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The Written Expression Abilities of Adolescents with Attention-Deficit/Hyperactivity Disorder

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THE WRITTEN EXPRESSION ABILITIES OF ADOLESCENTS WITH ATTENTION-DEFICIT/HYPERACTIVITY DISORDER

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science at Virginia Commonwealth University.

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Abstract

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Students with Attention-Deficit/Hyperactivity Disorder (ADHD) often experience significant academic underachievement. Written expression abilities in this population have not been extensively studied but existing prevalence estimates suggest that rates of comorbid writing underachievement may be substantially higher than comorbid reading and mathematics underachievement. The current study examined written expression abilities in a school-based sample of 326 adolescents with ADHD. The prevalence of written expression impairment, the associations between written expression and academic outcomes, and specific patterns of written expression were investigated. Results indicate that students with ADHD experience written expression impairment at a similar rate to reading and mathematics disabilities. Students' written expression abilities were significantly associated with school grades and parent ratings of academic functioning, above and beyond reading achievement and intelligence. Analyses suggest that students with ADHD exhibit global impairment in writing, as opposed to having specific deficits in certain aspects of writing.

The Written Expression Abilities of Adolescents with Attention-Deficit/Hyperactivity Disorder

Attention-Deficit/Hyperactivity Disorder (ADHD) is a neurodevelopmental disorder characterized by difficulties with sustained attention (e.g., frequent off-task behavior) and/or hyperactive or impulsive behaviors (e.g., interrupting others, frequently leaving seat) (American Psychiatric Association, 2013). Prevalence estimates purport that 6-7% of school-age children meet diagnostic criteria for ADHD based on *DSM-IV-TR* standards, although the alteration in age of onset from 7 to 12 years of age for the *DSM-5* may slightly increase these estimates (Vande Voort, He, Jameson, & Merikangas, 2014). The disorder first presents in childhood, and individuals are categorized into one of three presentations based upon the symptoms they currently exhibit. However, these presentations are not necessarily stable within an individual throughout the course of his or her life (Willcutt et al., 2012). While it was initially conceptualized as a childhood disorder, it is now clear that ADHD symptoms often persist into adulthood (Barkley, Fischer, Smallish, & Fletcher, 2002).

Children and adolescents who are diagnosed with ADHD are at high risk for a variety of poor developmental outcomes. For example, in comparison to their non-ADHD counterparts, youth with ADHD are more likely to exhibit poor social functioning and to be rejected by peers (Hoza, 2007; Tseng & Gau, 2013; Wheeler Maedgen & Carlson, 2000) and to engage in risky behaviors such as substance use and abuse, risky sexual behavior, and dangerous driving practices (Flory, Molina, Pelham, Gnagy, & Smith, 2006; Jerome, Segal, & Habinski, 2006; Molina & Pelham Jr, 2003). One of the most pervasive areas of impairment for youth with ADHD is in their academic performance (for reviews, see DuPaul & Langberg, 2014; Loe & Feldman, 2007). For example, students with ADHD perform significantly lower on traditional

indicators of academic achievement, such as standardized tests and grades (Frazier, Youngstrom, Glutting, & Watkins, 2007). They also struggle with daily academic tasks, including managing their academic materials (e.g., books and papers) and completing their homework assignments (Epstein, Polloway, Foley, & Patton, 1993; Power, Werba, Watkins, Angelucci, & Eiraldi, 2006). The academic struggles of youth with ADHD begin as early as the preschool years (DuPaul, McGoey, Eckert, & VanBrakle, 2001), and they appear to be persistent throughout childhood and adolescence (Massetti et al., 2008). Further, youth with ADHD frequently continue to display significant academic difficulties even after participation in intervention (Evans et al., 2001; Langberg & Becker, 2012; Molina et al., 2009). Ultimately, these academic difficulties lead to poor distal outcomes such as dropping out of school before earning a diploma (Kent et al., 2011). Recent evidence has even indicated that the relationship between symptoms of ADHD and poor life outcomes, such as delinquency, is mediated by academic achievement (Defoe, Farrington, & Loeber, 2013).

The theories regarding mechanisms driving the academic struggles of youth with ADHD are wide-ranging. The symptoms directly associated with the disorder can be significant impediments to learning; a child who is easily distracted or frequently leaves his or her seat will face challenges in a classroom setting. Symptoms of inattention may be particularly impairing for these children, and they are longitudinally predictive of academic functioning above and beyond hyperactive/impulsive symptoms (Galéra, Melchior, Chastang, Bouvard, & Fombonne, 2009; Massetti et al., 2008). However, other deficits apart from the core symptoms of the disorder may be equally or more detrimental to the academic functioning of youth with ADHD. For example, executive function (EF) abilities- a set of cognitive processes including working memory, cognitive flexibility, and attention that work together to facilitate the completion of

goal-oriented behaviors- are correlated with academic outcomes (Brock, Rimm-Kaufman, Nathanson, & Grimm, 2009; Langberg, Dvorsky, & Evans, 2013; Thorell, 2007). Youth with ADHD are more likely than their peers to experience EF deficits. These deficits result in increases in functional impairment during the adolescent years, as students transition from elementary to middle school (Jacobson, Williford, & Pianta, 2011), over and above the impact of ADHD symptoms (Langberg et al., 2013).

Children with ADHD are also more likely to be impaired in specific academic skill areas, such as basic reading and mathematics skills as early as Kindergarten (Spira & Fischel, 2005). A review by DuPaul, Gormley, and Laracy (2013) indicated that as many as 45% of students with ADHD may be diagnosed with some form of learning disability (LD). These rates are higher than rates found both for typically developing children (Faraone et al., 1993) and children with anxiety or depressive disorders (Mayes & Calhoun, 2006). Similarly to what is observed with EF deficits, students with ADHD and comorbid LD typically exhibit greater academic impairment than students with only ADHD (Seidman, Biederman, Monuteaux, Doyle, & Faraone, 2001).

Theory and Empirical Examination of Written Expression

To date, most of the research on academic skills as predictors of outcomes for youth with ADHD has focused on math and reading, and there is considerably less research on written expression. Written expression is a term that encompasses the ability to spell words correctly, use appropriate grammar and punctuation, and organize ideas into a coherent narrative (American Psychiatric Association, 2013). These skills are important for students across academic subjects, as students are often asked to generate written answers or essays to convey concepts or ideas to teachers and classmates. Already by elementary school, writing is involved with 30-60% of all tasks in the classroom (McHale & Cermak, 1992). Written expression

abilities become even more important in adolescence, as students move from elementary to middle and high school, because the written work that students are asked to generate is expected to be longer, better organized, and more complex (Poplin, Gray, Larsen, Banikowski, & Mehring, 1980) and writing becomes a primary form of academic evaluation in the classroom.

Most of the literature examining written expression has been guided by Hayes & Flower's (1980) cognitive model of the writing process. This model posits that creating a written work consists of three distinct and linear steps. In the first step, known as the planning step, a writer must develop the general concept and set specific goals for the written work he or she is about to complete. During this step, a writer generates ideas, organizes those ideas into a coherent order, and formulates a plan for turning those words into a written work. In the second step, the writer must translate the ideas and plans developed in the first step into the actual written product. This step consists of choosing the specific words and phrases to communicate the broad ideas previously generated. According to the final step of the model, a writer must then review his or her work. During the review, the writer evaluates whether the plan was successfully executed and whether the written work achieves the goals that were set in the first step. If the written product is not satisfactory, the writer then revises the product until all of the goals have been achieved.

Although Hayes and Flower's model was developed with adults as writers of interest, Berringer and Swanson (1994) modified the model to make it more applicable to children. The modified model takes into account the idea that children are not yet masters of the writing process, but instead are still learning how to write. Specifically, the children's model includes more basic processes, such as handwriting and appropriate use of punctuation and grammar, during the translation step because these processes are not yet automatic for children. These

basic processes are also incorporated into the revision step, as young writers must check that the rules of writing have been followed and that their handwriting is not so poor that it interferes with a reader's understanding of the written work.

