Academic Challenges for Children with ADHD: Policy Implications for School-Based Practice

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Accepted by the Faculty of the Graduate College, The University of Vermont, in partial fulfillment of the requirements for the degree of Doctor of Education, specializing in Educational Leadership and Policy Studies.

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ABSTRACT

While ADHD is primarily characterized by deficits in attention or inhibition, several other impairments have been found to be associated with ADHD. Risks including cognitive impairments and deficits in academic achievement have been well documented in comparison to controls. However, only a few studies have characterized ADHD using the most current DSM-IV-TR diagnostic criteria and examined subtype differences accordingly.

This study examined elementary students diagnosed with ADHD-Combined Type (ADHD-C), ADHD-Predominantly Inattentive Type (ADHD-IN), other clinically-referred children without ADHD (NON-ADHD REF), and non-referred control children (CONTROL). These groups of children were compared based on intellectual functioning as measured by performance on the WISC-IV, academic achievement as measured by performance on WIAT-II composites, and related academic enablers as measured by the ACES Academic Enablers scales. Results replicated findings in other studies indicating that children with ADHD generally display lower levels of overall cognitive functioning and academic achievement in comparison to normally-developing peers. The study further indicated that children with ADHD may exhibit weaker cognitive functioning specific to verbal and working memory skills, lower academic achievement in the areas of mathematics and written language, and weaker study skills as compared to other children with presenting behavioral or learning problems. Additionally, children with the ADHD-C subtype were found to exhibit lower reading abilities and lower levels of interpersonal skills and motivation in comparison to this group. Subtype differences between the ADHD groups were not found, except on a measure of interpersonal skills where the ADHD-C group scored significantly lower than the ADHD-IN group. In addition to accommodations and behavior modification programs implemented to promote on-task behaviors in the classroom, implications for school-based practice to address academic skill deficits for students with ADHD are discussed along with recommendations for future research.
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TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ACKNOWLEDGEMENTS</td>
<td>ii</td>
</tr>
<tr>
<td></td>
<td>LIST OF TABLES</td>
<td>v</td>
</tr>
<tr>
<td>1</td>
<td>CHAPTER 1: INTRODUCTION AND LITERATURE REVIEW</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>DSM-IV-TR Criteria for ADHD</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Prevalence and Gender Differences</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Historical Overview of ADHD</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Previous Research on ADHD Subtypes</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Cognitive Functioning of Children with ADHD</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>Cognitive Functioning of the ADHD Subtypes</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>Summary of Cognitive Findings</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td>Academic Achievement of Children with ADHD</td>
<td>22</td>
</tr>
<tr>
<td></td>
<td>Academic Achievement of the ADHD Subtypes</td>
<td>23</td>
</tr>
<tr>
<td></td>
<td>Summary of Achievement Findings</td>
<td>27</td>
</tr>
<tr>
<td></td>
<td>Dual Pathway Model</td>
<td>28</td>
</tr>
<tr>
<td></td>
<td>Classroom Behaviors Associated with Achievement</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>ADHD and Learning Behaviors</td>
<td>32</td>
</tr>
<tr>
<td>2</td>
<td>CHAPTER 2: DESIGN OF STUDY</td>
<td>33</td>
</tr>
<tr>
<td></td>
<td>Purposes of the Present Study</td>
<td>33</td>
</tr>
<tr>
<td></td>
<td>Cognitive Functioning</td>
<td>35</td>
</tr>
<tr>
<td></td>
<td>Academic Achievement</td>
<td>36</td>
</tr>
<tr>
<td></td>
<td>Academic Enablers</td>
<td>37</td>
</tr>
</tbody>
</table>
Method ........................................................................................................ 38
Participants .................................................................................................... 38
Measures ........................................................................................................ 39
  Wechsler Intelligence Scale for Children – Fourth Edition ........ 40
  Wechsler Individual Achievement Test – Second Edition .......... 42
  Academic Competence Evaluation Scales ................................. 43
Procedure ...................................................................................................... 45

CHAPTER 3: ANALYSIS OF THE DATA ................................................. 47
  WISC-IV ...................................................................................................... 48
  WIAT- II .................................................................................................... 49
  ACES ........................................................................................................ 50
  Group Differences Excluding Children with Learning Disabilities (LD) 51

CHAPTER 4: CONCLUSION ................................................................ 53
  Discussion ................................................................................................. 53
    Children with ADHD versus Normally-Developing Peers .......... 53
    Children with ADHD versus Children with Other Presenting Problems 53
    Children with ADHD-C versus Children with ADHD-IN .......... 55
    Impact of Learning Disabilities .......................................................... 56
  Implications .............................................................................................. 57
  Opportunities ............................................................................................ 63
  Limitations and Future Directions ......................................................... 65
# List of Tables

<table>
<thead>
<tr>
<th>Table</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Table 1</td>
<td>DSM-IV symptoms of ADHD</td>
<td>80</td>
</tr>
<tr>
<td>Table 2</td>
<td>Summary of studies examining cognitive functioning and academic</td>
<td>81</td>
</tr>
<tr>
<td></td>
<td>achievement in children with ADHD</td>
<td></td>
</tr>
<tr>
<td>Table 3</td>
<td>Demographic characteristics of sample</td>
<td>84</td>
</tr>
<tr>
<td>Table 4</td>
<td>Group differences on WISC-IV FSIQ and Index scores</td>
<td>85</td>
</tr>
<tr>
<td>Table 5</td>
<td>Group differences on WIAT-II Composite scores</td>
<td>86</td>
</tr>
<tr>
<td>Table 6</td>
<td>Group differences on ACES Academic Enabler Scales</td>
<td>87</td>
</tr>
</tbody>
</table>
CHAPTER 1: INTRODUCTION AND LITERATURE REVIEW

Children who present with significant problems marked by inattention and/or hyperactivity and impulsivity are often diagnosed with the psychiatric disorder of Attention-Deficit/Hyperactivity Disorder (ADHD) or what educators commonly refer to as Attention Deficit Disorder (ADD). These children are typically referred by classroom teachers due to chronic inattentive and/or disruptive behaviors exhibited in the classroom. They are described as easily distracted, as having difficulty completing assignments (not finishing things they start), and not returning homework (being forgetful and/or disorganized). Such students are at a higher risk for academic difficulties and for developing more severe behavior problems and/or problems with interpersonal relationships (Barkley, 2006). At the same time, teachers may also report that students exhibiting these characteristics are more capable than their academic performance indicates. The purpose of this study is to examine relationships among measures of cognitive functioning, academic performance, and academic enablers in children diagnosed with ADHD.

DSM-IV-TR Criteria for ADHD

The Diagnostic and Statistical Manual of Mental Disorders – Fourth Edition (DSM-IV; American Psychiatric Association, 1994) and its text revision (DSM-IV-TR; American Psychiatric Association, 2000) outline the specific diagnostic criteria for ADHD. To meet diagnostic criteria according to the DSM-IV-TR, individuals must have at least 6 of 9 symptoms of inattention and/or 6 of 9 symptoms of hyperactivity and impulsivity. The type of ADHD diagnosed depends on whether criteria are met for
inattention, hyperactivity-impulsivity, or both: the Predominantly Inattentive Type (ADHD-IN), the Predominantly Hyperactive-Impulsive Type (ADHD-HI), or the Combined Type (ADHD-C) (Barkley, 2006). Table 1 lists the DSM-IV-TR symptoms of ADHD.

The DSM-IV-TR criteria stipulate that individuals exhibiting the requisite inattentive symptoms and/or hyperactive-impulsive symptoms are considered to meet the criteria for ADHD provided that the individual has had symptoms for at least 6 months, some of the symptoms have occurred to a degree that is developmentally deviant, some of the symptoms produce impairment prior to the age of seven years, and some impairment is present across two or more settings. Furthermore, there must be evidence of clinically significant impairment in social, academic, and/or occupational functioning, and the symptoms cannot be explained by other physical or mental health disorders (American Psychiatric Association, 2000).

Prevalence and Gender Differences

The diagnostic criteria as outlined in the DSM-IV-TR, is currently used by physicians and mental health professionals as the basis for diagnosing ADHD in the United States. ADHD is one of the most common reasons children are referred to mental health practitioners and one of the most prevalent childhood psychiatric disorders (Barkley, 2006). A range of 3-7% of school-aged children currently are estimated to have ADHD (American Psychiatric Association, 2000; Barkley, 2006). According to information published by the Unites States Department of Health and Human Services, approximately one in twenty children (5%) is diagnosed with ADHD (National Institute
of Mental Health, 1996). Prevalence rates vary somewhat based on the methods chosen to define ADHD, the population studied, and the degree of agreement required between parents, teachers, and/or others in diagnosing ADHD (Barkley, 2006).

ADHD diagnosis has been suggested to change with development. For example, the diagnosis of the predominantly hyperactive-impulsive type of ADHD is most often found in preschoolers, whereas school-aged children are more typically diagnosed with the combined type, and the predominantly inattentive type is most associated with later development due to reductions in hyperactive behaviors during this developmental period (Nigg, 2006).

While the epidemiological profile of ADHD has been suggested to be closely linked to maturational development (Nigg, 2006), differences in prevalence rates have also been noted between males and females. Boys diagnosed with ADHD outnumber girls by approximately three to one (Barkley, 2006; National Institute of Mental Health, 1996). It is not clear whether boys are biologically more predisposed to ADHD symptoms than girls; or, if boys with ADHD are more easily identified given their tendency to exhibit more behaviorally disruptive hyperactive and impulsive characteristics than do girls. Girls more often than boys tend to exhibit the symptoms of inattention without accompanying externalizing behaviors, such as defiance, noncompliance, or hyperactivity. Considering this, girls may be under-identified given the decreased severity of their behavioral disruptions in comparison to those of boys with ADHD. This lends the question of whether boys are more often identified as having ADHD than girls because they cause greater behavioral disruptions in the classroom.
While speculation remains regarding the varied prevalence between genders, DuPaul, et al. (2006) found no significant gender differences in academic functioning for children with ADHD. They found impairment in school functioning for all ADHD participants, regardless of gender. DuPaul, et al. examined 133 boys and 42 girls in first through fourth grade who met DSM-IV criteria for ADHD. They were referred for participation by their teachers due to concerns regarding inattentive and/or hyperactive-impulsive behaviors as well as difficulties in reading and/or math. The students’ academic functioning was assessed based on performance on the Woodcock-Johnson III: Tests of Achievement (Mather & Woodcock, 2001), the Academic Competency Evaluation Scale (ACES; DiPerna & Elliott, 2000), and report card grades. Additionally, behavior was assessed according to teacher ratings on the Behavior Assessment System for Children (BASC; Reynolds & Kamphaus, 1992) and the Social Skills Rating System (SSRS; Gresham & Elliott, 1990). Both boys and girls with ADHD were found to perform below non-disabled peers in the areas of academic, behavioral, and social functioning. Additionally, boys were found to exhibit greater ADHD symptom severity than girls based on raw score ratings on the Conners Teacher Rating Scale (Conners, 1997), and girls were shown to exhibit a greater risk for internalizing behavior problems according to BASC ratings. Considering this, it was concluded that girls may be less likely to suffer from ADHD. However, when they do, the associated risks are at least as severe as those for boys with ADHD in comparison to nondisabled peers of the same gender (DuPaul et al., 2006).
Hinshaw, Owens, Sami, and Fargeon (2006) examined five-year outcomes for females diagnosed with ADHD in childhood between the ages of 6 and 12 years. Females with ADHD were referred for participation in the study by their pediatricians, school staff, mental health professionals, and/or via direct study advertisement. Baseline assessments were used to determine eligibility for study participation, with only those who met the full DSM-IV criteria for ADHD being eligible for participation. A group of matched controls, who did not meet DSM-IV criteria for ADHD, were used as a comparison group. The participants’ functioning related to ADHD symptomology was assessed at a five year follow-up (retention rate = 92%) from information gathered using the Diagnostic Interview Schedule for Children – Fourth Edition (DISC-4; Shaffer, Fisher, Lucas, Dulcan, & Schwab-Stone, 2000), the same measure used to determine whether the individual met DSM-IV diagnostic criteria for ADHD at baseline. Additionally, the females were assessed according to self, parent, and/or teacher ratings on the Swanson, Nolan, and Pelham Rating Scale – Fourth Edition (Swanson, 1992), Child Behavior Checklist (Achenbach, 1991a), Teacher Report Form (Achenbach, 1991b), Self-Reported Deliquency (Elliott, Huizinga, & Ageton, 1985), Children’s Depression Inventory (Kovacs, 1992), Substance Use Questionnaire (Molina & Pelham, 2003), Eating Disorders Inventory (Garner, 1991) and Eating Attitudes Test (Garner, Olmstead, Bohr, & Garfinkel, 1982). Hinshaw and his colleagues found that the comparison group maintained their non-ADHD status, with few developing ADHD symptoms later in development. A majority of those who had been diagnosed with ADHD-Inattentive-Type (ADHD-IN) at baseline maintained this classification at the
five-year follow-up. On the other hand, more than half of the females diagnosed with ADHD-Combined Type (ADHD-C) in childhood were classified with ADHD-IN five years later or found to exhibit a sub-clinical level of ADHD symptoms. This suggests a greater persistence of ADHD-IN symptoms in females as compared to the persistence of ADHD-C symptoms. Females with ADHD also continued to show greater psychiatric symptomology across areas including; ADHD, externalizing and internalizing behaviors, eating disorders, and/or substance abuse (Hinshaw et al., 2006). These findings further support the significance of ADHD in females given the likelihood of persisting symptoms and related impairments.

**Historical Overview of ADHD**

Several different terms have been used for the disorder the DSM-IV-TR calls ADHD. The historical context of ADHD as an emerging disorder can be traced back over nearly a century. Barkley (2006) examined the roots of ADHD beginning in the early 1900s through the most recent developments. According to Barkley, the earliest views of ADHD were based on a “social Darwinist perspective” in that the cause of the disorder was assumed to be biologically based. In the early 1900s, ADHD was seen as a “brain damage syndrome,” even in those cases where brain damage was not evident. The disorder was called “minimal brain damage” or “minimal brain dysfunction” (MBD).

As the second half of the century approached, the brain-based theories subsided as behavioral theories emerged. A child’s activity level became the major defining feature of the disorder. The second edition of the Diagnostic and Statistic Manual of Mental Disorders (DSM-II; American Psychiatric Association, 1968) used the term
“Hyperkinetic Reaction of Childhood” to characterize clinically over-active children. This nomenclature coincided with a rise in the use of stimulant medication for school-aged hyperactive children and research on the efficacy of medication therapy. Despite its proven efficacy, its widespread use as a primary treatment option led to some public misgivings about the “drugging” of school children and related controversies about medication therapies for children (Hancock, 1996). Despite continuing controversy over its use, stimulant treatment continues to be the most widely and thoroughly studied therapeutic treatment for ADHD (Barkley, 2006).

