DETERMINING THE EFFICACY OF THE BASC-2 PRS IN THE DIFFERENTIAL DIAGNOSIS OF AUTISM AND ATTENTION-DEFICIT/HYPERACTIVITY DISORDER

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ABSTRACT

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Autism and ADHD are two distinct disorders that share many overlapping symptoms, including attention problems, hyperactivity, behavior problems, and social skills deficits as well as co-occurring problems, such as mood disorders, emotional lability, anger, and conduct problems. The Behavioral Assessment System for Children, Second Edition (BASC-2; Reynolds & Kamphaus, 2004) is a frequently used behavioral rating scale designed to aid in the assessment of a variety of social and emotional problems. However, there is limited research on the use of the BASC-2 comparing the behavioral profiles of children with autism and ADHD, and the available research is flawed by methodological issues or has only examined autism or ADHD relative to typical development as opposed to comparing the two disorders. Given the potential of the BASC-2 to assist in the differential diagnosis of autism and ADHD, the current study aimed to compare maternal behavioral ratings of children diagnosed with ADHD and autism to each other and to children with neurotypical development using the BASC-2 PRS. Group profiles were compared to determine which composites and scales were

significantly different between diagnostic groups and which of the composites and scales were most predictive of diagnosis. Overall, children with a psychoeducational diagnosis were rated as having more maladaptive behaviors compared to children without a diagnosis. However, the level of severity differed between the autism group and the ADHD group. In general, children with autism received ratings indicating more maladaptive behavior than children with ADHD or neurotypical children. These finding support previous research indicating that children with autism tend to have more exaggerated behavioral problems than children with ADHD. Scales that showed significant group differences for children with autism and ADHD were then used to determine which of those scales were most predictive of diagnosis. The Withdrawal and Atypicality scales were determined to be the most predictive of diagnosis in the study sample. These scales were then used to create a weighted formula that can be used to predict the likelihood of a diagnosis of autism versus ADHD. Clinicians and school-based personnel can easily apply the findings of this study when conducting assessments with children suspected of having these disorders.

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CHAPTER I

INTRODUCTION

Autism and attention-deficit/hyperactivity disorder (ADHD) are two distinct disorders that share many similarities, which complicates differential diagnosis (Mayes, Calhoun, Mayes, & Molitoris, 2012). Research has shown that the disorders share behavioral characteristics and deficits in several areas, including attention problems, hyperactivity, behavior problems, social skills deficits, and executive dysfunction (American Psychiatric Association [APA], 2013; Calhoun & Mayes, 2005). Additionally, children with autism and ADHD share similar co-occurring problems, including learning problems, mood disorders, emotional lability, anger, conduct problems, early language delays (Mayes & Calhoun, 2011), and sleep difficulties (Mayes, Calhoun, Bixler, & Vgontzas, 2009). The symptomological overlap in the diagnostic and associated features of these disorders has prompted examination of the distinguishing features between autism and ADHD (Corbett, Constantine, Hendren, Rocke, & Ozonoff, 2009). Some researchers hypothesize that children with autism and ADHD present with similar symptoms of differing severity, but others believe that children with autism and ADHD have distinct symptom profiles (Mayes et al., 2012).

Most research indicates that ADHD-like symptoms, such as impairments in attention and hyperactivity, exist in many children with autism (Hattori et al., 2006;

Mayes et al., 2012). These children exhibit higher rates and increased severity of co-occurring aggression, anxiety, and depression than do children with autism but without additional symptoms (Gadow, DeVincent, Pomeroy, & Azizian, 2005). Conversely, some children with ADHD have symptoms similar to the core and associated characteristics of autism (Grzadzinski et al., 2011), including deficits in social interactions and communication, restrictive or repetitive behavior (Hattori et al., 2006), difficulties understanding pragmatic language (Geurts et al., 2004), and difficulty interpreting the feelings and thoughts of others (Santosh & Mijovic, 2004). However, the symptoms are generally less pronounced in children with ADHD than are the symptoms in children with autism (Hattori et al., 2006).

Although research shows many symptomological similarities between children with autism and children with ADHD, closer examination does reveal differences, particularly in the areas of executive functioning profiles, anxiety conditions, and descriptions of atypical behavior. Research also indicates that some deficits may be independent of diagnosis and more closely related to symptoms of inattention in general (de Bruin, Ferdinand, Meester, de Nijs, & Verheij, 2007; Gadow et al., 2005; Leyfer et al., 2006).

The Behavioral Assessment System for Children, Second Edition (BASC-2; Reynolds & Kamphaus, 2004) is a comprehensive behavioral rating system that identifies maladaptive and clinical functioning in children and adolescents and is the most

frequently used broad-based rating scale by school personnel (Hass, Brown, Brady, & Johnson, 2010). Despite widespread usage of the BASC-2, there appears to be limited research on the use of the instrument with children with autism or ADHD, even though the use of behavioral rating scales is common in the assessment of these disorders (Hass et al., 2010; Manning & Miller, 2001). Much of the available research using the BASC-2 to examine the behavioral profiles of these populations is limited by methodological issues, including small or discrepant sample sizes, unmatched control groups, limitation of focus only on children with higher-functioning autism, and the use of outdated research instruments. Additionally, a large proportion of research utilizing the BASC-2 has only examined autism or ADHD relative to typical development as opposed to examining differential diagnosis between the two disorders.

Statement of the Problem

Although autism and ADHD are considered two discrete diagnoses, they share many overlapping symptoms. Behavioral rating scales, particularly the BASC-2, appear to be potentially efficacious in discriminating between the two disorders, but there is a lack of quality research including these populations, leaving room for an innovative investigation comparing the two groups using a broader population of children with autism as well as larger group sizes.

Scope of the Study

Population

This study was designed to represent the responses of mothers with a school-aged child with a primary educational diagnosis of autism or ADHD, or a school-aged child with neurotypical development. An educational diagnosis indicates that the child meets the criteria under the Individuals with Disabilities Education Improvement Act (IDEIA) for the disability and, as a result, is eligible for special education services in the public school setting (IDEIA, 2004). Whether or not the child had received a clinical diagnosis of the disorder was not taken into account.

Inclusion criteria consisted of mothers of children ages 6–21 who completed the BASC-2 Parent Rating Scale (PRS) on behalf of their child with an educational diagnosis of autism, ADHD, or neurotypical (no diagnosis). Exclusionary criteria for the disability groups included mothers of children with educational diagnoses of both autism and ADHD as well as those whose primary educational diagnosis is not autism or ADHD. Children with comorbid educational diagnosis of emotional disturbance were removed from the sample while those with other comorbid diagnoses not considered psychiatric in nature, including speech impairment and learning disability, were retained. For the neurotypical group, children had no reported educational diagnosis. Mothers were chosen as raters in the study because research has shown that behavioral ratings of children by mothers and fathers differ significantly (Palomares, 1992).

The study sample consisted of at total of 343 participants. Participants from a medium-sized school district in north Texas were obtained by requesting access to the BASC-2 PRS data for parents meeting the inclusion criteria outlined above. Additional participants' data was gathered from faculty members at Texas Woman's University using data collected in previous research studies and a control sample obtained from Pearson Education, Incorporated (Inc.), the company that publishes the BASC-2. Both genders, as well as a variety of age and ethnic categories, were represented in the sample; however, the geographic region represented was primarily north Texas (for the diagnosis groups), although the control group contained participations from throughout the southern region of the United States, including Texas.

Research Design

This study employed a quasi-experimental, nonequivalent, differential, between-subjects design. Quasi-experimental research studies produce group scores that can be compared to test for significant differences, with the groups being defined in terms of a specific participant characteristic (Gravetter & Forzano, 2012). In this study, the groups of participants were formed based on educational diagnosis and are considered nonequivalent, since random assignment is not possible. This study utilized convenience sampling, which is the most common type of sampling used in behavioral science research (Gravetter & Forzano, 2012). All participant information collected was archival

data. Archival data allows for analysis of past events and behaviors by using historical records (Gravetter & Forzano, 2012).

The primary independent variable in this study was educational diagnosis (i.e., autism, ADHD, or neurotypical). Additionally, demographic variables including age, gender, and race/ethnicity were investigated to determine if results differ on these variables across disability groups. Dependent variables in this study consisted of the scales and composites generated from the BASC-2 PRS. Composites include Adaptive Skills, Behavioral Symptoms Index, Externalizing Problems, and Internalizing Problems. Primary scales on the PRS include Adaptability, Activities of Daily Living, Aggression, Anxiety, Attention Problems, Atypicality, Conduct Problems, Depression, Functional Communication, Hyperactivity, Leadership, Social Skills, Somatization, and Withdrawal. These scores were evaluated as dependent variables in this study.

Purpose of the Study

The BASC-2 PRS has the potential to aid in the differential diagnosis of autism and ADHD; however, there is a dearth of research in this area. The purpose of this study was to compare children diagnosed with ADHD and autism to each other and to children with neurotypical development using the BASC-2 PRS. Group profiles were compared to determine which composites and scales were significantly different between diagnostic groups and which of the composites and scales were most predictive of diagnosis.

Importance of the Study

Given the large number of overlapping characteristics of autism and ADHD, clinicians are in need of tools that can effectively assist in the differential diagnosis of these disorders. Behavior rating scales are commonly used assessment tools that may aid in the differential diagnosis of autism and ADHD. This study was conducted to document the behavioral and adaptive profiles of children with autism, children with ADHD, and children with neurotypical development using the BASC-2 PRS, a behavior rating scale widely used in the school setting. Profiles were generated for each group of children, and the profiles were examined to determine the extent to which the groups can be discriminated from each other using this instrument and which scales are most efficacious in differentiation. The findings can be easily applied by clinicians and school-based personnel conducting assessments with children suspected of having these disorders.

Definitions of Terms

The following definitions are offered to provide clarity for the purposes of this study:

Attention-Deficit/Hyperactivity Disorder (ADHD): ADHD is one of the most common neurodevelopmental disorders of childhood and is characterized by symptoms of inattention and/or impulsivity and hyperactivity (Anastopoulos et al., 2011). Students with ADHD can be eligible for special education services under a

number of disability categories, but are generally served under Other Health Impairment (IDEIA, 2004).

Autism: Autism is a pervasive developmental disorder, generally manifesting in early childhood, which involves deficits in communication and social interaction as well as restricted or repetitive patterns of behavior, interests, and activities (APA, 2013). Under IDEIA, an educational diagnosis of autism indicates the presence of a "developmental disability significantly affecting verbal and nonverbal communication and social interaction, generally evident before age three, that adversely affects a child's educational performance" (IDEIA, 2004, Sec, 300.8(c)(1)).

Clinical Diagnosis: A clinical diagnosis comes from a mental health or medical professional outside of a school system and may or may not be used by the school system to qualify a student for special education services.

Comorbidity: Comorbidity refers to an individual experiencing more than one disorder at the same time (American Psychological Association, 2014).

Diagnostic and Statistical Manual of Mental Disorders (DSM): The DSM is the standard classification of mental disorders used by mental health professionals in the United States. It is intended to be applicable in a wide array of contexts and used by clinicians and researchers of many different orientations (e.g., biological,

psychodynamic, cognitive, behavioral, interpersonal, family/systems). It is currently in the fifth edition and is published by the APA.

Differential Diagnosis: Differentiating between conditions with similar symptoms.

Educational Diagnosis: An educational diagnosis indicates that the child meets the criteria under IDEIA for the disability and, as a result, is eligible for special education services in the public schools (IDEIA, 2004). This is determined by a multidisciplinary team consisting of a variety of school personnel as well as the child's parents or legal guardians.

Individuals with Disabilities Education Improvement Act (IDEIA): IDEIA is a law ensuring services to children with disabilities throughout the nation (IDEIA, 2004). It governs how states and public agencies provide early intervention, special education, and related services to more than 6.5 million eligible infants, toddlers, children, and youth with disabilities (U.S. Department of Education, 2014).

Neurotypical: Neurotypical is a term used to describe someone considered to be developing typically (i.e., someone who does not have autism or another intellectual or developmental difference; Rudy, 2010).

Other Health Impairment: Other Health Impairment indicates the student has "limited strength, vitality, or alertness, including a heightened alertness to environmental stimuli, that results in limited alertness with respect to the education environment"

which is the result of an acute or chronic health problem and "adversely affects a child's educational performance" (IDEIA, 2004, Sec. 300.8(c)(9)).

Pervasive Developmental Disorder: Pervasive developmental disorder is an umbrella term under which autism and related disorders fall. These disorders involve severe and pervasive impairments in social interactions and either verbal or nonverbal communication or the presence of stereotyped behaviors, interest, or activities (APA, 2000).

Restricted or Repetitive Patterns of Behavior, Interests, and Activities: Restricted or repetitive patterns of behavior, interest, or activities refer to preoccupation in one or more of these areas that is abnormal in either intensity or focus. It can be related to inflexibility or adherence to nonfunctional routines or rituals, unusual motor movements, or preoccupation with parts of objects or narrow topics of interest (APA, 2000).

CHAPTER II

REVIEW OF EXISTING LITERATURE

This chapter provides a review of the existing literature surrounding the diagnostic characteristics and definitions of autism and ADHD as well as the similarities and differences between the two disorders. A review of current research using the BASC-2 with each of these disorders is included as well. Specifically, the DSM and IDEIA definitions for autism and ADHD are discussed, followed by the etiology, pathophysiology, and neurochemistry of the disorders. Then, co-occurring symptoms and disorders are examined, including cognitive and academic impairments, internalizing and externalizing behaviors, and adaptive functioning. This chapter concludes with a review of similarities and differences between the disorders and a description of research studies utilizing the BASC-2 PRS with these populations.

Autism

Autism is a pervasive neurodevelopmental disorder, generally manifesting in early childhood that involves deficits in communication and social interaction as well as restricted repetitive patterns of behavior, interests, and activities (APA, 2013). The most recent statistics suggest that one in 88 children meets the diagnostic criteria for an autism spectrum disorder (Centers for Disease Control and Prevention [CDC], 2013). Autism spectrum disorders are found in all racial, ethnic, and socioeconomic groups, but boys are

five times more commonly diagnosed than are girls. Individuals with autism are extremely diverse with a broad range in symptom severity and level of cognitive and adaptive functioning (Kanne et al., 2011). Associated symptoms often seen in this population (though not required for diagnosis) include self-injurious behavior (i.e., head banging, biting, hitting), aggression, tantrums, and noncompliance (Matson & Nebel-Schwalm, 2007). Both core and associated symptoms can have a profound impact on an individual's ability to participate in activities, to socialize, and to benefit from educational instruction (Luiselli, Blew, Keane, Thibadeau, & Holzman, 2000).

Individuals with autism experience social, emotional, and behavioral difficulties (APA, 2013; Kanner, 1943). For example, individuals with autism often feel extreme anxiety in response to changes in their routines or environment as well as anger and frustration when unable to communicate effectively or understand social expectations (Kanner, 1943). Additionally, they frequently have difficulty self-regulating, which can lead to problems with attention, obsessive-compulsive behavior patterns, and emotional dysregulation (Kanner, 1943).

Some individuals with autism are considered to be high functioning due to their relative strengths in language and cognition (Klin & Volkmar, 2000). Strengths in these areas have been linked to more positive outcomes for individuals with autism (Kanne et al., 2011). However, similar to their more severely impacted counterparts, these individuals also tend to have difficulties with social interaction and restricted patterns of

behavior or interest as well as deficits in the understanding of pragmatic language (APA, 2013; Landa, 2000).

The core traits of autism were first identified by Leo Kanner when he described a group of individuals having impairments in communication, a lack of ability to relate to others, sensory problems, and restricted or repetitive patterns of behavior and interest (Kanner, 1943). Kanner (1943) noted that social and emotional functioning was significantly impacted in individuals with autism. Shortly afterward, Hans Asperger described a group of children with similar, but less severe, traits (Asperger, 1944). Asperger also noted impairments in the social skills of this group and went on to describe these children as lacking empathy and intuition regarding the feelings of others, showing unusual affect, and intellectualizing their experiences. Wing (1981) further described these individuals as being naïve, lacking the ability to make and keep friends, and having inappropriate or one-sided conversations, sophisticated or repetitive speech, and poor use and perception of nonverbal communication. Today, all of these individuals would likely be diagnosed with autism (APA, 2013).

Defining Autism

DSM definition. Even though Kanner (1943) described autism decades earlier, it was not recognized as an official psychiatric diagnosis until the third edition of the DSM (DSM-III) was released in 1980, which included a narrow set of diagnostic criteria for the disorder (APA, 1980). When the DSM-III was revised in 1987, the diagnostic criteria for

autism became somewhat less stringent (APA, 1987). The fourth edition of the DSM (DSM-IV) continued with a similarly broad approach to the diagnosis of autism, requiring individuals to meet at least six behavioral criteria from three subsets: social impairment, communication, and restrictive or repetitive behaviors or interests (APA, 2000). It also specified that the age of onset had to be prior to 3 years of age. The DSM-IV also outlined separate diagnostic criteria for Asperger's disorder, which required the individual to meet at least three (as opposed to six) criteria from the same diagnostic categories and did not include the age of onset requirement. Additionally, a language delay was not required for the diagnosis of Asperger's disorder. At this point, critics began to argue that the criteria for autism spectrum disorders might have become too lenient. It was estimated that there were over 2,000 possible symptom combinations resulting in meeting the diagnostic criteria for autism, bringing into question reliability and validity issues with diagnosis (Lohr & Tanguay, 2013).

Concerns about the breadth of diagnostic criteria in the DSM-IV (APA, 1994) and its text revision (DSM-IV-TR; APA, 2000) resulted in critical changes in the diagnostic criteria of autism with the publication of the fifth edition of the DSM (DSM-5; APA, 2013). These changes were designed to add specificity and maintain the diagnostic integrity of the disorder (Worley & Matson, 2012). The DSM-5 autism diagnostic criteria removes the subtypes of autism (e.g., Asperger's disorder, pervasive developmental disorder—not otherwise specified [PDD-NOS]) and folds them into the

one-dimensional category of autism (Kaland, 2011) with considerations of severity and associated symptoms (Lohr & Tanguay, 2013). This allows practitioners to concentrate on the similar features of the disorders rather than focusing on the differences (Lohr & Tanguay, 2013). Additionally, the domains for social and communication problems were combined and unusual sensory activity was added to the restrictive and repetitive behaviors and interests section. Now, individuals must meet all criteria from the social and communication problems area and at least two out of four of the restricted and repetitive behaviors and interests section for diagnosis. The language delay requirement was also eliminated and a comorbid diagnosis with ADHD is now permitted.

Arguments for revision of diagnostic criteria to exclude distinct subtypes of the disorder include the idea that autism exists on a continuum without discrete boundaries (Manjiviona & Prior, 1995) and that, in the absence of biological markers, it is difficult to find support for specific disorder subtypes (Palmen & van Engeland, 2004). However, there is great concern for families and practitioners alike that the new criteria will not encompass all those currently diagnosed with an autism spectrum disorder (Lohr & Tanguay, 2013), and it appears that those with current diagnoses of Asperger's disorder or PDD-NOS, those with higher cognitive functioning, and females may be the most at risk for no longer meeting diagnostic criteria (McPartland, Reichow, & Volkmar, 2012). The idea that subtypes of autism spectrum disorder exist remains a controversial topic with conflicting research findings (Worley & Matson, 2012).