Some empirical data exists supporting the validity of the modified version of Hayes and Flower's model. Two separate studies using elementary and middle school populations have found nonsignificant correlations among measures of the three proposed steps of the writing process: planning, translating, and revision. This suggests that these constructs are independent from one another, meaning that children who have impairment in one step of the writing process may not necessarily have impairment in the others (Berninger, Whitaker, Feng, Swanson, & Abbott, 1996; Whitaker, Berninger, Johnston, & Lee Swanson, 1994). Additionally, Koutsoftas and Gray (2013) examined the linearity of the process by analyzing the written work of 201 sixth-grade students. A confirmatory statistical equation model found that measures of students' use of planning skills predicted their use of translation skills such that a more effective use of planning skills predicted a more effective use of translation skills. Similarly, students' use of translation skills predicted their use of revision skills. Interestingly, students' use of planning skills did not have a direct effect on their use of revision skills, supporting the hypothesis that writers move through the writing process linearly.

Researchers have also used Hayes and Flower's modified model of the writing process to develop interventions to improve students' written expression abilities. One intervention that has been introduced in the literature is known as Self-Regulated Strategy Development (SRSD). This intervention is designed to intervene during the first step of the model, focusing on the role of planning and organization in creating written work (Lienemann & Reid, 2008). SRSD has shown some promise in improving the written expression abilities of both elementary school (grades 2-

5) and high school students (grades 11-12) with ADHD (Jacobson & Reid, 2012; Reid & Lienemann, 2006). However, studies investigating this intervention to date have included only small elementary school age samples ($n < 10$). Other interventions have targeted the second step of the model- translation- using assistive technology. For example, a study by Quinlan (2004) found that the use of speech-recognition software improved the number of total words in the written work of students with poor productivity when compared to their handwritten work. Similarly, Hetzroni and Shrieber (2004) examined the use of using a word processing program on a laptop computer on the written expression abilities of students with written expression impairment. Their single-case design found that using word processing programs reduced spelling errors and improved the organization of ideas compared to traditional handwritten work. Unfortunately, the evidence base is still minimal for assistive technology as a written expression intervention due to the relatively recent emergence of these tools and a paucity of studies that adhere to rigorous methodologies (Burne, Knafelc, Melonis, & Heyn, 2011).

Measuring Written Expression Abilities

As discussed previously, written expression is a broad construct that requires the use and management of many skill sets. Writers must coordinate everything from fine motor skills to executive functions to produce a written work. As a result, it is challenging to accurately capture and quantify an individual's written expression abilities using a single measure and researchers have assessed written expression abilities using a myriad of strategies. One common strategy used in the literature is to generate a single holistic rating of the overall quality of students' written work (Graham & Perin, 2007; Lane et al., 2008; Reid & Lienemann, 2006). Using this method, raters are asked to evaluate the quality of written work based on a range of factors, from appropriate spelling and punctuation to adequate organization of ideas. A single score is

generated from this evaluation, and raters can be trained to code written work with high inter-rater reliability. Researchers and educators have argued for the use of holistic ratings based on Gestalt principles; arguing that an overall assessment of the written work is more informative than assessments of each specific aspect of the work (Myers, 1980). However, a review by Espin, Weissenburger, and Benson (2004) found little evidence that holistic ratings have predictive validity in relation to academic outcomes. Additionally, focusing on the overall quality of a written work provides no information about the specific strengths or weaknesses of the work, limiting its usefulness for identifying writing skills that may require intervention.

In contrast to holistic ratings, curriculum-based measurement (CBM) evaluates students' written work using a specific set of indicators of written expression abilities (Deno, 2003). CBM was initially designed for use in special education settings to provide instructors with methods to evaluate a student's progress in a specific academic skill over time (Deno, 1985). CBMs involve having a student complete a standard task repeatedly, and progress is evaluated based by comparing the student's performance on the task from one time point to the next. Numerous indicators of written expression ability have been used in CBM, from the total number of words written to proportion of correct punctuation marks to the number of long words (e.g., contain more than eight letters) used in the written work (for a more comprehensive list, see (Gansle, Noell, VanDerHeyden, Naquin, & Slider, 2002). Three of the most common indicators used in research are the total number of words written, number of correct word sequences (CWS) and number of correct word sequences minus incorrect word sequences (CWS-ICWS). A CWS is defined as two words that are appropriately spelled, use correct grammar, and are appropriately capitalized and punctuated. There is some support for the validity of these three indicators; a study by Espin, De La Paz, Scierka, and Roelofs (2005) found a strong correlation between CBM

assessments of these indicators and teacher ratings of the overall quality of the essays. Further, the study found that these indicators were sensitive to changes in performance over time.

Unfortunately, other studies have been more mixed on the sensitivity of these three indicators, citing a small magnitude of change over time that may not be useful for informing intervention (Espin et al., 2004). Further, there is minimal research investigating the reliability or validity of other CBM indicators of written expression, and some have expressed concern over the lack of face validity for productivity indicators like the total number of words written (Gansle et al., 2002). The development of written expression CBM has been significantly hampered by the lack of studies examining the psychometric properties of various CBM indicators. Gansle and colleagues (2002) reported that a PsychInfo search of work between 1981, when CBM was first introduced, and 2001 found only 8 articles addressing written expression CBM, in comparison to 88 studies for reading and 35 studies for mathematics.

One common weakness between both holistic ratings and CBM is that these systems of measurement often do not have estimates of normative performance, making it difficult to know how an individual's skills compare to others of a similar age or grade. Recently, measures of written expression have emerged that are normed on large samples of youth. Some written expression measures are components of a larger academic achievement test, such as the Wechsler Individual Achievement Test, Third edition (WIAT-III; Wechsler, 2009). Other measures, such as the Test of Written Language, fourth edition (TOWL-4; Hammill & Larsen, 2009.) are designed to exclusively evaluate written expression abilities. Both of these measures evaluate aspects of written expression associated with the translation step of the Hayes and Flower (1980) model, which are also commonly evaluated using CBM strategies. However,

these measures also contain protocols for evaluating aspects associated with the planning step of the model, such as the organization of the written work.

Identifying Written Expression Impairment

One of the major goals of measuring written expression abilities is to identify students whose abilities do not meet expected milestones or standards. Students who exhibit significant impairment in a specific academic domain are often diagnosed with a learning disability (LD; Proctor & Prevatt, 2003). According to the *DSM-5,* an LD diagnosis requires that skills in a particular area are significantly lower than expected and negatively impacting academic performance (American Psychiatric Association, 2013). Based on *DSM-5* criteria, LD can be diagnosed for reading, mathematics, and written expression. Written Expression LD can manifest as impairment in spelling, grammar/punctuation, and/or organization of the written product.

In practice, there are several methods commonly used for identifying students who meet criteria for written expression LD. Early models for diagnosing LD attempted to create a simple operational definition of impairment by establishing guidelines for identifying significant discrepancies between students' actual and expected abilities (Bateman, 1965). For example, Erickson (1975) proposed a z-score discrepancy model, which required psychologists to measure a student's intellectual and academic abilities using norm-referenced measures and then calculate the discrepancy between the students' standardized IQ score and standardized achievement score. Although various cutoff points are used, a generally accepted guideline for identifying a significant discrepancy between intelligence and achievement is a difference of 1 standard deviation (Mercer, Jordan, Allsopp, & Mercer, 1996). Later discrepancy models, known as regression-based discrepancy models, acknowledged that intelligence and achievement are not perfectly correlated with one another and incorporated multiple regression equations that more

accurately reflected the achievement scores that students should be expected to achieve based upon their performance on an intelligence test (Shepard, 1980).

As with many diagnostic models, discrepancy models have met significant criticism. Many critics argue that discrepancy models of LD diagnosis are too simplistic to accurately identify individuals with true impairment. For example, discrepancy models, especially simple discrepancy models, may over-identify students with high intelligence and under-identify students with low intelligence with LD diagnoses (Stanovich, 1986). Others have argued against discrepancy models because poor readers tend to exhibit similar reading process deficits, academic outcomes, and responses to intervention regardless of IQ scores (Aaron, 1997). These shortcomings have begun to push the field away from the discrepancy approach in favor other methods (Dombrowski, Kamphaus, & Reynolds, 2004). More recent approaches emphasize the role that underachievement should play in diagnosing individuals with LD. For example, one common underachievement method suggests that students should be diagnosed with LD if they score below a specified cutoff value (e.g., below the 25th percentile) on a standardized achievement test, regardless of IQ scores (Fletcher et al., 2002; Siegel, 1999). Other underachievement proposals have called for the elimination of the LD diagnosis altogether and instead focus intervention efforts on anyone who exhibits impairment in a specific academic area (Sternberg & Grigorenko, 2002).