In the 1970s, possibly as a reaction to controversies over medication treatment, the emphasis shifted from biological theories to environmental components being regarded as the leading cause of ADHD. This shift came at a time when popular culture was becoming more health-conscious, more focused on natural foods, and more concerned about the long-term effects of environmental manipulations. Hypothesized environmental contributors to ADHD in school-aged children included environmental irritants, such as preservatives or dyes in dietary selections, and environmental over-stimulation (Barkley, 2006). For example, suggestions have been made that electronic media such as television and video games may alter neural development, thus contributing to children’s attention problems and ADHD (Nigg, 2006). In addition to the possibility of environmental causes, speculation also arose about the link between ADHD and poor or ineffective child rearing (Barkley, 2006).

In the later 1970s and 1980s, inattention soon replaced hyperactivity as the primary defining feature of ADHD, and the association between attention problems and
learning difficulties was established. With the publication of the DSM’s third edition (DSM-III, American Psychiatric Association, 1980), the disorder was renamed Attention Deficit Disorder (ADD) and reconceptualized to include both the hyperactive-impulsive as well as the inattentive components of the disorder. Accordingly, the DSM-III defined two subtypes of ADD, with and without hyperactivity. The creation of two subtypes of ADD was marked with controversy given the limited body of research to support subtyping at the time. As a result, in the next text revision of the DSM (DSM-III-R; American Psychiatric Association, 1987) the subtypes of ADD were combined into one disorder labeled Attention Deficit Hyperactivity Disorder (ADHD).

As research developed in the field, evidence grew in support of important distinctions among individuals diagnosed with ADHD. In the early 1990s, the fourth edition of the DSM (DSM-IV; American Psychiatric Association, 1994) reintroduced the notion of subtypes by defining sets of symptom criteria that could comprise a purely inattentive type of ADHD (ADHD-IN, Predominantly Inattentive Type), a purely hyperactive-impulsive type (ADHD-HI, Predominantly Hyperactive-Impulsive Type), and a combined type including hyperactive-impulsive and inattentive symptoms (ADHD-C, Predominantly Combined Type) as shown previously in Table 1. The criteria also included pervasiveness of symptoms across settings, and clinical impairment in a major domain of life functioning. These changes were made in accordance with field trial data and other research and remain current in the most recent edition of the DSM (DSM-IV-TR; American Psychiatric Association, 2000; Barkley, 2006).
Best practice, as outlined by the American Academy of Pediatrics guidelines (American Academy of Pediatrics, 2000) and experts in the field (Barkley, 2006; DuPaul, 1992; DuPaul & Stoner, 1994; Hoff, Doepke, & Landau, 2002), suggest that current assessment of ADHD be multimethod, utilizing measures that gather information from various sources and across settings. Methods commonly employed in order to determine whether a student meets the DSM-IV-TR criteria for ADHD typically include an initial screening of the presenting concern(s), review of existing records, a direct history of the child, observations of student behavior, diagnostic interview with parent(s) and student, as well as behavioral ratings of the student’s behavior across environments. For example, behavioral ratings on the Child Behavior Checklist (CBCL), Teacher’s Report Form (TRF), and Youth Self-Report (YSR) (Achenbach & Rescorla, 2001) allow for a standardized assessment of a student’s behavior across settings as rated by parents/caregivers at home, teachers in the school setting, and children age eleven years or older. Attention problems rated in the clinical range according to the CBCL, TRF, and YSR or other standardized measures provide some evidence that a student may exhibit problems consistent with diagnostic symptoms of ADHD as outlined in the DSM-IV-TR. Examples of other rating scales also used to obtain parent and teacher ratings of ADHD symptoms or closely related problems include the Conners rating scales (Conners, 1997) and ADHD Rating Scale – Fourth Edition (DuPaul, Power, Anastopoulos, & Reid, 1998). Structured interviews with parents are becoming standard practice in research and epidemiological studies for diagnosis of ADHD and other psychiatric disorders. Examples of structured interviews include the Diagnostic Interview Schedule for
Children – Fourth Edition (DISC-4; Shaffer et al., 2000), the Diagnostic Interview for Children and Adolescents – Fourth Edition (DICA-4; Reich, 1995), and the Schedule for Affective Disorders and Schizophrenia for School-Age Children – Epidemiologic Version (K-SADS; Orvaschel & Puig-Antich, 1987). Given the considerable variation in symptomology across and within categories displayed by students with ADHD, the diagnosis must be made by a qualified mental health professional (i.e. physician, psychiatrist, school psychologist, or clinical psychologist). It is essential that the evaluator assess the developmental inappropriateness of reported and/or observed behavior (Hoff et al., 2002) and consider the possibility of co-existing conditions.

Previous Research on ADHD Subtypes

While some research supports subtyping of ADHD as defined in the DSM-IV-TR, debate continues regarding the significance of the subtype distinctions. Some experts argue that significant differences occur between these subgroups to merit the creation of independent categories with more specific diagnostic criteria. For example, Barkley (1997a) argued that ADHD-IN, rather than a mere subtype, may be better classified as a disorder separate from ADHD and that ADHD-HI may be a subtype or earlier representation of ADHD-C.

In one of the first comprehensive reviews, Milich, Balentine, and Lynam (2001) examined research findings on differences between subtypes of ADHD. They examined research based on different versions of the DSM (DSM-III, DSM-III-R, and DSM-IV). Their findings suggest that the combined group (ADHD-C) in comparison to the inattentive group (ADHD-IN) is more likely to be male, have an earlier age of onset (or
earlier age of referral), be actively rejected by peers (rather than simply socially inhibited), and more likely to exhibit comorbid externalizing behaviors. Based on their review, Milich et al. concluded that the inattentive type probably does represent a distinct disorder that is separate from the disorder that also includes hyperactivity and impulsivity.

Milich et al.’s view corresponds with Barkley’s (1997a; 1997b) theoretical model of ADHD. Barkley hypothesized that the ADHD subgroups that include a hyperactive component, namely ADHD-C or ADHD-HI, are disorders of behavioral inhibition or poor self-control. According to Barkley, individuals diagnosed with ADHD-C or ADHD-HI exhibit problems with behavioral inhibition characterized by limited self-control (often leading to poor planning), difficulty with organization, impaired rule-governed judgment, and challenges with emotional regulation. This limited self-control leads to poor response inhibition and interferes with executive functions, including working memory, regulation of emotional control, the internalization of speech (including problem solving and moral reasoning). Poor behavioral inhibition rather than inattention appears as the central deficiency among those diagnosed with ADHD-C or ADHD-HI. ADHD-IN, on the other hand, is a disorder of attention inhibition or an inability to selectively attend to relevant stimuli.

One study included in the Milich et al. review was conducted by Morgan, Hynd, Riccio, and Hall (1996). They examined the relationship between how children with a previous DSM-III or DSM-III-R diagnosis of Attention Deficit Disorder (ADD) were diagnosed according to the more recent DSM-IV criteria. They examined 56 children
aged seven to twelve years who had been referred to the Center for Clinical and Developmental Neuropsychology at the University of Georgia and had been diagnosed with ADD/without hyperactivity (ADD/WO; n = 20), ADD/with hyperactivity (ADD/H, n = 30), attention-deficit/hyperactivity disorder (ADHD, n = 29), and undifferentiated ADD (UADD, n = 1). Using information collected from the Swanson, Nolan, and Pelham Checklist (Pelham, Atkins, & Murphy, 1981), the Child Behavior Checklist (Achenbach, 1983), Teacher’s Report Form (Achenbach & Edelbrock, 1986), Structured Interview for Diagnostic Assessment of Children (SIDAC), which is a version of the Schedule for Affective Disorders and Schizophrenia for School-Age Children (Puig-Antich & Chambers, 1978), and other file information, they assigned the participants DSM-IV ADHD diagnoses. They found that DSM-III diagnoses of ADD/WO corresponded well with DSM-IV diagnoses of ADHD, predominantly inattentive type (ADHD-IN) and ADD/H corresponded well with the ADHD, combined type (ADHD-C). Only two of the participants were assigned a diagnosis of ADHD, predominantly hyperactive-impulsive type. The researchers then made comparisons between the ADHD-IN and ADHD-C subtypes. In addition to the information gathered on the aforementioned measures, each participant was administered the Wechsler Intelligence Scale for Children - Revised (Wechsler, 1974) or the Wechsler Intelligence Scale for Children – Third Edition (Wechsler, 1991) and the Basic Achievement Skills Individual Screener (Psychological Corporation, 1983). Results showed that children with the combined type diagnosis of ADHD exhibited more externalizing comorbid diagnoses, and were rated more often by parents to exhibit externalizing, delinquent, and aggressive
behaviors. Children with the predominantly inattentive type of ADHD were found to have more math learning disabilities. No significant differences were noted in the overall levels of cognitive functioning between the two subtypes.

Gaub and Carlson (1997), also included in the Milich et al. review, examined 221 elementary school children from the general population identified as meeting the DSM-IV criteria for ADHD as determined by scores on the Teacher’s Report Form (Achenbach, 1991b), the Swanson, Nolan, and Pelham Checklist – Fourth Edition (Swanson & Carlson, 1994), and three questions on social functioning adapted from a questionnaire developed by Dishion (1990). Behavioral variables were examined for the ADHD, Combined Type (n = 51), ADHD, Predominantly Inattentive Type (n = 123), ADHD, Predominantly Hyperactive-Impulsive Type (n = 47) and controls (n = 221). The results showed that children with the predominantly inattentive type of ADHD exhibit impairment across all behavioral variables in comparison to controls, but were rated as displaying more appropriate behaviors and fewer externalizing behaviors (such as aggressive behavior and delinquency) than children with the predominantly hyperactive-impulsive or combined types.

In addition to symptoms of ADHD and comorbid internalizing and/or externalizing problems, individuals with ADHD typically exhibit a variety of associated difficulties in cognitive and academic functioning. These associated difficulties are not included in the DSM-IV-TR diagnostic criteria for the disorder, and they are not necessarily displayed by all individuals with ADHD. However, when considered as a group, associated cognitive, developmental, and academic challenges are typically
displayed to a higher degree in individuals with ADHD than in children without the disorder (Barkley, 2006). Ten studies reported findings regarding cognitive functioning and nine reported findings on academic achievement. Table 2 summarizes these studies, each of which are discussed in the next two sections.

Cognitive Functioning of Children with ADHD

Several studies have shown that children diagnosed with ADHD exhibit lower levels of intellectual functioning than typical children (See column 6 in Table 2). Frazier, Demaree, and Youngstrom (2004) conducted a meta-analysis of existing literature to determine the magnitude of differences between ADHD and normal control participants according to several factors, including estimates of intellectual functioning. These researchers examined articles published during or after 1980 in which ADHD was diagnosed according to DSM-III, DSM-III-R, or DSM-IV criteria. They found 123 studies in which intellectual functioning was estimated. Some studies (n = 47) utilized complete measures of intellectual functioning, but most estimated intellectual functioning based on two or more subtests from one measure of intellectual functioning. Results showed that ADHD groups displayed significantly lower estimated full scale intelligence scores when compared to controls. The average effect size difference between children with ADHD and those without was equal to 0.61 standard deviations, for an average deficit of 9 points (range of 6-15 points). The meta-analysis showed no differences between inattentive and hyperactive-impulsive subtypes, although the sample size of studies examining subtype differences was small.
In further support of cognitive differences between ADHD participants and controls, Andreou, Agapitou, and Karapetsas (2005) from the University of Thessaly in Greece, examined 69 students aged 6 to 12 years from a general education setting who had been diagnosed with ADHD according to DSM-IV criteria. These students were compared to 69 controls matched for age and gender. This study used only the verbal scales of the WISC-III to determine level of intellectual functioning. Students with ADHD scored significantly lower than controls on the WISC-III Verbal IQ (VIQ), with an average deficit of 10 points. More specifically, children with ADHD scored significantly lower on all WISC-III verbal subtests: Information, Similarities, Arithmetic, Vocabulary, Comprehension, and Digit Span subtests. This study did not examine differences between the subtypes of ADHD. Andreou et al. recognized this limitation and suggested that further research is necessary to make a distinction among the ADHD subtypes with respect to verbal skills.

In their study titled, *Why children with ADHD do not have low IQs*, Schuck and Crinella (2005), studied 123 males diagnosed with ADHD from a clinic-referred sample and compared their WISC-III Full Scale IQ (FSIQ) to the test standardization sample. They found a mean FSIQ of 105.62 for the ADHD group, which was slightly higher than the standardization mean of 100. These researchers attributed the higher IQ finding to the relatively higher socio-economic status (SES) of their sample in comparison to the general population. While the findings appeared confounded by the higher SES of the studied population, the researchers supported their claim that individuals with ADHD do not have low IQs by suggesting that executive functioning is unrelated to cognitive
functioning. The same researchers measured executive functioning of the participants using a Continuous Performance Test (Conners, 1992) and Wisconsin Card Sorting Test (Heaton, 1981). Correlations among these measures of executive functioning and measures of intellectual functioning were determined to be “trivial at best.” Considering this, Schuck and Crinella argued that executive functioning might be a construct independent of the general measure of intelligence. While no differences were found in overall intellectual functioning, they did not refute the fact that students diagnosed with ADHD tend to have relative difficulty with executive functioning tasks. Along with others (e.g. Nigg, 2006), Schuck and Crinella argued that because executive functioning is not well correlated with general intelligence, generalizations should not be made implying that students diagnosed with ADHD have lower IQs or lower general intelligence.

**Cognitive Functioning of the ADHD Subtypes**

While several studies have shown significant cognitive differences between children diagnosed with ADHD versus controls, the research examining cognitive differences between the ADHD subtypes is mixed. Barkley, DuPaul, and McMurray (1990), for example, examined differences between children with hyperactivity (ADHD+H) and children without hyperactivity (ADHD-H) based on criteria outlined on the Child Attention Profile (CAP), a scale derived from items measuring inattention and overactivity on the Teacher Report Form (Achenbach & Edelbrock, 1986). They selected 90 children aged 6-11 years referred to outpatient clinics for inattentive or behavioral problems. Children found to have a score greater than the 93rd percentile on the
Inattentive and Overactivity scales of the CAP were selected for participation in the ADHD+H group, and those with a score in the 93rd percentile or greater on the Inattentive scale, but below the 84th percentile on the Overactivity scale were included in the ADHD-H group. These two groups were compared to a group of 16 same-aged children determined to have learning difficulties, but no attention or overactivity problems, and to a group of 34 community control children with no attention, overactivity, or learning problems. Barkley et al. found that both groups of children with ADHD exhibited significantly lower IQ scores on the Wechsler Intelligence Scale for Children-Revised (WISC-R) as compared to the control group, but higher IQ scores than the group with learning difficulties. The mean Full Scale IQ (FSIQ) score was 107.3 (SD = 11.7) for the ADHD+H group, 105.5 (SD = 15.0) for the ADHD-H group, 98.3 (SD = 9.1) for the group with learning difficulties, and 113.5 (SD = 11.1) for the control sample. No significant differences in WISC-R scores were found between the two ADHD subgroups.