IDEIA definition. Instead of diagnostic manuals, school personnel look to descriptions found in federal education law (i.e., IDEIA) to guide decisions about the presence of a disability. Beginning in 1994, IDEIA required that public schools recognize autism as a special education classification (IDEIA, 2004). In public schools, a medical diagnosis of autism is not required; however, the child must meet specific eligibility criteria to be considered for special education services under the classification of autism (Hass et al., 2010). Conversely, a medical diagnosis of autism does not guarantee a child special education services unless he or she experiences negative educational impact as a result of the disability.

According to the most recent authorization of IDEIA, autism is defined as a "developmental disability significantly affecting verbal and nonverbal communication and social interaction, generally evident before age three, that adversely affects a child's educational performance" (IDEIA, 2004, Sec. 300.8(c)(1)). The definition goes on to state that "[o]ther characteristics often associated with autism are engagement in repetitive activities and stereotyped movements, resistance to environmental change or change in daily routines, and unusual responses to sensory experiences" (IDEIA, 2004, Sec. 300.8(c)(1)). This determination is made by a multidisciplinary team comprised of school personnel as well as the child's parents or legal guardians.

Etiology

Despite evidence of a strong biological foundation, the etiology of autism is largely unknown (Barnard, Young, Pearson, Geddes, & O'Brien, 2002; Posey & McDougle, 2001). Originally, autism was thought to be the result of environment causes, and treatment largely focused on psychodynamic and behavioral interventions (Posey & McDougle, 2001). More recently, however, pharmacological treatments, including antipsychotic and serotoninergic medications, have become increasingly popular, and others have examined the effectiveness of alternative and micronutrient treatments for autism. Family and twin studies have yielded the most consistent findings in autism research, indicating that autism can be inherited (Wassink & Piven, 2000). Genetic and chromosomal abnormalities are indicated in a significant number of autism cases (Corbett & Gunther, 2011). As opposed to a single-gene disorder, autism is currently thought to be a polygenetic disorder, involving numerous interacting genes.

Increasing prevalence rates of autism point to involvement of environmental causes as well (Corbett & Gunther, 2011). Some suspected environmental factors include prenatal and perinatal infections; perinatal insults; exposure to heavy metals, mercury, or pesticides; and vaccines containing thimerosal. There is also an increased rate of autism in individuals who were prenatally exposed to ethanol or valproic acid. Correlations have been found in families with autoimmune disorders as well. Most data supports a prenatal or very early postnatal etiology for autism (Corbett & Gunther, 2011).

Pathophysiology and Neurochemistry

Postmortem investigations have revealed a variety of neural abnormalities in people with autism, including increased density in the anterior cingulate, small neuronal cell size, megalencephaly, and cortical dysgenesis (Corbett & Gunther, 2011). A consistent finding in autism research has been a larger head circumference with enlarged cerebral volume in children with autism, indicating a period of abnormal brain growth followed by a period of protracted growth as a neural precursor for autism (Corbett & Gunther, 2011).

Functional neuroimaging studies show reduced or differential activation of the amygdala with greater activity in other brain regions, including the superior temporal cortex and anterior cingulate cortex, in individuals with autism (Corbett & Gunther, 2011). Amygdala dysfunction likely contributes to difficulties with facial processing, emotional lability, and anxiety, all commonly found in individuals with autism. Individuals with autism also tend to have reduced mirror neuron action in the inferior frontal gyrus. Mirror neurons are responsible for an individual's ability to understand and imitate actions, as well as understand the intentions of others, and provide the foundation for empathy. Reduced size and number of Purkinje neurons, as well as abnormal volume in the cerebellum, has been found in individuals with autism. Abnormalities in the cerebellum likely influence some of the primary deficits found in autism. Despite these structural abnormalities, it is difficult to determine if they are

causal factors or the result of the impairments associated with autism (Corbett & Gunther, 2011).

Neurochemical investigations have also been conducted for individuals with autism (Corbett & Gunther, 2011). Several studies implicate dysregulation in the serotonin (5-HT) levels in individuals with autism (e.g., Corbett & Gunther, 2011; Posey & McDougle, 2001). Serotonin effects the regulation of mood, arousal, hormone release, pain sensitivity, eating, sexual behavior, and temperature (Corbett & Gunther, 2011). Research shows that as many as 33% of people with autism have elevated 5-HT levels. Other neurochemical irregularities have also been implicated in individuals with autism as well. Children with autism demonstrate variability in cortisol levels, possibly resulting in an exaggerated response to stress (Corbett & Gunther, 2011). Lower levels of oxytocin, which is implicated in the formation of social bonds and in stress, have also been found in children with autism. Posey and McDougle (2001) reported that individuals with autism displayed fewer repetitive behaviors after treatments with an oxytocin infusion. Children with autism often have low or abnormal patterns of melatonin, and melatonin treatments have resulted in fewer sleep disturbances in this population (Corbett & Gunther, 2011).

Co-Occurring Symptoms and Disorders

In addition to the core features of deficits in communication and social interaction and restricted repetitive patterns of behavior, interests, and activities, children with

autism often experience secondary symptoms and challenging behaviors (Matson & Nebel-Schwalm, 2007). Children with autism also tend to exhibit more co-occurring psychopathology than do children with neurotypical development. These additional issues can have a significant negative impact on the functioning of individuals with autism. These co-occurring problems include cognitive impairments (APA, 2013; Rutter et al., 1988) and academic problems (Hass et al., 2010), internalizing behaviors (e.g., anxiety and depression; Lainhart, 1999), externalizing behaviors (e.g., aggression, hyperactivity, and conduct problems; Leyfer et al., 2006), and adaptive skill deficits (Kanne et al., 2011).

Specific rates of co-occurring disorders are difficult to ascertain in this population due to communication and cognitive impairments that make it difficult for these individuals to describe their internal experiences (Leyfer et al., 2006). Additionally, the validity of available prevalence rates is questionable because many studies did not utilize instruments designed for use with this population. Despite these factors, many individuals diagnosed with autism receive an additional diagnosis before reaching adulthood (Loveland & Tunali-Kotoski, 2005).

Cognitive impairments and academic problems. As many as 75% of individuals with autism have co-occurring intellectual disabilities, with verbal abilities typically weaker than nonverbal abilities (APA, 2013; Rutter et al., 1988). Intellectual disabilities can increase the social and communication difficulties that individuals with

autism already face. Individuals with autism also have impairments in executive functioning, as well as theory of mind and central coherence deficits (Leyfer et al., 2006; Manteris, 2013). Executive functioning refers to the ability to plan and organize behavior, maintain and direct attention, and use problem-solving skills (Jarratt, Riccio, & Siekierski, 2005). Theory of mind is related to understanding the mental states of oneself and others, and is innately present in most individuals, but is usually lacking in individuals with autism (Manteris, 2013). Individuals with autism also frequently have weak central coherence, which involves processing individual parts of an object over the whole (Manteris, 2013). Though not part of the diagnostic criteria, deficits in central coherence and theory of mind are often present in individuals with autism.

Co-occurring problems can have a significant impact on the education of individuals with autism (Matson & Nebel-Schwalm, 2007; Nicholas et al., 2008). Teachers frequently report learning problems in this population (Hass et al., 2010), likely resulting from attention deficits and other associated behavior problems (Matson & Nebel-Schwalm, 2007). Nearly all studies examining educational difficulties of children with autism cite attention problems as a major concern (Foley Nicpon, Doobay, & Assouline, 2010; Hass et al., 2010; Knoll, 2008; Mahan & Matson, 2011; Nicholas et al., 2008; Volker et al., 2010), particularly when students are engaged in cognitively demanding or less preferred tasks (Leyfer et al., 2006). Children with autism can

maintain attention for long periods of time when participating in their preferred activity, but show impairments in other situations, regardless of cognitive level.

Internalizing behaviors. Research on internalizing behaviors, including anxiety, depression, and somatization, is mixed in this population. For individuals with autism, mood disorders (e.g., anxiety and depression) are the internalizing issues most often reported (Loveland & Tunali-Kotoski, 2005), with overall rates as high as 58% for depression and 84% for anxiety (Lainhart, 1999). Level of functioning appears to impact mood disturbance, with higher-functioning individuals tending have increased rates of anxiety and depression (Knoll, 2008; Volker et al., 2010).

Anxiety. Anxiety is extremely common in individuals with autism; however, debilitating anxiety is not a core symptom of autism and is not equivocally found in this population (Leyfer et al., 2006). Several studies have revealed elevated ratings for anxiety for individuals with autism, particularly in higher functioning individuals (Hass et al., 2010; Kanne, Christ, & Reirsen, 2009; Knoll, 2008; Lopata et al., 2010; Loveland & Tunali-Kotoski, 2005; Volker et al., 2010). A few studies have failed to find elevated rates of anxiety in individuals with autism (Foley Nicpon et al., 2010). For example, Foley Nicpon et al. (2010) found average levels of anxiety reported by parents and teachers as well as in the self-reports of adolescents with autism. However, up to 65% of children with autism are prescribed medication for anxiety-related conditions (Loveland & Tunali-Kotoski, 2005).

Specifically, high rates of specific phobias and obsessive-compulsive disorder have been found in individuals with autism and co-occurring anxiety (Leyfer et al., 2006). Leyfer et al. (2006) found specific phobias to be the most common co-occurring condition in their sample of 109 children with autism, with a prevalence rate of 44%. Interestingly, specific phobias commonly found in the general population (i.e., fear of flying) were low in the sample. Instead, the most common phobias involved crowds, needles or shots, and loud noises. Despite the fact that individuals with anxiety are frequently bothered by social situations, low rates of social phobia are generally found in this population.

Obsessive-compulsive disorder was the second most common co-occurring diagnosis in the study, with a rate of 37% (Leyfer et al., 2006). Almost half of the children that met criteria for this diagnosis had compulsions requiring others to do things a certain way, such as maintaining daily routines or greeting and separation rituals. Another common compulsion was the "need to tell or ask," which involved having to repeat statements or participate in elaborate questioning rituals. These types of compulsions are both related to dysfunctional social interactions, one of the core symptoms of autism.

Depression. Depression is also a common problem for individuals with autism (Foley Nicpon et al., 2010; Hass et al., 2010; Kanne et al., 2009; Knoll, 2008; Lopata et al., 2010; Mahan & Matson, 2011; Nicholas et al., 2008; Volker et al., 2010). Depression

appears to increase with age in individuals with autism (Ghaziuddin, Weidmer-Mikhail, & Ghaziuddin, 1998). Ghaziuddin et al. (1998) found that adolescents and adults (ages 13 to 51) with autism tend to have higher rates of depression (53%) than do children (ages 6 to 12) with autism (25%). Leyfer et al. (2006) found that 24% of children in their sample met the lifetime diagnostic criteria for at least one episode of major depressive disorder. Potential causes for mood disorders in this population include stress, social situations resulting in isolation or failure, changes in routines, increasing awareness of their disability, and genetics (Klin, McPartland, & Volkmar, 2005; Shea & Mesibov, 2005; Volker et al., 2010). However, some researchers hypothesize that parents and teachers erroneously assume that the unusual or atypical nonverbal behaviors of individuals with autism are symptoms of internalized problems (Gillberg, 2002).

Somatization. Somatization appears to be less frequent in this population. Although some research indicates elevated ratings of somatization in individuals with autism, this tends to be reported only in higher-functioning individuals (Knoll, 2008; Mahan & Matson, 2011). Reasons for the low prevalence of somatic complaints may include that the symptoms are attributed to anxiety or avoidance behavior or it may be that many individuals with autism lack the communication skills to effectively describe and report somatic complaints (Mahan & Matson, 2011).

Externalizing behaviors. Externalizing behaviors, operationalized as hyperactivity, aggression, and conduct problems (Reynolds & Kamphaus, 2004) in the

proposed study, can be extremely problematic for individuals with autism (Leyfer et al., 2006). Hyperactivity is a major area of concern in children with autism (Foley Nicpon et al., 2010; Knoll, 2008; Mahan & Matson, 2011; Volker et al., 2010). Behaviors associated with hyperactivity (e.g., interrupting) are among the most problematic in the school setting (National Research Council, 2001). Hyperactivity and other behaviors often associated with ADHD are common in children with autism as well (de Bruin et al., 2007; Gadow et al., 2005). Studies of ADHD symptoms in individuals with autism have reported rates anywhere from 29 –73% (Ghaziuddin et al., 1998). Individuals with autism show much higher rates of ADHD symptomatology than the general population.

Research shows that many children with autism display aggression (Knoll, 2008; Matson & Nebel-Schwalm, 2007; Nicholas et al., 2008) and symptoms of oppositional-defiant disorder or conduct disorder (de Bruin et al., 2007; Gadow et al., 2005; Mahan & Matson, 2011; Matson & Nebel-Schwalm, 2007; Nicholas et al., 2008). However, factors associated with the oppositional behavior found in children with autism may be qualitatively different than they are in children with neurotypical development (Leyfer et al., 2006). Many children with autism do not understand concepts like intentionally annoying others, displacing blaming, or being vindictive or spiteful. Additionally, some researchers hypothesize that aggression and noncompliance may actually be manifestations of anxiety (Loveland & Tunali-Kotoski, 2005) related to poor social

functioning or inflexible thinking rather than a disruptive disorder (Klin & Volkmar, 2000; Leyfer et al., 2006; Volker et al., 2010).

Other behavioral difficulties. Other behavioral difficulties frequently found in individuals with autism include withdrawal and atypicality. Withdrawal is defined as the tendency to avoid others and refrain from entering social situations (Reynolds & Kamphaus, 2004). Atypicality relates to repetitive or odd behaviors, which many individuals with autism exhibit (Mahan & Matson, 2011). Numerous studies report elevated scores for withdrawal and atypicality on behavioral measures for this population, with most noting elevated scores in both areas (Foley Nicpon et al., 2010; Hass et al., 2010; Knoll, 2008; Mahan & Matson, 2011; Volker et al., 2010). According to Reynolds and Kamphaus (2004), atypicality and withdrawal are two of the main indicators of autism on the BASC-2, a multidimensional behavioral rating scale for youth.

Adaptive functioning. Adaptive behavior refers to age-appropriate performance in areas including daily living, motor movement, socialization, and communication skills (Sparrow, Balla, & Cicchetti, 1984). Deficits in adaptive skills are not generally included as part of the diagnostic criteria for autism; however, many individuals with autism have problems with adaptive functioning (Lee & Park, 2007) and assessment of adaptive skills is considered an important part of an evaluation for individuals suspected of having a developmental disability (Stein, Szumowski, Blondis, & Roizen, 1995). Research shows that children with autism have deficits in adaptive behavior regardless of cognitive ability

(Kanne et al., 2011); however, the discrepancy between cognitive ability and adaptive functioning can be quite significant in this population (Klin, 2000).

Adaptive skills are often predictors of long-term outcomes for individuals with autism (Kanne et al., 2011). Kanne et al. (2011) investigated the relationship between adaptive functioning and autism severity in 1,089 verbal children and adolescents with autism. Notable results include (a) a strong positive relationship between adaptive functioning and cognitive ability and (b) a negative association between adaptive behavior and age. These findings indicate that cognitive ability is a strongly associated with adaptive skill level and the gap between cognitive ability and adaptive functioning increases with age.

Several studies utilizing the BASC-2 have noted deficits in adaptive functioning in individuals with autism (Foley Nicpon et al., 2010; Knoll, 2008; Mahan & Matson, 2011; Volker et al., 2010). These studies found that, when compared to children with neurotypical development, children with autism received lower ratings on all of the adaptive subscales of the measure, including Adaptability, Functional Communication, Social Skills, Activities of Daily Living, and Leadership. Even higher-functioning individuals with autism showed deficits in many of these same areas (Foley Nicpon et al., 2010).

A meta-analysis compiled by Lee and Park (2007) examined the adaptive skills of individuals with autism in terms of communication, daily living, social, and motor skills

from available research studies. Deficits in social skills, one of the primary characteristics of autism (APA, 2013) were also reviewed in the meta-analysis by Lee and Park (2007) who found low or moderately low levels of social skills across studies. Compared to other areas of adaptive functioning, individuals with autism have the most difficulty in this area (Lee & Park, 2007). Results in the area of adaptive communication, another primary characteristic of autism, revealed moderately low to adequate ratings for verbal individuals with autism despite relatively high receptive language abilities indicating that, even though some individuals with autism show average to above average verbal ability, their language comprehension can be deficient.

For daily living skills, which include activities like getting dressed, maintaining personal hygiene, and completing general household tasks (Sparrow et al., 1984), individuals with autism showed moderately low levels of functioning (Paul et al., 2005). Research has also found that many individuals with autism have motor impairments, including clumsiness, odd posture and gait, and poor hand-eye coordination (Manjiviona & Prior, 1995; Nicholas et al., 2008; Wing, 1981). Myles, Cook, Miller, Rinner, and Robbins (2000) found that sensory regulation is related to movement. Individuals with autism often experience vestibular hypersensitivity, resulting in difficulties in gross and fine motor activities. Studies in the meta-analysis found motor skills to be adequate to moderately low in individuals with autism (Lee & Park, 2007).

Other research has identified sleeping and eating difficulties in this population, specifically with falling and staying asleep as well as self-imposed restrictions on types of food consumed (Nicholas et al., 2008). For individuals with autism, difficulties in these areas may also be discrepant from cognitive ability (Lee & Park, 2007). Evidence from available literature indicates that, although adaptive behavior is not directly included as a part of the diagnostic criteria, many individuals with autism experience difficulties in this area (Lee & Park, 2007). However, it makes sense that individuals with autism would receive significantly lower ratings on measures of adaptive behavior because the skills measured include abilities in the areas of communication and social skills, which are core symptoms of autism (Mahan & Matson, 2011).

Autism Summary

Overall, children and adolescents with autism display significantly more challenging behaviors than do children and adolescents with neurotypical development (Matson & Nebel-Schwalm, 2007; Nicholas et al., 2008). Researchers estimate that up to 72% of individuals with autism have at least one psychiatric disorder in addition to the diagnosis of autism, and this number may actually be an underestimate (Leyfer et al., 2006). The reason for such high co-occurrence in individuals with autism is not known; however, these additional problems result in medical and educational issues that extend beyond the core symptoms of autism (Nicholas et al., 2008).

Attention-Deficit/Hyperactivity Disorder

ADHD is one of the most common neurodevelopmental disorders of childhood, with an estimated prevalence rate of 3 –10% of school-aged children (APA, 2013; Barkley, 2006). As in autism, boys are more likely than are girls to be diagnosed with ADHD. The primary symptoms of the disorder include inattention and/or impulsivity and hyperactivity (Anastopoulos et al., 2011); however, individuals with ADHD often have behaviors that extend beyond the primary symptoms. For example, individuals with ADHD have also been found to exhibit impairments in communication as well as atypical, odd, or immature behaviors (Manning & Miller, 2001). The impact of ADHD is chronic and pervasive (Mueller & Tomblin, 2012). Individuals with ADHD tend to reach lower educational and occupational levels than one would expect, relative to their generally average to above average cognitive ability (Kessler et al., 2005).

