correct and Total writing sequences (CWS & TWS). Staple the provided slips of paper to the sample to record the scores and please identify special characteristics of the writing sample not captured in the scores in the space for notes on the slip. Keep a log of any dilemmas/issues you have scoring the data; Include the subject number, type of issue and if and how you resolved it.

1. Handwriting (HW): Use the scale below to assess the visual presentation of the writing sample based on a) legibility of letters written and b) uniformity of written product; these two scores will be combined to provide a score for overall visual presentation of the writing sample. (1= well below avg, 2= below avg, 3= avg, 4= above avg, 5= well above avg)

<table>
<thead>
<tr>
<th>Score</th>
<th>Letter legibility (letter form, orientation, pencil control)</th>
<th>Uniformity of written text (letter size, spacing between &amp; within words, alignment)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1= well below avg</td>
<td>Student appears to have considerable difficulty writing letters; letters are barely identifiable. Written product may contain scribbles, incorrect letter forms, reversals, rotations, letters with missing or extra parts, letters too small or printed too lightly to read, etc.</td>
<td>Difficult to read and understand because of inconsistent and/or inappropriate spacing within and between words, letter size, and/or alignment. May include: strings of letters and words not separated by spaces, overlapping letters, writing that doesn’t follow or fit between lines on the page.</td>
</tr>
<tr>
<td>2= below avg</td>
<td>Student appears to have some difficulty shaping and orienting letters. Reader has some difficulty identifying letters, but most letters can be identified. Large proportion letters may be inappropriately capitalized.</td>
<td>Some difficulty reading and/or understanding content because of issues with uniformity of writing such as letter strings, words not separated by spaces, overlapping letters, or writing that doesn't follow or fit between lines on the page.</td>
</tr>
<tr>
<td>3= avg,</td>
<td>Letters are clearly identifiable and basically formed correctly. Upper and lower case letter use is mostly correct. There are no (or few for Gr.1) letter reversals or rotations.</td>
<td>Written product demonstrates adequate letter size, spacing between letters and words, and alignment of words across lined page. (Consider sample relative to grade level)</td>
</tr>
<tr>
<td>4= above avg,</td>
<td>Letters are clearly identifiable and readable. They are clearly and correctly formed, well proportioned there are no reversals, rotations</td>
<td>Clear, consistent and appropriate spacing between letters and words; letter size and alignment across the page makes written product easy to read and understand.</td>
</tr>
<tr>
<td>5= well above avg</td>
<td>Letters have a pleasant appearance that enhances readability of the written product. Letters are well formed, clearly printed, nicely proportioned relative to each other and lines on the page</td>
<td>Communicative value of the written product is enhanced by consistent and appropriate letter size, spacing between letters and words and alignment through easy readability and pleasing visual presentation.</td>
</tr>
</tbody>
</table>

(Letter legibility score + Uniformity score ) /2 = Overall Handwriting Score
2. **Total Words Written (TWW)**: Count the total number of words written during the 3-minute period, including the words that are spelled incorrectly. Do not count numbers that are not spelled out (1987, 3, 29) as words. Be sure to count the title if written and proper names and nouns as words. If the student writes the story starter as part of the story, include those words in the count. Abbreviations count. Strings = one word but try to break apart any recognizable invented spelling words. Each line of letters strings counts as one word. Time needs be written as a word ; a.m. or p.m. are abbreviations so count as 1 word.

3. **Words Spelled Correctly (WSC)**: Total number of words spelled correctly. Following Gansle et al. (2006) rules, consider words in isolation. Words do not have to be grammatically correct or make sense in the sentence. Draw a box around incorrectly spelled words.

   **Words DO count as correct if they:**
   - are correct abbreviations such as 'a.m.' and 'Mr.'
   - contain incorrectly capitalized letters, but are spelled correctly such as 'fun' written as 'fuN' or 'Fun'

   **Words DO NOT count as correct if:**
   - a letter reversal makes a word incorrect such as dog written as bog
   - the word includes as letter that is not recognizable
   - a proper noun that is not capitalized such as 'Sarah' written as 'sarah', or I written as 'i'
   - contractions missing punctuation such as 'didn't' written as 'didnt'