Morgan, et al. (1996) in their study, as described earlier, examined children who had been assigned DSM-IV ADHD subtype diagnoses of the predominantly combined type (ADHD-C) or predominantly inattentive type (ADHD-IN). Upon examination of participants’ performance on the WISC-R or WISC-III measures of cognitive functioning, no significant differences were found in FSIQ, Verbal IQ (VIQ), or Performance IQ (PIQ) scores between the two subtypes.

Marshall, et al. (1997) examined 182 children aged 8 to 12 years divided into two groups of ADD/H and ADD/noH, according to DSM-III criteria. They found no significant differences in FSIQ or VIQ scores on the WISC-R or WISC-III for students
with ADD/noH versus ADD/H. They did, however, find that ADD/noH students scored significantly lower on the WISC-R or WISC-III PIQ than ADD/H students.

Faraone, Biederman, Weber, and Russell (1998) examined differences between DSM-IV ADHD subtypes for 301 children and adolescents, aged 5-15 years, referred to a pediatric psychopharmacology clinic. They used an adaptation of the Schedule for Affective Disorders and Schizophrenia for School-Age Children – Epidemiologic Version (K-SADS; Orvaschel & Puig-Antich, 1987) to obtain DSM-III-R and DSM-IV diagnoses of ADHD for these children, making comparisons between the subtypes as well as to a control group of 135 participants. These groups were compared on parent ratings on the Child Behavior Checklist (Achenbach, 1991a), the Social Adjustment Inventory for Children and Adolescents, subtests of the WISC-R, the Wide Range Achievement Test – Revised (WRAT-R; Jastak & Jastak, 1987), and the Gilmore Oral Reading Test (Gilmore, 1968), as well as school functioning based on reported school failures that included placement in special education classes, resource room tutoring, and repeated grades. Faraone et al. found that while children with ADHD, as a group, showed more impairment on measures of intellectual functioning and academic achievement than controls, there were few differences between the ADHD subtypes. They did find that the age of onset of ADHD symptoms was significantly younger for the combined type as compared to the inattentive type and the combined type were found to have higher lifetime rates for comorbid disorders including conduct, oppositional, bipolar, language, and tic disorders in comparison to the other two subtypes.
Marshall, Schafer, O’Donnell, Elliot, and Handwerk (1999) examined WISC-R and WISC-III scores in school records of 40 out of 182 students between the ages of 8 to 12 years who had been referred for specialized services due to emotional or learning problems. Their sample was from mostly White, middle or upper class families. Participants’ original diagnoses were based on DSM-III and DSM-III-R criteria. The researchers divided participants into two subgroups (ADD/H or ADD/noH) according to DSM-III criteria. The first 20 participants meeting criteria for ADD/H formed one group and the first 20 meeting criteria for ADD/noH formed the second group. Results showed that students with ADD/noH scored significantly lower than those with ADD/H on WISC-R or WISC-III FSIQ and PIQ.

Chhabildas, Pennington, and Willcutt (2001) examined neuropsychological profiles of children diagnosed with DSM-IV ADHD, Predominantly Inattentive Type (ADHD-IN), ADHD, Combined Type (ADHD-C), and ADHD, Predominantly Hyperactive-Impulsive Type (ADHD-HI) in a sample of 114 children aged 8 to 18 years diagnosed with ADHD and 82 children without ADHD referred as part of a larger twin study. Measures included the Peabody Individual Achievement Test (Dunn & Markwardt, 1970) to assess levels of academic achievement, the WISC-R to assess cognitive functioning, the Gordon Diagnostic System (Gordon & Mettelman, 1988) and the Stop Signal Task (Logan, Cowan, & Davis, 1984) to assess vigilance and inhibition, and the Trailmaking Test (Reitan & Wolfson, 1985) to assess speed of processing. Results showed significant impairments in the ADHD-IN group in comparison to the control group on all neuropsychological measures. The only measure on which the
ADHD-IN and ADHD-C groups differed was the Trailmaking Test. The ADHD-IN group scored significantly lower on the Trailmaking Test than the ADHD-C group. The ADHD-HI group did not show significant impairment on any measure. The results of this study did not support the distinction between ADHD subtypes, but did suggest that inattention, rather than hyperactivity-impulsivity was more associated with neuropsychological impairments.

Todd, Sitdhiraksa, Reich, Ji, Joyner, Heath and Neuman (2002) conducted an analysis of 453 twin families in which at least one twin, aged 7 to 17 years, met DSM-IV diagnostic criteria for ADHD-C, ADHD-IN, or ADHD-HI according to ratings by parents and participants on a modified DSM-IV Diagnostic Interview for Children and Adolescents called the MAGIC (Reich, 2000). They compared children with ADHD to 124 children randomly selected as controls. Children diagnosed with ADHD-C scored significantly lower than controls on the Block Design and Vocabulary subtests of the WISC-III. Children with ADHD-IN also displayed significantly lower scores on the WISC-III Vocabulary subtest in comparison to controls, but displayed no significant difference on the WISC-III Block Design subtest scores. No cognitive differences were found between the ADHD-HI subgroup versus controls or between ADHD-HI and the other two ADHD subgroups. The measures of cognitive ability were limited to two subtests of the WISC-III, allowing for only a cursory assessment of cognitive functioning rather than a more specific examination of the entire cognitive profile or full scale IQ scores.
In contrast to the constructs of the Weschler scales, Naglieri and Das (2005) have conceptualized a Planning, Attention, Simultaneous processing, and Successive processing (PASS) theory of cognitive functioning. The planning function encompasses intentionality, self-regulation, and other processes involved in problem solving. The attention function involves selected focus and resistance to distraction. Simultaneous processing is a mental activity involving spatial reasoning such as organizing or integrating information (parts to make a whole). Successive processing involves the ordering of information, such as in the sequencing of objects or events. Naglieri and Das (2005) reported that individuals with ADHD have been found to have distinct PASS profiles, with deficits in the planning function, rather than the attention function as measured on the Cognitive Assessment System (CAS) (Naglieri & Das, 2005). Naglieri and Das (2006) (not shown in Table 2) argued that their findings suggested the ADHD-HI and ADHD-C subtypes may be characterized by deficits in planning while the ADHD-IN subtype is characterized by a deficit in attention. Consistent with Barkley’s (Barkley, 1997a, 1997b) theoretical model of ADHD, they maintained that individuals diagnosed with ADHD-HI and ADHD-C are better characterized as having deficits in self-regulation or behavioral inhibition, whereas attention deficits more accurately characterize those diagnosed with ADHD-IN.

Summary of Cognitive Findings

While students diagnosed with ADHD are likely to represent a wide spectrum of intellectual abilities, most of the studies to date show that children with ADHD tend to display lower levels of overall intellectual functioning in comparison to their non-
disabled peers. However, little is known about which cognitive abilities are most compromised by the disorder. Several researchers have speculated that students with ADHD tend to be more challenged by those tasks involving working memory, mental manipulation, verbal thought, and other executive or planning functioning (Barkley, 2006). Naglieri and Das (2005, 2006) reported notable differences in executive functioning as measured by the Cognitive Assessment System (CAS) with ADHD students (specifically those diagnosed with ADHD-C or ADHD-HI) generally displaying lower Planning scores than the ADHD-IN subtype. However, when these areas are examined independent of overall cognitive ability (e.g. FSIQ), the notion of a generalized executive functioning or other neurological deficit has not been supported in studies using the Weschler scales (Frazier et al., 2004). Research on specific cognitive differences between the ADHD subtypes has varied. While studies have suggested differences in cognitive processes between children with ADHD and controls, only Marshall and his colleagues (1997, 1999) have found any significant differences in cognitive performance between the ADHD subtypes.

Academic Achievement of Children with ADHD

Several studies have reported that ADHD is associated with impaired academic achievement and lower grades (See column 7 in Table 2) when compared to nondisabled peers. DuPaul, Volpe, Jitendra, Lorah, and Gruber (2004) examined academic achievement of students from urban and suburban public elementary schools referred by their teachers due to concerns regarding inattention and/or hyperactive-impulsive behaviors as well as difficulties with reading and/or math achievement. Students (n =
136) were identified as having ADHD according to DSM-IV-TR criteria identified by parent interview using the NIMH Diagnostic Interview Schedule for Children –Fourth Edition (NIMH-DISC-IV; Shaffer, Fisher, & Lucas, 1998) and parent and teacher ratings on the ADHD Rating Scale – Fourth Edition (DuPaul et al., 1998) at or above the 90th percentile on the Inattention and/or Hyperactivity-Impulsivity subscales. Students with ADHD exhibited significantly lower levels of achievement than the control group (n = 53) without a diagnosis of ADHD as indicated by scores on the Woodcock-Johnson Tests of Achievement – Third Edition (WJ-III), report card grades, and teacher ratings of academic skills on the Academic Competence Evaluation Scale (DiPerna & Elliott, 2000).

**Academic Achievement of the ADHD Subtypes**

In addition to comparisons of academic achievement between individuals diagnosed with ADHD versus controls, several studies have examined differences in achievement for the ADHD subtypes. Along with their examination of cognitive differences between ADHD subtypes, Barkley et al. (1990) also examined subtype differences in academic achievement. As indicated earlier, they assessed differences in children with ADHD with and without hyperactivity (ADHD-H and ADHD+H) as determined by cut-off scores on the CAP and compared them to children with learning difficulties (LD) and to non-disabled controls. All three clinical groups (ADHD-H, ADHD+H, and LD) were found to score lower on measures of reading, spelling, and arithmetic on the Wide Range Achievement Test – Revised (WRAT-R; Jastak & Jastak,
1987) compared to the non-disabled controls. However, there were no differences between the two ADHD subtypes, or between the ADHD and the LD groups.

Morgan, et al. (1996) in their previously described study examined children who had been assigned DSM-IV diagnoses of ADHD Combined Type (ADHD-C) or ADHD Predominantly Inattentive Type (ADHD-IN). Upon examination of participants’ performance on the Basic Achievement Skills Individual Screener (BASIS; Psychological Corporation, 1983), they found no significant differences between ADHD subtypes on BASIS Reading, Math, and Spelling scores, but did note an increased comorbidity of math disabilities for those with ADHD-IN as compared to those with ADHD-C.

In addition to examining cognitive differences in IQ scores, Marshall et al. (1997) also examined ADHD subtype differences in academic achievement. As indicated earlier, their sample included 182 children aged 8 to 12 years divided into two groups of ADD/H and ADD/noH, according to DSM-III criteria. Group scores were compared for academic achievement in the areas of math and reading according to the BASIS (Psychological Corporation, 1983) and Wide Range Achievement Test – Revised (WRAT-R; Jastak & Jastak, 1987). Results showed that the ADD/noH group scored significantly lower than the ADD/H group on the BASIS Math subtest, but there were no significant differences between the two subtype groups in math achievement according to the WRAT-R Arithmetic subtest. There were also no significant differences between the two subtype groups in reading achievement according to the BASIS Reading subtest,
Faraone et al. (1998) also examined differences between the DSM-IV subtypes of ADHD on tests of achievement as well as cognitive functioning. Their measures of achievement included performance on the WRAT-R and the Gilmore Oral Reading Test (Gilmore, 1968), as well as reports of school failures that included placement in special education classes, resource room tutoring, and repeated grades. Faraone et al. found that while students with ADHD, as a group, showed more impairment on measures of academic achievement compared to controls, there were no significant differences between the ADHD subtypes on any of the standardized measures of achievement.

In addition to examining cognitive differences between ADHD subtypes, Marshall et al. (1999) examined between and within subtype differences in achievement levels according to the Woodcock Johnson Tests of Achievement – Revised (WJ-R; Woodcock & Johnson, 1989). They found no significant differences between DSM-III diagnosed ADD/H and ADD/noH groups according to their levels of achievement on the WJ-R Math Calculations, Applied Problems, Letter-Word Identification, and Passage Comprehension subtests. However, they did find different patterns of subtest scores within the ADHD/noH versus ADHD/H. Students with ADD/noH scored significantly lower on the WJ-R Math Calculations subtest in comparison to all other WJ-R subtests, suggesting challenges for students with ADD/noH in the area of calculation skills relative to their performance in other skill areas. By contrast, students with ADD/H scored significantly lower on the WJ-R Math Calculations subtest as compared to their
performance on the Math Applied Problems subtest, but not in comparison to their performance in other skill areas. Marshal et al. suggested that the selective attention difficulties for children with ADD/noH (compared to sustained attention difficulties for those with ADD/H) are associated with their challenges in the area of math calculations.

Merrell and Tymms (2001) conducted a study examining the level of academic progress made by children in England over a two year period in the areas of mathematics and reading. A sample size of 4,148 children aged four and five years at study inception were rated by their teachers using a behavioral scale based on the DSM-IV criteria for ADHD. Children were categorized into one of the three ADHD subtypes (ADHD-C, ADHD-IN, or ADHD-HI) and ranked according to whether they met 0-18 of the criteria outlined by the DSM-IV. These children were then compared based on their performance on individually administered assessments of mathematics and reading that were specifically designed for administration in schools participating in the study. The findings of this study were suggestive of lower academic achievement in the areas of mathematics and reading for children with more symptom criteria endorsed (6 or more) for ADHD-C and ADHD-IN versus those rated as exhibiting none of the behavioral criteria. Children with more symptom criteria endorsed (6 or more) for ADHD-HI were not found to differ significantly from those rated as exhibiting no behavioral criteria for ADHD. Differences between the ADHD-C and ADHD-IN subtypes were not formally assessed in this study, but a cursory examination of the results is not suggestive of differences between these subtypes. Merrell and Tymms suggest that the inattentive component of ADHD contributes to academic deficits. Given that children with ADHD-
C and ADHD-IN both exhibit characteristics of inattention, they share a similar pattern of impairment in reading and mathematics achievement in comparison to control or ADHD-HI children who do not exhibit characteristics of inattention.

Along with their cursory examination of cognitive profiles between ADHD subgroups (using only two subtests from the WISC-III), Todd et al. (2002)’s study of twin families also compared academic achievement of individuals who met DSM-IV criteria for one of the ADHD subtypes to each other and to randomly selected controls. They found that students with ADHD-C scored significantly lower than individuals with ADHD-IN, ADHD-HI, and controls on the Reading, Spelling, and Math tests that comprise the Wide Range Achievement Test – Version 3 (WRAT-3; Wilkenson, 1993). Additionally, individuals meeting DSM-IV criteria for ADHD-IN scored lower on the WRAT-3 Math test as compared to controls, while the ADHD-HI group did not score significantly lower than controls. The ADHD-C and ADHD-IN groups had lower grades and were more likely to receive special education services than the ADHD-HI and control groups.

Summary of Achievement Findings

Students with ADHD have been shown to exhibit lower levels of academic achievement overall as compared to those without ADHD. When examining differences in academic achievement between the subtypes of ADHD (ADHD-C, ADHD-IN, and ADHD-HI) patterns of achievement were more ambiguous. Some studies only examined differences between the ADHD-C and ADHD-IN subtypes, but results of those
examining all three subtypes suggest that ADHD-HI groups are the least impaired of the subtypes and the most similar in academic achievement to the control group.