Like autism, the diagnosis of ADHD is quite heterogeneous (Mueller & Tomblin, 2012). Research supports two symptom clusters, inattention and hyperactivity/ impulsivity, resulting in three subtypes of ADHD: predominantly inattentive, predominantly hyperactive/impulsive, and combined (APA, 2013). Inattention is associated with deficits in processing and vigilance (Mueller & Tomblin, 2012). Children with the predominantly inattentive subtype of ADHD have more problems focusing and engaging selective attention, frequently daydream, and have slower information processing skills (McBurnett et al., 1999). Children with this subtype are

also more likely to meet the diagnostic criteria for a learning disability (Davidson, 2008); however, children with the hyperactive/impulsive subtype of ADHD receive higher parent and teacher ratings of school difficulty (Lahey et al., 1994). Children with the hyperactive/impulsive subtype also have increased problems with persistence, distractibility, and inhibition (Mueller & Tomblin, 2012; Barkley, 1997). Children with the combined subtype of ADHD experience the cumulative effect of difficulties across all these domains (Mueller & Tomblin, 2012).

As previously noted, studies of gender differences in ADHD reveal that more boys than girls are diagnosed with the disorder, with ratios ranging from 3:1 to 6:1 (Pastor & Ruben, 2008). This gender discrepancy is likely due to the fact that males are more likely to be referred for psychological services than females (Biederman & Faraone, 2005) as well as indications that ADHD manifests itself differently in males and females (Mueller & Tomblin, 2012). For example, females with ADHD tend to be less disruptive than males (Biederman & Faraone, 2005). Thus, females have higher prevalence rates of the inattentive subtype of ADHD than the hyperactive/impulsive or combined subtypes and present with fewer overall symptoms (Gershon, 2002).

Defining ADHD

DSM definition. ADHD has been included as a diagnosis since the DSM-I, when it was considered a “minimal brain dysfunction” (APA, 1952). The DSM-II labeled it “hyperkinetic reaction of childhood” (APA, 1968), and in the DSM-III it was coined

“ADD with or without hyperactivity” (APA, 1980). The revision of DSM-III (DSM-III-R; APA, 1987) was the first to use the acronym ADHD to describe the syndrome. More recently, the DSM-IV-TR (APA, 2000) characterized the symptoms of ADHD as persistent, developmentally inappropriate, and impairing difficulties with inattention, impulsivity, and hyperactivity. To qualify for a diagnosis of ADHD, children had to meet six or more symptoms of inattention, hyperactivity, or both as outlined in the DSM-IV-TR and symptoms must have emerged before age 7 and been present across two or more settings (e.g., home and school). Traditionally ADHD has been considered a disorder of childhood but disagreement regarding the age-of-onset criterion prompted changes in the diagnostic criteria (Faraone, Biederman & Mick, 2006).

The publication of the DSM-5 yielded several changes in the diagnostic criteria of ADHD (APA, 2013). The age of onset description was changed to state that symptoms must be present prior to age 12, instead of 7, and information was added in an attempt to apply diagnostic criteria across the life span. Additionally, five symptoms, instead of six, are now required for diagnosis in younger individuals for both the inattentive and hyperactivity/impulsivity subtypes. As mentioned previously, a comorbid diagnosis with autism spectrum disorder is now permitted as well. Changes in the diagnostic criteria for ADHD in the DSM-5 may impact the generalizability of this study as a medical diagnosis using this or a similar diagnostic tool is frequently required for an educational diagnosis

of ADHD to be considered in the school setting (National Association of School Psychologists [NASP], 2005).

IDEIA definition. Students with a medical diagnosis of ADHD can be eligible for special education services under a number of disability categories, but are generally served under the disability category of Other Health Impairment (IDEIA, 2004). According to IDEIA, Other Health Impairment means the student has "limited strength, vitality, or alertness, including a heightened alertness to environmental stimuli, that results in limited alertness with respect to the education environment" which is the result of an acute or chronic health problem (ADHD is specifically listed as an example) and "adversely affects a child's educational performance" (IDEIA, 2004, Sec. 300.8(c)(9)). In public schools, this impairment is generally documented by a physician. Although some states require only a physician's diagnosis, others consider a medical diagnosis only part of the evaluation for special education eligibility (NASP, 2005).

Etiology

Research shows that ADHD is influenced by both genetic and environmental factors (Mueller & Tomblin, 2012). The presence of elevated rates of ADHD among the biological relatives of children with ADHD suggest that familial factors may increase susceptibility (Faraone & Doyle, 2001), with 30 –35% of first-degree relatives of children with ADHD also having the disorder. Those figures represent a relative risk six to eight times greater than in the general population (Faraone & Biederman, 2000). Twin studies

show mean estimates of heritability around 76%, indicating that, although genetic predisposition provides a strong influence, environmental factors also play a role in the etiology of the disorder (Faraone et al., 2006).

Despite the strong evidence of a genetic etiology, identifying individual genes responsible for the disorder has been difficult (Mueller & Tomblin, 2012). This is likely due to the multifaceted nature of ADHD, with a large number of susceptibility genes acting together to manifest the disorder (Lander & Schork, 1994). Another possible explanation for the inability to pinpoint a consistent etiology of the disorder is that unique profiles may exist for the individual subtypes of ADHD (Mueller & Tomblin, 2012). Furthermore, genetic and environmental interactions may influence the expression of the disorder. Most candidate gene studies have targeted genes in the dopaminergic, serotonergic and norepinephrine systems (Mueller & Tomblin, 2012).

Pathophysiology and Neurochemistry

The pathophysiology of ADHD most likely involves dysfunction of the dopaminergic and noradrenergic pathways on the prefrontal cortex and subcortical regions of the brain, which support executive functioning (Konrad, Neufang, Hanisch, Fink, & Herpertz-Dahlmann, 2006). Dysfunctional neurotransmission of dopamine is one suspected underlying pathological mechanism of ADHD. Research shows that individuals with ADHD have abnormal levels of the SLC6A3/DAT1 dopamine transporter in brain regions including the striatum, mid-brain, and frontal cortex (Spencer,

Biederman, & Mick, 2007). The corticostriatal system is also a strong candidate in the etiology of ADHD (Mueller & Tomblin, 2012). Imaging studies have revealed anatomical changes in the brain structures of individuals with ADHD (Bush, Valera, & Seidman, 2005). Findings show reductions in total brain size as well as reduced dimensions of the caudate nucleus, prefrontal cortex, corpus callosum, and cerebellar vermis. Additionally, brain-imaging studies suggest that ADHD is associated with abnormal cerebellar activity (Mueller & Tomblin, 2012).

It is hypothesized that the three dominant symptoms of ADHD, inattention, hyperactivity, and impulsivity, all arise, in part, from abnormalities in various areas of the prefrontal cortex (Stahl, 2008). The hyperactive symptoms in ADHD are linked to the supplementary motor cortex and prefrontal motor cortex, whereas impulsive symptoms are linked to the orbital frontal cortex. Each of these areas is linked to other brain areas by cortical circuits and, thus, the symptoms of ADHD are linked to each of these prefrontal brain circuits as well.

Brain structures, including the basal ganglia and prefrontal cortex, are also implicated in ADHD (Mueller & Tomblin, 2012). The prefrontal cortex is linked to inhibition and executive functioning and the basal ganglia serves as an interface between the cortical and subcortical regions of the brain (Barkley, 2006). Reinforcement is linked to the basal ganglia and dopaminergic systems whereas the striatal dopaminergic system appears to play a role in the anticipation of future reward (Mueller & Tomblin, 2012).

Altered levels of dopaminergic receptors and neurotransmitter in individual s with ADHD lead to inefficiency in this system. Evidence for this is found in that children with ADHD tend to choose smaller, immediate rewards over larger, delayed ones (Mueller & Tomblin, 2012).

Motor activity, such as hyperactivity and psychomotor agitation and retardation, can be regulated by a cortico-striatal-thalamic-cortical (CSTC) loop from the prefrontal motor cortex to the putamen to the thalamus and back to the prefrontal motor cortex (Stahl, 2008). Impulsivity is associated with a CSTC loop that involves the orbital frontal cortex, the bottom of the caudate, and the thalamus. The orbital frontal cortex is part of the limbic system and is linked to the nucleus accumbens, another limbic area, by CSTC loops. This specific circuit may be responsible for connecting incoming stimuli to emotions and transforming emotions into actions through the release of neurotransmitters such as dopamine. For impulsive people, stimuli have the potential of being immediately transformed from emotions into actions before inappropriate action can be inhibited. This may be due to dysfunctional thalamic information filtering, allowing impulsive action to occur before the dorsolateral prefrontal cortex can inhibit it.

Genes implicated in ADHD are primarily linked to neurotransmitters including dopamine, adrenaline, and serotonin (Stahl, 2008). Stimulant medications treat ADHD by boosting norepinephrine and dopamine, increasing the efficiency of information processing in the prefrontal cortex and, thus, improving symptoms of inattention,

impulsivity, and hyperactivity. Dopaminergic projections to the striatum signal reward pathways that influence several aspects of learning, such as working memory, planning, state regulation, and procedural and reinforcement learning (Cohen, 2008). Thus, the altered levels of dopamine in children with ADHD may lead to inefficient or ineffective learning (Frank, Moustafa, Haughey, Curran, & Hutchison, 2007).

Co-Occurring Symptoms and Disorders

Children with ADHD are at risk for impairments in academic and social functioning, and the risk increases in the presence of co-occurring conditions (Barkley, 2006). Co-occurring conditions in ADHD are highly impairing and not well understood (Takeda, Ambrosini, deBerardinis, & Elia, 2012). As in autism, children with ADHD have high rates of co-occurring diagnoses, with estimates between 29% and 66% (Jensen et al., 2001; Spencer et al., 2007) regardless of cognitive ability (Katusic et al., 2011). Co-occurring conditions commonly experienced by individuals with ADHD include anxiety, depression, aggression, and conduct problems (Blackman, Ostrander, & Herman, 2005; Booster, DuPaul, Eiraldi, & Power, 2012). Children with ADHD and a co-occurring condition have more social problems and poorer overall outcomes than children with only ADHD (Booster et al., 2012).

Cognitive impairments and academic problems. Children with ADHD frequently have problems maintaining attention (Manning & Miller, 2001). This inability to attend to information long enough to understand it can result in learning problems

(Manning & Miller, 2001) and study skills deficits (Jarratt et al., 2005), independent of cognitive ability (Stein et al., 1995). Additionally, learning disabilities are common in children with ADHD (Mattison & Mayes, 2012), with rates varying from 8–60%, depending on the criteria used (Barkley, 2006; Harrison, Vannest, & Reynolds, 2011) and, with estimates reaching as high as 71%, rates of learning disabilities appear to be higher in children with the combined subtype (Mayes & Calhoun, 2006).

Harrison et al. (2011) found that parents rated attention problems as the strongest discriminator between children and adolescents with and without ADHD. Inattention has been shown to predict social difficulties (Andrade, Brodeur, Waschbusch, Stewart, & McGee, 2009) by impairing children's abilities to attend to social cues and causing them to miss opportunities to learn social norms and expectations and to practice social reciprocity (Graziano, Geffken, & McNamara, 2011). Inattention may also be perceived as disinterest by peers, resulting in peers initiating fewer social interactions with children with attention problems (Dodge & Pettit, 2003). Furthermore, symptoms of inattention are significantly related to poor academic achievement and deficits in general cognitive ability, as well as in short-term and working memory, processing speed, and vigilance (Davidson, 2008; Mueller & Tomblin, 2012).

Attention is an important component of executive functioning (Mayes et al., 2012) so it should be no surprise that executive functioning is often impaired in individuals with ADHD (Barkley, 1997). Executive functioning is comprised of several

components, such as inhibition, working memory, set shifting, and interference control that serve to regulate complex behaviors (Miyake et al., 2000). Inhibition refers to the ability to stop an automatic response from occurring. Working memory describes cognitive processes where information is temporarily stored and manipulated and is highly important for learning and memory tasks (Andrade, 2001). Set shifting is the ability to act flexibly when patterns of reinforcement change (Mueller & Tomblin, 2012). Finally, interference control involves the suppression of automatic responses when superfluous information is introduced. Executive dysfunction is considered by some to be a core symptom of ADHD (Shimoni, Engel-Yeger, & Tirosh, 2012). The symptoms associated with ADHD (e.g., irregularities in attention, impulsiveness, and hyperactivity [APA, 2013]), are directly related to difficulties with executive functions, particularly those involving self-regulation and inhibition (Shimoni et al., 2012).

Children, adolescents, and adults show impaired functioning on measures of executive functioning (Nigg, 2005) with as many as 30–50% of children with ADHD showing executive dysfunction (Biederman et al., 2004). Jarratt et al. (2005) found that children with ADHD had difficulties in all aspects of executive functioning, particularly in the areas of working memory, metacognition, planning, and task initiation. Shimoni et al. (2012) found significant differences between subjects with ADHD and subjects with neurotypical development on two parent rating scales assessing executive functioning, particularly in the areas of metacognition and behavioral control. Deficits in inhibition

and vigilance are linked to other executive functioning difficulties in children with ADHD, including working memory and the attention-related actions of set shifting, task switching, and interference control (Mueller & Tomblin, 2012).

The acquisition of executive functioning skills in children and adolescents with ADHD may also differ from that of children and adolescents with neurotypical development (Qian, Shuai, Chan, Qian, & Want, 2013). Qian et al. (2013) studied the developmental trajectories for components of executive functioning in children and adolescents with ADHD and with neurotypical development. Participants with ADHD showed delays in development of inhibition and shifting, with performance comparable to participants with neurotypical development in the control group that were 2 years younger. This delay resolved for inhibition by ages 13–15, but the discrepancy for shifting remained. No significant differences in the developmental trajectories of working memory or planning were found between the two groups. These deficits are thought to result from delayed brain maturation as opposed to an alternative pathway of executive functioning development (Sowerby, Seal, & Tripp, 2011).

Difficulties with executive functioning have implications in daily living and impact social competence, academic achievement, and occupational success (Rogers, Hwang, Toplak, Weiss, & Tannock, 2011). Executive dysfunction in children and adolescents with ADHD has been linked to decreased academic achievement and grade retention (Biederman et al., 2004) and can predict later academic and occupational

functioning (Miller, Ho, & Hinshaw, 2012). The presence of co-occurring learning disabilities with ADHD is associated with even greater levels of executive dysfunction, resulting in more dire consequences for these individuals (Mattison & Mayes, 2012).

Internalizing behaviors. Children with ADHD are also at increased risk for internalizing behavior problems, likely resulting from emotional lability (Anastopoulos et al., 2011). Research shows that children with all subtypes of ADHD have similar levels of anxiety and depression (Faraone, Biederman, Weber, & Russell, 1998; Power, Costigan, Eiraldi, & Leff, 2004). Between 25% and 30% of children with ADHD have at least one anxiety disorder (Tannock, 2000). Higher rates of anxiety have been found in children without hyperactivity (Lahey, Schaugnhency, Hynd, Carlson, & Nieves, 1987) and with lower levels of impulsivity (Newcorn et al., 2001). The most common types of anxiety disorders found in children with ADHD include tic disorders and social phobia (Karabekiroğlu & Akbaş, 2011).

Research shows high rates of co-occurring depression and ADHD in children as well (Blackman et al., 2005). Barkley (2006) found that 25–30% of a clinical sample of children with ADHD had co-occurring major depressive disorder. Rates of co-occurring depression in individuals with ADHD are much greater than would be expected in the general population (Blackman et al., 2005). Overall, about 2% of children and adolescents aged 3 to 17 in the general population suffer from depression (Perou et al., 2013), whereas 9% of school-aged children and adolescents with ADHD suffer from

depression (Youngstrom, Findling, & Calabrese, 2003). Children with co-occurring ADHD and depression show greater impairments in academic and social functioning and are at increased risk of developing additional psychiatric problems than are children with ADHD only (Biederman et al., 1996). Overall, children with internalizing symptoms receive poorer ratings of social functioning from parents and teachers as well (Blackman et al., 2005).

Externalizing behaviors. Relationships between externalizing behaviors and ADHD are well documented (Booster et al., 2012; Cunningham & Boyle, 2002; Manning & Miller, 2001). Children diagnosed with the hyperactive/impulsive or combined subtypes of ADHD tend to have more externalizing behaviors (e.g., hyperactivity, aggression, and conduct problems) than do children with the inattentive subtype of ADHD (Manning & Miller, 2001). Individuals with ADHD also frequently act impulsively, without thinking of or considering consequences (Barkley, 1997).

Conduct problems, such as oppositional defiant disorder and conduct disorder, are common co-occurring conditions in this population as well (Cunningham & Boyle, 2002). Studies show that up to half of adolescents with ADHD also meet diagnostic criteria for behavioral or conduct disorders (Barkley, 2006), as opposed to 3.5% of the general population (Perou et al., 2013). These children tend to have poorer social functioning and higher levels of aggression, engage in more off-task behaviors, are more disliked, and get into more fights than children with ADHD alone (Abikoff et al., 2002;

Ostrander, Crystal, & August, 2006). Overall, children with an externalizing disorder in addition to ADHD tend to experience more peer victimization, have more social skills deficits, and have higher rates of academic problems than children with ADHD alone, and these difficulties increase with age (Booster et al., 2012).

Other behavioral difficulties. Atypical behaviors have been shown to predict the social functioning of children with ADHD, regardless of symptom severity (Graziano et al., 2011). In fact, Graziano et al. (2011) found atypicality to be as strong a predictor as externalizing behaviors in predicting the social functioning in children with ADHD. Measures of atypicality have been shown to effectively discriminate children with and without ADHD (Harrison et al., 2011). However, it is important to note that many atypical behaviors reported in individuals with ADHD are related to inattention, such as staring into space.

Difficulty with emotional regulation, or emotional lability, is a feature found in many individuals with in ADHD (Anastopoulos et al., 2011). Emotional lability is related to an individual's inability to self-regulate his or her emotions and results in higher highs and lower lows of mood in response to everyday situations. Children who are unable to self-regulate are more likely to exhibit impulsive and negative social behaviors, such as aggression, and are less likely to practice prosocial behaviors, such as showing empathy (Eisenberg et al., 1993). In a study of 216 children with ADHD and with neurotypical development, Anastopoulos et al. (2011) found significantly elevated

levels of emotional lability in almost half of subjects with ADHD compared to about 15% of subjects with neurotypical development. Children with the combined subtype of ADHD are at greater risk for problems with emotional lability than are those with the inattentive or hyperactive/impulsive subtypes (Anastopoulos et al., 2011). Overall, children with high emotional lability are at increased risk for negative outcomes (Anastopoulos et al., 2011). Children with ADHD also show higher rates of negative affect, including anger and dysphoria, as well as lower levels of empathy compared to neurotypical children (Martel, 2009).

Adaptive functioning. Even though evaluation of adaptive functioning is generally focused more on the assessment of developmental disabilities, it is also an important component for assessments of individuals with ADHD. Stein et al. (1995) recommend the evaluation of adaptive skills to be a routine part of evaluations of ADHD, as these skills can significantly impact an individual's level of functioning. Like autism, research on the adaptive skills of children with ADHD also indicates adaptive skill deficits in this population (Jarratt et al., 2005; Reynolds & Kamphaus, 2004).

An important factor to consider regarding adaptive functioning is that it is defined by actual performance, as opposed to the ability to perform the skills in question (Stein et al., 1995). Thus, although an individual may have knowledge and ability to perform adaptive tasks, failure to consistently perform these tasks is considered a deficit. Children with attention problems tend to be inconsistent in their behavior across time and

situation, and consequently, deficits in performance of adaptive tasks are common in children with ADHD, despite having generally average cognitive ability (Roizen, Blondis, Irwin, & Stein, 1994; Stein et al., 1995).