Another alternative strategy that is popular in educational systems is the Response to Intervention (RTI) approach. RTI refers to a hierarchical strategy that follows a continuous pattern of intervention and assessment (Fuchs, Mock, Morgan, & Young, 2003). The first step in RTI requires all students in a school to receive evidence-based classroom instruction and for their achievement to be briefly assessed. Students who are not meeting sufficient levels of

achievement (i.e., non-responders) are provided a more intensive intervention, and their achievement is again assessed; this cycle is repeated until students demonstrate sufficient academic progress. In relation to academic underachievement, students who do not respond to less-intensive interventions may be eligible for a LD diagnosis, and evidence gathered during the assessment paired with each increase in intervention helps inform the diagnosis. Unfortunately, RTI faces similar issues to other diagnosis models for identifying students with LD. Specifically, there is not a consensus on how to identify when a child is or is not responding to intervention (i.e., what degree of improvement should be observed), and therefore would meet criteria for an LD diagnosis and need additional intervention (Burns, Jacob, & Wagner, 2008).

Given the variety of broad approaches for diagnosing LD in the literature, it can be difficult to identify a specific strategy to use in research and in schools. One of the more promising models proposed by Dombrowski and colleagues (2004) is an underachievement model that incorporates a focus on academic impairment and consists of two simple yet important criteria. First, students must exhibit impairment on a norm-referenced measure of academic achievement as evidenced by a standard score at least 1 standard deviation below the normative group mean (i.e., a score at or below 85). Second, students must demonstrate impairment in the classroom setting through poor grades or parent/teacher report. These criteria maximize the likelihood that children who are experiencing significant impairment in relation to their peers will be identified. It is important to note that although Dombrowski and colleagues' methodology does not rely on an intelligence-achievement discrepancy, it does require that the impairment is not better accounted for by low overall cognitive abilities (e.g., intellectual disability).

Written Expression Abilities of Students with ADHD

Despite the limited evidence available and the controversies in the current literature, researchers generally agree that youth with ADHD struggle more with written expression abilities than their non-ADHD peers (Barry, Lyman, & Klinger, 2002). Specifically, students with ADHD generate less organized written work, write fewer words, and make more mechanical errors (e.g., misspelled words and poor handwriting) (Casas, Ferrer, & Fortea, 2013; Re, Pedron, & Cornoldi, 2007; Resta & Eliot, 1994). Further, they appear to struggle in comparison to their non-ADHD peers even when they have equivalent knowledge about the basic rules of writing (Re & Cornoldi, 2010).

Although current research indicates that a portion of students with ADHD struggle with written expression, prevalence estimates vary significantly. For example, a study conducted by Del'Homme, Kim, Loo, Yang, and Smalley (2007) found that only 9% of a community sample of siblings 6-17 years of age with ADHD also met criteria for written expression LD, using an underachievement method of LD diagnosis (i.e., standard score below 7th percentile on test of written expression achievement). The prevalence increased to 14% when a simple discrepancy model (i.e., 1.5 standard deviation difference between IQ and achievement score) was used to diagnose LD. In contrast, Mayes and Calhoun (2006) reported that 63% of a clinic-referred sample of children with ADHD met criteria for a written expression LD using a regression-based discrepancy method.

There is also significant variability in the literature regarding the potential mechanisms that lead youth with ADHD to exhibit written expression impairment. One of the more established factors contributing to written expression impairment is an individual's basic cognitive abilities as indicated by performance on tests of intelligence (i.e., IQ). IQ has been

identified as one of the most closely related individual factors related to academic achievement, including written expression (Gagné & St Père, 2002; Mayes, Calhoun, Bixler, & Zimmerman, 2009). This may be an especially important factor for children with ADHD, as children with the disorder score 5-6 points lower on average on standardized tests of intelligence in comparison to children without the disorder (Frazier, Demaree, & Youngstrom, 2004). Further, IQ has been found to be a significant predictor of achievement in an ADHD sample (Mayes & Calhoun, 2007b), and there is evidence for a causal relationship from these basic cognitive abilities to later achievement (Watkins, Lei, & Canivez, 2007). Working memory, a cognitive ability which is often considered both as a component of general intelligence and a component of executive functioning, has been of particular interest to written expression abilities and has been found to predict written expression abilities above and beyond reading abilities (Swanson & Berninger, 1996).

Outside of the influence of intelligence, other factors that mirror the previously discussed mechanisms leading to general academic impairment have also been examined more specifically in relation to written expression. For example, an older set of research found that basic reading and language abilities are correlated with written expression (for a review, see Stotsky, 1983). Other empirical evidence suggests that reading abilities may be directly responsible for written expression impairment. A longitudinal study of 153 typically developing students found that basic language and reading skills (e.g., phonological awareness) predicted later spelling abilities (Caravolas, Hulme, & Snowling, 2001). A second longitudinal study of 54 elementary school students found that poor reading abilities in first grade predicted poor writing abilities in fourth grade (Juel, 1988). The core symptoms of inattention and hyperactivity are a third factor that has been posited as a potential influence on written expression abilities (Lee & Hinshaw, 2006;

Mayes & Calhoun, 2007a; Rodriguez et al., 2007). Currently, it is not clear whether these factors all contribute to written expression, or whether a subset of these factors are the main cause of poor written expression. A study by DeBono and colleagues (2012) reported that both cognitive abilities and ADHD symptoms were significantly associated with the written expression abilities of 97 clinic-referred adolescents with the disorder, although a greater association was found for cognitive abilities.

Limitations of Past Research on Written Expression and ADHD

Despite these recent advances, there are several areas regarding the written expression abilities of students with ADHD that require further investigation. First, questions remain regarding the true prevalence of writing difficulties in this population. The variation in current estimates (9 – 63%) makes it unclear how many students with ADHD struggle in this academic domain. The largest samples of written expression in youth with ADHD published to date were obtained either exclusively or significantly from mental health clinics (DeBono et al., 2012; Mayes & Calhoun, 2007a). Clinic-referred samples often present with greater impairment than community samples in numerous domains (Gadow, Sprafkin, & Nolan, 2001; Goodman et al., 1997). Examining written expression in samples of students recruited through schools may provide a more representative estimate of prevalence. Further, previous studies have also sampled a wide age range, including children as young as 6 and as old as 17. This broad range is also likely contributing to the variations in reported prevalence.

Second, it is unclear whether written expression impairment contributes to the poor academic outcomes associated with a diagnosis of ADHD beyond the effects of general cognitive and basic reading abilities. The majority of previous studies have focused on predictors of writing abilities. However, given the increased role that writing plays in completing

assignments and exams as students enter upper levels of education, it is important to understand whether writing abilities may affect academic outcomes, such as course grades.

Third, research has not investigated whether there are distinct patterns of written expression impairment in youth with ADHD. Previous studies have established that youth with ADHD struggle with several aspects of written expression (Casas et al., 2013; Re et al., 2007; Resta & Eliot, 1994). These results may indicate that a portion of students with ADHD struggle with all facets of written expression, but it is also plausible that groups of students struggle in different areas. For example, some students may be able to effectively organize their written work, but struggle with grammatical errors while other students may write grammatically correct work that is poorly organized.

Addressing these questions is important to inform the development and refinement of interventions for students with ADHD. Currently, no evidence-based psychosocial interventions for ADHD such as parent training, summer treatment programs, or organizational skills interventions address written language abilities (Evans, Owens, & Bunford, 2013). This is due at least in part to the fact that there is little empirical evidence indicating that written expression abilities significantly impact the academic outcomes of students with ADHD. Written expression is a major component of students' education, especially in middle and high school. If written expression impairments are in fact influencing academic outcomes beyond other known factors, then current ADHD treatment options may need to be refined to include a focus on writing. Further, it would be important to identify which specific areas of written expression are most commonly deficient and therefore should be focus of intervention.

Current Study

The current study examined the written expression abilities of adolescents with ADHD and addressed many of the limitations in the current literature. Written expression abilities as measured using the Wechsler Individual Achievement Test (WIAT) were evaluated in a large sample of middle-school students comprehensively diagnosed with ADHD. This well-validated measure of written expression is norm-referenced and avoids many of the shortcomings of holistic ratings of written work while capitalizing on the strengths of CBM (i.e., the evaluation of specific aspects of written expression) by examining student performance using CBM strategies that are then converted into standardized scores. Specifically, this study focused on three major goals.