Of the 6 studies examining subtype differences in academic achievement, 4 found no significant differences between the ADHD-C and ADHD-IN groups across skill areas based on standardized achievement measures. On the other hand, findings from Marshall and his colleagues (1997, 1999) as well as Morgan et al. (1996) showed that students with the inattentive type of ADHD exhibited more difficulties in the area of mathematics or calculation than students who exhibit ADHD with a hyperactive component. Only one study (Todd et al., 2002) found that students diagnosed with ADHD-C exhibited lower levels of academic achievement across skill areas of reading, spelling, and math than those diagnosed with ADHD-IN or ADHD-HI.

Dual Pathway Model

Preceding studies looked at cognitive functioning and academic achievement as separate constructs associated with ADHD. None of these studies examined classroom behavior that may be associated with or have an impact on academic functioning. Motivation, rapport with teachers, engagement in the classroom, and/or cooperation are examples of learning behaviors that may effect other areas of functioning such as academic achievement (Schaefer, 2004).

Rapport, Scanlan, and Denney (1999) addressed the constructs of cognition, achievement, and behavior, in a proposed dual pathway model. They hypothesized two mediating factors for associations between ADHD and achievement. They hypothesized that: 1) ADHD impacts achievement by way of vigilance and memory deficits (cognitive
pathway); and 2) ADHD impacts achievement by way of behavioral problems (behavioral pathway). Rapport et al. (1999) examined relationships between cognitive functioning, academic achievement, and overall behavior for a general population sample of students aged 7 to 16 years selected for participation from public and private school settings. They examined intelligence based on the two subtests (a vocabulary and a matrices task) that comprise the Kaufman Brief Intelligence Test (KBIT; Kaufman & Kaufman, 1990), vigilance according to performance on two continuous performance tasks, and short term memory based on the Paired Associate Learning Task (Carroll, 1993). Academic achievement measures included the Academic Performance Rating Scale (DuPaul, Rapport, & Perriello, 1991) and Stanford Achievement Test: Eighth edition (SAT; 1996). Overall behavior was assessed based on the Teacher’s Report Form (TRF; Achenbach, 1991b). Students from the sample were identified as exhibiting characteristics of ADHD based on high raw scores on the attention scale of the TRF. Structural equation modeling was used to test their proposed dual pathway model. The results supported the hypothesized model, suggesting that ADHD may interfere with a student’s academic achievement based on behavioral challenges exhibited in the classroom, in addition to select challenges of vigilance and memory in cognitive functioning. The researchers acknowledged that their research did not answer the question of whether cognitive deficits are general to ADHD or unique to specific subgroups of these children. It also did not demonstrate causality of the dual pathway model. That is, a determination of whether ADHD is the cause of cognitive deficits or if cognitive deficits have placed children at a greater risk for developing behavior problems,
cannot be made. Furthermore, the mediating behaviors examined in this study were primarily related to conduct, such as aggression and rule-breaking behaviors. Rapport et al. (1999) did not examine other kinds of problems that have been posited to effect achievement in children such as engagement, motivation, and study skills.

Classroom Behaviors Associated with Achievement

Educational outcomes for students are affected by several key variables including ability (marked by prior achievement), motivation, temperament, quantity and quality of instruction, as well as classroom, home, and social environments (DiPerna, Volpe, & Elliott, 2001; Schaefer, 2004). Specific learner behaviors such as desire and motivation were identified in Schaefer’s (2004) survey of students’ behaviors. The survey of 1,500 students aged 5-17 years included teacher reports of their learning behavior as rated on the Learning Behaviors Scale (McDermott, Green, Francis, & Stott, 1999). The prevalence of learning behaviors was found to vary according to age, ethnicity, and socioeconomic status. Significant variability was found in learning behaviors attributed to students categorized in special education versus those within the general education curriculum. Schaefer (2004) provided prevalence rankings of specific behavioral responses, but these learning behaviors were not linked to academic achievement or other specific academic outcomes.

DiPerna and Elliott (2000) developed the Academic Competence Evaluation Scale (ACES) as a measure of learning behaviors or what they call “academic enablers.” The ACES is a teacher rating instrument designed to measure student academic skills and academic enablers, including motivation, engagement, study skills, and interpersonal
(social) skills. DiPerna and Elliott (2000) define academic competence as a multidimensional construct that consists of two domains: academic skills and academic enablers. Academic skills are those skills centrally involved in the academic curriculum in an educational setting. Academic enablers are the attitudes and behaviors of students that mediate their availability to access classroom instruction. Academic skills are those typically taught by classroom teachers. Academic enablers, by contrast, are rarely taught, but rather are expressed as behaviors that interact with instruction, allowing or disallowing learning to take place (DiPerna & Elliott, 2000).

Prior academic skills are usually the strongest predictor of current achievement. However, several “enablers” have also been found to be correlated with current academic achievement (DiPerna, 2006). In two studies examining academic enablers and their relationship with achievement, DiPerna, Volpe, and Elliott (2001; 2005) proposed a theoretical model for academic achievement in which prior achievement and interpersonal skills influence motivation and motivation, in turn, influences study skills and engagement. In support of the model, DiPerna et al. (2001; 2005) found that study skills and engagement impacted levels of achievement in both reading and math. The effects of engagement were stronger in the primary grades (grades 1-3), while study skills became more important as children matured and progressed into older grades. This is consistent with the shift in curriculum in early middle school from “learning to read” to “reading to learn.”
ADHD and Learning Behaviors

In another study by DuPaul et al. (2004) discussed earlier, students with ADHD were found to score significantly lower than controls on measures of achievement and teacher ratings of academic skills and academic enablers according to ratings on the ACES. This study raises the question of whether academic enablers contribute some predictive power to the academic achievement of individuals with ADHD (DuPaul et al., 2004).

In a recent study, Volpe, DuPaul, DiPerna, Jitendra, Lutz, Tresco, and Junod (2006) examined the effects of ADHD symptoms on academic achievement in reading and mathematics using a participant population similar to the previously mentioned study by DuPaul et al. (2004). Potential predictors of academic achievement for students with ADHD were examined, along with teacher ratings on the ACES Academic Enabler subscales (interpersonal skills, engagement, study skills and motivation). Results showed that study skills and motivation were relatively compromised for students with ADHD and thus served as mediating factors impacting academic achievement.
CHAPTER 2: DESIGN OF STUDY

Purposes of the Present Study

The purpose of this study is to examine the differences in cognitive functioning as measured by the Wechsler Intelligence Scale for Children, Fourth Edition (WISC-IV; Wechsler, 2003), academic achievement as measured by the Wechsler Individual Achievement Test, Second Edition (WIAT-II; Wechsler, 2002), and academic enablers assessed via teacher ratings on the Academic Competence Evaluation Scale (ACES; DiPerna & Elliott, 2000) for children diagnosed with DSM-IV-TR Attention-Deficit/Hyperactivity Disorder, Predominantly Inattentive Type (ADHD-IN), Attention-Deficit/Hyperactivity Disorder, Combined Type (ADHD-C), clinically referred children without ADHD (NON-ADHD-REF), and non-referred controls (CONTROLS). Students with the ADHD subtypes will be compared on each set of measures to each other, as well as to clinically-referred students who do not meet DSM-IV-TR criteria for ADHD and to a non-referred control sample.

Few studies to date have examined cognitive functioning and academic achievement of the subtypes of ADHD according to DSM-IV or DSM-IV-TR criteria. Of the three subgroups, a proportionately small number of individuals are diagnosed with ADHD, Predominantly Hyperactive-Impulsive Type (ADHD-HI) in comparison to those diagnosed with ADHD-IN or ADHD-C (Nigg, 2006). Most individuals exhibiting a hyperactive-impulsive component also exhibit inattention and are therefore categorized under the ADHD-C type. Considering this, and given that the primary defining feature of ADHD for preschoolers is overactivity and difficulties with conduct, ADHD-HI has been
considered an earlier form of ADHD-C as is more commonly diagnosed in grade school (Nigg, 2006). The current study focused primarily on school-aged children. Accordingly, comparisons will only be made between the subgroups of ADHD-C and ADHD-IN.

Most previous studies have examined differences between children with ADHD versus a “normal” or typically developing control group. Of the studies reviewed, only one (Barkley et al., 1990) compared cognitive or academic functioning of students exhibiting ADHD symptomology to children determined to have learning difficulties without significant problems with inattention, hyperactivity and/or impulsivity (see column 8 in Table 2). Differences between children with ADHD and other clinically-referred children who do not exhibit ADHD symptomology, but exhibit another mental health or learning disorder, may provide further insight into the similarities and differences between students with one or the other subtype of ADHD and other clinically-referred students. Given specific cognitive, achievement, or learning profile differences, suggestions for special education and/or mental health treatment programming may be developed. Many services as outlined in Individualized Education Programs (IEPs) or accommodations as offered via Section 504 Plans provide a one size fits all approach to special services. Highlighting specific differences will allow for a more individualized approach to service planning and delivery. For example, it may be important to implement specialized services to target executive function and/or processing deficits in students with ADHD-IN rather than simply providing classroom accommodations to increase on-task behaviors and reduce disruptive behaviors.
This study is designed to make use of cognitive, academic, and behavioral measures that are typically gathered as part of comprehensive psycho-educational evaluations. Considering this, the information obtained within this research study will be similar to that used by school-based practitioners in order to make eligibility and program planning determinations. In this way, the results will be based on information gathered in schools and will directly relate to school-based practice.

Based on findings from previous literature, several hypotheses are presented below regarding group differences on measures of cognitive functioning, academic achievement, and academic enablers (see the Method section for detailed descriptions of the samples and measures):

**Cognitive Functioning**

1. The literature supports the finding that children with ADHD-C and ADHD-IN score significantly lower than CONTROLS on measures of cognitive functioning and perhaps executive functioning (Andreou et al., 2005; Barkley et al., 1990; Faraone et al., 1998; Frazier et al., 2004). Considering this, findings are hypothesized to be replicated in the current study, with ADHD-C and ADHD-IN children scoring significantly lower than CONTROLS on the WISC-IV Full Scale IQ, Verbal Comprehension Index, Perceptual Reasoning Index, Working Memory Index, and Processing Speed Index. It is also hypothesized that children with ADHD-C and ADHD-IN will score significantly lower than NON-ADHD-REF on the WISC-IV Processing Speed Index.
2. While most of the reviewed literature does not support ADHD subtype differences in cognitive functioning (Barkley et al., 1990; Faraone et al., 1998; Morgan et al., 1996; Todd et al., 2002), it is hypothesized that in this study where ADHD subtype determinations are made based on DSM-IV-TR criteria and cognitive differences are assessed based on the complete battery of the WISC-IV, children with ADHD-IN will score significantly lower than children with ADHD-C on the WISC-IV Processing Speed Index. This hypothesis is made based on the idea that students with ADHD-IN are likely to have the most significant challenges focusing on the tasks that comprise this index given that these tasks involve selective attention and visual scanning among distractive stimuli/pictures. No differences are expected between ADHD-C and ADHD-IN on WISC-IV Full Scale IQ, Verbal Comprehension Index, Perceptual Reasoning Index, and Working Memory Index.

Academic Achievement

1. Given that the reviewed literature suggests that children with ADHD-C and ADHD-IN tend to perform significantly lower than their normally developing peers on measures of academic achievement (Barkley et al., 1990; DuPaul et al., 2004; Faraone et al., 1998; Merrell & Tymms, 2001), it is hypothesized that these findings will be replicated in the current study. That is, it is hypothesized that children with either ADHD-C or ADHD-IN will score significantly lower than CONTROLS on the WIAT-II Reading, Mathematics, and Written Language composites.
2. Considering that ADHD has been associated with low academic achievement, and given that lower academic achievement is an identifying characteristic of children with learning disabilities, it is hypothesized that children with ADHD-IN and ADHD-C will score significantly lower on the WIAT-II Reading, Mathematics, and Written Language composites than the NON-ADHD-REF group when LD cases are removed from the sample. While most of the reviewed literature did not support significant subtype differences in academic achievement according to standardized measures (Barkley et al., 1990; Faraone et al., 1998; Morgan et al., 1996), Marshall and his colleagues (1997, 1999) found evidence suggesting that students with ADHD-IN perform more poorly in the area of mathematics and specifically calculation. Considering this, it is hypothesized that students with ADHD-IN will perform significantly lower than students with ADHD-C on the Mathematics composite of the WIAT-II.

3. Given that the NON-ADHD-REF group may include children with emotional, behavioral and/or learning difficulties, I have no hypotheses for how the ADHD groups will perform in comparison to this group as a whole.

Academic Enablers

According to the theoretical model of factors influencing current academic achievement proposed by Volpe et al. (2001, 2005), prior achievement, interpersonal skills, motivation, study skills, and engagement have been found to indirectly or directly influence current academic achievement. Furthermore, academic enablers have been found to be important predictors of academic achievement for children with ADHD.
(DuPaul et al., 2004). Considering this, and after examining the congruence of ACES items and DSM-IV-TR criteria for ADHD, the following hypotheses are presented:

1. Children with ADHD-C and ADHD-IN are predicted to score significantly lower than CONTROLS on ACES Engagement, Motivation and Study Skills subscales.

2. Children with ADHD-C tend to exhibit more externalizing behaviors than children with ADHD-IN; therefore, children with ADHD-C are expected to score significantly lower than children with ADHD-IN on the ACES Interpersonal Skills subscale, but similarly on all other Academic Enabler subscales.

3. Given that the NON-ADHD-REF group may include children with emotional, behavioral and/or learning difficulties; I have no hypotheses for how the ADHD groups will perform on the ACES in comparison to this group as a whole.

Method

Participants

Participants included 238 children (167 boys and 71 girls) aged 6 to 11 years all of whom participated in a research protocol at the University of Vermont, Department of Psychiatry Center for Children, Youth, and Families in Burlington, VT, the Children’s Seashore House of The Children’s Hospital of Philadelphia in Philadelphia, PA, and the Department of Psychiatry at the SUNY Upstate Medical University in Syracuse, NY. Of these participants, 327 were referred by a parent or teacher due to concerns regarding
attention, learning, and/or behavior problems. Clinically referred children were assigned to one of three diagnostic groups: ADHD-Combined (ADHD-C); ADHD-Inattentive (ADHD-IN); and Non-ADHD Referred (NON-ADHD REF). To be assigned to the NON-ADHD REF group, children had to have no ADHD diagnosis, but could have other DSM-IV-TR diagnoses, learning disabilities (LD), or no DSM-IV-TR diagnosis. (See Procedure section for assignment of DSM-IV-TR diagnoses.) Thirty additional children were typically developing children (CONTROLS) who had not been referred for services due to behavioral or learning problems in the past year according to their parents or school staff. CONTROLS were recruited via letters to parents at participating schools. Children were excluded from the study if they had a WISC-IV Full Scale IQ < 70 and/or physical or medical disabilities that might affect cognitive test performance (e.g. seizure disorders, cerebral palsy, learning impairment, or autism.) Children who were prescribed medications for behavioral problems (e.g. stimulants) were asked to refrain from taking their medication for the duration of the testing and observation period during the study (approximately 1-3 days). Table 3 shows demographic characteristics of the sample.