Stein et al. (1995) examined the adaptive skills of 122 children with ADHD and found their adaptive functioning to be well below average in the areas of communication, social skills, and daily living. These deficits were even more prominent when cognitive ability was taken into account, with a greater disparity between cognitive ability and adaptive functioning than other groups in the study (i.e., individuals with a pervasive developmental disorder or mild intellectual disability). These findings were corroborated by Klimkeit et al. (2006) who found deficits in the same areas in their sample of individuals with ADHD. Manning and Miller (2001) also found deficits in leadership skills (skills associated with working with others to accomplish goals) in their sample of children with ADHD.

Children with ADHD frequently have problems with social skills, including forming and maintaining friendships, due to impulsive and disruptive behaviors (Manning & Miller, 2001). For example, peer rejection rates are higher for children with ADHD than they are for children with neurotypical development (Hoza et al., 2005). For children with ADHD, rejection commonly occurs in a matter of hours or days (Bagwell, Molina, Pelham, & Hoza, 2001). Children with ADHD also report having fewer close friends and poorer social skills than other children (Mrug, Hoza, Pelham, Gnagy, &

Greiner, 2007) and these deficits continue through adolescence and into early adulthood (Barkley, Murphy, & Fischer, 2008). Social difficulties found in this population are likely related to the symptoms of ADHD, including problems with attention, self-regulation, and impulsivity (Barkley, 1997; Stein et al., 1995). Due to these self-regulation problems, children with ADHD are often seen by their peers as negative, aggressive, and controlling (Mrug et al., 2007). Social dysfunction is a strong predictor of long-term outcomes for children with ADHD (Greene, Biederman, Faraone, Sienna, & Garcia-Jetton, 1997). As children move toward adolescence, the greatest areas of challenge in adaptive functioning become study and organizational skills, time management, and self-confidence (Langberg et al., 2008).

ADHD Summary

Overall, children and adolescents with ADHD display significantly more emotional and behavioral difficulties than the general population (Blackman et al., 2005). Many of these difficulties are thought to be the result of the core symptoms of the disorder, including inattention, hyperactivity, and impulsivity (APA, 2013). These symptoms can cause increased problems with social and academic functioning, despite generally average cognitive abilities (Stein et al., 1995). Fortunately, most research suggests that symptom severity of ADHD declines with age (Barkley, 2006; Langberg et al., 2008). In particular, hyperactivity and impulsivity appear to decline with age, although symptoms of inattention tend to remain constant.

Differential Diagnosis

Autism and ADHD are both severely impairing, highly heritable neurodevelopmental disorders (van der Meer et al., 2012) with unknown etiology (Manteris, 2013) that share many similarities, making differential diagnosis complicated and difficult (Mayes et al., 2012). However, it is only in the last decade that researchers have begun to investigate the relationship between the two disorders (Gargaro, Rinehart, Bradshaw, Tonge, & Sheppard, 2011). The symptomatological overlap between autism and ADHD has led to questions regarding distinguishing features between children presenting symptoms of these disorders (Corbett et al., 2009). Subsequent research has shown that the disorders share behavioral characteristics and deficits in several areas including attention problems, hyperactivity, behavior problems, social skills deficits, and executive dysfunction (APA, 2013; Calhoun & Mayes, 2005). Children with autism and ADHD share similar co-occurring problems, including learning problems, mood disorders, emotional lability, anger, and conduct problems. Both groups may also have early language delays (Mayes & Calhoun, 2011) and sleep difficulties (Mayes et al., 2009).

Some studies, however, have shown that children with autism and ADHD present with significantly different severity of symptoms (Mayes et al., 2012). For example, some research has found that children with autism have more severe deficits in language, communication, and social skills (Luetijn et al, 2000); greater difficulty with emotional

regulation (Koyama, Tachimori, Osada, & Kurita, 2006); more problems sustaining eye contact and peer relationships; and increased levels of stereotyped language and behavior (Hartley & Sikora, 2009) than do children with ADHD. Additionally, Mayes et al. (2012) found that children with autism may have different symptom profiles than do children with ADHD. Almost all participants in their sample of 847 children with autism showed unusual fascination with repetitive movement, language regression, and special abilities. None of these were found in the majority of the 158 children with ADHD in their sample. However, conclusions from this research should be interpreted with caution due to the large discrepancy in sample sizes between the groups as well as the symptom severity of the participants, which was not taken into account.

Co-Occurring Symptoms

Research shows that over half of children diagnosed with autism or ADHD have at least one co-occurring disorder (Karabekiroğlu & Akbaş, 2011; van Steensel, Bögels, & de Bruin, 2013). As mentioned previously, there is a high rate of symptom overlap between autism and ADHD, though comorbid diagnosis in the field of mental health was not allowed until recently. Both disorders also share similar cognitive, externalizing, internalizing, and adaptive difficulties.

ADHD symptoms in autism. Most research indicates that ADHD-like symptoms (e.g. impairments in attention and/or hyperactivity) are frequently present in children with autism (Hattori et al., 2006; Mayes et al., 2012). Prevalence rates of

ADHD-like symptoms in individuals with autism range from 13–50% in community samples (Bradley & Isaacs, 2006) and 20–85% in clinical samples (Gadow, DeVincent, & Drabick, 2008; Goldstein & Schwebach, 2004; Ronald, Simonoff, Kuntsi, Asherson, & Plomin, 2008). Children with autism and ADHD-like symptoms exhibit higher rates and increased severity of co-occurring aggression, anxiety, and depression compared to those without additional symptoms (Gadow et al., 2008).

Autistic symptoms in ADHD. Conversely, some children with ADHD have symptoms similar to the core characteristics of autism (Grzadzinski et al., 2011), including deficits in social interactions and communication, though generally less pronounced than those seen in autism (Hattori et al., 2006). Rates of autistic symptomatology in ADHD are estimated to be between 20% and 50% (Ronald et al., 2008) with those diagnosed with the combined subtype having more symptoms of autism (Reiersen, Constantino, Volk, & Todd, 2007).

The subgroup of children with ADHD and additional autistic symptoms show higher levels of oppositional behavior and communication difficulties, including deficits in imaginative play, nonverbal communication, and the ability to maintain conversation (Clark, Feehan, Tinline, & Vostanis, 1999; Hattori et al., 2006), as well as more problems with peers and a lack of empathy compared to children with the more traditional presentation of ADHD (Kadesjö, 2000). Some children with ADHD also show difficulties similar to those of children with autism in the area of restrictive/repetitive

behavior (Hattori et al., 2006). Children with ADHD may also have difficulties with pragmatic language that are more significant than are difficulties for children with neurotypical development but are not as severe as difficulties for children with autism (Geurts et al., 2004). Similar to children with autism, children with ADHD and additional autistic symptoms may also have difficulty interpreting others' feelings and thoughts (Santosh & Mijovic, 2004). Even the earliest studies of co-occurring problems in children with ADHD identified core autistic traits (along with motor coordination problems, depression, anxiety, and behavior problems) as some of the most commonly associated features (Gillberg, 1983).

Cognitive impairments and academic problems. Research shows that overlapping cognitive deficits are present in children and adolescents with autism and ADHD, but individuals with autism tend to be more impaired (van der Meer et al., 2012). Both disorders share deficits in executive functioning (Barkley, 2003; Booth & Happé, 2010; Buitelaar, van der Wees, Swaab-Barneveld, & van der Gaag, 1999; Geurts et al., 2004; Nijmeijer et al., 2009), poor theory of mind (Buitelaar et al., 1999), and weak central coherence (Corbett et al., 2009). Both disorders also share higher than expected rates of learning and attention problems (APA, 2013; Hattori et al., 2006).

Executive function deficits are related to frontal lobe dysfunction (Alvarez & Emory, 2006; Hanson et al., 2013). Children with autism and ADHD share overlaps in executive functioning deficits in areas including inhibitory control and planning;

however, the specific executive functioning impairments differ slightly across disorders. Additionally, individuals who have symptoms of both disorders demonstrate greater impairments in executive functioning (Sinzig, Morsch, Bruning, Schmidt, & Lehmkul, 2008).

Research shows that children with each disorder have deficits in inhibition, which is the ability to suppress a response or information that interferes with a cognitive or behavioral task (Nigg, 2000). Sanderson and Allen (2013) examined inhibitory control in 31 children with autism and 28 children with neurotypical development on three types of inhibitory tasks: delay inhibition, conflict inhibition, and resistance to distractor inhibition. Delay inhibition requires children to suppress or delay an impulsive response (Carlson & Moses, 2001). Conflict inhibition is similar to delay inhibition but also requires individuals to substitute the suppressed response with an opposing one. Resistance to distractor inhibition requires individuals to resist interference information that is irrelevant to the task when the two are displayed simultaneously (Friedman & Miyake, 2004). In line with previous research, Sanderson and Allen (2013) found children with autism to be impaired only on the conflict inhibition task, but children with ADHD were impaired in all three areas. This indicates that deficits in inhibition should not be considered a core symptom of autism.

Deficits in working memory and planning have been found in individuals with autism and ADHD (Happé, Booth, Charlton, & Hughes, 2006). Working memory

involves the temporary storage and mental manipulation of information (Baddeley, 2007), and planning involves spatial skills and time management (Brookshire, Levin, Song, & Zhang, 2004). Salcedo-Marin, Moreno-Granados, Ruiz-Veguilla and Ferrin (2013) examined planning dysfunction in 80 male children and adolescents with ADHD and 23 male children and adolescents with autism using the Zoo Map test (Wilson, Alderman, Burgess, Esmile, & Evans, 1996). Results showed a significant difference in the number of errors made on open-ended tasks, with the autism group making more errors on the less structured tasks than those with ADHD (Salcedo-Marin et al., 2013). These errors appear to be mediated by deficits in motor coordination and processing speed in individuals with autism.

Attention problems are also common in children with autism and in those with ADHD (APA, 2013; Hattori et al., 2006). When compared to children with neurotypical development, children in both groups (autism and ADHD) scored significantly higher on ratings of inattention (Hattori et al., 2006). In particular, individuals with ADHD or autism share deficits in sustained attention (Christakou et al., 2013). Christakou et al. (2013) examined sustained attention in 20 boys with ADHD, 20 boys with autism, and 20 boys with neurotypical development using functional magnetic resonance imaging (fMRI). Participants with ADHD and autism both had significantly reduced activation in the bilateral striato-thalamic regions, left dorsolateral prefrontal cortex, and superior parietal cortex during a vigilance task designed to assess sustained attention. However,

left dorsolateral prefrontal cortex under-activation was more pronounced in participants with ADHD than it was in participants with autism.

These findings support the hypothesis that, although executive dysfunction is part of the behavioral phenotype of both disorders (Manteris, 2013), autism and ADHD may be distinguished based on specific profiles of executive functioning. Compared to children with ADHD, inhibitory control may be mostly intact in children with autism (Happé et al., 2006). However, children with autism appear to have more significant planning dysfunction than do children with ADHD. These findings are further supported by brain imaging, which indicates that boys with ADHD and autism have shared and disorder-specific abnormalities in brain functioning during sustained attention tasks.

Internalizing behaviors. As mentioned previously, individuals with autism and ADHD both have high rates of internalizing behaviors. However, research indicates that children with autism have higher prevalence rates of anxiety disorders than do children with ADHD, and the two groups differ in the most common types of disorders (van Steensel et al., 2013). The most common anxiety disorders in autism are obsessive-compulsive disorder and specific phobias (Karabekiroğlu & Akbaş, 2011; Leyfer et al., 2006), and children with ADHD tend to have higher rates of tic disorders and social anxiety (Karabekiroğlu & Akbaş, 2011). Additionally, although symptoms of sadness are present in both groups, Semrud-Clikeman, Walkowiak, Wilkinson, and Minne (2010)

found that children with autism showed more problems with dysphoria than did children with ADHD.

Externalizing behaviors. Research on rates of externalizing behaviors in these populations is varied. Although some studies report that children with autism have more externalizing symptoms than do children with ADHD (Semrud-Clikeman et al., 2010), van Steensel et al. (2013) found similar rates of externalizing behaviors in children with autism and ADHD. Furthermore, research shows that children with ADHD who also have autistic traits tend to have higher rates of externalizing behaviors than do children with autism alone (Yerys et al., 2009), indicating an additive effect. Externalizing behaviors in both groups may be related to frustration resulting from difficulties with communication (Fodstad, Matson, Hess, & Neal, 2009).

Other behavioral difficulties. Research shows high levels of atypicality in both groups; however, there appear to be qualitative differences in the descriptions of atypicality in children with ADHD as opposed to those with autism (Graziano et al., 2011). In ADHD, many behaviors endorsed as atypical on behavior rating scales are related to inattention, such as “stares blankly” or “seems out of touch with reality.” In children with autism, items contributing to a high atypicality score tend to include items such as “saying things that make no sense” and “acting strangely,” which are independent of inattention. Empathy is also lacking in many children with ADHD as compared to children with neurotypical development, but to a lesser degree than it is in children with

autism (Dyck, Ferguson, & Sochet, 2001). Similar rates of hyperactivity are generally found in both groups (Hattori et al., 2006).

Adaptive functioning. Both children with ADHD and children with autism have deficits in adaptive functioning (Stein et al., 1995), and individuals who have symptoms of both disorders demonstrate greater impairments (Goldstein & Schwebach, 2004; Saulnier & Klin, 2007). This finding was confirmed by Mattard-Labrecque, Ben Amor, and Couture (2013) who reported adaptive behavior difficulties in 100% of their sample of children with autism and additional ADHD-like symptoms and 41% of those with ADHD only. Children with autism generally display adaptive functioning consistent with their cognitive ability, indicating deficits in adaptive functioning are related to deficits in knowledge or skills in this population. Conversely, children with ADHD display more pronounced deficits relative to cognitive ability, which are thought to be related to poor execution of social skills as opposed to deficits in knowledge of the requisite skills (Nijmeijer et al., 2008). In children with ADHD, these deficits are likely due to problems with attention, resulting in inconsistent performance stemming from lack of self-control or motivation, or an inability to accurately process social information (Semrud-Clikeman et al., 2010; Stein et al., 1995).

Children with autism and ADHD both exhibit social deficits, including difficulty with social perception and emotional regulation (Barkley, 2003; Buitelaar et al., 1999); however, most research indicates that children with autism have more severe problems

with social interactions than do children with ADHD (Hattori et al., 2006). Despite the overlaps, it is unclear if these problems stem from the same cause. Some argue that children with autism have poor social behaviors because of deficits in social perception, but similar problems in children with ADHD are attributed to performance deficits associated with impulsivity and inattention (Semrud-Clikeman, 2007) rather than actual impairments in social functioning (Biederman et al., 1999).

This argument is supported by research indicating that inattention is directly related to social perception. Fine, Semrud-Clikeman, Butcher, and Walkowiak (2008) investigated differences in social perception among children with autism, ADHD, and neurotypical development and found a significant difference between the groups in the recognition of emotions, with children with autism and with ADHD both performing more poorly than did children with neurotypical development on measures of emotional expression and understanding of nonverbal cues. Fine et al. found the number of inattention symptoms, as opposed to diagnosis, to be a significant predictor of social perception. However, Semrud-Clikeman et al. (2010) found that children with autism had greater difficulty understanding emotional and nonverbal cues than did children with ADHD. Children with autism also showed more significant signs of social withdrawal than did children with ADHD. However, the core and associated symptoms of autism (e.g., difficulty with social reciprocity, poor eye contact, difficulty sharing) are thought to

significantly contribute to difficulty in social understanding more than attention problems do in this population.

One's ability to process and integrate sensory information is related to his or her ability to function in the environment (Dunn, 2001). Sensory processing is the manner in which visual, auditory, tactile, olfactory, vestibular, and proprioceptive information is perceived and integrated in the central nervous system. About half of children with ADHD (Yochman, Ornoy, & Parush, 2006) and 90% of children with autism (Jasmin et al., 2009) have problems with sensory processing. Motor skills deficits are also present in 70% of those with autism (Green et al., 2009) and about half of individuals with ADHD (Pitcher, Piek, & Hay, 2003). Both groups tend to have problems with dexterity, balance, and coordination, and children with autism also tend to have difficulties with motor planning and visual motor control (Pan, Tsai, & Chu, 2009; Pitcher et al., 2003). Additionally, children with ADHD generally report walking and talking significantly earlier than those with autism (Karabekiroğlu & Akbaş, 2011).

Table 1

Summary of General and Specific Deficits Common to Autism and ADHD

Symptom	Specific Deficits/Rates		Research
	Autism	ADHD	
Cognitive			
Executive Dyfunction	Inhibition, Working Memory, Planning (more significant)	Inhibition (more significant), Working Memory, Planning	Alvarez & Emory, 2006; APA, 2013; Barkley, 2003; Booth & Happé, 2010; Buitelaar et al., 1999; Calhoun & Mayes, 2005; Geurts et al., 2004; Hanson et al., 2013; Happé et al., 2006; Nijmeijer et al., 2009; Salcedo-Marin et al., 2013; Sanderson & Allen, 2013; Sinzig et al., 2008
Attention Problems	Sustained Attention	Sustained Attention	APA, 2013; Calhoun & Mayes, 2005; Christakou et al., 2013; Hattori et al., 2006; Semrud-Clikeman, 2007
Behavioral			
Anxiety	Higher overall rates; OCD, Specific Phobias	Tic Disorders, Social Anxiety	Karabekiroğlu & Akbaş, 2011; Leyfer et al., 2006; Mayes & Calhoun, 2011; Semrud-Clikeman et al., 2010; van Steensel et al., 2013
Depression	Sadness, Dysphoria	Sadness	Mayes & Calhoun, 2011; Semrud-Clikeman et al., 2010
Conduct/Behavior Problems	Anger	Anger	APA, 2013; Calhoun & Mayes, 2005; Fodstad et al., 2009; Mayes & Calhoun, 2011; Semrud-Clikeman et al., 2010; van Steensel et al., 2013; Yerys et al., 2009
Atypicality			Graziano et al., 2011

Empathy	Lack of empathy	Lack of empathy	Dyck, Ferguson, & Sochet, 2001
Hyperactivity			APA, 2013; Calhoun & Mayes, 2005; Hattori et al., 2006
Adaptive			
Adaptive Behavior	100%; Consistent with cognitive ability (lack of knowledge)	41%; Deficits relative to cognitive ability (inability to execute)	Goldstein & Schwebach, 2004; Mattard-Labrecque et al., 2013; Nijmeijer et al., 2008; Saulnier & Klin, 2007; Semrud-Clikeman et al., 2010; Stein et al., 1995
Social Skills Deficits	Social Perception, Emotional Regulation, Recognizing nonverbal cues, Withdrawal	Social Perception, Emotional Regulation	APA, 2013; Barkley, 2003; Buitelaar et al., 1999; Calhoun & Mayes, 2005; Hattori et al., 2006; Mayes & Calhoun, 2011
Sensory Processing	90%	50%	Yochman, Ornoy, & Parush, 2006; Jasmin et al., 2009
Motor Skills Deficits	70%; Dexterity, Balance, Coordination, Motor Planning, Visual motor control	50%; Dexterity, Balance, Coordination	Green et al., 2009; Pan et al., 2009; Pitcher et al., 2003

Differential Diagnosis Summary

Research shows many symptomalogical similarities between children with autism and children with ADHD (see Table 1 above). These similarities are found among the core symptoms of the disorders as well as with co-occurring problems. However, closer examination does reveal differences, particularly in the areas of executive functioning deficit profiles, anxiety conditions, and descriptions of atypical behavior. Research also indicates that some deficits may be independent of diagnosis and more closely related to symptoms of inattention. It is important to account for co-occurring symptoms as well as symptom severity because these factors can have a profound impact on an individual's functioning, provision of services, and response to intervention (de Bruin et al., 2007; Gadow et al., 2005; Leyfer et al., 2006).