Aim I: Estimating prevalence of written expression impairment. First, the prevalence of writing expression impairment was assessed in a large school-based (N = 326) sample of middle school age adolescents with ADHD and compared to the prevalence of impairment in other domains (e.g., reading and mathematics impairment). As mentioned earlier, there is no clear consensus regarding the formal diagnosis of learning disorders. However, the current movement in the field is away from discrepancy models and towards underachievement models. Accordingly, students were identified as struggling in an academic area using an underachievement method, with scores of < 85 (more than 1SD below the mean) considered to be indicative of underachievement. It was hypothesized that the prevalence rates of written expression impairment would be lower than the rate reported from clinic-referred samples (e.g., Mayes & Calhoun, 2006). Given the lack of evidence comparing written expression impairment to reading or mathematics impairment for this population, no a priori hypotheses were made. Additionally, exploratory analyses were conducted to determine whether prevalence varies as a

function of ADHD presentation, externalizing disorder comorbidity, and ADHD medication status.

Aim II: Examining the relation between written expression and academics. Second – and perhaps most importantly – regression analyses were conducted to cross-sectionally examine the association between written expression abilities and academic performance. To date, no studies have examined the impact of written expression on academic outcomes in ADHD populations. Two stringent hierarchical regression analyses were conducted to examine this relationship. Specifically, the influence of written expression abilities on academic functioning were evaluated above and beyond both general intelligence and basic reading abilities. Academic functioning was measured using school grades and parent ratings. Further, two exploratory analyses examined which specific aspects of writing may most prominently impact academics. Due to the increased role of written expression for middle school students, it was hypothesized that written expression abilities would significantly predict academic outcomes above and beyond intelligence and reading abilities.

Aim III: Identifying Patterns of written expression abilities. Third, a latent profile analysis (LPA) was conducted to determine if distinct patterns of written expression impairment emerged within the sample. To date, no other subject-centered analyses of written expression for students with ADHD have been reported. Three different sets of parameters with increasing numbers of covariates were examined, and the best model was identified for each set. This is an exploratory analysis, and therefore no a priori hypotheses were made. Instead, the best possible model was elicited and that model was interpreted in the context of current theories regarding written expression.

Methods

Participants

Participants who provided data for the current study were recruited as part of a larger study evaluating school-based intervention programs for adolescents with ADHD. All data evaluated in the present study were collected at baseline, prior to participants receiving any intervention. 326 middle-school students (grades 6-8) from nine public middle schools in the Eastern United States were recruited over three academic years. Participants were recruited using study announcement letters mailed to all parents at participating middle schools, fliers posted in each school, and direct referral by school staff. Information describing the symptoms of ADHD and associated academic impairment was provided to aid staff in making referrals, and a prior diagnosis of ADHD was not required for participation in the study. 232 participants (71% of sample) were male, 77% of the sample self-identified as Caucasian, 12% identified as African American, 8% identified as Biracial, and 2% identified with another race. 3% of the sample was also identified as Hispanic. 101 participants (31%) were receiving accommodations at school through either Individualized Education Plans (IEPs) or 504 plans.

Procedure

Parents (or primary caregivers) who were interested in participating in the study contacted the research team, and a brief telephone screen was conducted. As part of the phone screen parents were verbally administered the nine DSM-IV items from the ADHD inattentive domain. A full inclusion/exclusion evaluation was scheduled if parents reported that their child had a previous diagnosis of ADHD *or* if they endorsed the presence of at least 4 symptoms of inattention at clinically significant levels.

During the inclusion/exclusion evaluation, students were comprehensively assessed for an ADHD diagnosis. Each student and at least one parent completed the Parent Children's Interview for Psychiatric Syndromes (P-ChIPS; Weller, Weller, Fristad, Rooney, & Schecter, 2000), a semi-structured interview which was administered by a doctoral student supervised by a licensed clinical psychologist. Parents and teachers of the students also completed the Disruptive Behavior Disorders rating scales (DBD; Van Eck, Finney, & Evans, 2010). Additionally, parents were asked to complete rating scales regarding potential comorbidities and their child's functioning. Students completed a brief battery assessing their cognitive and academic achievement abilities, including four subtests from the Wechsler Intelligence Scale for Children-Fourth Edition (WISC-IV; Wechsler, 2003), and seven subtests from the WIAT-III to estimate reading, mathematics, and writing (see measures section for more detail). Participants were considered eligible for the study if they met five criteria: 1.) attended a participating middle school, 2.) met full DSM-IV-TR diagnostic criteria for ADHD-Predominantly Inattentive or Combined presentation based on the combination of parent report on the P-ChIPS and teacher report on the DBD, 3.) experienced significant impairment due to ADHD symptoms based on parent and/or teacher report, 4.) had an estimated FSIQ of at least 80 according to performance on the WISC-IV , 5.) did not meet diagnostic criteria for any pervasive developmental disorder, bipolar disorder, psychosis, or obsessive-compulsive disorder according to parent report on the P-ChIPS. Students with comorbid diagnoses of Oppositional Defiant Disorder, Conduct Disorder, and anxiety and mood disorders were allowed to participate in the study. Data collected from the evaluation of each student was comprehensively assessed by two doctoral level psychologists to determine study eligibility and any relevant comorbid diagnoses.

Within the sample, 49% of students were diagnosed with ADHD, Combined Subtype and the remaining participants were diagnosed with ADHD, Primarily Inattentive Subtype. Subtype diagnoses were determined using all available information from both parent and teacher report. To meet criteria for any subtype, parent interview data was allowed to be supplemented with teacher report of unique ADHD symptoms. For supplementation to occur, both the parent and the teacher had to endorse at least 4 symptoms in the same domain. For example, if a parent endorsed 4 symptoms of hyperactivity/impulsivity and a teacher endorsed 6 symptoms of hyperactivity/impulsivity, 2 of the teacher endorsed symptoms would be considered unique and the student would be classified Combined Subtype (assuming criteria was met for the inattention domain).

Written Expression/Academic Achievement Measures

Wechsler Individual Achievement Test, third edition (WIAT-III). The WIAT-III (Wechsler, 2009) is a well-validated measure of academic achievement that has been standardized on a nationally representative sample of individuals, including 2,775 school-age children (ages 4-20). The WIAT-III provides eight composite scores and sixteen subtest scores that can be used to identify a student's specific academic strengths and weaknesses. The Basic Reading, Mathematics, and Written Expression Composite scores all demonstrate high internal consistency ($\alpha \geq .94$). Each composite score also has strong correlations with measures of cognitive ability, such as the WISC-IV (rs $\geq .83$) and with comparable composite scores of the previous edition of the WIAT (rs $\geq .83$). Overall, WIAT Written expression subtest scores exhibit strong internal consistency ($\alpha \geq .85$) and strong 2-week test-retest reliability ($\alpha \geq .79$).

All subtests of the Written Expression Composite - Spelling, Sentence Composition, and Essay Composition- were administered to students during the evaluation. Each Written

Expression subtest produces a standard score, but two of these subtests also produce five more detailed standardized scores. Four of these scores are referred to as component scores, and one is a supplementary score that does not contribute to the calculation of any subtest. The Spelling subtest requires students to accurately write a word provided verbally and produces a single standard score for the subtest. The Sentence Composition subtest first requires students to combine multiple complete sentences (e.g., "Dogs have fur. Cats have fur.") into a single sentence (e.g., "Dogs and cats have fur."). Students are then asked to build a sentence from a key word (e.g., "while"). Students are evaluated on using appropriate syntax and mechanics. A separate component score is produced from each part of the Sentence Composition subtest. For the Essay Composition Subtest, students are given 10 minutes to write an essay about their favorite game and provide at least three reasons why they like the game. Two component scores are generated for this subtest: one score that evaluates the student's development and organization of ideas and another that evaluates a student's productivity (i.e., a word count). A supplemental score can also be generated based on the student's appropriate use of grammar and mechanics. A manual that provides specific scoring rules and numerous examples is used to assist the scoring of both the Sentence Composition and the Essay Composition subtests.

For the current study, WIAT subtests were scored by a team of research assistants supervised by a licensed clinical psychologist. Each scorer was trained by a lead scorer, which involved reading the WIAT manual thoroughly, scoring sample subtests simultaneously with the lead scorer until agreement was achieved, and then scoring several real subtests on their own. The lead scorer then scored the same subtests to check for inter-rater agreement. The lead scorer also conducted periodic checks of scored subtests throughout the project in order to prevent drift. The Written Expression Composite score was used to evaluate prevalence rates and in the

primary regression analyses, and the five component/supplemental scores and Spelling subtest score were used in the exploratory regression analyses and the LPA.