Measures

ADHD Rating Scale – Fourth Edition – School Version (ADHDRS-IV). The ADHD Rating Scale – Fourth Edition – School Version (ADHDRS-IV-School Version; DuPaul et al., 1998) contains the same 18 items as are scored on the Home Version. Teachers rate students according to these 18 items that correspond to the DSM-IV diagnostic criteria for ADHD. Raw scores, T-scores, and percentiles are provided for
Total Problems, Inattention, and Hyperactivity-Impulsivity scales based on a large stratified national sample. The ADHDRS-IV-School Version has internal consistencies ranging from .88 to .96 for the three scales. Test-retest reliabilities over a 4-week interval were: Total Problems = .90; Inattention = .89; Hyperactivity-Impulsivity = .88. Logistic regression analyses indicated that the Inattention and Hyperactivity-Impulsivity scales were successful in discriminating ADHD-C and ADHD-IN from CONTROL groups in clinic-based and school-based samples. The Hyperactivity-Impulsivity scale on the ADHDRS-IV-School Version successfully discriminated ADHD-C from ADHD-IN subtypes in clinic-based and school-based samples. In clinic-based samples, teacher ratings were better at predicting ADHD subtypes than parent ratings, though both informants contributed significantly to group classifications (DuPaul et al., 1998).

**Wechsler Intelligence Scale for Children-Fourth Edition (WISC-IV).** The Wechsler Intelligence Scale for Children-Fourth Edition (WISC-IV; Wechsler, 2003) is an individually administered assessment of cognitive ability for individuals aged 6 to 16 years. It is designed to give a global intelligence score designated by the Full Scale IQ score (FSIQ), as well as composite scores including the Verbal Comprehension Index (VCI), Perceptual Reasoning Index (PRI), Working Memory Index (WMI), and Processing Speed Index (PSI). The Verbal Comprehension Index (VCI) measures verbal abilities that utilize reasoning, comprehension, and conceptualization. It is comprised of the Comprehension subtest that examines knowledge related to conventional standards of behavior and social judgment; the Similarities subtest that measures abilities in verbal abstract reasoning; and the Vocabulary subtest that measures word knowledge and verbal
concept formation. The Perceptual Reasoning Index (PRI) measures fluid reasoning and organization. It is comprised of the Picture Concepts subtest measuring fluid and categorical reasoning, as well as perceptual organization; the Matrix Reasoning subtest measuring visual information processing and abstract reasoning skills; and the Block Design subtest that examines abilities to analyze and synthesize abstract visual stimuli. The Working Memory Index (WMI) measures attention, concentration, and working memory (the ability to actively maintain information in immediate memory while simultaneously performing an operation). It is comprised of the Digit Span subtest measuring auditory short-term memory and sequencing skills; and the Letter-Number Sequencing subtest utilizing auditory short-term memory, mental manipulation, sequencing, and spatial visualization. The Processing Speed Index (PSI) measures the ability to process non-verbal information visually and efficiently. It is comprised of the Symbol Search subtest that involves short-term visual memory, visual-motor coordination, visual discrimination, and perceptual organization; and the Coding subtest that also measures short-term visual memory, as well as visual scanning and visual perception.

Standard scores with a mean of 100 and standard deviation of 15 according to age norms can be obtained for an individual’s overall performance (WISC-IV FSIQ) as well as each of the four composite indexes. The WISC-IV was nationally normed on 2,200 individuals. Strong reliability has been demonstrated in the FSIQ as well as the four composites indexes with an average aged-based internal consistency coefficient of .97 for the FSIQ, .94 for the VCI, .92 for the PRI, .92 for the WMI, and .88 for the PSI. Test-
retest reliabilities over an average interval of 32 days were .93 for the FSIQ, .93 for the VCI, .89 for the PRI, .89 for the WMI, and .86 for the PSI.

**Wechsler Individual Achievement Test-Second Edition (WIAT-II).** The Wechsler Individual Achievement Test – Second Edition (WIAT-II; Wechsler, 2002) is an individually administered assessment of academic achievement for individuals aged 4 to 85 years. It is comprised of four composites: Reading, Mathematics, Written Language, and Oral Language. The Reading composite is made up of the Word Reading, Reading Comprehension, and Pseudoword Decoding subtests. It assesses phonological awareness, the ability to reflect upon reading instruction in the classroom, and the ability to apply decoding skills. The Mathematics composite consists of the Numerical Operations and Math Reasoning subtests and evaluates the ability to identify and write numbers as well as the ability to reason mathematically. The Written Language composite is made up of the Spelling and Written Expression subtests. It assesses spelling and writing skills. The Oral Language composite measures the ability to listen for details on the Listening Comprehension subtest as well as assesses language expression on the Oral Expression subtest.

Standard scores with a mean of 100 and standard deviation of 15 according to age or grade norms can be obtained based on an individual’s performance on each of the four composites. Only the Reading, Mathematics, and Written Language composites and corresponding subtests were administered in this study. The WIAT-II was nationally normed on 5,586 individuals. Strong reliability has been demonstrated in the total measure as well as across the four composites with an average aged-based internal
consistency coefficient of .98 for the WIAT-II total score, .98 for the Reading composite, .95 for the Mathematics composite, .94 for the Written Language composite, and .89 for the Oral Language composite. Test-retest reliabilities over an average of 10 days ranged from .91 to .98.

**Academic Competence Evaluation Scales (ACES).** The Academic Competence Evaluation Scale (ACES; DiPerna & Elliott, 2000) is designed to assess skills, attitudes, and behaviors that may be associated with a student’s academic competence. The ACES Teacher Form that was used in this study is comprised of 81 items rated by a student’s classroom teacher. The items are divided into two scales (Academic Skills and Academic Enablers) and two ratings are recorded per item. One rating is based on a 5-point Likert rating of the student’s Proficiency on the item (1 = far below, 2 = below, 3 = grade level, 4 = above, 5 = far above for the Academic Skills scale and 1 = never, 2 = seldom, 3 = sometimes, 4 = often, 5 = almost always for the Academic Enablers scale). The other rating is based upon the Importance of the item given it’s relevance to the individual (rated as not important, important, or critical). Ratings can be made for students in grades K-12. Three subscales comprise the Academic Skills scale (Reading/Language Arts, Mathematics, and Critical Thinking), and four subscales comprise the Academic Enablers scale (Interpersonal Skills, Engagement, Motivation, and Study Skills.)

Within the Academic Skills scale, the Reading/Language Arts subscale is comprised of 11 items measuring reading, writing, and verbal communication skills. The Mathematics subscale is comprised of 8 items measuring mathematical concepts and
skills used in the application of numbers, such as measurement, computation, and problem solving. The Critical Thinking subscale consists of 9 items for students in grades K-2, and 14 items for students in grades 3-12. The items on this subscale are designed to measure skills related to analysis, synthesis, and investigation.

Within the Academic Enablers scale, the Interpersonal Skills subscale is comprised of 10 items, measuring communication skills, cooperation, and self-control behaviors necessary for appropriate social interaction in the classroom. The Motivation scale is also comprised of 10 items, assessing a student’s initiative and persistence regarding assigned tasks in the classroom. The Study Skills subscale is comprised of 10 items measuring behaviors such as completing homework, being prepared for tests or quizzes, paying attention in class, taking notes, and being prepared for class in general. Finally, the Engagement subscale is comprised of 8 items, measuring a student’s level of participation in the classroom, such as volunteering, asking questions, or participating in class discussions.

Proficiency scores are summed to create scale and subscale raw scores. The scores on the item sets for the Academic Skills Scale and the Academic Enablers Scale are summed to provide raw scores for each subscale. These raw scores are plotted on a scoring summary based on a 90% confidence interval. The student’s overall skill level for each subscale is assessed based upon where they fall along the continuum. Skill levels falling within the “developing” range represent areas of weakness where interventions should be targeted. Those skill levels falling in the “advanced” range represent areas of student strength. This information can be used in program planning in
order to develop interventions most appropriate for targeting areas of weakness (DiPerna & Elliott, 2000).

The scores from each of the scales and subscales of the ACES have demonstrated strong reliability and validity (DiPerna & Elliott, 2000). Internal consistency coefficients (Cronbach’s alphas) were high for the scales, ranging from .92 to .98 and test-retest stability coefficients were found to range from .81 to .92.

**Procedure**

School districts around the three test site areas were informed of a research study designed to develop better procedures for identifying children with ADHD. Recruitment letters to parents described the study as an effort to better understand children’s learning and behavior so as not to bias selections of participants with and without ADHD. Child participants attended a half-day testing session during which WISC-IV, WIAT-II and a continuous performance test (CPT) were administered. Test examiners were “blind” to the child participants’ group assignment during administration of the WISC-IV, WIAT-II, and CPT. Parents participated in the Diagnostic Interview Schedule for Children – Fourth Edition (DISC-4; Shaffer et al., 2000) and parents and teachers completed several behavioral rating scales, including the ACES. Child participants were also observed in their classroom settings. Parents and teachers of clinically referred children were each offered $15 for participation. Parents of CONTROLS were offered $50 for participation.

To be assigned to the ADHD-C group, children had to have a positive diagnosis of ADHD-Combined type (314.01) on the parent DISC-4, plus total scores at or above the 80th percentile on the Inattention or Hyperactivity-Impulsivity subscales of the
Teacher Version of the ADHD Rating Scale (DuPaul et al., 1998). To be assigned to the ADHD-IN group, children had to have a positive diagnosis of ADHD-Predominantly Inattentive type (314.00) on the parent DISC-4, a total score at or above the 80th percentile on the Inattention subscale, and a total score below the 80th percentile on the Hyperactivity-Impulsivity subscale of the Teacher Version of the ADHD Rating Scale (DuPaul et al., 1998). To be assigned to the NON-ADHD-REF group, children had to have no ADHD diagnosis on the parent DISC-4 and a total score below the 80th percentile on both subscales of the ADHD Rating Scale, but could have other DSM-IV-TR diagnoses or no diagnosis. To be assigned to the CONTROLS group, children had to have not been referred for special education or mental health services in the past 12 months. No requirements were made regarding DISC-4 diagnoses for the CONTROLS group. As indicated earlier, CONTROLS were recruited by sending letters to parents describing the study. Parents were informed that researchers were seeking typically-developing children for a study to develop procedures for observing children’s behavior in their classrooms and during cognitive testing. School staff of participating schools sent recruitment letters home to parents. Researchers were unaware of the names of possible participants until the parent returned the consent form. A few of the CONTROLS were typically developing siblings of clinically referred children whose parents inquired about having a second child in the study. Only siblings meeting CONTROLS criteria were invited to participate.
CHAPTER 3: ANALYSIS OF DATA

To test group differences of cognitive functioning, academic achievement, and academic enablers, a series of MANOVAs were performed, treating diagnostic group (ADHD-C, ADHD-IN, NON-ADHD-REF, and CONTROLS) as a between subject variable, and cognitive functioning, academic achievement, and teacher ratings of academic enablers as dependent variables. The following dependent variables were grouped together in separate MANOVAs to avoid co-linearity a) WISC-IV VCI, PRI, WMI, and PSI; b) WIAT-II Reading, Mathematics, and Written Language composite scores; and c) ACES academic enablers: Interpersonal Skills, Engagement, Motivation, and Study Skills. For all a priori analyses, SPSS General Linear Model (GLM; SPSS, 2000) was used. When the overall MANOVAs showed a significant main effect of group, ($p<.05$), they were followed by one-way ANOVAs and single step Tukey Honestly Significant Difference (Tukey HSD) tests to identify differences between groups on each dependent variable.

In addition to the MANOVAs, a one-way analysis of variance (ANOVA) was performed separately on WISC-IV FSIQ. The Tukey HSD test was used to test group differences on this dependent variable. Using Wilks’ Lambda with $\alpha = .05$, effect sizes (ES) were determined by partial Eta$^2$. According to Cohen’s (1988) criteria; ES accounting for 1 to 5.8% of variance are small; 5.9 to 13.7% of variance are medium; and $>$13.8% of variance are large.
Table 4 summarizes the results of analyses of the WISC-IV scores. To test group difference on the WISC-IV FSIQ, a univariate ANOVA showed significant effects of diagnostic group, $F(3, 215) = 25.02, p < .001, \text{Eta}^2 = .259$. A Tukey HSD pair-wise comparisons showed that CONTROLS scored significantly higher ($p < .05$) than all three diagnostic groups. There was no significant difference between the ADHD-C, ADHD-IN, and NON-ADHD REF groups.

For WISC-IV Index scores, the overall MANOVA showed a significant effect of diagnostic group, $F(12, 561) = 6.89, p < .001, \text{Eta}^2 = .114$. Subsequent one-way ANOVAs showed significant main effects of group for each of the four WISC-IV Index scores, as shown in Table 4. These effects accounted for 11.4 to 25.9 percent of variance.

For the VCI, CONTROLS scored significantly higher ($p < .05$) than both ADHD groups. The NON-ADHD REF group also scored significantly higher ($p < .05$) than both ADHD groups. There was no significant difference between the CONTROL and the NON-ADHD REF group, or between the ADHD-C and ADHD-IN groups. For the PRI, CONTROLS scored significantly higher ($p < .05$) than all three diagnostic groups (NON-ADHD REF, ADHD-C, and ADHD-IN), with no significant difference between the three diagnostic groups. For the WMI, CONTROLS scored significantly higher ($p < .05$) than all three diagnostic groups, and the NON-ADHD REF group scored significantly higher than both ADHD groups. There was no significant difference between the ADHD-C and ADHD-IN groups. For the PSI, CONTROLS scored significantly higher ($p < .05$) than
both ADHD groups, with no significant differences between the three diagnostic groups (NON-ADHD REF, ADHD-C, and ADHD-IN).

WIAT-II

For WIAT-II Composites, the overall MANOVA showed a significant effect of diagnostic group, \( F(9,463) = 6.86, p<.001, \text{Eta}^2 = .097. \) Subsequent one-way ANOVAs showed significant main effects of group for each of the three WIAT-II composite scores, as shown in Table 5. These effects accounted for 19.1 to 20.8 percent of variance.