Research With the BASC and BASC-2

The BASC-2 is a comprehensive behavioral rating system that identifies maladaptive and clinical functioning in children and adolescents (Reynolds & Kamphaus, 2004). It is the most frequently used broad-based rating scale by school personnel (Hass et al., 2010), reportedly used in 45% of behavioral assessments (Reynolds & Kamphaus, 2004). The BASC-2 is comprised of three types of report forms: Self Report of Personality (SRP), TRS, and PRS. The clinical and adaptive scales for the TRS, PRS, and SRP are provided in Table 2 and Table 3.

Table 2

BASC-2 TRS/PRS Clinical and Adaptive Scales

	Teacher Rating Scales (TRS)			Parent Rating Scale (PRS)		
	Pre-school (2–5)	Child (6–11)	Adolescent (12–21)	Pre-school (2–5)	Child (6–11)	Adolescent (12–21)
Activities of Daily Living				x	x	x
Adaptability	x	x	x	x	x	x
Aggression	x	x	x	x	x	x
Anxiety	x	x	x	x	x	x
Attention Problems	x	x	x	x	x	x
Atypicality	x	x	x	x	x	x
Conduct Problems		x	x		x	x
Depression	x	x	x	x	x	x
Functional Communication	x	x	x	x	x	x
Hyperactivity	x	x	x	x	x	x
Leadership		x	x		x	x
Learning Problems		x	x			
Social Skills	x	x	x	x	x	x
Somatization	x	x	x	x	x	x
Study Skills		x	x			
Withdrawal	x	x	x	x	x	x

Note. Adaptive scales are in gray.

Table 3

BASC-2 SRP Clinical and Adaptive Scales

	Child (8–11)	Adolescent (12–21)	College (18–25)
Alcohol Abuse			x
Anxiety	x	x	x
Attention Problems	x	x	x
Attitude to School	x	x	
Attitude to Teachers	x	x	x
Atypicality	x	x	x
Depression	x	x	x
Hyperactivity	x	x	x
Interpersonal Relations	x	x	x
Locus of Control	x	x	x
Relations With Parents	x	x	x
School Maladjustment			x
Self-Esteem	x	x	x
Self-Reliance	x	x	x
Sensation Seeking		x	x
Sense of Inadequacy	x	x	x
Social Stress	x	x	x
Somatization		x	x

Note. Adaptive scales are in gray.

BASC-2 Scales

Profile scores vary by age group but generally include clinical scales, which consist of Aggression, Anxiety, Attention Problems, Atypicality, Conduct Problems, Depression, Hyperactivity, Learning Problems, Somatization, and Withdrawal subscales as well as adaptive scales comprised of Activities of Daily Living, Adaptability, Functional Communication, Leadership, Social Skills, and Study Skills subscales for the PRS and TRS (Reynolds & Kamphaus, 2004). The SRP yields ratings for clinical scales, including Alcohol Abuse, Anxiety, Attention Problems, Attitude to School, Attitude to Teachers, Atypicality, Depression, Hyperactivity, Locus of Control, School Maladjustment, Sensation Seeking, Sense of Inadequacy, Social Stress, and Somatization subscales in addition to adaptive scales including Interpersonal Relations, Relations With Parents, Self-Esteem, and Self-Reliance subscales.

Additionally, advanced scoring software allows seven empirically and theoretically oriented content scales to be included at the clinician's discretion (Reynolds & Kamhpaus, 2004). These scales include (a) Anger Control, (b) Bullying, (c) Developmental Social Disorders, (d) Emotional Self-Control, (e) Executive Functioning, (f) Negative Emotionality, and (g) Resiliency. However, limited research has examined the efficacy of using the BASC-2 content scales for identifying children and adolescents with autism (Bradstreet, Robbins, & King, 2013) and no studies were located on children with ADHD. The BASC-2 also yields several composite scores (Reynolds & Kamphaus,

2004). These include the Internalizing Problems composite, which consists of scales measuring behaviors that are not disruptive, but are overcontrolled to the point of interfering with the child's ability to function; the Externalizing Problems composite, which is characterized by scales measuring the presence of disruptive or impulsive behaviors; the Adaptive Skills composite, which is an overall assessment of the individual's adaptive behaviors; and the Behavioral Symptoms Index, which is an estimate of the individual's overall level of functioning (Reynolds & Kamphaus, 2004). Behavioral rating scales, like the BASC-2, are designed to assist in differential diagnosis and have been normed using individuals with autism and ADHD (Reynolds & Kamphaus, 2004; Manning & Miller, 2001).

Autism Studies

Despite widespread usage of the BASC-2, there appears to be limited research on the instrument using children with autism (Hass et al., 2010). Available research using the BASC-2 with individuals with autism has investigated the content, clinical, and adaptive scales using the TRS and PRS. Volker et al. (2010) compared BASC-2 PRS profiles of 62 children with autism to profiles of 62 children with neurotypical development. Results indicated that, with the exception of the Somatization, Conduct Problems, and Aggression subscales, the children with autism scored significantly higher than did the children with neurotypical development in all areas. Children with autism scored in the "clinically significant" range on the Behavioral Symptoms Index, the

Withdrawal subscale (see Table 1), the Atypicality subscale (see Tables 1 and 2), and the Developmental Social Disorders content scale. At-risk scores for children with autism were found on the Adaptive Skills composite; the Hyperactivity, Attention Problems, and Depression subscales (see Tables 1 and 2); and six of the seven BASC-2 content scales (all except the Bullying scale).

Another study utilized the BASC-2 content scales to investigate the efficacy of the scales in differentiating children and adolescents with and without autism (Bradstreet et al., 2013). Parents of 25 children and adolescents with autism and 32 children and adolescents without autism completed the BASC-2 PRS. Controlling for level of cognitive functioning, the responses of parents of children with autism showed significantly higher levels of behavior problems overall than did the responses of parents of children without autism. Specifically, the responses of parents of children with autism received more "clinically significant" ratings on the Developmental Social Disorders, Anger Control, and Resiliency content scales. Based on these limited findings, the BASC-2 content scales appear to show promise in effectively discriminating between children and adolescents with and without autism.

Two additional studies used the BASC-2 PRS to investigate profile differences between children with and without autism through the use of the clinical and adaptive scales (Knoll, 2008; Mahan & Matson, 2011). In a study by Mahan and Matson (2011), primary caregivers of 80 children and adolescents, 38 with autism and 42 with

neurotypical development, completed the BASC-2 PRS. Results showed that, with the exception of the Internalizing Problems composite and the Aggression and Anxiety subscales, the children with autism scored significantly higher on all clinical subscales and composites (i.e., Internalizing Problems, Externalizing Problems, and Behavioral Symptoms Index) and lower on all adaptive subscales and composites (i.e., Adaptive Skills) than did the group of children with neurotypical development.

Knoll (2008) also found that the BASC-2 PRS was able to effectively differentiate between children with neurotypical development and children with autism. Using a sample of 187 children, 121 with autism and 66 with neurotypical development, Knoll found that, compared to children with neurotypical development, children with autism obtained lower scores on the Adaptive Skills composite (and all subscales comprising it) and higher scores on the Externalizing Problems composite (and all associated subscales with the exception of the Conduct Problems subscale). Knoll found no statistically significant differences between children with autism and children with neurotypical development on the Internalizing composite or associated subscales.

One study utilized the BASC-2 TRS to distinguish between children and adolescents with and without an educational diagnosis of autism (Hass et al., 2010). Teachers completed the BASC-2 TRS for 26 students with an educational diagnosis of autism, and ratings were compared to a sample of neurotypical controls. Results showed that children and adolescents with autism received significantly higher ratings on the

Developmental Social Disorders content scale as well as on the Withdrawal and Functional Communication subscales. Results from these studies indicate that profile differences exist between children with neurotypical development and children with autism.

ADHD Studies

There is an even greater paucity of research using the BASC-2 with children with ADHD; however, the use of behavioral rating scales is common in the assessment of ADHD as they can shed light on the presence or absence of symptoms such as hyperactivity, impulsiveness, and inattention (Manning & Miller, 2001). Available research using the Behavioral Assessment System for Children (BASC; Kamphaus & Reynolds, 1992) and BASC-2 with children and adolescents with ADHD has investigated the TRS and PRS. Despite the fact that a significant portion of available research with ADHD was done using the BASC instead of the BASC-2, it can be assumed that the results would be similar based on significant correlations between the two instruments on all scales (Waggoner, 2005).

In their study of 42 children with ADHD and 26 children with neurotypical development, Jarratt et al. (2005) found significant differences between parent ratings on the Hyperactivity and Attention Problems subscales of the BASC. In addition, significant group differences were also found for parent ratings on the Aggression, Conduct Problems, and Atypicality subscales as well as the Externalizing Problems composite,

even after controlling for cognitive ability. Jarratt et al. found parent ratings of hyperactivity and attention to be the best predictors of ADHD on the BASC. In the same study, teacher ratings also yielded significant differences for Hyperactivity and Attention Problems subscales for children with ADHD. Significant group differences were found for teacher ratings on the Aggression, Conduct Problems, Atypicality, Withdrawal, Depression, Somatization, Anxiety, and Learning Problems subscales as well as for the Externalizing Problems composite and the Behavioral Symptoms Index. In both groups, cognitive ability was a predictor of behavior problems: Children with lower IQs exhibited more behavior problems. Compared to children with neurotypical development, children with ADHD received lower ratings on the Adaptive Skills composite and associated subscales of the BASC (indicating more inappropriate behaviors; Jarratt et al., 2005).

In another study of 71 children with and without ADHD that used the BASC, Manning and Miller (2001) found significant differences between children with ADHD and children without ADHD on all scales and composites with the exception of the Somatization subscale. Additionally, Blackman et al. (2005) used the BASC to examine differences in parent and teacher ratings on the clinical scales between 309 children with ADHD and 144 children with neurotypical development. Results indicated significant group differences on the Anxiety, Depression, Inattention, Hyperactivity, Conduct Problems, and Aggression subscales, with children with ADHD receiving significantly higher ratings than did children in the neurotypical group. However, Vaughn, Riccio,

Hynd, and Hall (1997) found the Hyperactivity and Attention Problems subscales to be the best discriminators for ADHD on the PRS and that the Attention Problems and Withdrawal subscales were the best discriminators on the TRS for the BASC.

As part of a larger study, Booster et al. (2012) used the BASC to determine levels of functioning for individuals with ADHD only and with ADHD and co-occurring problems. Researchers used the BASC PRS to examine parent reports of social functioning and homework problems as well as the BASC TRS to examine teacher ratings of social functioning and academic performance. Parents of children with ADHD and co-occurring internalizing and externalizing behavior problems reported significantly higher rates of homework problems than did parents of children with ADHD only. Parents and teachers of children with ADHD and co-occurring externalizing behaviors reported significantly greater impairments in social functioning than did parents and teachers of children with ADHD only. These results indicate that children with ADHD and additional symptoms have greater social and academic difficulties than do those with ADHD alone. However, it is somewhat distressing that a study published in 2012 reported using the BASC as opposed to the BASC-2, which became available in 2004, bringing the validity of the study into question.

In one study using the BASC-2 with children diagnosed with ADHD, Anastopoulos et al. (2011) examined emotional lability in 358 children diagnosed with ADHD and their siblings to examine functional impairments and co-occurring symptoms

in the two groups. Higher levels of emotional lability were associated with greater impairments in social skills, daily living skills, and overall adaptive functioning. High emotional lability was also associated with higher ratings on emotional and behavioral composites, especially the Depression and Aggression subscales (Anastopoulos et al., 2011).

In another study using the BASC-2 PRS, Harrison et al. (2011) found that the behaviors that discriminate children and adolescents with ADHD from those without ADHD are related to the primary symptoms of the disorder, co-occurring conditions, and adaptive skills. For participants with ADHD, parents rated hyperactivity as the strongest predictor of the disorder for children and attention problems, followed by hyperactivity, for adolescents. In the study sample, the Hyperactivity, Attention Problems, Atypicality, and Conduct Problems subscales were significantly higher for children and adolescents with ADHD than they were for children and adolescents without ADHD. For children and adolescents with ADHD, clinical subscales that fell in the at-risk range included Hyperactivity, Attention Problems, Conduct Problems, Aggression, and Atypicality. Parent ratings of adaptive behavior also strongly discriminated between adolescents with and without ADHD. On the adaptive scales, Functional Communication, Activities of Daily Living, and Adaptability fell in the at-risk range for participants with ADHD (Harrison et al., 2011). Overall, research indicates that the BASC-2 can be efficacious in differentiating between children and adolescents with and without ADHD. However, due

to extremely discrepant sample sizes (202 with ADHD versus 1680 without ADHD), results should be interpreted with caution. A summary of the available research examining autism and ADHD using the BASC and BASC-2 is provided in Table 4 below.

Table 4

Summary of Research Examining Parent Ratings of Autism and ADHD to Neurotypical Development on the BASC and BASC-2

	Groups Compared			
Study	Autism	ADHD	NT	Description/Findings
Blackman et al. (2005)		309	144	Significant group differences on the Anxiety, Depression, Inattention, Hyperactivity, Conduct Problems, and Aggression subscales, with children with ADHD receiving significantly higher ratings than did children in the neurotypical group.
Bradstreet et al. (2013)	25		32	Children with autism showed significantly higher levels of behavior problems overall than did the responses of parents of children without autism.
Harrison et al. (2011)		202	1680	The Hyperactivity, Attention Problems, Atypicality, and Conduct Problems subscales were significantly higher for children and adolescents with ADHD than they were for children and adolescents without ADHD.
Jarratt et al. (2005)		42	26	Significant differences between parent ratings on the Hyperactivity and Attention Problems subscales. Significant group differences were also found for parent ratings on the Aggression, Conduct Problems, and Atypicality subscales as well as the Externalizing Problems composite. Parent ratings of hyperactivity and attention were found to be the best predictors of ADHD.

Knoll (2008)	121		66	Compared to children with neurotypical development, children with autism scored lower on the Adaptive Skills composite and associated subscales, and higher on the Externalizing Problems composite and associated subscales with the exception of the Conduct Problems subscale. No statistically significant differences between children with autism and children with neurotypical development were found on the Internalizing composite or associated subscales.
Mahan & Matson (2011)	38		42	With the exception of the Internalizing Problems composite and the Aggression and Anxiety subscales, the children with autism scored significantly higher on all clinical subscales and composites and lower on all adaptive subscales and composites than did the group of children with neurotypical development.
Manning & Miller (2001)		71	71	Significant differences between children with ADHD and children without ADHD on all scales and composites with the exception of the Somatization subscale.
Volker et al. (2010)	62		62	With the exception of the Somatization, Conduct Problems, and Aggression subscales, the children with autism scored significantly higher than children with neurotypical development in all areas.

Note. NT = Neurotypical

Comparison Study

One study compared BASC-2 PRS ratings of children with high-functioning autism (HFA), children with ADHD, children with traumatic brain injury, and children with neurotypical development (Sanders, 2009). Results from analysis of the clinical scales showed that children with HFA and children with ADHD received significantly higher scores on the Hyperactivity, Aggression, and Depression subscales relative to

neurotypical controls. High ratings of hyperactivity were related to higher ratings of aggression and conduct problems, anxiety and somatization, and attention problems, as well as lower ratings of adaptive skills. Aggression was related to higher ratings of conduct problems, depression, somatization, and attention problems and lower ratings of adaptive skills. High ratings of depression were related to higher ratings of somatization and attention as well as lower ratings of adaptive skills. Children with ADHD received significantly higher ratings on the Conduct Problems subscale than did children with HFA and children with neurotypical development. Conduct problems were associated with higher ratings of depression, somatization, and attention problems, and lower ratings of adaptive skills. No group differences were found on the Anxiety or Somatization subscales.

In the same study, analysis of the adaptive scales revealed that children with HFA received significantly lower ratings on the Adaptability, Social Skills, and Leadership subscales than did children with ADHD and children with neurotypical development (Sanders, 2009). However, children with ADHD received significantly lower ratings on these subscales than did the children with neurotypical development. Problems with adaptability, social skills, and leadership were associated with attention problems and poorer adaptive functioning. Children with HFA and children with ADHD received significantly lower ratings on the Activities of Daily Living subscale and significantly

higher ratings on the Attention Problems subscale than did children with neurotypical development (Sanders, 2009).

Although these findings are relatively consistent with existing literature that examines each of these disorders independently by using the BASC-2 PRS, this was the only study located that included both children with autism and children with ADHD in the sample as well as children with neurotypical development. However, the sample sizes were small (33–50 participants in each group) and the participating children with autism were all considered to be high functioning, leaving room for additional investigation using a broader population of children with autism and larger group sizes.

Summary and Critique

Although considered distinct disorders, autism and ADHD are neurodevelopmental disabilities that share numerous similarities (van der Meer et al., 2012). They both are highly heritable but can also be attributed to environmental factors in addition to genetic predisposition (Faraone & Doyle, 2001; Wassink & Piven, 2000). Both disorders are also more frequently diagnosed in males than in females (CDC, 2005; CDC, 2013; Pastor & Ruben, 2008). Additionally, children with autism and with ADHD both have high rates of co-occurring diagnoses (Anastopoulos et al., 2011; Matson & Nebel-Schwalm, 2007). Common co-occurring conditions include anxiety, depression, aggression, and conduct problems. Other problems associated with both disorders

include social problems, atypicality, executive functioning impairments, adaptive skill deficits, and emotional lability.

However, behavioral profile differences between autism and ADHD do exist. For example, anxiety manifests differently in the disorders. Although specific phobias and obsessive-compulsive disorder are more commonly found in autism, social anxiety and tic disorders are more common in ADHD (Karabekiroğlu & Akbaş, 2011). In addition, although atypicality and conduct problems are present in both groups, the types of behaviors exhibited are qualitatively different between the groups (Graziano et al., 2011). Research shows differential profiles of executive dysfunction in children with autism and ADHD as well (Alvarez & Emory, 2006; Hanson et al., 2013).

Although behavioral rating scales and particularly the BASC-2 appear to be efficacious in discriminating between autism and ADHD, there is a lack of quality research on the subject. Many available studies are plagued with problems including small or discrepant sample sizes and methodological issues, such as the use of outdated research instruments. Additionally, the vast majority of research utilizing the BASC-2 has only examined autism or ADHD relative to neurotypical development as opposed to examining differential diagnosis between the two disorders. This study sought to expand on the previous research by including a more inclusive sample of children with autism, using a larger sample of children, and matching participants to children with neurotypical development.

Hypotheses

H_1: There are distinct behavioral profiles for children and adolescents with autism, with ADHD, and with neurotypical development as rated by the BASC-2 PRS.