Additionally, the subtests that create the Basic Reading Composite and Mathematics Composite were also administered to all students during the evaluation. The Basic Reading Composite is generated from two subtests; the first subtest evaluates how well students can read a set of words aloud, and the second subtest evaluates how well students can phonetically decode a set of pseudowords. The Mathematics Composite score also consists of two subtests, with students completing verbal math problems in the first subtest and written math problems in the second subtest.

Academic Outcome Measures

Grade Point Average (GPA). GPA is a numerical system commonly used for quantifying letter grades. A four point scale (4.0 = A, 3.0 = B, 2.0 = C, 1.0 = D, 0 = F) was used for the current study. Grades from the core subjects- English, Mathematics, Science, and Social Studies- were collected for each student over the course of the larger intervention study. For the current study, grades were analyzed from the same semester that the evaluation appointment was conducted. Each grade was converted into a GPA, and then all four course GPAs were averaged into a single core-course GPA.

Weiss Functional Impairment Rating Scale (WFIRS). The parent report version of the WFIRS (Weiss, 2000) is designed to assess an individual's overall functioning. This 50 item measure asks parents to rate how frequently or extensively their child's emotional or behavioral difficulties affect their functioning in a variety of life domains. Ratings are made on a 4-point Likert scale (0 = never or not at all, 3 = very often or very much). The WFIRS assesses functioning in 6 different domains: family, school, life skills, self-concept, social activities, and

risky activities. Within the school domain, items assess either impairment in learning (e.g., "Needs tutoring") or impairment in behavior (e.g., "Suspended or expelled from school"). The WFIRS demonstrates high internal consistency across subscales, with α values ranging from .75-.93. For the current study, the school domain that evaluated impairment to learning was analyzed as an outcome.

Other Measures

Children's Interview for Psychiatric Syndromes- Parent Report (P-ChIPS). The P-ChIPS (Weller, Weller, Fristad, Rooney, & Schecter, 2000) is a semi-structured interview that is administered to parents of children ages 6–18. The interview assesses 20 different disorders based on *DSM-IV* criteria. The P-ChIPS has shown high internal consistency and test-retest reliability (Fristad, Teare, Weller, Weller, & Salmon, 1998) and high convergent validity in relation to the Diagnostic Interview for Children and Adolescents—Revised–Child Version (Teare, Fristad, Weller, Weller, & Salmon, 1998).

In the current study, only selected modules of the P-ChIPS were administered. Specifically, the modules assessing ADHD, ODD, CD, pervasive developmental disorder, bipolar disorder, psychosis, obsessive-compulsive disorder and anxiety and mood disorders were completed. The comprehensive procedure for diagnosing ADHD was previously described, but comorbid diagnoses were determined based upon parent responses to the P-ChIPS. Students were classified as having a comorbid externalizing disorder if they met or exceeded the threshold for number of criteria endorsed for ODD (4 symptoms) or CD (3 symptoms).

Demographic information. A brief demographic questionnaire was completed by a parent of all participants. The questionnaire gathered information regarding each participant's

sex, race/ethnicity, family status (i.e., number of parents living in the household), and socioeconomic information (e.g., household income).

Analytic Plan

Missing data was assessed to determine the total proportion of data that is missing from all variables of interest before analyses begin. Strategies for addressing issues of missing data were based on the recommendations of Schafer and Graham (2002). Little's Missing Completely at Random (MCAR) test was used to ensure that data was not missing from subjects in a systematic manner, which could skew analyses and lead to incorrect interpretation of data (Little, 1988). If data was determined to be missing at random, then missing data would be accounted for in subsequent analyses using maximum likelihood estimation. If data was determined to be missing not at random, then a pattern-mixture modeling approach would be used to reduce the potential of biased results for subsequent analyses.

Additionally, a correlation matrix was generated that compares sex, race, and household income to the academic outcome variables examined in Aim II before conducting analyses. If a demographic variable was significantly correlated with one of these variables, they were controlled for in the hierarchical regression analyses. Some evidence exists that supports the investigation of these demographic variables. For example, females have generally found to exhibit better academic performance across all academic subjects (Pomerantz, Altermatt, & Saxon, 2002; Stoet & Geary, 2015). Additionally, students who identify with a minority racial or ethnic group tend to experience poorer academic outcomes than non-minority students, although these group differences appear to be shrinking (for a review, see Kao & Thompson, 2003). However, it appears that these racial differences in academic performance are at least partially confounded by other variables, such as socioeconomic status (Orr, 2003).

Aim I. To achieve the first aim, data on the overall performance of the sample on both broad and specific scores of the Written Expression Composite of the WIAT-III was presented. Next, the overall Written Expression Composite score was compared to performance in other academic domains. Specifically, the prevalence of written expression impairment was compared to the prevalence of reading and mathematics impairment both individually and in combination with all possible comorbidity patterns. The current study used an underachievement method similar to the one recommended by Dombrowski and colleagues (2004) for identifying written expression impairment. Students were considered to be impaired if the Composite score of that particular academic domain was 1 standard deviation below the mean of the norm-referenced sample (i.e., a composite score below 85). School referrals to the study were made based upon the combination of ADHD symptoms and academic impairment, and students were not included unless there was evidence of impairment from the parent or teacher perspective. Accordingly, students who are below 85 on writing in in this sample are also likely experiencing levels of overall academic impairment that would meet the Dombrowski and colleagues (2004) threshold. Further, independent-sample t-tests were conducted for each of three dichotomous groupings: ADHD subtype (ADHD-I or ADHD-C), comorbid externalizing disorders (i.e., presence of ODD or CD), and ADHD medication status.

Aim II. To identify associations between writing and academic outcomes, regression analyses were conducted. Because of the strong associations previously established in the literature between IQ and written expression skills, as well as the established correlation between reading and written expression skills, regression analyses included measures of these constructs as covariates. Four separate analyses were conducted. Two primary analyses included the Written Expression Composite score as a predictor. These analyses were hierarchical in nature,

examining the prediction of written expression abilities above and beyond the effect the covariates. Two additional exploratory analyses were also conducted, which included each Written Expression component/supplementary score and the Spelling subtest score as simultaneous predictors of the dependent variables. To reduce the number of variables in the models and to ensure that any potential writing effects are not missed, no covariates were included in the exploratory analyses. Additionally, the multicollinearity of these predictors were examined. If two variables were closely related, then any potential effect of one predictor could be artificially reduced by the presence of the collinear variable in the model. To test for multicollinearity, the Variance Inflation Factor (VIF) was calculated for each predictor in the models, with VIFs greater than 10 indicating multicollinearity. For all regression analyses, three different dependent variables were examined: core course GPA, total score of the learning items of the School subscale on the WFIRS-Parent report.

Aim III. Finally, to examine whether there are within group differences in writing abilities, students' written expression scores were analyzed through a latent profile analysis (LPA), which was conducted using Mplus Version 6.11 (Muthén & Muthén, 1998-2010). Six available standard scores that represent different written expression abilities were used as indicators to build the models and three different models are presented. The first model included no covariates, which allows for the least restricted exploration of patterns of written expression abilities. Due to previous research that has suggested a causal relationship between written expression and IQ (Watkins et al., 2007), an argument could be made to control for intelligence. Therefore, the second model included students' estimated FSIQ scores as a covariate. The third model was the most stringent test of patterns in written expression abilities, mirroring the regression analyses. Both estimated FSIQ scores and basic reading abilities were included as

covariates in this this model. Five criteria for determining the appropriate number of profiles for this sample were used: theoretical rationale, the presence of profiles that may be reasonably replicated (i.e., no profile contains less than 5% of entire sample), the Bayesian Information Criterion (BIC), the Vuong-Lo-Mendell-Rubin test (LMR), and the bootstrapped parametric likelihood ratio test (BLRT). A model is considered a better "fit" to the data if its BIC value is lower than other models and a model with *k* profiles is considered better than a model with *k*-1 profiles if the LMR and/or the BLRT are significant (Nylund, Asparouhov, & Muthén, 2007).

An LPA was constructed instead of a latent class analysis (LCA) because it allows written expression to be examined as a continuous construct instead of a binary construct (i.e., impaired/not impaired) when investigating patterns of written expression abilities. Examining written expression as a continuous construct allows more of the potential variability in samples to be accounted for in analyses (Irwin & McClelland, 2003). There is also theoretical support for this approach in the written expression literature; Mayes, Calhoun, & Crowell (2000) found that individuals that meet criteria for ADHD but not LD still experience some learning problems that those with comorbid LD also experience and that individuals with LD but not ADHD experience some attention problems, suggesting that the two constructs may exist on a continuum with one another. The fact that data included in the model are measured using the same standardized scale scores also lends itself to analysis via LPA because it allows for a clear interpretation of each estimated indicator value in relation to one another.