For the Reading Composite, CONTROLS scored significantly higher \((p<.05)\) than both ADHD groups. The NON-ADHD REF group scored significantly higher \((p<.05)\) than the ADHD-C group. There were no significant differences between CONTROLS and the NON-ADHD REF group, between the NON-ADHD REF group and the ADHD-IN group, or between the ADHD-C and ADHD-IN groups. For the Mathematics Composite, CONTROLS scored significantly higher \((p<.05)\) than both ADHD groups. The NON-ADHD REF group scored significantly higher \((p<.05)\) than both ADHD groups. There were no significant differences between the CONTROLS and NON-ADHD REF group and between the ADHD-C and ADHD-IN groups. For the Written Language Composite, CONTROLS scored significantly higher \((p<.05)\) than all three diagnostic groups and the NON-ADHD REF group scored significantly higher \((p<.05)\) than both ADHD groups. No significant differences were found between the ADHD-C and ADHD-IN groups.
ACES

For the ACES Enabler Scales, the overall MANOVA showed a significant effect of diagnostic group, $F(12,312) = 13.08$, $p<.001$, $\eta^2 = .302$. Subsequent one-way ANOVAs showed significant main effects of group for each of the four Academic Enabler Scale scores, as shown in Table 6. These effects accounted for 21.6 to 48.8 percent of variance.

For the Interpersonal Skills Scale, CONTROLS scored significantly higher ($p<.05$) than both ADHD groups. The NON-ADHD REF group scored significantly higher ($p<.05$) than the ADHD-C group. The ADHD-IN group scored significantly higher than the ADHD-C group. There were no significant differences between CONTROLS and the NON-ADHD REF group, or between the NON-ADHD REF group and the ADHD-IN group. For the Engagement Scale, CONTROLS scored significantly higher ($p<.05$) than all three diagnostic groups (ADHD-C, ADHD-IN, and NON-ADHD REF). There were no significant differences between the three diagnostic groups. For the Motivation Scale, CONTROLS scored significantly higher ($p<.05$) than all three diagnostic groups. The NON-ADHD REF group scored significantly higher ($p<.05$) than the ADHD-C group. There were no significant differences between the NON-ADHD REF and ADHD-IN groups, or between the ADHD-C and ADHD-IN groups. For the Study Skills Scale, CONTROLS scored significantly higher ($p<.05$) than all three diagnostic groups. The NON-ADHD REF group scored significantly higher ($p<.05$) than both ADHD groups. There were no significant differences between the ADHD groups.
Group Difference Excluding Children with Learning Disabilities (LD)

To examine the impact of co-morbid LD on group differences, a nominal LD variable was created (LD = 1, no LD = 0). Subjects were determined to either exhibit co-morbid LD in one or more of the three academic areas (Reading, Mathematics, or Written Language) or not. This determination was made using a discrepancy analysis between subjects’ FSIQ score on the WISC-IV and their achievement scores on the Reading, Mathematics, and Written Language Composites of the WIAT-II. If subjects exhibited an IQ-achievement discrepancy greater than or equal to 22 points (1.5 standard deviation) on one or more of the composites examined, they were determined to exhibit co-morbid LD (and labeled LD =1). While the use of the discrepancy model to determine LD is no longer required according to the Vermont Department of Education’s Special Education Regulations (2006) (in accordance with the federal Individuals with Disabilities Education Improvement Act), it continues to be the most conventional method for determining LD (Mayes & Calhoun, 2007).

Approximately 5% percent of subjects were determined to exhibit LD in one or more of the three areas of achievement. These subjects were eliminated and group differences were re-assessed using MANOVAs and univariate ANOVAs similar to the analyses ran to determine group differences for the sample with LD cases. The findings revealed similar group differences for both samples. Table 4 shows the similarity between group differences found when LD was included in the sample as compared to when LD was removed (as indicated by values in parentheses). The similar results suggest that LD did not account for the differences noted.
Group differences on the WIAT-II Reading and Mathematics Composite scores, as shown in Table 5, were similar for both samples. The NON-ADHD REF group was found to score significantly higher ($p<.05$) than both ADHD groups in the sample that included LD cases on the Written Language Composite, but significantly higher ($p<.05$) than only the ADHD-C group when LD cases were eliminated. This suggests that LD may account for the difference that was found between the NON-ADHD REF group and the ADHD-IN group on the Written Language Composite.

Group differences were similar on the ACES Engagement, Motivation, and Study Skills scales with or without LD cases, as shown in Table 6. CONTROLS scored significantly higher ($p<.05$) than both ADHD groups in the sample including LD cases on the Interpersonal Skills scale, but significantly higher ($p<.05$) than only the ADHD-C group when LD cases were eliminated (as noted by the values in parentheses in Table 6). This suggests that LD may account for the difference that was found between the CONTROLS and the ADHD-IN group on the Interpersonal Skills scale.
CHAPTER 4: CONCLUSION

Discussion

Children with ADHD versus Normally-Developing Peers

The findings of the current study are consistent with previous literature that suggests children with ADHD have a tendency to display lower levels of overall intellectual functioning and academic achievement in comparison to their non-disabled peers (Andreou et al., 2005; Barkley, 2006; Barkley et al., 1990; Chhabildas et al., 2001; DuPaul et al., 2004; Faraone et al., 1998; Frazier et al., 2004; Merrell & Tymms, 2001; Todd et al., 2002). As hypothesized, both ADHD groups scored significantly lower than CONTROLS on the WISC-IV FSIQ and individual indexes, as well as on the WIAT-II Reading, Mathematics, and Written Language composites.

In addition to confirming findings of previous literature suggesting that children with ADHD exhibit lower overall levels of intellectual functioning and academic achievement than CONTROLS, the findings of the current study further suggest that children with ADHD also exhibit poorer learner behaviors than CONTROLS. Both of the ADHD groups scored significantly lower than CONTROLS on the ACES Interpersonal Skills, Engagement, Motivation, and Study Skills scales.

Children with ADHD versus Children with Other Presenting Problems

In the present study, children with ADHD were not only compared to CONTROLS, but were also compared to the NON-ADHD REF group, a group of children referred for study participation due to learning or behavior problems. These children were determined not to meet DSM-IV-TR criteria for ADHD, although
approximately seventy-five percent of these students met criteria for another DSM-IV-TR disorder including: Generalized Anxiety, Separation Anxiety, Specific Phobia, Conduct Disorder, and Oppositional Defiant Disorder. Results showed no significant differences between the ADHD groups and the NON-ADHD REF group on the WISC-IV PRI or PSI. However, the ADHD groups scored significantly lower than the NON-ADHD REF group on the WISC-IV FSIQ, VCI, and WMI. This suggests that children with ADHD may demonstrate lower levels of overall cognitive functioning and may be weaker than NON-ADHD REF children on verbal and working memory tasks.

In addition to overall differences in cognitive functioning, children with ADHD were also found to demonstrate significantly lower scores than the NON-ADHD REF group on the Mathematics and Written Language composites of the WIAT-II, suggesting weaker academic achievement in these areas. Only children with ADHD-C were found to score significantly lower than NON-ADHD REF children on the WIAT-II Reading composite. No significant difference was found between the ADHD-IN group and the NON-ADHD REF group on the Reading composite. This suggests that children with ADHD-IN are likely to perform similarly in the area of reading achievement to children with other presenting learning or behavioral problems.

On the ACES, ADHD children scored significantly lower than the NON-ADHD REF group on the Study Skills scale. Additionally, children with ADHD-C scored significantly lower than children in the NON-ADHD REF group on the ACES Interpersonal Skills and Motivation scales. No significant differences were noted
between the ADHD groups and the NON-ADHD REF group on the ACES Engagement scale.

**Children with ADHD-C versus Children with ADHD-IN**

This study examined differences between the ADHD-C and ADHD-IN subtypes as determined by DSM-IV-TR criteria on cognitive functioning according to performance on the complete battery of the WISC-IV. Most of the reviewed literature did not support ADHD subtype differences in cognitive functioning, but many of these studies did not make comparisons between the subtypes using a complete cognitive battery. Instead, comparisons were often made based on one or two subtests of an assessment battery. According to the findings of the current study, it appears that there are no significant differences between the ADHD subtypes in cognitive functioning according to WISC-IV FSIQ, VCI, PRI, WMI, and PSI scores. This finding supports most of the reviewed literature that did not find significant ADHD subtype differences in cognitive functioning (Barkley et al., 1990; Faraone et al., 1998; Morgan et al., 1996).

Most literature also did not support significant differences between the subtypes on measures of academic achievement (Barkley et al., 1990; Faraone et al., 1998; Morgan et al., 1996). Only Marshall and colleagues (1997, 1999) found evidence to support subtype differences in the area of mathematics. The findings of the current study further reveal no significant differences in academic achievement as measured by the WIAT-II Reading, Mathematics, and Written Language composites.

The only difference found between the two subtypes of ADHD across measures was on the ACES Interpersonal Skills scale. As predicted, children with ADHD-C were
found to have lower scores on the ACES Interpersonal Skills scale than children with ADHD-IN. However, given the multiple statistical tests performed, this one difference between subtypes could be a chance finding. However, children with ADHD-C have been found to experience more co-morbid externalizing behaviors than children with ADHD-IN (Gaub & Carlson, 1997); therefore, it is not surprising that they have been found to exhibit weaker interpersonal skills.

Impact of Learning Disabilities

It could be argued that co-morbid learning disabilities (LD) account for the differences (or lack thereof) found between groups. Using a discrepancy analysis of FSIQ minus WIAT-II scores on the Reading, Mathematics, and Written Language composites to estimate learning disabilities, only approximately 5% of the sample was found to exhibit the discrepancy criteria for LD in one or more of the three areas of achievement (Reading, Mathematics, and/or Written Language). Potential confounding effects of LD were reduced by removing those children with LD from the sample for further analyses. However, after removing those cases, there were few changes in comparisons between ADHD groups and CONTROLS. For example, both ADHD groups still scored significantly lower than CONTROLS on the WISC-IV FSIQ and Index scores, the measured WIAT-II composites, and on the ACES Engagement, Motivation, and Study Skills scales. Without LD cases in the sample, the only change in findings was that only the ADHD-C group scored lower than the CONTROL group on the Interpersonal Skills scale of the ACES rather than both ADHD subtypes. This change
in findings suggests LD may have accounted for the difference between ADHD-IN and the CONTROL group that was found in analysis with the full sample.

Likewise, no changes were found regarding differences between the ADHD groups and the NON-ADHD REF group in cognitive functioning as measured by the FSIQ, VCI, PRI, WMI, and PSI scores when LD cases were removed. Visual inspection of Table 5 shows that there was little change in mean scores for academic achievement as measured by performance on the WIAT-II composites. The only change suggests that LD might account for the difference between ADHD-IN and NON-ADHD REF on the Written Language composite given that without LD cases, the difference between the ADHD-IN and NON-ADHD REF group in mean scores on the Written Language composite did not reach significance.

Implications

The present study suggests that it is imperative to develop academic, in addition to behavioral, interventions for students with ADHD. With ADHD as one of the most common childhood mental health disorders, strategies for most effectively working with students with the disorder are essential for all educators and related professionals. Several accommodations are implemented as traditional strategies for managing the behavior of students with ADHD in order to maximize productivity in the classroom. These accommodations, geared toward increasing level of attention and minimizing fidgeting or hyperactivity, include: smaller student-teacher ratios, providing only one assignment at a time, allowing the student to stand by his/her work area (rather than requiring him/her to sit in the seat), using manipulatives such as a stress ball, gum, or a
“wiggle” seat, assigning a peer buddy, providing regular and consistent feedback, increasing immediate rewards and consequences, limiting distractions, creating reasonable challenges, and providing preferential seating. For some students, preferential seating may be in the front of the room and/or near the instructional source to allow for more frequent redirection as necessary. For others, preferential seating may be most effective in the back of the room, near the exit door, or in an area isolated from others to allow for movement or time-outs without presenting as a distraction to peers. These strategies have been found effective in increasing productivity, increasing levels of attention and/or minimizing fidgeting for students in the classroom (Abramowitz & O'Leary, 1991; McIntyre, 2004). However, they may work for one student with ADHD and not for another. Furthermore, some strategies may work for a student some of the time or in some settings, and not others. This arsenal of strategies can be helpful to educators or other individuals working to improve on-task behavior for students with ADHD, however, it is also imperative to recognize that these types of behavior strategies can be limiting and do not directly address the academic achievement needs of these students.

A large body of research has shown that stimulant medication is effective in reducing the primary behavioral symptoms of ADHD; however, school practitioners cannot prescribe medication. Regardless of the position of school personnel on this issue, it is ultimately the decision of the parent, in conjunction with the child’s physician, whether or not to treat a child with stimulant medication. With this in mind, recent findings of Fabiano, et al. (2007) are encouraging and especially promising for school
practitioners. Fabiano and colleagues (2007) examined the effects of two treatment modalities on classroom behavior and productivity in students aged 6-12 years diagnosed with ADHD. The effects of varying doses (.15 mg, .30 mg, or .60 mg) of stimulant medication and varying intensities (low intensity or high intensity) of behavioral modification programming were examined individually and in conjunction with each other. Fabiano and colleagues found a significant main effect of medication alone suggesting beneficial effects in minimizing associated problematic behaviors. Additionally, however, they found further improvements on measures of rule violations, percentage of seatwork completed, and parent and teacher ratings of inattention, overactivity, oppositional behavior, and defiance when at least some behavioral modification was implemented along with medication therapy. They also found that lower dosages of stimulant medication were equally effective as higher dosages in managing classroom behaviors when used in conjunction with some type of behavioral modification programming.

Even without any medication therapy, Fabiano and colleagues found behavioral modification alone (either implemented with low or high intensity) produced reductions in student rule violations, increases in productivity, and improvements in teacher ratings of effectiveness with their students. Considering this, comprehensive programming for students with ADHD should continue to include behavioral modification as well as medication. According to their findings, it is suggested that effective behavior modification programs should incorporate the following: a) A daily review of the classroom expectations, b) Frequent use of praise and social reinforcement, c) Time-
out/removal contingencies, and d) Daily reports/behavioral plans linked to a positive reward contingency (Dawson, 2007; Fabiano et al., 2007).

The four elements of effective behavior modification programming can be implemented via a specifically designed behavior plan. For example, the specific expectations for the student may be noted at the top of the plan, with frequent use of praise incorporated via sticker reinforcements provided every class period, and contingency strategies incorporated when the expectations are not met. Furthermore, sending the daily log home each day and linking it to a reward earned at the end of each day allows for a positive contingency. This type of a program can be tailored to fit the specific needs of individual students. For example, some students may need more frequent reward contingencies, such as one in the morning and one in the afternoon. For some students, frequent praise and reinforcement can be given in the form of stickers. For other students, direct verbal acknowledgement or nonverbal cues, such as a thumbs-up, is sufficient. Regardless of the individual design, any system in which the essential components are included can be an effective and essential tool for working with and increasing productivity for students with ADHD. In sum, while medication therapy has been found effective in managing behaviors manifested by students with ADHD, behavior modification programming, as designed by education professionals and including the four key components can also be an effective method of treatment, especially when combined with low doses of medication treatment.