- $H_{1.1}$ There are significant differences between groups (autism, ADHD, and neurotypical) on the Withdrawal subscale: Children and adolescents with autism will have higher ratings than will children and adolescents with ADHD or neurotypical development.
- $H_{1.2}$ There are significant differences between groups (autism, ADHD, and neurotypical) on the Atypicality subscale: Children and adolescents with autism will have the highest ratings, followed by children and adolescents with ADHD; children and adolescents with neurotypical development will have the lowest scores.
- $H_{1.3}$ There are significant differences between groups (autism, ADHD, and neurotypical) on the Adaptive Skills composite: Children and adolescents with autism will have the lowest ratings, followed by children and adolescents with ADHD; children and adolescents with neurotypical development will have the highest scores.

H_2: There are significant profile differences between children and adolescents diagnosed with a disorder (autism or ADHD) and children and adolescents with neurotypical development as rated by the BASC-2 PRS.

$H_{2.1}$ There are significant differences between groups (disorder and neurotypical) on the Anxiety subscale: Children and adolescents diagnosed with a disorder (autism or ADHD) will have higher ratings than will children and adolescents with neurotypical development.

$H_{2.2}$ There are significant differences between groups (disorder and neurotypical) on the Depression subscale: Children and adolescents diagnosed with a disorder (autism or ADHD) will have higher ratings than will children and adolescents with neurotypical development.

$H_{2.3}$ There are significant differences between groups (disorder and neurotypical) on the Hyperactivity subscale: Children and adolescents diagnosed with a disorder (autism or ADHD) will have higher ratings than will children and adolescents with neurotypical development.

$H_{2.4}$ There are significant differences between groups (disorder and neurotypical) on the Attention Problems subscale: Children and adolescents diagnosed with a disorder (autism or ADHD) will have higher ratings than will children and adolescents with neurotypical development.

$H_{2.5}$ There are significant differences between groups (disorder and neurotypical) on the Externalizing Problems composite: Children and adolescents diagnosed with a disorder (autism or ADHD) will have higher ratings than will children and adolescents with neurotypical development.

H_3: Scores on significantly different subscales and composites of the BASC-2 are predictive of group membership (autism, ADHD, and neurotypical).

CHAPTER III

RESEARCH METHODS

The purpose of this study was to compare parent ratings of the behavior of children with ADHD, children with autism, and children with neurotypical development using the scales of the BASC-2 PRS. This chapter introduces the following components for this study: the research design, the participants, the variables to be examined, the assessment tool utilized, and the analyses conducted.

Research Design

This study employed a quasi-experimental, nonequivalent, differential, between-subjects design. As in experimental research, quasi-experimental research studies produce group scores that can be compared to test for significant differences (Gravetter & Forzano, 2012). However, in quasi-experimental studies, the groups are defined in terms of a specific participant characteristic as opposed to being determined by a true independent variable. In this study, the groups of participants were formed based on their disability diagnosis. Quasi-experimental research studies attempt to minimize threats to internal validity but do not meet the strict requirements of a true experiment. Furthermore, since random assignment is not possible in this study, the groups are considered nonequivalent.

A differential research design is employed when individual differences are of interest and researchers deliberately create separate groups based on a specific individual difference, such as disability diagnosis (Gravetter & Forzano, 2012). As a result, determination of a direct cause-and-effect relationship is not possible due to assignment bias or baseline differences between the groups. Finally, a between-subjects design allows for scores from different groups to be obtained for comparison. The primary advantage of a between-subjects design is that each participant's scores are independent from all other scores, but it does not account for individual differences between participants.

Finally, this study utilized convenience sampling, which is the most common type of sampling used in behavioral science research (Gravetter & Forzano, 2012). Participant information was collected using archival data from schools and previously conducted research. Archival data allows for analysis of past events and behaviors by using historical records (Gravetter & Forzano, 2012).

Participants

Participants in this study were divided into three groups based on diagnosis. The first two groups included mothers of children with primary educational diagnoses of either autism or ADHD who completed the BASC-2 PRS on behalf of their children (ages 6–21). A third group of mothers of children with no educational diagnosis who completed the BASC-2 PRS on behalf of their children were employed as controls. An

educational diagnosis indicates that the child meets the criteria under IDEIA for the disability and, as a result, is eligible for special education services (IDEIA, 2004). Whether or not the child has received a clinical diagnosis of the disorder was not taken into account. These groups are intended to be representative of mothers of all school-aged children who either have an educational diagnosis of autism, ADHD, or are considered neurotypical. Inclusion criteria included mothers of these children ages 6–21 who completed the BASC-2 PRS on behalf of their children. Exclusionary criteria included mothers of children with dual educational diagnoses of autism and ADHD as well as those whose primary educational diagnosis was not autism or ADHD (for the disability groups), and those in the neurotypical group should have no educational diagnosis. Children with a comorbid educational diagnosis of emotional disturbance were excluded as well. Mothers were chosen as raters in the study because research using the BASC has shown that behavioral ratings of children by mothers and fathers differ significantly, particularly ratings of male children (Palomares, 1992).

Gender, age, and ethnic categories were representative of all school-aged children; however, the geographic region represented will primarily be north Texas, although the neurotypical control group was more widely distributed throughout the southern region of the United States. An *a priori* power analysis was conducted using G*Power, version 3.1 (Erdfelder, Faul, & Buchner, 1996), software to determine the minimum sample size required to find significance with a desired power set at .95 and an

α-level at .05. Based on previous findings (e.g. Fine et al., 2008; Semrud-Clikeman et al., 2010), a moderate effect size of .25 (Cohen's f^2) was expected. Based on the analysis, it was determined that a minimum of 318 participants total was required to ensure adequate power for the MANOVA.

Participants from the medium-sized school district in north Texas were obtained by requesting access to the BASC-2 PRS data for parents meeting the inclusion criteria outlined above. A proposal was sent to the district requesting access and outlining the steps for ensuring privacy and anonymity to the parents and children whose data was used for the study (see Appendix A). Additional participants' data was gathered from faculty members at Texas Woman's University using data collected in previous research studies and in private practice and a neurotypical control group was obtained from Pearson Education, Inc.

Variables of Interest

Independent Variables

In this study, the primary independent variable was educational diagnosis (autism, ADHD, or neurotypical). Again, an educational diagnosis indicates that the child meets disability criteria under IDEIA (2004) for the disability, not that the child has received a clinical diagnosis of the disorder. Under IDEIA, an educational diagnosis of autism indicates the presence of a "developmental disability significantly affecting verbal and nonverbal communication and social interaction, generally evident before age three, that

adversely affects a child's educational performance" (IDEIA, 2004, Sec. 300.8(c)(1)). As mentioned previously, students with ADHD can be eligible for special education services under a number of disability categories, but are generally served under Other Health Impairment (IDEIA, 2004). Other Health Impairment means the student has "limited strength, vitality, or alertness, including a heightened alertness to environmental stimuli, that results in limited alertness with respect to the education environment" which is the result of an acute or chronic health problem and "adversely affects a child's educational performance" (IDEIA, 2004, Sec. 300.8(c)(9)). Additionally, demographic variables including age, gender and race/ethnicity were investigated to determine if results differed on these variables across disability groups.

Dependent Variables

The BASC-2 is a multidimensional system used to evaluate the behavior of children and adolescents (Reynolds & Kamphaus, 2004). It measures both positive (adaptive) and negative (clinical) dimensions of personality and was designed to aid in the differential diagnosis of an array of emotional and behavioral disorders. The dimensions assessed directly relate to DSM-IV-TR (APA, 2000) as well as IDEIA (2004) diagnostic criteria, and it evaluates broad categories of clinical and adaptive behaviors as well as more specific behavioral concerns. The BASC-2 scales and composites have high internal consistency and test-retest reliability. Norms are based on large, representative samples differentiated according to age, gender, and clinical diagnosis.

The PRS is a comprehensive measure of a child's behavior in home and community settings. It utilizes a four-choice response format and takes approximately 20 minutes to complete (Reynolds & Kamphaus, 2004). The PRS has three forms: preschool, child, and adolescent; however, due to differences in the scales yielded by the instrument, parents completing the preschool form were not included in this study. Parents or primary caregivers are asked to read phrases describing behaviors and rate how the child has behaved in the past several months. Response alternatives include "N" if the behaviors never occurs, "S" if the behavior sometimes occurs, "O" if the behavior often occurs, and "A" if the behavior almost always occurs. Data from the PRS yield several composites and scales. The composites included in the current study were the Adaptive Skills, Behavioral Symptoms Index, Externalizing Problems, and Internalizing Problems composites. Primary scales on the PRS included in the current study were the Adaptability, Activities of Daily Living, Aggression, Anxiety, Attention Problems, Atypicality, Conduct Problems, Depression, Functional Communication, Hyperactivity, Leadership, Social Skills, Somatization, and Withdrawal scales.

BASC-2 PRS composites and scales. Composite scores on the BASC-2 represent distinct, but interrelated, behavioral dimensions and can be helpful in summarizing behavior and reaching diagnostic conclusions (Reynolds & Kamphaus, 2004). The clinical scales measure maladaptive behavior, and the adaptive scales

measure desirable behaviors. The BASC-2 PRS composites and scales for the child and adolescent forms are summarized in Table 3.

The Externalizing Problems composite is made up of the Hyperactivity, Aggression, and Conduct Problems scales and is characterized by disruptive or impulsive behaviors stemming from behavioral undercontrol. Aggression is the tendency to do physical or emotional harm to others or their property and clinically significant Aggression scores suggest high levels of disruptive behavior. The Hyperactivity scale assesses activity level and impulsivity and can aid in the diagnosis of behavioral symptoms commonly associated with ADHD. The Conduct Problems scale measures deviant or disruptive behaviors, such as cheating, stealing, lying, running away from home, and substance use (Reynolds & Kamphaus, 2004).

The Internalizing Problems composite consists of the Anxiety, Depression, and Somatization scales and is characterized by behaviors that are not disruptive, but overcontrolled to the point of interfering with the child's ability to function (Reynolds & Kamphaus, 2004). The Anxiety scale includes items aimed at assessing excessive worry, fears, phobias, self-deprecation, and nervousness. The Depression scale includes items aimed at assessing dysphoria, withdrawal, and self-criticism. The Somatization scale assesses the child's tendency to over-report and complain about relatively minor physical problems. Elevated scores on this scale may indicate the presence of anxiety or mood disorders (Reynolds & Kamphaus, 2004).

Other scales related to, but not derived as part of, the composites are Attention Problems, Atypicality, and Withdrawal (Reynolds & Kamphaus, 2004). The Attention Problems scale measures the child's level of distractibility and inability to maintain attention. It is designed to be examined in concert with the Hyperactivity scale to aid in the diagnosis of behavioral symptoms commonly associated with ADHD. The Atypicality scale assesses the child's tendency to behave in strange or odd ways and may suggest a number of behavioral problems including psychosis, developmental delay, intellectual disability, autism, and disruptive disorders. The Withdrawal scale measures the child's tendency to avoid social contact and to lack interest in participating in social settings. Children with high Withdrawal scores tend to have difficulty forming relationships with peers and adults, and elevated scores on this scale are frequently found in children with autism. These scales do, however, contribute to the Behavioral Symptoms Index, which consists of the Hyperactivity, Aggression, Depression, Attention Problems, Atypicality, and Withdrawal scales, and they reflect the overall amount of problem behavior displayed by the child. The Behavioral Symptoms Index provides an estimate of the child's general level of functioning (Reynolds & Kamphaus, 2004).

The Adaptive Skills composite includes the Adaptability, Activities of Daily Living, Functional Communication, Social Skills, and Leadership scales (Reynolds & Kamphaus, 2004). This composite summarizes appropriate emotional control and expression, daily living skills, and communication skills. Low scores on this composite

may indicate the presence of intellectual disability, autism, or other disorders. The Activities of Daily Living scale is intended to screen for adaptive skills deficits by examining the child's ability to act in a safe manner and organize and perform daily tasks. Low scores on this scale are often associated with intellectual disability and lower-functioning autism. The Adaptability scale is designed to assess the child's ability to adjust to changes in routine, shift from one task to another, and share possessions. The Functional Communication scale assesses the child's ability to communicate and express ideas in understandable ways, and it evaluates expressive, receptive, and written communication skills. The Leadership scale assesses competencies related to leadership potential, ability to participate in social activities and situations, and problem-solving ability. Finally, the Social Skills scale emphasizes interpersonal competencies such as complimenting and assisting others and using conventional manners (Reynolds & Kamphaus, 2004).

Scoring. Participant responses on the BASC-2 are scored using computer software available from Pearson Education, Inc. and scores yielded from the PRS data include *T* scores and percentiles (Reynolds & Kamphaus, 2004). *T* scores indicate the distance of the child's score from the mean of the norm-group. These scores have a mean of 50 and a standard deviation of 10. However, on the BASC-2, *T* scores are not normally distributed; they are linear transformations of raw scores designed to retain the shape of the raw score distribution and may be significantly skewed. Therefore, the

relationship between *T* scores and percentiles varies across scales. The percentile indicates the percentage of the norm group scoring below a given raw score. *T* scores describe the distance from the mean whereas percentiles describe unusualness of the score. The BASC-2 rating scales offer general or clinical norm samples and combined or separate sex norms are available for each norm sample (Reynolds & Kamphaus, 2004). Additionally, the clinical norm groups can be further subdivided into diagnostic categories (e.g., learning disability, ADHD).

Descriptive labels can be applied to each scale and composite score (Reynolds & Kamphaus, 2004). On all scales, the average *T* score range is 41 through 59. Scale scores in the at-risk range are between one and two standard deviations from the mean. This corresponds to *T* scores from 61 through 69 on the clinical scales and 31 through 40 on the adaptive scales. An at-risk score indicates the presence of a significant concern that, despite requiring monitoring, may not be severe enough to warrant a formal diagnosis. Scores in the clinically significant range correspond to scores two or more standard deviations from the mean and indicate a high level of maladaptive behavior or lack of adaptive behavior. Scores of 70 or above on the clinical scales and 30 or below on the adaptive scales indicate clinically significant concerns (Reynolds & Kamphaus, 2004).

Psychometric Properties. The BASC-2 is normed on a large, representative sample differentiated according to age, gender, and clinical diagnosis (Reynolds &

Kamphaus, 2004). The BASC-2 PRS norm sample included 4,800 participants with children ages 2–18. The sample was drawn from across the United States matching the 2001 U.S. population census. The BASC-2 also includes several indexes of validity to which the mental health professional can refer in order to ensure validity is not threatened by factors such as failure to pay attention to item content, carelessness, attempting to represent the child in an excessively positive or negative way, failure to respond truthfully, or poor comprehension of items (Reynolds & Kamphaus, 2004).

The psychometric properties of the BASC-2 reported in the examiner's manual include several types of reliability and validity. Reynolds and Kamphaus (2004) provide information on reliability: test-retest reliability, internal consistency, and inter-rater reliability. Internal consistency, which provides a measure of the degree to which the items on a scale measure the same construct (Gravetter & Forzano, 2012), is high and consistent across age and gender, with scores in the low to mid .90s for the Adaptive Skills composite and in the mid .80s to mid .90s for the Externalizing Problems and Internalizing Problems composites (Reynolds & Kamphaus, 2004). The test-retest reliability for the BASC-2 PRS was established by collecting forms at an interval of 9 and 70 days between ratings, and was found to be in the low .80s to low .90s for all composite scales except on the Internalizing Problems composite, which was .78 (Reynolds & Kamphaus, 2004). Inter-rater reliability describes the level of agreement among raters providing concurrent ratings (Gravetter & Forzano, 2012). To establish

this, each child in the normative sample was rated by two parents or caregivers. Inter-rater reliabilities were .69, and .77 across age groups (child, and adolescent, respectively) and were similar for composite scores (Reynolds & Kamphaus, 2004).

Measures of validity included in the BASC-2 examiner's manual are factor analysis for grouping scales into composite scores, pattern correlations of the PRS scales and composites with other behavior measures, and score profiles for groups of children with specific diagnoses (Reynolds & Kamphaus, 2004). Factor analysis of the BASC-2 utilized the same factor structure of the BASC. The Externalizing Problems composite, Internalizing Problems composite, and Adaptive Scales composite were used in the final factor loading (Waggoner, 2005). The BASC-2 examiner's manual reports correlations with three instruments designed to assess aspects of child and adolescent behavior, including the Achenbach System of Empirically Based Assessment Child Behavior Checklist (CBCL), the Connors' Parent Rating Scales-Revised, and the Behavior Rating Inventory of Executive Functioning, as well as the first version of the BASC PRS (Reynolds & Kamphaus, 2004). Correlations with the CBCL overall score were moderate to high for similar scales, ranging from .73–.84, Externalizing Problems correlations were also moderate to high and ranged from .74–.83, and Internalizing Problems correlations ranged from .65–.75. Overall correlations for the Connors' Parent Rating Scales-Revised and Behavior Rating Inventory of Executive Functioning were

moderate to high as well, and correlations between the BASC and BASC-2 were extremely high (Reynolds & Kamphaus, 2004).

Procedures

Prior to initiating research, permission to conduct this study was obtained from the Institutional Review Board (IRB) at Texas Woman's University (see Appendix B). An Exempt Application was submitted to the IRB. According to the Texas Women's University IRB, exempt studies include "research conducted using questionnaires or surveys, research conducted in educational settings involving normal curriculum . . . and research conducted using archival data, provided that the information collected is anonymous" (Texas Woman's University, 2014). The IRB application outlined the purpose of this study, a description of the participants including gender and ethnicity considerations, approximate number of participants expected, and a rationale for the inclusionary and exclusionary criteria. It also included a detailed description of the data collection procedures, including safeguards to ensure privacy of participants. Because archival data was used for the study, informed consent from individual participants was not required (Gravetter & Forzano, 2012).

Next, permission to use archival data was obtained from the school district by submitting a proposal outlining this study's aims and the proposed procedures for data collection in the school system (see Appendix A). The proposal informed district personnel of the following: That the researcher would work with district personnel to

determine which students received educational diagnoses of Autism or ADHD and gather their BASC-2 data from the scoring computers located in the administration building of the school district; and that once the appropriate students' BASC-2 PRS data was collected, it would be deidentified, with only the students' age, gender, ethnicity, and BASC-2 PRS scores to be saved on an external drive in a password protected file before removing the data from the building. The proposal also ensured that district personnel had the ability to access the data before removal from the building in order to ensure proper procedures were followed and that the name of the school district would not be used in the study. Concurrently to requesting permission to obtain data from the school district, e-mail contact was made with Texas Women's University faculty and the Pearson Education, Inc. representative to document agreement and consent to provide data for this study (see Appendix C). Once data was received from the school district and from Texas Women's University faculty, a list of the age, ethnicity, and gender of study participants was sent to Pearson Education, Inc. for matching with participants in the norm group.

Data Analysis

After all data was received, it was analyzed using SPSS software, version 19. Study variables included all subscales and composites of the BASC-2 PRS, as well as disability status (primary diagnosis of autism, primary diagnosis of ADHD, or neurotypical) and demographic variables, including gender, age, and ethnicity. First,

independent samples *t*-tests were conducted to determine group differences on BASC-2 variables between participants with an educational diagnosis versus those with no educational diagnosis. Independent samples *t*-tests are used to compare the means of two independent groups and requires an independent variable with two discrete levels (e.g., diagnosis versus neurotypical) and one or more dependent variables measured on a continuous, interval, or ratio scale (e.g., BASC-2 PRS variables; Field, 2009). Assumptions that must be met in order to conduct independent samples *t*-test include the following: (a) the observations within each group must be independent from one another, (b) the dependent variable is approximately normally distributed, and (c) the variances of the dependent variable in each population are equal with approximately the same number of observations in each group. These assumptions were checked by examining the skewness and kurtosis of the distribution of the dependent variables and using Levene's test for equal variances. If Levene's test is significant ($p < .05$), then equal variances are not assumed, if it is not significant ($p > .05$), then equal variances are assumed.