Results

Pre-Analysis

All independent variables included in the data set met the assumptions of normality, so no transformation of the data was necessary. An exploration of all independent and dependent

variables found that 2.9% of all data were missing, indicating that maximum likelihood estimation of the data is warranted. Little's MCAR test resulted in a nonsignificant p-value (p = .45), which demonstrates that data are missing in a random fashion and are not significantly influenced by a confounding variable.

A series of correlations were run examining the association between demographic variables and the academic outcomes of interest in the study to determine if any demographic variables needed to be included as covariates. Specifically, students' sex, race, and household socioeconomic status as represented by household income were correlated with GPA and WFIRS ratings. These correlations are presented in Table 1. The results of the correlation analyses found that none of the demographic variables were significantly correlated with WFIRS ratings (all p > .08). Additionally, students' sex (p = .94) was not significantly correlated with GPA. However, students' race (r = .204, p = .001) and household income (r = .373, p < .001) were significantly correlated with GPA. To remain consistent across models, both of these variables were included as covariates in all hierarchical regression analyses.

Table 1.

Intercorrelations Between Demographic Variables and Academic Outcomes

Variable	1	2	3	4	5
1. Sex	--	.043	.101	-.004	.017
2. Race		--	.043	.204**	.008
3. Household Income			--	.373**	-.098
4. GPA				--	-.482**
5. WFIRS Learning Ratings					--

Note. **p < .01.

WIAT-III Written Expression Performance and Prevalence of Impairment

Descriptive statistics for students' Written Expression, Basic Reading, and Mathematics Composite scores of the WIAT-III, as well as all subtest, component, and supplementary standard scores that are encompassed by the Written Expression Composite are presented in Table 2. Students' estimated FSIQ scores are also provided in this table. On average, students in this sample scored seven points lower (M = 93) on the Written Expression Composite score than the normative sample of the WIAT-III, which has a mean score of 100.

Table 2.

Descriptive Statistics of Students' FSIQ, Reading, Mathematics, and Written Expression Scores

Variable	*Mean ± SD*	*Median Score*
Estimated FSIQ	100.31 ± 13.62	98
Basic Reading	95.30 ± 14.19	97
Mathematics	90.93 ± 14.85	89
Written Expression Cluster	95.29 ± 13.17	93
Subtest Scores	--	--
Spelling	93.89 ± 15.41	92
Sentence Composition	100.96 ± 13.56	100
Essay Composition	94.57 ± 12.34	93
Component/Supplementary Scores	--	--
Sentence Combining	108.45 ± 13.17	109.5
Sentence Building	92.88 ± 14.36	92
Word Count	94.57 ± 14.43	91
Theme Development/Text Organization	93.50 ± 11.89	92
Grammar/Mechanics	89.85 ± 14.33	89

Table 3 presents the rates of reading, mathematics, and written expression impairment in this sample; defined as a score below 85. The majority of students were not identified as

impaired in any domain (*n* = 170, 53.5%). Twenty-two percent (*n* = 70) of the sample was identified as impaired in s single domain. Approximately equal numbers of the remaining students were identified either as impaired in either two domains (*n* = 38, 12.0%) or all three domains (*n* = 39, 12.3%). In regards to the number of students specifically struggling with writing, approximately 23% of the entire sample (*n* = 71) was identified as impaired. A similar number of students, (*n* = 77, 24% of sample) were identified as impaired in reading. Consistent with other studies documenting high prevalence of math problems among samples of ADHD (Barkley, 1998; Capano, Minden, Chen, Schacher, & Ickowicz, 2008; Nussbaum, Grant, Roman, Poole, & Bigler, 1990). Impairment in the mathematics domain was most common (*n* = 115, 36% of sample).

Table 3.

Prevalence Rates of Academic Impairment in Reading, Mathematics, and Written Expression

Academic Domain	Total Students	Percent of Sample
Reading	77	24.3
Mathematics	115	36.3
Written Expression	71	22.4
Number of Impaired Domains	--	--
None	170	53.5
One	70	22.1
Two	38	12.0
Three	39	12.3

Independent sample t-tests were conducted to compare the Written Expression Composite scores across ADHD subtypes, comorbid externalizing conditions, and use of ADHD medication. . The t-test comparing participants diagnosed with Primarily Inattentive Type (M=

95.94; SD = 12.71) to those diagnosed with Combined Type (M= 95.04; SD = 13.63) was not significant (t = .60, p = .55), indicating that the mean Written Expression Composite scores did not differ depending on ADHD presentation. Similarly, the means scores of students with a comorbid diagnosis of ODD and/or CD (M= 95.67; SD = 13.76) did not differ from the mean scores from those without a comorbid externalizing diagnosis (M= 94.98; SD = 12.40) (t = .46, p = .64). The third t-test comparing the mean scores of students who were taking medication for ADHD (M= 96.07; SD = 13.45) to scores of students who were not taking medication (M= 94.83; SD = 12.99) was also not significant (t = 1.41, p = .16).

Associations Between Writing Skills and Theoretical Outcomes

Table 4 shows the results of the two hierarchical multiple regression analyses when the Written Expression Cluster score was included as a predictor. For the first model, GPA was the academic outcome of interest. IQ, reading abilities, student race, and household income were entered in the first step of the model. In the second step, the Written Expression Cluster score was entered into the model. The final model was statistically significant [$F(5,268) = 25.02$, p <.001, R^2 = .32]. Further, Written Expression Composite scores significantly predicted students' GPA above and beyond the effect of IQ and reading abilities [$\Delta F(1,268) = 4.47$, p = .04, ΔR^2 = .01]. Written Expression scores accounted for an additional 1% of the variance in GPA for this sample. The second regression model used WFIRS School-Learning subscale scores as the outcome. Both steps of this model were identical to the GPA model in regards to the variables entered at each step. Like the GPA model, this final model was also statistically significant [$F(5,300) = 8.13$, p <.001, R^2 = .12], and Written Expression Composite score significantly predicted students' GPA above and beyond the effect of the covariates [$\Delta F(1,300) = 4.41$, p = .03, ΔR^2 = .01]. Written Expression scores again accounted for an additional 1% of the variance.

Table 4.

Hierarchical Regression Models for WIAT Written Expression Scores Predicting Academic Outcomes

	Step 1 Model Summary				Step 2 Model Summary			
DV: Core Class GPA	*B*	*SE*	*β*	*t*	*B*	*SE*	*β*	*t*
	$F(4,269) = 29.77, R^2 = .31$***				$F(5,268) = 25.02, R^2 = .32$*** $\Delta F(1,268) = 4.47, \Delta R^2 = .01$*			
Estimated FSIQ	.02	.01	.36	5.51***	.02	.01	.33	4.84***
Reading Achievement	.01	.01	.06	0.96	-.01	.01	-.03	-.46
Student Race	.26	.09	.15	3.00***	.26	.09	.15	3.03***
Household Income	.01	.01	.20	3.50***	.01	.01	.19	3.45***
Written Expression	--	--	--	--	.01	.01	.16	2.12*

	Step 1 Model Summary				Step 2 Model Summary			
DV: WFIRS Learning Score	*B*	*SE*	*β*	*t*	*B*	*SE*	*β*	*t*
	$F(4,301) = 8.96, R^2 = .11$***				$F(5,300) = 8.132, R^2 = .12$*** $\Delta F(1,300) = 4.42, \Delta R^2 = .01$*			
Estimated FSIQ	-.05	.02	-.20	-2.84**	-.04	.02	-.16	-2.28*
Reading Achievement	-.04	.02	-.18	-2.72**	-.02	.02	-.08	-0.95
Student Race	.41	.35	.07	1.18	.41	.35	.06	1.17
Household Income	.01	.01	.01	0.08	.01	.01	.01	0.21
Written Expression	--	--	--	--	-.04	.02	-.17	-2.10*

Note. * $p < .05$. ** $p < .01$. *** $p < .001$.