This study emphasizes the need to implement academic interventions to foster academic success in addition to interventions (accommodations, medication, and
behavior plans) that manage associated behaviors. Educators are experts in meeting academic needs of all students. With this in mind, an emphasis should be placed on the importance of their role in providing supplemental and/or additional academic supports to students with ADHD. The findings of this study highlight the need for direct intervention in academic skill areas. Children with ADHD were found to exhibit significantly lower levels of academic achievement than CONTROLS based on their performance on the WIAT-II Reading, Mathematics, and Written Language composites even when learning disabilities were accounted for. Considering this, children with ADHD, even when they do not meet the discrepancy criteria for exhibiting a co-morbid learning disability, are likely to benefit from academic supports similar to those provided to students who do have learning disabilities. Students with learning disabilities are typically afforded individualized programming through special education services that includes more intensive, structured, comprehensive, and/or multi-sensory instruction in specific academic areas. Based on findings from the present study, and the skills assessed on the WIAT-II, children with ADHD are likely to benefit from increased skill instruction in the areas of reading comprehension, decoding real and nonsense words in isolation, numerical operations, mathematical reasoning, spelling, and/or written expression.

In addition to direct instruction in areas of basic academic functioning, the findings of this study further highlight the importance of targeting behaviors that enhance learning (learner behaviors/academic enablers) when designing interventions for students with ADHD. Children with ADHD were found to exhibit lower levels of engagement, motivation, and study skills than CONTROLS as rated by teachers on the ACES
Academic Enabler Scale. Children with ADHD were also found to exhibit weaker study skills than NON-ADHD REF students (those referred with learning or behavioral problems not characterized by ADHD). These learner behaviors are not specifically targeted via the typical accommodations employed in classrooms for improving on-task behaviors. Instead, these learner behaviors must be explicitly taught via specific programming such as illustrated in Powers, Karustis, and Habboushe’s (2001) family-school intervention program. This program provides a structure for teaching organizational and planning skills in order to improve homework success, with homework being strongly associated with study skills (academic enabler).

According to the findings of the current study, comprehensive programming aimed at assisting children with ADHD to reach their full potential should include direct academic instruction and specific programming geared toward enhancing study skills and/or other academic enablers, in addition to more traditional strategies. The traditional arsenal of strategies including classroom accommodations, medication, and specific behavior plans, are typically made available to all students regardless of whether they are found to meet eligibility requirements for special education services. Meeting the criteria for special education eligibility includes having a documented disability, proving that the disability adversely impacts the student’s ability to learn, and reaching a team decision that special education services are necessary. At some schools, academic services for students who do not meet this criteria, may be limited. Regardless however, of whether students with ADHD meet the criteria, the findings of the current study underscore the importance of interventions that target academic skills in addition to the use of classroom
behavior accommodations. This leads to the question as to how the needs of students with ADHD can be comprehensively met in schools.

Opportunities

Many schools are still using the severe discrepancy model (a standard deviation of 1.5 or greater between general cognitive functioning and a specific area of academic achievement) to determine whether a student exhibits a specific learning disability (SLD). Often whether a student receives supplemental and/or specialized services in a particular academic skill area is based upon whether the student met the discrepancy criteria for having an SLD. This study suggests that regardless of whether SLD criteria is met, students with ADHD in general perform lower in academic skill areas (specifically in reading, writing, and mathematics as measured on the WIAT-II) than typically-developing peers.

As previously discussed, schools are equipped to provide accommodations and behavior modification programs to promote on-task behavior for students with ADHD in the classroom. Additionally, schools now have the opportunity to utilize a response-to-intervention (RtI) approach in order to identify a student’s level of responsiveness to instruction and in turn guide service delivery decisions for addressing unmet academic needs. RtI is an approach used to evaluate the effectiveness of instruction for meeting individual student needs. Schools using an RtI model have developed a tiered approach to assessment and intervention services. In the most typical three tiered approach, students’ academic needs in the first tier are met via universal or generalized interventions within the classroom. Progress in Tier 1 is monitored through basic,
universal screenings. Students whose academic needs are unmet in Tier 1 are selected for targeted or supplemental intervention as provided in the second tier. The specific academic strengths and weaknesses of students in Tier 2 are identified via selected assessments and targeted via selected interventions. Students whose academic progress is lacking despite several trials of selected interventions are referred for diagnostic testing in order to determine their specialized needs. These needs are addressed via more intensive intervention provided in Tier 3 or special education programming. Progress monitoring, or periodic student assessment, within each tier is essential for making appropriate decisions regarding intervention programming (Glover & Diperna, 2007; Klotz & Canter, 2006).

The opportunity exists for academic needs of students with ADHD to be identified and targeted under an RtI model. The basis for determining the need for academic interventions is unrelated to whether a discrepancy exists between cognitive functioning and academic achievement levels, but is rather based upon whether provided instruction is responsive to a student’s educational progress or lack thereof. An evaluation of progress over time allows for a systematic determination of need. For example, whether or not a student with ADHD also meets discrepancy criteria, in an RtI model academic skill deficits will be identified and addressed. Through an RtI approach, all students, including those diagnosed with ADHD, are ensured to benefit from the instruction they are receiving. If not responding to instruction provided in Tier 1, students with ADHD would be afforded the opportunity for selected, intensive instruction as provided in Tier 2 or 3 to meet their academic skill deficits.
The RtI approach can be combined with other approaches that have been used for children with ADHD, such as medication and/or classroom accommodations to improve on-task and reduce disruptive behaviors. Progress monitoring of academic as well as behavioral goals will assist educational teams in making appropriate decisions regarding academic and behavior intervention programming for students with ADHD.

Limitations and Future Directions

When interpreting the findings of this study, a few limitations should be addressed. First, the sample sizes within groups were relatively small for some of the statistical analyses, such as those involving the ADHD-IN (n = 18). The differences between the means for the two subtypes of ADHD were subtle and the sample sizes, especially for the ADHD-IN group were small. This small sample size reduces the power to find statistically significant differences. This could have been one reason the statistical test failed to show any significant differences between the subtypes on measures of cognitive and academic functioning.

A closer examination of the group means reveals little difference between subtypes on the WISC-IV FSIQ and Index scores or on the WIAT-II Mathematics and Written Language composite scores. Group differences between the means were within two points across these measures. Therefore, a larger sample for these analyses likely would not have altered the findings. However, a larger sample may have detected some statistical differences between the subtypes on the WIAT-II Reading composite as well as on the ACES Motivation and Study Skills scales in addition to the statistical difference that was found using the current sample on the Interpersonal Skills scale. While a larger
sample may have allowed for greater statistical power in finding group differences, it is important to recognize that the effect sizes for the difference would likely remain small.

Another limitation of the small sample size is that further divisions of the data were precluded. Given the small sample, further examination of gender effects within subtypes or further examination of specific mental health diagnoses for those within the NON-ADHD REF group could not be made.

A second limitation of the current study is that the broad cognitive measures provided by the WISC-IV FSIQ and Index scores do not measure more subtle areas of cognitive functioning. For example, areas of executive functioning deficits such as working memory, planning, and response shifting have been shown in ADHD children (Nigg, 2006). Studies have not supported subtype differences in these areas; however, larger deficits have been found between the ADHD-C group and normals versus between the ADHD-IN group and normals (Nigg, 2006). Considering this, it is possible that subtype differences exist, but not in the areas examined in this study. As a result, future research should examine more subtle areas of cognitive functioning in order to determine whether subtype differences in cognitive functioning exist. The current study only suggests that such differences do not occur on broad measures of cognitive functioning such as on the WISC-IV FSIQ or WISC-IV Index scores.

Finally, the current study examined each domain of functioning; such as, cognitive functioning on the WISC-IV, academic achievement on the WIAT-II, and academic enablers on the ACES, separately. The study did not examine whether combinations of these areas of functioning might better characterize or distinguish the
ADHD subtypes. For example, subtype differences were found on the ACES Interpersonal Skills scale, and potential differences between the subtypes were detected on the WIAT-II Reading composite, as well as across the ACES Motivation and Study Skills scales. For example, given the present findings, the ADHD-IN group may perform better on the WIAT-II Reading composite because as a group they have better reading skills or because they may have greater motivation, study skills, and/or interpersonal skills as measured by the ACES that contribute to greater academic achievement in the area of reading. Logically, the ADHD-IN group characterized by inattentive behaviors alone is likely to have more appropriate learner behaviors (academic enablers) than the ADHD-C group that is characterized by disruptive behavior (hyperactivity and impulsivity) in addition to inattention. Considering this, examining a combination of the variable effects may provide a better predictor of subtype status.

Another way to examine a combination of the variables is to examine them in terms of mediators or moderators through structural equation modeling (SEM). Again, this study did not examine the mediating or moderating effects of ADHD on the variables examined. Volpe et al. (2006) developed a model of mediation between ADHD and academic achievement via academic enablers such as those measured using the ACES. He and his colleagues found that ADHD influences motivation, which in turn influences study skills, promoting academic achievement. In other studies, DiPerna, Volpe, and Elliott (2001, 2005) developed a model of academic enablers and reading achievement and academic enablers and mathematics achievement. This model suggests prior achievement and interpersonal skills influence motivation which in turn influence study
skills and engagement to promote academic achievement in the areas of reading and mathematics, respectively. Future examination of the mediating or moderating effects of ADHD on cognitive functioning, academic achievement, and academic enablers collectively is needed. For example, it will be important to further determine the effect size of the impact of lower intellectual abilities on academic functioning in comparison to the effect size of the impact of academic enablers on academic functioning for students with ADHD.
References


Table 1

DSM-IV symptoms of ADHD

*Inattention* (6 of 9)

a) often fails to give close attention to details or makes careless mistakes in schoolwork, work, or other activities

b) often has difficulty sustaining attention in task or play activities

c) often does not seem to listen when spoken to directly

d) often does not follow through on instructions and fails to finish schoolwork, chores, or duties in the workplace (not due to oppositional behavior or failure to understand instructions)

e) often has difficulty organizing tasks and activities

f) often avoids, dislikes, or is reluctant to engage in tasks that require sustained mental effort (such as schoolwork or homework)

g) often loses things necessary for tasks or activities (e.g., toys, school assignments, pencils, books, or tools

h) is often easily distracted by extraneous stimuli

i) is often forgetful in daily activities

*Hyperactivity and Impulsivity* (6 of 9)

a) often fidgets with hands or feet or squirms in seat

b) often leaves seat in classroom or other situations in which remaining seated is expected

c) often runs about or climbs excessively in situations in which it is inappropriate (in adolescents or adults, may be limited to subjective feelings of restlessness)

d) often has difficulty playing or engaging in leisure activities quietly

e) is often “on the go” or often acts as if “driven by a motor”

f) often talks excessively

g) often blurts out answers before questions have been completed

h) often has difficulty awaiting turn

i) often interrupts or intrudes on others (e.g., butts into conversations or games)
Table 2
Summary of studies examining cognitive functioning and academic achievement in children with ADHD

<table>
<thead>
<tr>
<th>Article</th>
<th>Age Range</th>
<th>Sample Type</th>
<th>Gender</th>
<th>Diagnostic Criteria</th>
<th>Cognitive Measure</th>
<th>Achievement Measure</th>
<th>Groups</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Andreou, Agapitou, &amp; Karapetsas, 2005</td>
<td>6-12 years</td>
<td>Community sample</td>
<td>50 Males, 19 Females</td>
<td>DSM-IV</td>
<td>WISC-III (VIQ, VC, &amp; FFD)</td>
<td>N/A</td>
<td>ADHD, Controls</td>
<td>ADHD children displayed poor verbal skills in comparison to Controls.</td>
</tr>
<tr>
<td>Barkley, DuPaul, &amp; McMurray, 1990</td>
<td>6-11 years</td>
<td>Clinic-referred</td>
<td>Males and Females</td>
<td>Child Attention Profile (CAP) of the TRF</td>
<td>WISC-R, CPT</td>
<td>WRAT-R</td>
<td>ADHD+H, ADHD-H, LD, and Controls</td>
<td>Controls&gt; ADD groups&gt; LD for IQ; no difference in IQ between ADD groups; Controls&gt; all groups for WRAT-R scores; no difference in WRAT-R scores between ADD and LD groups.</td>
</tr>
<tr>
<td>Chhabildas, Pennington, &amp; Willcutt, 2001</td>
<td>8-18 years</td>
<td>Clinic-referred</td>
<td>Males and Females</td>
<td>DSM-IV checklist</td>
<td>WISC-R and WAIS-R FSIQ, VIQ, and PIQ, Gordon Diagnostic System (continuous performance task), Trailmaking Test</td>
<td>Peabody Individual Achievement Test</td>
<td>ADHD-IN, ADHD-C, ADHD-HI, Controls</td>
<td>ADHD-IN scored lower than controls on all measures. ADHD-IN and ADHD-C shared similar profiles with the exception of the Trailmaking test (processing speed) on which ADHD-IN scored lower than ADHD-C.</td>
</tr>
<tr>
<td>DuPaul, Volpe, Jitendra, Lutz, Lorah, &amp; Gruber, 2004</td>
<td>1st-4th graders</td>
<td>Community sample</td>
<td>Males and Females</td>
<td>ADHD Rating Scale IV, Diagnostic interview of DSM-IV-TR criteria</td>
<td>N/A</td>
<td>WJ-III, ACE S</td>
<td>ADHD, Controls</td>
<td>Controls obtained significantly higher WJ-III scores, report card grades, teacher ratings of academic skills and enablers than ADHD.</td>
</tr>
</tbody>
</table>