Next, a multiple analysis of variance (MANOVA) was conducted to determine group differences on BASC-2 variables between participants in the autism, ADHD, and neurotypical groups. MANOVA is a multivariate test used to determine the effects of one or more categorical independent variables (e.g., autism, ADHD, neurotypical) on multiple continuous dependent variables (e.g., BASC-2 PRS variables; Meyers, Gamst, & Guarino, 2006). There are several assumptions that must be met in order to conduct a

MANOVA. The first assumption is that, as with the independent samples *t*-test, the observations must be independent from one another. Group sizes must also be approximately equal. Additionally, MANOVA is extremely sensitive to outliers, so any outliers should be resolved prior to analysis. As mentioned previously, the variables in the analysis must also consist of categorical independent variables and continuous dependent variables. Furthermore, there must be an adequate sample size meaning each cell must contain more observations than there are dependent variables. Residuals should also be randomly distributed, with a multivariate normal distribution around a mean of zero. Dependent variables are assumed to have multivariate normal distributions as long as they follow a normal distribution and/or the sample size is large. The sample must have homoscedasticity, or equal amounts of variability across the independent variables, as well. This can be examined using Box's M and Levene's test. If Box's M or Levene's test are significant ($p < .05$), homoscedasticity has been violated, resulting in heteroscedasticity. Finally, the dependent variables should be moderately correlated (Meyers et al., 2006).

The overall effects were significant on all composites and scales, with the exception of Conduct Problems, so post hoc tests using one-way analyses of variance (ANOVAs) were conducted to determine which groups showed significant differences on the BASC-2 variables of interest. A one-way ANOVA is used to examine differences between groups on a measure of interest and consists of one categorical variable (i.e.,

group) and one continuous variable (i.e., Hyperactivity subscale; Field, 2009). Assumptions are similar to those for MANOVA and include the following: (a) data are from a normally distributed population, (b) observations are independent from one another, (c) the dependent variable is continuous, (d) homoscedasticity is present, (e) sample sizes are similar for each level of the independent variable, and (f) no outliers are present. Since Box's M was significant, indicating a violation of the assumptions of the analysis, Kruskal-Wallis tests, the nonparametric equivalent of the one-way ANOVA, were used (Field, 2009) to confirm the results of the ANOVAs.

Finally, discriminant function analysis was conducted to determine which BASC-2 PRS scales were most predictive of autism and ADHD and how those groups differed from children with neurotypical development. Discriminant function analysis can serve one of two purposes: prediction, which is referred to as predictive discriminant analysis, or explanation, which is referred to as descriptive discriminant analysis (Meyers et al., 2006). Since the purpose of discriminant analysis in this study is to predict a participant's membership in one of the groups, predictive discriminant analysis was utilized. The goal of the current study was to use the model derived from the analysis to predict the diagnosis in other samples of children based on their scores on the BASC-2 PRS.

The purpose of a discriminant function analysis is to develop a weighted linear composite to predict membership in two or more groups (Meyers et al., 2006). In

discriminant function analysis, the variable being predicted is a categorical variable and the predictors are continuous variables. In this study, the variable being predicted was disability group (i.e., ADHD, autism, or no disability). Discriminant function analysis uses a linear model, so the predictor and the criterion variables have a constant relationship with one another (Meyers et al., 2006). The weighted combination of the predictor variables (i.e., the discriminant function) is designed to maximize the separation of the groups, which allows for the calculation of a discriminant score for each case. Discriminant analysis permits the groups to be of different sample sizes, but the sample size of the smallest group should substantially exceed the number of predictor variables (Meyers et al., 2006).

The assumptions of discriminant function analysis are rigorous and include the presence of a linear relationship between predictor variables as well as a normal distribution, independence of predictors, homoscedasticity, absence of perfect multicollinearity (when more than two predictors correlate very strongly), absence of outliers, and also presumes the use of interval data (Meyers et al., 2006). Discriminant function analysis is fairly robust to violations of most of these assumptions; however, it is highly sensitive to outliers and these should be resolved prior to analysis. If one group contains extreme outliers, it will bias the mean away from the bulk of the values and increase the variance. Because the overall significance test is calculated using pooled

variance (i.e., the average variance across all groups), these significant tests are prone to Type I error (i.e., erroneously reporting statistical significance).

CHAPTER IV

RESULTS

The purpose of the current study was to compare ratings of children diagnosed with autism, Attention-Deficit/Hyperactivity Disorder (ADHD), and a neurotypical control group with no psychoeducational diagnosis based on the composites and scales of the BASC-2 PRS as reported by mothers. It was hypothesized that each disorder would have a pattern of relative weaknesses displayed by the scores and that the pattern and degree of weaknesses would be unique to each disorder. Analyses were conducted using *t*-tests, analyses of variance (ANOVAs), and multivariate analyses of variance (MANOVAs) as well as their nonparametric equivalents, where appropriate, to determine how diagnostic groups differed on the BASC-2 PRS composites and scales, as well as which composites and scales are most predictive of each psychoeducational diagnosis using discriminant function analysis.

It should be noted that extreme outliers were identified as those scores greater than 1.5 standard deviations from the mean. Analysis was conducted with and without outliers; however, the presence of the outliers did not impact the significance of the results so outliers are included in the following analyses. Parametric analyses were followed up with nonparametric equivalents and yielded similar results, except where indicated.

Demographic Variables

The sample consisted of information gathered on a total of 343 children. The frequencies and percentages of the categorical demographic variables for the whole sample and across the three diagnostic groups are shown in Table 5. A majority of parents completed the child form (71.1%) compared to the adolescent form (28.9%). Most of the children were male (73.8%) as opposed to female (26.2%), and most were Caucasian (74.9%) as opposed to African American (13.1%), Hispanic (7.6%), multi-racial (1.7%), Asian (1.5%), and Native American (.3%). Finally, 23.3% of the children were diagnosed with autism, 26.5% were diagnosed with ADHD, and 50.1% had no reported psychoeducational diagnosis. All raters (100.0%) were mothers.

For the neurotypical group, the majority of parents completed the child form (67.4%) compared to the adolescent form (32.6%). Most of the children in this group were male (69.8%) as opposed to female (30.2%) and most were Caucasian (75.0%) as opposed to African American (15.1%), Hispanic (7.0%), multi-racial (1.2%), Asian (1.2%) and Native American (.6%). For the autism group, most parents also completed the child form (67.5%) compared to the adolescent form (32.5%). The majority of the children in this group were also male (85.0%) as opposed to female (15.0%) and most were Caucasian (81.3%) as opposed to African American (5.0%), Hispanic (6.3%), multi-racial (2.5%), and Asian (2.5%). Similar demographics were found in the ADHD group as well. Most parents completed the child form (81.3%) compared to the adolescent form

(18.7%) and the majority of the children were male (71.4%) as opposed to female (28.6%). Most children were also Caucasian (69.2%) as opposed to African American (16.5%), Hispanic (9.9%), multi-racial (2.2%), and Asian (1.1%).

Table 5

Frequencies and Percentages of Categorical Demographic Variables

	Full Sample		Neurotypical		Autism		ADHD	
	n	(%)	n	(%)	n	(%)	n	(%)
Form								
Child	244	(71.1)	116	(67.4)	54	(67.5)	74	(81.3)
Adolescent	99	(28.9)	56	(32.6)	26	(32.5)	17	(18.7)
Gender								
Male	253	(73.8)	120	(69.8)	68	(85.0)	65	(71.4)
Female	90	(26.2)	52	(30.2)	12	(15.0)	26	(28.6)
Race								
Caucasian	257	(74.9)	129	(75.0)	65	(81.3)	63	(69.2)
African American	45	(13.1)	26	(15.1)	4	(5.0)	15	(16.5)
Hispanic	26	(7.6)	12	(7.0)	5	(6.3)	9	(9.9)
Multi-racial	6	(1.7)	2	(1.2)	2	(2.5)	2	(2.2)
Asian	5	(1.5)	2	(1.2)	2	(2.5)	1	(1.1)
Native American	1	(.3)	1	(.6)	0	(.0)	0	(.0)
Diagnosis								
Neurotypical	172	(50.1)						
Autism	80	(23.3)						
ADHD	91	(26.5)						
Rater								
Mother	343	(100.0)	172	(100.0)	80	(100.0)	91	(100.0)

As shown in Tables 6a and 6b, the average age of the overall sample was approximately 10 years (*M* = 10.34, *SD* = 2.97), with a range of 6 to 18 years. The average ages for the neurotypical (*M* = 10.59, *SD* = 3.06) and autism (*M* = 10.64, *SD* = 3.02) groups was 11 years, also with a range of 6 to 18 years. The ADHD group was slightly younger with an average age of 10 years (*M* = 9.60, *SD* = 2.62) and a range of 6 to 17 years.

Table 6a

Means and Standard Deviations of Continuous Demographic Variables (Full Sample)

	n	*M*	*SD*	Min	Max
Age	343	10.34	2.97	6	18

Table 6b

Means and Standard Deviations of Continuous Demographic Variables by Group

	Neurotypical				Autism				ADHD			
	M	*SD*	Min	Max	*M*	*SD*	Min	Max	*M*	*SD*	Min	Max
Age	10.59	3.06	6	18	10.64	3.02	6	18	9.6	2.62	6	17

The means and standard deviations for the BASC-2 PRS composites and scales are shown in Tables 7a and 7b. For the whole sample, the mean scores for all clinical composites and scales ranged from 50 (*M* = 49.87, *SD* = 9.80) to 54 (*M* = 54.12, *SD* = 9.98), which fell in the average range. The mean scores for the adaptive composite and scales ranged from 46 (*M* = 46.47, *SD* = 10.48) to 48 (*M* = 48.19, *SD* = 9.94), also in the average range. Similar results to these were found for the neurotypical group, whose mean clinical composites and scales ranged from 48 (*M* = 48.08, *SD* = 8.65) to 51 (*M* = 50.93, *SD* = 9.52) and whose mean adaptive composite and scales ranged from 51 (*M* = 50.81, *SD* = 9.42) to 52 (*M* = 52.28, *SD* = 9.76), indicating an average level of concern in both areas. For the ADHD group, mean scores for the clinical composites and scales ranged from 48 (*M* = 47.55, *SD* = 9.71) to 58 (*M* = 58.09, *SD* = 7.35) while mean scores for the adaptive composite and scales ranged from 45 (*M* = 45.16, *SD* = 8.96) to 50 (*M* = 50.22, *SD* = 10.09), indicating average levels of concern in the ADHD group overall. For the autism group, mean scores for the clinical composites and scales ranged from 50 (*M* = 50.43, *SD* = 11.60) to 69 (*M* = 68.74, *SD* = 13.78). The Externalizing Problems and Internalizing Problems composites as well as the Aggression, Conduct Problems, Anxiety, and Somatization subscales fell in the average range for the autism group overall, while the Behavioral Symptoms Index (BSI) composite as well as the Hyperactivity, Depression, Atypicality, Withdrawal, and Attention Problems subscales

fell in the at-risk category. Scores on the adaptive composite and scales ranged from 37 (*M* = 37.35, *SD* = 8.58) to 40 (*M* = 39.60, *SD* = 9.99), which falls in the at-risk range.

Table 7a

Means and Standard Deviations of BASC-2 PRS Composites and Subscales (Full Sample)

	n	*M*	*SD*	Min	Max
Clinical Composites/Scales					
Externalizing Problems Composite	343	51.26	10.23	33	106
Internalizing Problems Composite	343	52.57	11.26	31	88
BSI	343	53.56	11.44	34	102
Hyperactivity	343	53.59	11.13	36	96
Aggression	343	50.22	10.02	35	108
Conduct Problems	336	49.87	9.80	36	97
Anxiety	343	52.46	11.43	30	90
Depression	343	52.61	11.35	36	89
Somatization	343	50.96	11.51	36	101
Atypicality	343	54.00	12.71	38	112
Withdrawal	343	52.76	13.57	28	100
Attention Problems	343	54.12	9.98	33	82
Adaptive Composite/Scales					
Adaptive Skills Composite	343	47.50	10.80	20	71
Adaptability	343	47.54	11.27	5	73
Social Skills	343	48.14	11.07	21	70
Leadership	336	48.19	9.94	27	75
Daily Living	343	46.47	10.48	16	68
Functional Communication	343	48.00	10.91	3	68

Table 7b

Means and Standard Deviations of BASC-2 PRS Composites and Subscales by Group

	Neurotypical (n=172)				Autism (n=80)				ADHD (n=91)			
	M	*SD*	Min	Max	*M*	*SD*	Min	Max	*M*	*SD*	Min	Max
Clinical Composites/Scales												
Ext. Probs. Composite	49.48	8.50	35	82	55.31	12.33	36	106	51.08	10.31	33	81
Int. Probs. Composite	50.16	9.63	31	81	59.88	12.30	37	88	50.69	9.42	32	79
BSI	48.92	8.15	35	78	*65.34*	11.84	40	102	51.96	9.01	34	76
Hyperactivity	49.83	8.95	36	87	*60.46*	12.45	36	96	54.68	10.60	36	78
Aggression	49.61	8.82	37	82	54.20	12.89	35	108	47.89	8.20	35	73
Conduct Problems	49.02	8.26	37	75	50.43	11.60	36	97	50.91	10.59	36	91
Anxiety	50.34	10.30	30	83	57.53	13.19	30	90	52.05	10.52	31	80
Depression	49.13	8.48	37	85	*62.00*	12.48	36	89	50.92	9.43	37	77
Somatization	50.93	9.51	36	82	54.25	14.85	36	97	48.12	10.96	36	101
Atypicality	49.20	8.65	41	81	*67.48*	13.92	39	112	51.24	9.39	38	83
Withdrawal	48.08	8.65	35	78	*68.74*	13.78	33	100	47.55	9.71	28	76
Attention Problems	49.16	9.35	33	82	*60.26*	8.40	39	74	58.09	7.35	40	71
Adaptive Composite/Scales												
Adaptive Skills Composite	51.76	9.66	24	71	*37.35*	8.58	20	62	48.37	8.62	24	68
Adaptability	51.42	9.51	31	69	*38.05*	9.71	16	59	48.53	10.86	5	73
Social Skills	51.01	10.03	22	70	*39.60*	9.99	21	65	50.22	10.09	21	70
Leadership	52.28	9.76	31	75	*39.47*	6.25	27	63	48.44	7.83	27	67

Daily Living	50.81	9.42	24	68	*38.61*	9.30	16	60	45.16	8.96	30	66
Functional Comm.	52.19	9.41	20	68	*38.33*	10.29	3	62	48.60	8.58	27	67

Note. Means in *italics* indicate scores in the at-risk range.

Relationships between Demographic Variables

Potential differences in demographic variables were assessed across groups. Table 8 shows categorical variables, including rating form, gender, and ethnicity, evaluated with crosstabulations using Pearson's chi-square. For this analysis, ethnicity was categorized into Caucasian and non-Caucasian to create adequate cell sizes (minimum of five observations per cell) for analysis. There was a significant difference in the proportion of mothers completing the form types, with a greater proportion of mothers of children with ADHD completing child forms (81.3%) compared to the autism (67.5%) and neurotypical (67.4%) groups, $x^2 = 6.25$, $p = .044$, $\phi = .044$. There was also a significant gender difference between groups with a greater proportion of males in the autism group (85.0%) compared to the ADHD (71.4%) and neurotypical (69.8%) groups, $x^2 = 6.89$, $p = .032$, $\phi = .032$. There was no significant difference in ethnicity between the three groups, $p > .05$. Pearson's product moment correlations were conducted to examine the relationships between age and the BASC-2 PRS composites and scales for the total sample (see Table 9). Age was significantly correlated with the Withdrawal scale ($r = .11$, $p = .046$). Older children tended to receive slightly higher ratings of withdrawal behaviors. Age was not significantly correlated with any other BASC-2 PRS composite or scale, all *p*s > .05.

Table 8

Crosstabulations for Categorical Demographic Variables

	Neurotypical		Autism		ADHD			
	n	%	n	%	n	%	x^2	*p*
Form							6.25	0.04
Child	116	67.4	54	67.5	74	81.3		
Adolescent	56	32.6	26	32.5	17	18.7		
Gender							6.89	0.03
Male	120	69.8	68	85	65	71.4		
Female	52	30.2	12	15	26	28.6		
Ethnicity (2 groups)							4.09	0.13
Caucasian	129	75.0	65	83.3	63	70.0		
Non-Caucasian	43	25.0	13	16.7	27	30.0		

Table 9

Correlations between Age and BASC-2 PRS Scales

	Age (*r*)	
Hyperactivity	-0.06	
Aggression	-0.01	
Conduct Problems	-0.05	
Anxiety	-0.04	
Depression	-0.01	
Somatization	0.05	
Atypicality	-0.01	
Withdrawal	0.11	*
Attention Problems	-0.07	
Adaptability	0.03	
Social Skills	0.01	
Leadership	0.05	
Daily Living	0.08	
Functional Communication	-0.01	

Note. * = Statistically significant at the .05 level.

BASC-2 PRS Comparisons

Diagnosis

Independent samples *t*-tests were conducted to compare the mean parent ratings of children with a psychoeducational diagnosis (autism or ADHD) to those with no reported psychoeducational diagnosis on BASC-2 PRS scales and composites. This was done by grouping children with a diagnosis of ADHD or autism together into one group and comparing that group to children with neurotypical development. As shown in Table 10, analysis revealed that children who had a psychoeducational diagnosis scored significantly higher on average (indicating more problems) than the neurotypical group on the Externalizing Problems (M = 53.06, SD = 11.46 versus M = 49.48, SD = 8.50), Internalizing Problems (M = 54.99, SD = 12.26 versus M = 50.16, SD = 9.63), and Behavioral Symptoms Index (BSI; M = 58.22, SD = 12.37 versus M = 48.92, SD = 8.15) composites, as well on the Hyperactivity (M = 57.39; SD = 11.83 versus M = 49.83, SD = 8.95), Anxiety (M = 54.60, SD = 12.13 versus M = 50.34, SD = 10.30), Depression (M = 56.11, SD = 12.74 versus M = 49.13, SD = 8.48), Atypicality (M = 58.84, SD = 14.24 versus M = 49.20, SD = 8.65), Withdrawal (M = 57.46, SD = 15.83 versus M = 48.08, SD = 8.65), and Attention Problems (M = 59.11, SD = 7.91 versus M = 49.16; SD = 9.35) clinical scales, all ps $\leq .001$. The diagnosis group also scored significantly lower on average (indicating more problems) on the Adaptive Skills composite (M = 43.22, SD = 10.20 versus M = 51.76, SD = 9.66) as well as the Adaptability (M = 43.63, SD = 11.57 versus M = 51.42, SD = 9.51), Social Skills (M = 45.25, SD = 11.34 versus M = 51.01, SD = 10.03), Leadership (M = 44.25, SD = 8.41 versus M = 52.28, SD = 9.76), Daily

Living (*M* = 42.10, *SD* = 9.66 versus *M* = 50.81, *SD* = 9.42), and Functional Communication (*M* = 43.80, *SD* = 10.71 versus *M* = 52.19; *SD* = 9.41) adaptive scales, all *p*s < .001. There was no significant difference between groups on the Aggression, Conduct Problems or Somatization scales, all *p*s > .05. This indicates, that on all composites and most scales, children with a psychoeducational diagnosis of autism or ADHD showed more problems with clinical and adaptive behaviors than did children with no psychoeducational diagnosis.