4. **Correct Writing Sequences (CWS) and Total Writing Sequence (TWS)**: Count correct units of writing and their relation to one another. Mark the presence of a correct writing sequence with a caret (+) and mark missing or incorrect writing sequences with a (*) so that 'Total possible writing sequences' can be easily counted. Words and critical punctuation marks (e.g., periods) are considered separate writing units; each successive pair of correct writing units (writing sequence) from beginning to end of sample are counted. To receive credit, writing sequences must be correctly spelled and be grammatically correct. The words in each writing sequence must also make sense within the context of the sentence. The right form of the word (for example: our, are, their, there, they’re, etc.) must be used to count as a correct sequence. If two words should be an adjoined compound word (for example: outside, uptown, upstairs, etc.) and the two words are not connected, consider how the two words flow with the sentence separately, not as a compound. For compound words that are separate, give the student credit prior to and after the compound word but not the one between the two words (e.g. can not). Consider sentences separately; the word at the end of a sentence should never make a correct sequence with a word at the beginning of another sentence. This applies to when you determine a sentence should end and another begin and the punctuation to mark it as such is missing. 'Total number of possible writing sequences' (TWS): Count all possible writing sequences, both incorrect & correct writing sequences in sample in order to calculate percentage and correct minus incorrect scores. For example:

   - ^I^ played^ outside* *it ^was^ fun* is scored as TWS=8 / CWS=5
   - ^I^played^outside^.^It ^was ^fun^.  CWS=TWS=8

   **Note:** In practice (see example below) we found it more efficient and clear to use “+” and “o” instead of “^” and “*”.

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Appendix A cont’d – Examples of Scored CBM Writing Samples

Sample 1 – Grade 3.

One day our teacher ripped his pants. He went down to pick something up then his pants ripped. Everyone burst out laughing. One almost fainted. Then he went home to change. The next day he came back to school.

Sample 2 – Grade 2.

One day I was playing with my dog. She was so excited she jumped up on me and
## APPENDIX B

Correlations between Curriculum Based Measures of Writing and Teacher Ratings of Writing

<table>
<thead>
<tr>
<th></th>
<th>HW</th>
<th>TWW</th>
<th>WSC</th>
<th>CWS</th>
<th>%WSC</th>
<th>%CWS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>N = 85</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Literacy Rating Scale (LRS)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Handwriting skills</td>
<td>.587***</td>
<td>.229*</td>
<td>.314**</td>
<td>.376***</td>
<td>.473***</td>
<td>.489***</td>
</tr>
<tr>
<td>Spelling skills</td>
<td>.568***</td>
<td>.309**</td>
<td>.402***</td>
<td>.474***</td>
<td>.529***</td>
<td>.537***</td>
</tr>
<tr>
<td>Written expression skills</td>
<td>.489***</td>
<td>.280**</td>
<td>.335**</td>
<td>.382***</td>
<td>.403***</td>
<td>.395***</td>
</tr>
<tr>
<td><strong>Academic Competence Evaluation Scale (ACES)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Language Arts (N = 83)</td>
<td>.523***</td>
<td>.297**</td>
<td>.381***</td>
<td>.464***</td>
<td>.491***</td>
<td>.492***</td>
</tr>
</tbody>
</table>

Note: Spearman’s rho correlation coefficient values shown. HW = Handwriting, TWW = Words written, WSC = Words spelled correctly, CWS = Correct writing sequences, %WSC = WSC/TWW, %CWS = CWS/total writing sequences