18
<table>
<thead>
<tr>
<th>Article</th>
<th>Age Range</th>
<th>Sample Type</th>
<th>Gender</th>
<th>Diagnostic Criteria</th>
<th>Cognitive Measure</th>
<th>Achievement Measure</th>
<th>Groups</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frazier, Demarec, &amp; Youngstrom, 2004</td>
<td>Variable-only 23 of 123 studies examined individuals older than 12 years &amp; only 10 examined adults</td>
<td>Unknown</td>
<td>4 of 123 studies examined females; 53 of 123 examined males; 72 included males and females</td>
<td>Majority used DSM-III, DSM-III-R, or DSM-IV – only 4 out of 123 studies did not report any criteria</td>
<td>Variable (mostly WISC-R or WISC-III, also WAIS-R, KBIT, PPVT, Stanford-Binet, and Shipley Institute for Living Scale) – 47 of 123 studies examined complete cognitive assessments</td>
<td>N/A</td>
<td>ADHD, Controls. (A few studies also examined ADHD subtypes.)</td>
<td>Overall intellectual ability was significantly lower for ADHD than Controls. No differences in FSIQ noted in the few studies examining ADHD subtypes.</td>
</tr>
<tr>
<td>Marshall, Hynd, Handwerk, &amp; Hall, 1997</td>
<td>6-12 years</td>
<td>Clinic-referred</td>
<td>Males and Females</td>
<td>Multi-informant/multi-modal, including interviews, self-reports, &amp; ratings based on DSM-III or DSM-III-R</td>
<td>WISC-R and WISC-III FSIQ, PIQ, and VIQ</td>
<td>BASIS reading &amp; math, WRAT-R arithmetic, WRAT-R passage comprehension and reading comprehension</td>
<td>ADHD, ADD/noH</td>
<td>No cognitive differences between subtypes for FSIQ &amp; VIQ; ADHD &gt; ADD/noH for PIQ; ADD/noH&lt;ADHD for math</td>
</tr>
<tr>
<td>Marshall, Schafer, O’Donnell, Elliott, &amp; Handwerk, 1999</td>
<td>8-12 years</td>
<td>Community sample</td>
<td>Assumed to be males and females</td>
<td>Physician’s diagnosis or special education diagnosis of OHI according to DSM-III or DSM-III-R criteria</td>
<td>WISC-R and WISC-III FSIQ, VIQ, and PIQ</td>
<td>WJ-R Tests of Achievement</td>
<td>ADD/H, ADD/noH</td>
<td>ADD/H &gt;ADD/noH for FSIQ and PIQ. No differences between groups in achievement, within group differences found in math calculation. ADD/noH may be at increased risk for math calc. deficits</td>
</tr>
<tr>
<td>Article</td>
<td>Age Range</td>
<td>Sample Type</td>
<td>Gender</td>
<td>Diagnostic Criteria</td>
<td>Cognitive Measure</td>
<td>Achievement Measure</td>
<td>Groups</td>
<td>Results</td>
</tr>
<tr>
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</tr>
<tr>
<td>Merrell &amp; Tymms, 2001</td>
<td>Progress-monitored for 1 yr. 4 to 5 years of age at start of reception year</td>
<td>Community sample</td>
<td>52.3% Males 47.7% Females</td>
<td>Teacher rating based on DSM-IV criteria</td>
<td>CPT</td>
<td>Individually administered assessments specifically designed for participating schools</td>
<td>ADHD-C, ADHD-HI, ADHD-IN, Controls</td>
<td>Children with ADHD received lower grades and achieved lower scores on individually administered assessments of mathematics and reading than Controls.</td>
</tr>
<tr>
<td>Morgan, Hynd, Riccio, &amp; Hall, 1996</td>
<td>7-12 years</td>
<td>Clinic-referred</td>
<td>Males and Females</td>
<td>DSM-III and DSM-III-R diagnoses transferred to DSM-IV diagnoses</td>
<td>WISC-III Full scale</td>
<td>BASIS Reading, Math, and Spelling</td>
<td>ADHD/PI, ADHD/C</td>
<td>No cognitive differences between subtypes: ADHD/C more externalizing behaviors; ADHD/PI more math learning disability codiagnoses</td>
</tr>
<tr>
<td>Schuck &amp; Crinella, 2005</td>
<td>7-13 years</td>
<td>Clinic-referred</td>
<td>123 Males</td>
<td>DSM-IV</td>
<td>WISC-III (FSIQ), RPM (fluid intelligence), CPT, WCS T</td>
<td>N/A</td>
<td>ADHD, standardization sample (no control group)</td>
<td>FSIQ scores of children with ADHD as a group were not significantly different than those of the general population.</td>
</tr>
<tr>
<td>Todd, Sidthiraksa, Reich, Ji, Joyner, Heath, &amp; Neuman, 2002</td>
<td>7-17 years</td>
<td>Community sample of twin families</td>
<td>Males and Females</td>
<td>At least one twin with DSM-IV ADHD and other family members with latent class (at least 3 ADHD symptoms)</td>
<td>WISC-III (BD and V ONLY)</td>
<td>WRAT - 3</td>
<td>ADHD-C, ADHD-IN, ADHD-HI, Controls</td>
<td>ADHD-C scored lower than Controls on WISC-III BD &amp; V and lower than all groups on WRAT-3 Reading, Spelling, Math. ADHD-IN scored lower than Controls on WISC-III V, and on WRAT-3 Math. No difference between ADHD-HI and Controls.</td>
</tr>
</tbody>
</table>
Table 3

Demographic characteristics of sample

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>ADHD-C</th>
<th>ADHD-IN</th>
<th>NON-ADHD REF</th>
<th>CONTROL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boys (n)</td>
<td>82</td>
<td>23</td>
<td>44</td>
<td>18</td>
</tr>
<tr>
<td>Girls (n)</td>
<td>28</td>
<td>8</td>
<td>20</td>
<td>15</td>
</tr>
<tr>
<td>Total (n)</td>
<td>110</td>
<td>31</td>
<td>64</td>
<td>33</td>
</tr>
<tr>
<td>Mean Age (SD)</td>
<td>7.64 (1.58)</td>
<td>8.39 (1.65)</td>
<td>8.38 (1.65)</td>
<td>8.33 (1.41)</td>
</tr>
<tr>
<td>DSM-IV Diagnosis (%)a</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Generalized Anxiety</td>
<td>7.3%</td>
<td>9.7%</td>
<td>6.3%</td>
<td>0%</td>
</tr>
<tr>
<td>Specific Phobia</td>
<td>27.3%</td>
<td>29.0%</td>
<td>17.2%</td>
<td>18.2%</td>
</tr>
<tr>
<td>Separation Anxiety</td>
<td>18.2%</td>
<td>9.7%</td>
<td>7.8%</td>
<td>0%</td>
</tr>
<tr>
<td>Conduct Disorder</td>
<td>17.3%</td>
<td>6.5%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Oppositional Defiant</td>
<td>56.4%</td>
<td>29.0%</td>
<td>25.0%</td>
<td>6.1%</td>
</tr>
<tr>
<td>Other Diagnosis</td>
<td>19.1%</td>
<td>22.6%</td>
<td>18.8%</td>
<td>3.0%</td>
</tr>
</tbody>
</table>

Note: ADHD-C = ADHD, Combined Type (n = #); ADHD-IN = ADHD, Inattentive Type (n = #); NON-ADHD REF = Non-ADHD Clinically Referred (n = #); CONTROL = Nonreferred controls (n = #).

aPercentages represent cases with each diagnosis; children with comorbid diagnoses were counted more than once for the different categories.
Table 4

Group differences on WISC-IV FSIQ and Index scores

<table>
<thead>
<tr>
<th>Diagnostic Group</th>
<th>WISC-IV ADHD-C</th>
<th>ADHD-IN</th>
<th>NON-ADHD REF</th>
<th>CONTROL</th>
<th>F</th>
<th>p</th>
<th>ES</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n = 98 (91)</td>
<td>n = 28 (26)</td>
<td>n = 60 (57)</td>
<td>n = 33 (32)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FSIQ</td>
<td>90.3 (89.7)</td>
<td>91.2 (90.7)</td>
<td>101.5&lt;sup&gt;a&lt;/sup&gt; (100.8&lt;sup&gt;a&lt;/sup&gt;)</td>
<td>111.1&lt;sup&gt;b&lt;/sup&gt; (110.6&lt;sup&gt;b&lt;/sup&gt;)</td>
<td>F(3,215) = 25.02</td>
<td>.001</td>
<td>.259</td>
</tr>
<tr>
<td>VCI</td>
<td>92.8 (92.6)</td>
<td>93.2 (92.4)</td>
<td>104.7&lt;sup&gt;a&lt;/sup&gt; (104.2&lt;sup&gt;a&lt;/sup&gt;)</td>
<td>109.9&lt;sup&gt;c&lt;/sup&gt; (109.5&lt;sup&gt;c&lt;/sup&gt;)</td>
<td>F(3,215) = 18.66</td>
<td>.001</td>
<td>.207</td>
</tr>
<tr>
<td>PRI</td>
<td>94.5 (94.2)</td>
<td>95.6 (95.2)</td>
<td>101.1 (100.4)</td>
<td>111.0&lt;sup&gt;b&lt;/sup&gt; (110.6&lt;sup&gt;b&lt;/sup&gt;)</td>
<td>F(3,215) = 11.26</td>
<td>.001</td>
<td>.136</td>
</tr>
<tr>
<td>WMI</td>
<td>92.2 (91.9)</td>
<td>91.2 (90.1)</td>
<td>100.7&lt;sup&gt;a&lt;/sup&gt; (100.4&lt;sup&gt;a&lt;/sup&gt;)</td>
<td>108.2&lt;sup&gt;b&lt;/sup&gt; (107.6&lt;sup&gt;b&lt;/sup&gt;)</td>
<td>F(3,215) = 19.32</td>
<td>.001</td>
<td>.212</td>
</tr>
<tr>
<td>PSI</td>
<td>88.6 (87.5)</td>
<td>90.2 (90.7)</td>
<td>95.6 (95.0)</td>
<td>102.2&lt;sup&gt;c&lt;/sup&gt; (101.8&lt;sup&gt;c&lt;/sup&gt;)</td>
<td>F(3,215) = 9.18</td>
<td>.001</td>
<td>.114</td>
</tr>
</tbody>
</table>

Note. ES = partial Eta<sup>2</sup>. Values in parentheses show sample sizes and results for diagnostic group excluding LD cases.

<sup>a</sup>NON-ADHD REF > ADHD-IN and ADHD-C

<sup>b</sup>CONTROLS > NON-ADHD REF, ADHD-IN, and ADHD-C

<sup>c</sup>CONTROLS > ADHD-IN and ADHD-C
### Table 5

Group differences on WIAT-II Composite Scores

<table>
<thead>
<tr>
<th>WIAT-II Composite</th>
<th>Diagnostic Group</th>
<th></th>
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</thead>
<tbody>
<tr>
<td></td>
<td>ADHD-C</td>
<td>ADHD-IN</td>
<td>NON-ADHD REF</td>
<td>CONTROL</td>
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</tr>
<tr>
<td></td>
<td>n = 86 (81)</td>
<td>n = 24 (22)</td>
<td>n = 56 (53)</td>
<td>n = 30 (29)</td>
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<td></td>
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</tr>
<tr>
<td>Reading</td>
<td>93.2 (93.9)</td>
<td>97.1 (98.4)</td>
<td>105.2&lt;sup&gt;a&lt;/sup&gt; (106.0&lt;sup&gt;c&lt;/sup&gt;)</td>
<td>112.9&lt;sup&gt;b&lt;/sup&gt; (113.0&lt;sup&gt;b&lt;/sup&gt;)</td>
<td></td>
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<tr>
<td></td>
<td>F(3,192) = 15.08</td>
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<tr>
<td></td>
<td>p = .001</td>
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<tr>
<td></td>
<td>ES = .191</td>
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<td></td>
</tr>
<tr>
<td>Math</td>
<td>92.6 (92.0)</td>
<td>94.3 (94.7)</td>
<td>104.4&lt;sup&gt;c&lt;/sup&gt; (104.3&lt;sup&gt;c&lt;/sup&gt;)</td>
<td>113.2&lt;sup&gt;b&lt;/sup&gt; (113.7&lt;sup&gt;b&lt;/sup&gt;)</td>
<td></td>
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<tr>
<td></td>
<td>F(3,192) = 16.79</td>
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<tr>
<td></td>
<td>p = .001</td>
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</tr>
<tr>
<td></td>
<td>ES = .208</td>
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<td></td>
</tr>
<tr>
<td>Written Language</td>
<td>94.8 (94.5)</td>
<td>95.1 (97.1)</td>
<td>105.8&lt;sup&gt;c&lt;/sup&gt; (106.7&lt;sup&gt;d&lt;/sup&gt;)</td>
<td>117.0&lt;sup&gt;d&lt;/sup&gt; (117.3&lt;sup&gt;d&lt;/sup&gt;)</td>
<td></td>
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<tr>
<td></td>
<td>F(3,192) = 15.74</td>
<td></td>
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<td></td>
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<tr>
<td></td>
<td>p = .001</td>
<td></td>
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<tr>
<td></td>
<td>ES = .197</td>
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</tr>
</tbody>
</table>

*Note.* ES = partial Eta<sup>2</sup>. Values in parentheses show sample sizes and results for diagnostic group excluding LD cases.

<sup>a</sup>NON-ADHD REF > ADHD-C

<sup>b</sup>CONTROLS > ADHD-IN and ADHD-C

<sup>c</sup>NON-ADHD REF > ADHD-IN and ADHD-C

<sup>d</sup>CONTROLS > NON-ADHD REF, ADHD-IN, and ADHD-C
Table 6

Group differences on ACES Academic Enabler Scales

<table>
<thead>
<tr>
<th>ACES Scale</th>
<th>ADHD-C</th>
<th>ADHD-IN</th>
<th>NON-ADHD REF</th>
<th>CONTROL</th>
<th>F</th>
<th>p</th>
<th>ES</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n = 51 (47)</td>
<td>n = 18 (17)</td>
<td>n = 39 (37)</td>
<td>n = 17 (16)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interpersonal Skills</td>
<td>26.6 (26.3)</td>
<td>37.7&lt;sup&gt;a&lt;/sup&gt; (38.2&lt;sup&gt;a&lt;/sup&gt;)</td>
<td>39.7&lt;sup&gt;b&lt;/sup&gt; (39.7&lt;sup&gt;b&lt;/sup&gt;)</td>
<td>43.6&lt;sup&gt;c&lt;/sup&gt; (43.2&lt;sup&gt;d&lt;/sup&gt;)</td>
<td>F(3,121) = 38.52</td>
<td>.001</td>
<td>.488</td>
</tr>
<tr>
<td>Engagement</td>
<td>23.5 (23.3)</td>
<td>21.8 (21.9)</td>
<td>25.7 (25.5)</td>
<td>33.9&lt;sup&gt;e&lt;/sup&gt; (34.1&lt;sup&gt;f&lt;/sup&gt;)</td>
<td>F(3,121) = 11.10</td>
<td>.001</td>
<td>.216</td>
</tr>
<tr>
<td>Motivation</td>
<td>21.9 (21.8)</td>
<td>25.2 (25.3)</td>
<td>31.1&lt;sup&gt;b&lt;/sup&gt; (30.7&lt;sup&gt;b&lt;/sup&gt;)</td>
<td>44.5&lt;sup&gt;c&lt;/sup&gt; (44.1&lt;sup&gt;c&lt;/sup&gt;)</td>
<td>F(3,121) = 30.78</td>
<td>.001</td>
<td>.433</td>
</tr>
<tr>
<td>Study Skills</td>
<td>24.0 (23.8)</td>
<td>27.7 (27.9)</td>
<td>33.7&lt;sup&gt;f&lt;/sup&gt; (33.7&lt;sup&gt;f&lt;/sup&gt;)</td>
<td>40.2&lt;sup&gt;e&lt;/sup&gt; (40.0&lt;sup&gt;e&lt;/sup&gt;)</td>
<td>F(3,121) = 35.45</td>
<td>.001</td>
<td>.468</td>
</tr>
</tbody>
</table>

<sup>a</sup>ADHD-IN > ADHD-C

<sup>b</sup>NON-ADHD REF > ADHD-C

<sup>c</sup>COUNTROLS > ADHD-IN and ADHD-C

<sup>d</sup>COUNTROLS > ADHD-C

<sup>e</sup>COUNTROLS > NON-ADHD REF, ADHD-IN, and ADHD-C

<sup>f</sup>NON-ADHD REF > ADHD-IN and ADHD-C

Note. ES = partial Eta<sup>2</sup>. Values in parentheses show sample sizes and results for diagnostic group excluding LD cases.