Table 5 presents the results of the exploratory multiple regression analyses for GPA and WFIRS scores. Each of these models included students' component/supplementary scores from the Sentence Composition and Essay Composition subtests and Spelling subtest scores as predictors in each model. These scores were modestly to moderately correlated with one another (*r*s = .13 -.55), and all variables demonstrated acceptable VIF values (< 10). Together, the component/supplementary scores significantly predicted both student GPA and WFIRS scores in their respective models (*p* values <.001). For the model predicting GPA, the Theme Development and Organization of Text component score was the only significant predictor of GPA ($\beta = .17$, $p = .01$). In contrast, Spelling scores ($\beta = -.15$, $p = .02$) and Grammar and

Mechanics scores (β = -.17, p = .02) were significant predictors in the model predicting WFIRS scores.

Table 5.

Exploratory Regression Models for WIAT Written Expression Scores Predicting Academic Outcomes

DV: Core Class GPA	Model Summary			
	B	*SE*	*β*	*T*
	$F(6,267) = 8.69$, $R^2 = .16$***			
Spelling	.01	.01	.13	1.88
Sentence Combining	.01	.01	.08	1.21
Sentence Building	.01	.01	.12	1.62
Word Count	-.01	.01	-.08	-1.14
Theme Development	.02	.01	.17	2.66**
Grammar/Mechanics	.01	.01	.11	1.48

DV: WFIRS Learning Score	Step 1 Model Summary			
	B	*SE*	*β*	*T*
	$F(6,298) = 6.33$, $R^2 = .11$***			
Spelling	-.03	.01	-.15	-2.27*
Sentence Combining	-.02	.02	-.07	-1.10
Sentence Building	-.02	.02	-.08	-1.19
Word Count	.02	.02	.07	1.07
Theme Development	.01	.02	.03	.44
Grammar/Mechanics	-.04	.02	-.17	-2.21*

Note. * $p < .05$. ** $p < .01$. *** $p < .001$.

Latent Profile Analysis of Written Expression Abilities

A latent profile analysis was conducted to examine whether distinct patterns of written expression abilities were present in this sample of adolescents with ADHD. Models were built using the five component scores, the Grammar/Mechanics supplementary scores, and the Spelling subtest of the Written Expression Cluster as indicator variables. Each set of models used a progressively more stringent set of covariates: 1.) No covariates, 2.) IQ scores, 3.) IQ scores and reading abilities.

In the model with no covariates, fit criteria indicated that a three-profile solution provided the best explanation of the data. A table containing the estimated mean scores of each WIAT score used as an indicator for these profiles can be found in Table 6. In this model, two of the three profiles exhibited a global level of achievement; Profile 1 (10% of sample) consisted of mean scores approximately 10 points higher than the normative mean across all indicators, and Profile 2 (62% of sample) consisted of mean scores generally at or below 90. Profile 3 (28% of sample) exhibited more variability. Specifically, the profile consisted of mean scores similar to the high-achievement group for the spelling and sentence composition indicators, but mean scores similar to the low-achievement group for the essay indicators.

Table 6.

Estimated Means of WIAT Scores for LPA with No Covariates

Profile (% of sample)	SP	SC	SB	WC	TD	GM
1 (10%)	102.7	113.7	103.3	122.0	107.9	113.7
2 (62%)	86.3	102.6	85.9	90.0	89.8	83.1
3 (28%)	107.7	119.4	104.4	94.8	96.4	96.0

Note: SP = Spelling, SC = Sentence Combining, SB = Sentence Building, WC = Word Count, TD = Theme Development and Text Organization, GM = Grammar and Mechanics.

The majority of fit statistics for the second model, which included FSIQ as a covariate, indicated that either a four-profile or a five-profile solution were the best explanations for the data. The four-profile solution met all required model fit criteria. In contrast, the five-profile solution violated two selection criteria. Specifically, the five-profile solution produced a nonsignificant LMR test and included a profile that only consisted of 2.2% (n = 7) of individuals from the sample. Therefore, the four-profile solution was determined to the optimal model for this sample and the estimated mean scores for each WIAT score is presented in Table 7. The three profiles that emerged in the model without any covariates were retained in this model. A

unique profile emerged that consisted of mean scores that were within the Average range of scores compared to the normative WIAT sample across all indicators. This new profile aligns more closely with a global conceptualization of impairment, but the retaining of the unique profile (Profile 4 in this model, 17% of sample) continues to suggest that some students with ADHD may exhibit a specific pattern of deficits.

Table 7.

Estimated Means of WIAT Scores for LPA with FSIQ as Covariate

Profile (% of sample)	SP	SC	SB	WC	TD	GM
1 (8%)	102.8	113.9	104.1	122.6	109.8	114.8
2 (47%)	92.4	110.2	91.7	92.5	93.4	89.3
3 (28%)	81.7	96.1	81.5	87.9	86.4	77.5
4 (17%)	115.1	121.9	109.6	96.6	96.8	98.6

Note: SP = Spelling, SC = Sentence Combining, SB = Sentence Building, WC = Word Count, TD = Theme Development and Text Organization, GM = Grammar and Mechanics.

All fit criteria for the final model, which contained both FSIQ and reading achievement as covariates, indicated that a five-profile solution was best. The estimated mean scores for each WIAT score is presented in Table 8. This profile presents a more heterogeneous picture of students' written expression abilities than the previous models. Profiles that appear to represent a global conceptualization of written expression abilities (i.e., high, average, and low profiles) again emerge in this model. Additionally, the profile that appears to represent students who struggle with complex writing tasks was also present. The unique profile that emerged in the model appears to represent students who are particularly impaired in their spelling abilities. Estimated means for the Spelling subtest and the Grammar/Mechanics supplementary score in this profile were lower than the rest of the means in the profile.

Table 8.

Estimated Means of WIAT Scores for LPA with FSIQ and Reading Achievement as Covariates

Profile (% of sample)	SP	SC	SB	WC	TD	GM
1 (8%)	101.6	114.5	104.7	121.5	110.7	115.3
2 (40%)	96.0	109.6	92.5	91.5	94.0	89.2
3 (33%)	78.8	101.7	84.2	91.7	89.1	81.4
4 (4%)	90.1	91.4	76.3	78.8	77.5	72.9
5 (16%)	117.1	120.9	109.8	98.0	96.3	99.4

Note: SP = Spelling, SC = Sentence Combining, SB = Sentence Building, WC = Word Count, TD = Theme Development and Text Organization, GM = Grammar and Mechanics.

Discussion

This study sought to evaluate the prevalence of written expression impairment in a large sample of middle school age adolescents with ADHD and associations between writing abilities and academic impairment. In addition, specific patterns of writing abilities were explored using Latent Profile Analyses. Written expression abilities were in the impaired range for approximately 22% of the sample. Importantly, written expression abilities were associated with academic impairment above and beyond the influence of intelligence and reading abilities. Overall, the findings indicate that written expression impairment in ADHD is generally global (i.e., performed poorly on all tests). However, a unique group of students exhibited impairment only on the most complex writing tasks. These findings are discussed in more detail below along with the clinical implications.

In regards to the prevalence of written expression impairment, the results supported the hypothesis that rates would be lower than previously reported estimates from clinic-based samples. Indeed, the prevalence of written expression underachievement in this sample (22%) was significantly lower than clinic-based estimates (e.g., 65%; Mayes & Calhoun, 2006).

Previous research has shown that clinic-based samples tend to exhibit greater impairment in a variety of domains in comparison to non-clinic samples (Gadow et al., 2001; Goodman et al., 1997). Therefore, clinic-based prevalence rates likely provide an overestimate of the true prevalence of writing impairment associated with ADHD. Further, the various methodologies for classifying youth as impaired in writing are also likely influencing the variability in prevalence rates. Specifically, the Mayes and Calhoun (2006) study used a discrepancy model, while this study used an underachievement approach (Dombrowski et al., 2004; Fletcher et al., 2002; Stanovich, 1986). Finally, it is important to note that although the rate of written expression impairment in this sample was lower than previous clinic-based ADHD estimates, 22% is still higher than rates reported in the general population (8-15%) (Lyon, 1996; Yoshimasu et al., 2011) and was similar to the rate of reading impairment found in this sample (24%).

The results of the hierarchical regression analyses generally supported the hypothesis that written expression abilities are significantly associated with academic outcomes. The analyses indicated that written expression abilities only accounted for a small increase in the predictive ability of the models, explaining only an additional 1% of the variance. However, these were highly stringent tests that controlled for multiple variables previously shown to be associated with academics (i.e., intelligence, reading, income, and race), and so it is noteworthy that writing remained significant at all. These more restrictive tests may also have led to an underrepresentation of the true impact of written expression abilities on academic outcomes. At the bivariate level, correlations between written expression and the academic outcomes are moderate to strong (*r*s = .358 and -.277 for GPA and WFIRS, respectively), and similar to the associations between reading and academic outcomes (*r*s = .296 and -.255).