*p<.05, **p<.01, ***p<.001
APPENDIX C

Means and Standard Deviations for Direct Measures of Writing by Gender and Group

<table>
<thead>
<tr>
<th></th>
<th>Typical</th>
<th>Attention Problems</th>
<th>Attention and Reading Problems</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
<td>n</td>
</tr>
<tr>
<td>Boys</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Handwriting quality</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HW</td>
<td>2.95</td>
<td>0.55</td>
<td>21</td>
</tr>
<tr>
<td>Fluency scores</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WSC</td>
<td>26.05</td>
<td>13.14</td>
<td>21</td>
</tr>
<tr>
<td>CWS</td>
<td>22.86</td>
<td>12.52</td>
<td>21</td>
</tr>
<tr>
<td>Accuracy scores</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% WSC</td>
<td>86%</td>
<td>.09</td>
<td>21</td>
</tr>
<tr>
<td>%CWS</td>
<td>67%</td>
<td>.15</td>
<td>21</td>
</tr>
<tr>
<td>Girls</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Handwriting quality</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HW</td>
<td>3.88</td>
<td>0.92</td>
<td>13</td>
</tr>
<tr>
<td>Fluency scores</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TWW</td>
<td>36.00</td>
<td>17.40</td>
<td>13</td>
</tr>
<tr>
<td>WSC</td>
<td>32.38</td>
<td>17.91</td>
<td>13</td>
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<tr>
<td>CWS</td>
<td>29.69</td>
<td>19.09</td>
<td>13</td>
</tr>
<tr>
<td>Accuracy scores</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>%WSC</td>
<td>86%</td>
<td>.12</td>
<td>13</td>
</tr>
<tr>
<td>%CWS</td>
<td>70%</td>
<td>.20</td>
<td>13</td>
</tr>
</tbody>
</table>

Note: HW = Handwriting, TWW = Total words written, WSC = Words spelled correctly, CWS = Correct writing sequences, %WSC = WSC/TWW, %CWS = CWS/Total writing sequences.

A significant gender difference was found for handwriting within the TYP group, \( t(32) = -3.32, p < .01 \); and the AP group, \( t(26) = -3.79, p < .01 \).

\*p < .05, \**p < .01, \***p < .001
APPENDIX D

Means and Standard Deviations for Teacher Ratings of Writing by Gender and Group

<table>
<thead>
<tr>
<th></th>
<th>Typical</th>
<th></th>
<th>Attention problems</th>
<th>Attention+Reading problems</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
<td>n</td>
<td>M</td>
</tr>
<tr>
<td><strong>Boys</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Literacy Rating Scale (LRS)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Handwriting skills</td>
<td>3.52</td>
<td>0.81</td>
<td>21</td>
<td>2.15</td>
</tr>
<tr>
<td>Spelling skills</td>
<td>3.67</td>
<td>0.86</td>
<td>21</td>
<td>2.40</td>
</tr>
<tr>
<td>Written expression skills</td>
<td>3.24</td>
<td>0.77</td>
<td>21</td>
<td>2.25</td>
</tr>
<tr>
<td><strong>Academic competence evaluation scale (ACES)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Language arts subscale</td>
<td>38.81</td>
<td>7.55</td>
<td>21</td>
<td>28.65</td>
</tr>
<tr>
<td><strong>Girls</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Literacy Rating Scale (LRS)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Handwriting skills</td>
<td>4.00</td>
<td>0.82</td>
<td>13</td>
<td>2.86</td>
</tr>
<tr>
<td>Spelling skills</td>
<td>3.92</td>
<td>0.95</td>
<td>13</td>
<td>2.71</td>
</tr>
<tr>
<td>Written expression skills</td>
<td>4.08</td>
<td>0.64</td>
<td>13</td>
<td>2.29</td>
</tr>
<tr>
<td><strong>Academic competence evaluation scale (ACES)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Language arts subscale</td>
<td>42.62</td>
<td>7.83</td>
<td>13</td>
<td>28.14</td>
</tr>
</tbody>
</table>

Note: A significant gender difference was found for teacher ratings of written expression within the TYP group, \( t(32) = .28, p<.01 \).

*\( p<.05 \), **\( p<.01 \), ***\( p<.001 \)
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FIGURE CAPTIONS

**Figure 1.** Schematic Diagram for the Simple View of Writing

**Figure 2.** Hypothetical Model of Relationships between Attention Problems and Written Expression Outcomes
Figure 1.

Schematic Diagram of the Simple View of Writing

The Simple View of Writing, adapted from Berninger et al., (2003) describes key developmental constraints that influence children’s writing during composing.

*Limited working memory resources hold and manipulate knowledge retrieved from long term memory to execute transcription, self regulation and text generation while composing.

Note: The diagram in Fig. 1 was adapted from Berninger, V.W., & Amtmann, D. (2003). Preventing written expression disabilities through early and continuing assessment and intervention for handwriting and/or spelling problems: Research into practice, Fig. 21.1 on page 350 in Ch. 21 in H. L. Swanson, K.R. Harris & S. Graham (Eds.), Handbook of Learning Disabilities, 345-363. New York: Guilford Press.
**Figure 2.**

Hypothetical Model of the Relationships between Inattention and Written Expression