The results of the exploratory regression analyses with all of the written expression subscales included separately varied depending on the academic outcome of interest. Specifically, students' ability to develop organized and coherent written products was significantly associated with their GPA. In contrast, their spelling and grammar abilities were associated with their parents' perceptions of their learning on the WFIRS. These associations may result from differences in teacher and parent experiences. Given that there is a shift to complex writing tasks as a central form of evaluation as students transition to middle school (Poplin et al., 1980), teachers are likely to place high value on the organization and flow of students' written work. Parents, on the other hand, are more likely to have spent significant time helping their children with homework by checking for careless mistakes with spelling, punctuation, and capitalization. Specifically, lack of attention to detail and making careless mistakes are core symptoms of ADHD, and parents frequently report that their children with ADHD rush through homework assignments (Epstein et al., 1993; Power et al., 2006). Indeed, multiple studies have found that students with ADHD made significantly more grammatical mistakes and spelling errors than their non-ADHD peers, and these differences emerge as early as nine years of age (Casas et al., 2013; Re et al., 2007). Thus, while middle school teachers are focused on teaching and evaluating complex writing skills such as theme organization and these skills in turn impact grades (i.e. GPA), careless mistakes with spelling and punctuation are likely to remain most salient from the parent perspective.

The individual writing subscales included in the exploratory regression analyses were also evaluated in an LPA. Notably, similar patterns of written expression abilities emerged regardless of the covariates included in the model. Of the profiles presented in these models, the majority appears to indicate that written expression abilities are consistent across tasks; students

who perform poorly in spelling are also likely to perform poorly in sentence composition and on essays. However, one profile that also emerged in each of the models did not fit the high-average-low pattern. The estimated mean scores in this profile were consistently higher than all other classes for the Spelling subtest and the Sentence Building and Sentence Combining scores. In contrast, the estimated means for the three scores of the Essay Composition subtest were more closely comparable with the average writing skill profiles, with each estimated mean score slightly below 100. Importantly, this varied profile was also consistent in total group membership, averaging 16-18% of the entire sample across models. This profile appears to represent a group of students who have the basic skills needed to be a successful writer, such as accurate spelling and knowledge about how to create complete sentences, but do not yet have the ability to effectively use these skills to complete a complex writing task. It should also be noted that these students, although they exhibit a deficit in their more complex writing abilities relative to their basic skills, are not likely to be diagnosed with LD based upon the underachievement model recommendations of Dombrowski et al. (2004).

Limitations

Although the current study makes several significant contributions to the literature, its methodology also presents some limitations. The cross-sectional nature of the data precludes causal relationship conclusions from being drawn regarding students' written expression abilities and their academic outcomes. The cross-sectional data also fails to provide information about changes in written expression abilities over time. As a result, it is not clear whether the patterns elicited from the LPA are stable over time. For example, it is possible that the unique group of students struggling to put their skills together to generate a high quality essay may merge with those students who are globally skilled writers as they get more practicing creating complex

written products. Finally, this study purposely limited the academic outcomes examined to two; one school-based metric (i.e. GPA) and one based upon parent perceptions. There are many ways to evaluate academic functioning and it is unclear whether the findings would generalize to other metrics, such as student or teacher perceptions of academics or statewide achievement tests.

Clinical Implications

The results of this study have a number of important clinical implications for educators and clinicians who work with middle school age adolescents with ADHD. First, written expression impairment is clearly a common phenomenon in this population. Therefore, it is important to consider specifically screening students' written expression abilities if they meet criteria for ADHD. However, the methodology used in the current study presents a practical limitation for educators and clinicians. The WIAT Written Expression subtest requires a significant time commitment to administer (30 minutes) and score (30-45 minutes). While it is a reliable and valid measure of written expression, it is likely not feasible to widely administer the WIAT Writing subtest for screening purposes. Other, more feasible strategies include using a brief screening tool, such as the spelling subtest from the Wide Range Achievement Test (Wilkinson & Robertson, 2006), or evaluating a written assignment using holistic ratings or CBM strategies. A more comprehensive assessment could then be conducted for students who exhibit impairment on these screeners. Schools using the RTI model likely use a similar strategy for other behavioral and academic concerns, broadly and quickly screening at Tier 1 and following up with those students who are struggling despite evidence-based classroom practices with more intensive screening at Tier 2. Alternatively, educators could first focus on the educational impairment aspect of Dombrowski et al.'s (2004) dual-deficit model. This strategy could involve a systematic review of students' grades and statewide standardized achievement

scores and gathering feedback from parents and teachers regarding written expression abilities. Students who are classified as exhibiting writing impairment using those methods would then be assessed using the WIAT or another appropriate tool.

The association found in this study between written expression abilities and academic outcomes above and beyond reading and intelligence suggests that targeted writing intervention could lead to improved academic outcomes. Unfortunately, information regarding potential interventions to improve written expression abilities is scarce. The few interventions that have been investigated in the literature are varied in their focus and the resources necessary to implement them. For example, Self-Regulated Strategy Development (SRSD) is designed to improve students' planning and organization skills when creating written work (Lienemann & Reid, 2008). SRSD requires one-on-one instruction over as many as 15 sessions (Lane et al., 2008; Reid & Lienemann, 2006), which may be difficult to implement in a school. Assistive technology interventions, which target the translation phase of the Hayes and Flower (1980) model, place less strain on educators' time, but still require investment in a laptop or other device for a single student's full-time use. For some students, specifically those who appear to struggle with the complex task of composing an essay, using an intervention such as SRSD that focuses on helping students plan and organize their written work is likely to lead to improvement on its own. However, given the results of the current study suggest written expression impairment in students with ADHD is largely global in nature, using interventions that only target a subset of writing skills may leave students impaired in other domains. Finally, writing interventions may need to be tailored to be effective for students with ADHD who often have significant difficulty maintaining focus during academic tasks. Specifically, it seems likely that at a minimum,

evidence-based behavior management strategies will need to be incorporated into the writing intervention curriculum.

Future Directions

To expand upon this study's findings, future research should seek to accomplish several goals. To the best of our knowledge, this was the first study to evaluate the association between writing and academic outcomes in a sample of youth with ADHD, above and beyond important covariates. However, the study was cross-sectional and a significantly more compelling case for intervention would exist if there were evidence that written expression abilities at an earlier time point predicted academic outcomes at a later point. Similarly, a longitudinal evaluation of changes in written expression abilities would also advance the literature. It is possible that students with ADHD are simply delayed in their written expression development, and they may eventually catch up to their peers. On the other hand, these patterns may persist over time or worsen as the importance of written expression for academic success continues to increase in high school and postsecondary education settings. In sum, longitudinal studies would shed light on whether there is truly a need for specific writing interventions for students with ADHD.

Another important area for future research is the role of executive functions on the development of written expression abilities. EF has been cross-sectionally linked with written expression abilities (Hooper, Swartz, Wakely, de Kruif, & Montgomery, 2002; Mayes et al., 2009), but a causal relationship has not been established. In the current study, it is possible that the unique writing profile that emerged from the LPA is linked to students' EF abilities. Specifically, these students may have deficits in their overall planning/organization skills, which would interfere with their ability to successfully create an organized and coherent essay. If future research determines that EFs are significant contributors to the development of written

expression abilities, then ADHD interventions that target EF may improve writing. Previous studies have demonstrated that interventions targeting the EF abilities of students with ADHD lead to gains on achievement tests and grades (Langberg, Epstein, Becker, Girio-Herrera, & Vaughn, 2012; Pfiffner, Villodas, Kaiser, Rooney, & McBurnett, 2013), but written expression outcomes have not been examined.

Conclusions

In summary, the current study found that a significant portion of a large school-based sample of adolescents with ADHD had written expression impairment. Further, written expression abilities were found to be associated with both grades and parent perceptions of academic success above and beyond reading abilities and intelligence. Students in this sample tended to exhibit global competence or impairment across writing tasks, but some students did exhibit competence in basic writing tasks (e.g., spelling and sentence composition) and worse performance in more complex tasks (e.g., essay composition). Future longitudinal research is needed to uncover the full impact of writing abilities on the academic success of students with ADHD.

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Vita

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