Table 10

Mean Differences of BASC-2 PRS Composites and Scales by Diagnosis (Dichotomous)

	n	*M*	*SD*	*t*	*p*
Externalizing Problems				3.28	.001
Yes	171	53.06	11.46		
No	172	49.48	8.5		
Internalizing Problems				4.05	< .001
Yes	171	54.99	12.26		
No	172	50.16	9.63		
BSI				8.21	< .001
Yes	171	58.22	12.37		
No	172	48.92	8.15		
Hyperactivity				6.68	< .001
Yes	171	57.39	11.83		
No	172	49.83	8.95		
Aggression				1.14	.255
Yes	171	50.84	11.08		
No	172	49.61	8.82		
Conduct Problems				1.56	.119
Yes	171	50.68	11.04		
No	172	49.02	8.26		

Anxiety				3.51	.001
Yes	171	54.6	12.13		
No	172	50.34	10.3		
Depression				5.97	< .001
Yes	171	56.11	12.74		
No	172	49.13	8.48		
Somatization				0.05	.963
Yes	171	50.99	13.25		
No	172	50.93	9.51		
Atypicality				7.57	< .001
Yes	171	58.84	14.24		
No	172	49.2	8.65		
Withdrawal				6.81	< .001
Yes	171	57.46	15.83		
No	172	48.08	8.65		
Attention Problems				10.63	< .001
Yes	171	59.11	7.91		
No	172	49.16	9.35		
Adaptive Skills Composite				-7.97	< .001
Yes	171	43.22	10.2		
No	172	51.76	9.66		
Adaptability				-6.82	< .001
Yes	171	43.63	11.57		
No	172	51.42	9.51		
Social Skills				-4.98	< .001
Yes	171	45.25	11.34		
No	172	51.01	10.03		
Leadership				-8.09	< .001
Yes	171	44.25	8.41		
No	172	52.28	9.76		
Daily Living				-8.46	< .001
Yes	171	42.1	9.66		
No	172	50.81	9.42		
Functional Comm.				-7.71	< .001
Yes	171	43.8	10.71		
No	172	52.19	9.41		

In order to further assess differences between diagnostic categories, a multivariate analysis of variance (MANOVA) was conducted to determine in what ways children in the psychoeducational diagnosis groups (autism, ADHD, neurotypical) differed on the BASC-2 PRS composites and scales. Results revealed a significant multivariate effect, $F(2,333) = 14.08$, $p < .001$, $\eta^2 = .446$. Results revealed significant effects of diagnosis on all composites and scales except the Conduct Problems subscale. Follow-up one-way analyses of variance (ANOVAs) were conducted to determine the location of these differences. However, since Box's M was significant ($p < .001$), nonparametric Kruskal-Wallis tests were also conducted to support the findings of the ANVOAs. As findings of the nonparametric analysis were not different from the ANOVAs, the results of the ANOVAs are reported in Table 11.

Clinical Composites and Scales. As shown in Table 11, children in the autism group ($M = 55.31$, $SD = 12.33$) received significantly higher scores on the Externalizing problems composite compared to children in the ADHD ($M = 51.08$, $SD = 10.31$) and neurotypical ($M = 49.48$, $SD = 8.50$) groups. Similarly, children in the autism group ($M = 59.88$, $SD = 13.30$) received significantly higher scores compared to children in the ADHD ($M = 50.69$, $SD = 9.42$) and neurotypical ($M = 50.16$, $SD = 9.63$) groups on the Internalizing problems composite. Children in the autism group ($M = 65.34$, $SD = 11.84$) received significantly higher ratings on the BSI compared to children in the ADHD ($M = 51.96$, $SD = 9.01$) and neurotypical ($M = 48.92$, $SD = 8.15$) groups as well. For the clinical scales, children in the autism group ($M = 54.20$, $SD = 12.89$) received

significantly higher ratings for Aggression compared to children in the ADHD (*M* = 47.89, *SD* = 8.20) and neurotypical (*M* = 49.61, *SD* = 8.82) groups. Similarly, children in the autism group (*M* = 57.53, *SD* = 13.19) received significantly higher scores for Anxiety compared to children in the ADHD (*M* = 52.02, *SD* = 10.52) and neurotypical (*M* = 50.34, *SD* = 10.30) groups. Children in the autism group (*M* = 62.00, *SD* = 13.48) received significantly higher scores for Depression compared to children in the ADHD (*M* = 50.92, *SD* = 9.43) and neurotypical (*M* = 49.13, *SD* = 8.48) groups as well. Children in the autism group (*M* = 67.48, *SD* = 13.92) also received significantly higher scores on the Atypicality scale compared to children in the ADHD (*M* = 51.24, *SD* = 9.39) and neurotypical (*M* = 49.20, *SD* = 8.65) groups. Children in the autism group (*M* = 68.74, *SD* = 13.78) received significantly higher scores compared to children in the ADHD (*M* = 47.55, *SD* = 9.71) and neurotypical (*M* = 48.08, *SD* = 8.65) groups on Withdrawal as well. Children in the autism group (*M* = 60.46, *SD* = 12.45) received significantly higher scores on Hyperactivity than children in the ADHD group (*M* = 54.68, *SD* = 10.60), who received significantly higher scores than children in the neurotypical group (*M* = 49.83, *SD* = 8.95). Children in the autism group (*M* = 60.26, *SD* = 8.40) and the ADHD group (*M* = 58.09, *SD* = 7.35) received similar scores to one another on Attention Problems but significantly higher scores than children in the neurotypical group (*M* = 49.16, *SD* = 9.35). Finally, children the autism group (*M* = 54.25, *SD* = 14.85) received significantly higher scores on Somatization than children in the ADHD group (*M* = 48.12, *SD* = 10.96); however, children in the neurotypical group

did not receive scores significantly different than either group (*M* = 50.93, *SD* = 9.51). There were no significant differences on the Conduct Problems scale, $p > .05$.

Adaptive Composite and Scales. On the Adaptive Skills composite, each group was rated significantly different from one another. The autism group was rated as having the most severe problems (*M* = 37.35, *SD* = 8.58), followed by the ADHD group (*M* = 48.37, *SD* = 8.62), and the neurotypical group received the highest ratings of adaptive skills (*M* = 51.76, *SD* = 9.66). For the adaptive scales, children in the autism group (*M* = 38.05, *SD* = 9.71) received significantly lower scores on Adaptability compared to children in the ADHD (*M* = 48.53, *SD* = 10.86) and neurotypical (*M* = 51.42, *SD* = 9.51) groups. Children in the autism group (*M* = 39.60, *SD* = 9.99) also received significantly lower scores on Social Skills compared to children in the ADHD (*M* = 50.22, *SD* =10.09) and neurotypical (*M* = 51.01, *SD* = 10.03) groups. Children in all three groups were significantly different on Leadership. Children in the autism group (*M* = 39.48, *SD* = 6.25) received significantly lower scores than children in the ADHD group (*M* = 48.44, *SD* = 7.83), who received significantly lower scores than children in the neurotypical group (*M* = 52.28, *SD* = 9.76). Similarly, children in the autism group (*M* = 38.61, *SD* = 9.30) received significantly lower scores on Daily Living than children in the ADHD group (*M* = 45.16, *SD* = 8.95), who received significantly lower scores than children in the neurotypical group (*M* = 50.81, *SD* = 9.42). Finally, children in the autism group (*M* = 38.33, *SD* = 10.29) received significantly lower scores on Functional Communication

than children in the ADHD group (*M* = 48.60, *SD* = 8.58), who received significantly lower scores than children in the neurotypical group (*M* = 52.19, *SD* = 9.41).

Table 11

Mean Differences of BASC-2 PRS Composites and Scales by Disability

	n	*M*		*SD*	*F*	*p*
Externalizing Problems					9.34	< .001
Neurotypical	172	49.48	[a]	8.50		
Autism	80	55.31	[b]	12.33		
ADHD	91	51.08	[a]	10.31		
Internalizing Problems					25.12	< .001
Neurotypical	172	50.16	[a]	9.63		
Autism	80	59.88	[b]	13.30		
ADHD	91	50.69	[a]	9.42		
BSI					85.92	< .001
Neurotypical	172	48.92	[a]	8.15		
Autism	80	65.34	[b]	11.84		
ADHD	91	51.96	[a]	9.01		
Hyperactivity					29.83	< .001
Neurotypical	172	49.83	[a]	8.95		
Autism	80	60.46	[c]	12.45		
ADHD	91	54.68	[b]	10.60		
Aggression					9.55	< .001
Neurotypical	172	49.61	[a]	8.82		
Autism	80	54.20	[b]	12.89		
ADHD	91	47.89	[a]	8.20		
Conduct Problems					1.26	.285
Neurotypical	165	49.02		8.26		
Autism	80	50.43		11.60		
ADHD	91	50.91		10.59		
Anxiety					11.55	< .001
Neurotypical	172	50.34	[a]	10.30		
Autism	80	57.53	[b]	13.19		
ADHD	91	52.02	[a]	10.52		

Depression					46.10	< .001
Neurotypical	172	49.13	[a]	8.48		
Autism	80	62.00	[b]	13.48		
ADHD	91	50.92	[a]	9.43		
Somatization					6.22	.002
Neurotypical	172	50.93	[a,b]	9.51		
Autism	80	54.25	[b]	14.85		
ADHD	91	48.12	[a]	10.96		
Atypicality					90.50	< .001
Neurotypical	172	49.20	[a]	8.65		
Autism	80	67.48	[b]	13.92		
ADHD	91	51.24	[a]	9.39		
Withdrawal					124.98	< .001
Neurotypical	172	48.08	[a]	8.65		
Autism	80	68.74	[b]	13.78		
ADHD	91	47.55	[a]	9.71		
Attention Problems					58.12	< .001
Neurotypical	172	49.16	[a]	9.35		
Autism	80	60.26	[b]	8.40		
ADHD	91	58.09	[b]	7.35		
Adaptive Skills Composite					68.32	< .001
Neurotypical	172	51.76	[c]	9.66		
Autism	80	37.35	[a]	8.58		
ADHD	91	48.37	[b]	8.62		
Adaptability					50.13	< .001
Neurotypical	172	51.42	[b]	9.51		
Autism	80	38.05	[a]	9.71		
ADHD	91	48.53	[b]	10.86		
Social Skills					37.95	< .001
Neurotypical	172	51.01	[b]	10.03		
Autism	80	39.60	[a]	9.99		
ADHD	91	50.22	[b]	10.09		
Leadership					60.73	< .001
Neurotypical	165	52.28	[c]	9.76		
Autism	80	39.48	[a]	6.25		
ADHD	91	48.44	[b]	7.83		

Daily Living					48.55	< .001
Neurotypical	172	50.81	c	9.42		
Autism	80	38.61	a	9.30		
ADHD	91	45.16	b	8.95		
Functional Communication					59.41	< .001
Neurotypical	172	52.19	c	9.41		
Autism	80	38.33	a	10.29		
ADHD	91	48.60	b	8.58		

Note. Multivariate effect: $F(2,333) = 14.08$, $p < .001$, $\eta^2 = .446$. Means with different superscripts differ significantly, $p < .05$.

Gender

Because significant group differences were previously identified for gender, Mann Whitney *U* analyses (the nonparametric equivalent of independent samples *t*-tests) were conducted to compare the means ranks of males and females on the BASC-2 PRS scales and composites by diagnosis. Table 12 shows the location of significant differences for each diagnosis group. Interestingly, mothers did not rate males and females in the autism group significantly different on any of the composites or subscales, all *p*s > .05. Conversely, mothers rated males and females in the neurotypical group significantly different on the Externalizing Problems ($M = 50.48$, $SD = 8.87$ versus $M = 47.15$, $SD = 7.11$) and Adaptive Skills ($M = 50.32$, $SD = 9.91$ versus $M = 55.10$, $SD = 8.20$) composites as well as on the Hyperactivity ($M = 50.77$, $SD = 9.40$ versus $M = 47.65$, $SD = 7.45$), Anxiety ($M = 49.38$, $SD = 10.44$ versus $M = 52.54$, $SD = 9.73$), Attention Problems ($M = 50.27$, $SD = 9.74$ versus $M = 46.62$, $SD = 7.87$), Social Skills ($M = 49.33$, $SD = 10.45$ versus $M = 54.88$, $SD = 7.79$), and Activities of Daily Living ($M = 48.72$, $SD = 9.38$ versus $M = 55.65$, $SD = 7.61$) scales, all *p*s < .05. Males in this group

received higher scores on all of the significant clinical composites and scales (indicating more maladaptive behaviors) with the exception of the Anxiety scale, on which mothers rated females as having more anxious behaviors. Males in this group also received lower scores on all of the significant adaptive composites and scales (indicating more maladaptive behaviors). However, the mean scores for both males and females fell within the average range on all of these variables. Finally, mothers rated males and females in the ADHD group significantly different on the Externalizing Problems composite (M = 48.49, SD = 8.55 versus M = 57.54, SD = 11.60) and BSI (M = 49.91, SD = 7.78 versus M = 57.08, SD = 9.96) as well as on the Hyperactivity (M = 53.00, SD = 10.17 versus M = 58.88, SD = 10.66) subscale, all ps < .05, with females receiving higher scores on each of the significant variables. However, as with the neurotypical group, the mean scores for both males and females in this group fell within the average range for these variables as well.

Table 12

Mean Differences of BASC-2 PRS Composites and Scales by Gender and Disability Group

	Neurotypical			Autism			ADHD		
	n	*M*	*SD*	n	*M*	*SD*	n	*M*	*SD*
Ext. Probs. Composite									
Male	120	50.48 [a]	8.87	68	55.04	12.75	65	48.49 [a]	8.55
Female	52	47.15 [b]	7.11	12	56.83	9.94	26	57.54 [b]	11.60
Int. Probs. Composite									
Male	120	49.48	9.80	68	60.25	12.99	65	50.06	7.98
Female	52	51.73	9.12	12	57.75	15.37	26	52.27	12.36
BSI									
Male	120	49.59	8.52	68	65.22	11.88	65	49.91 [a]	7.78
Female	52	47.38	7.06	12	66.00	12.10	26	57.08 [b]	9.96
Hyperactivity									
Male	120	50.77 [a]	9.40	68	60.78	12.79	65	53.00 [a]	10.17
Female	52	47.65 [b]	7.45	12	58.67	10.59	26	58.88 [b]	10.66
Aggression									
Male	120	50.43	9.09	68	53.82	13.24	65	46.82	7.59
Female	52	47.71	7.90	12	56.33	10.98	26	50.58	9.17
Conduct Problems									
Male	114	49.90	8.72	68	50.51	12.16	65	49.86	10.05
Female	51	47.06	6.79	12	49.92	8.04	26	53.54	11.64

Anxiety									
Male	120	49.38[a]	10.44	68	58.38	13.29	65	51.45	9.94
Female	52	52.54[b]	9.73	12	52.67	11.95	26	53.46	11.94
Depression									
Male	120	49.017	8.67	68	61.88	13.30	65	49.94	9.21
Female	52	49.385	8.11	12	62.67	15.09	26	53.38	9.70
Somatization									
Male	120	50.29	9.50	68	54.32	14.78	65	47.38	8.77
Female	52	52.40	9.44	12	53.83	15.90	26	49.96	15.18
Atypicality									
Male	120	49.84	9.23	68	67.62	13.35	65	50.78	8.86
Female	52	47.71	7.01	12	66.67	17.47	26	52.38	10.70
Withdrawal									
Male	120	47.81	8.67	68	69.16	13.64	65	47.17	8.73
Female	52	48.69	8.64	12	66.33	14.94	26	48.50	11.97
Attention Problems									
Male	120	50.27[a]	9.74	68	60.43	8.19	65	57.31	7.30
Female	52	46.62[b]	7.87	12	59.33	9.89	26	60.04	7.27
Adaptive Skills Composite									
Male	120	50.32[a]	9.91	68	37.88	8.70	65	49.37	8.18
Female	52	55.10[b]	8.20	12	34.33	7.48	26	45.88	9.34
Adaptability									
Male	120	50.83	9.69	68	38.29	9.64	65	48.89	9.75
Female	52	52.79	9.04	12	36.67	10.46	26	47.62	13.41

Social Skills									
Male	120	49.33[a]	10.45	68	39.85	9.90	65	50.48	8.87
Female	52	54.88[b]	7.79	12	38.17	10.77	26	47.15	7.11
Leadership									
Male	114	51.46	10.00	68	39.76	6.37	65	49.48	9.80
Female	51	54.12	9.03	12	37.83	5.47	26	51.73	9.12
Daily Living									
Male	120	48.72[a]	9.38	68	38.90	9.57	65	49.59	8.52
Female	52	55.65[b]	7.61	12	37.00	7.76	26	47.38	7.06
Functional Communication									
Male	120	51.30	9.79	68	38.90	9.40	65	50.32	9.91
Female	52	54.23	8.20	12	35.08	14.46	26	55.10	8.20

Note. Means with different superscripts differ significantly, $p < .05$.

Form

Because the BASC-2 PRS has different forms for children and adolescents, and group differences were previously identified for this variable, Mann Whitney *U* analyses were conducted to compare the means scores for children (ages 6-11) and adolescents (ages 12-18) on the BASC-2 PRS scales and composites. As shown in Table 13, analysis revealed no significant differences between age groups on any of the BASC-2 PRS composites or scales, all *p*s > .05.

Table 13

Mean Differences of BASC-2 PRS Composites and Scales by Form

	n	*M*	*SD*	*U*	*p*
Externalizing Problems				10876.00	.148
Child	243	51.65	10.33		
Adolescent	99	50.30	9.96		
Internalizing Problems				11515.00	.498
Child	243	52.69	10.88		
Adolescent	99	52.27	12.20		
BSI				11407.50	.420
Child	243	53.68	11.10		
Adolescent	99	53.26	12.29		
Hyperactivity				11142.50	.260
Child	243	53.94	11.15		
Adolescent	99	52.75	11.10		
Aggression				10973.50	.184
Child	243	50.48	9.74		
Adolescent	99	49.59	10.68		
Conduct Problems				10659.00	.186
Child	243	50.32	10.22		
Adolescent	99	48.80	8.65		

Anxiety				10957.50	.178
Child	243	52.98	11.36		
Adolescent	99	51.18	11.57		
Depression				11705.00	.654
Child	243	52.73	11.29		
Adolescent	99	52.31	11.56		
Somatization				11860.00	.793
Child	243	50.61	10.92		
Adolescent	99	51.82	12.86		
Atypicality				11286.50	.341
Child	243	54.29	12.68		
Adolescent	99	53.29	12.80		
Withdrawal				11283.50	.339
Child	243	52.07	12.90		
Adolescent	99	54.43	15.02		
Attention Problems				11469.00	.464
Child	243	54.40	10.10		
Adolescent	99	53.42	9.69		
Adaptive Skills Composite				11742.00	.686
Child	243	47.30	10.76		
Adolescent	99	48.00	10.94		
Adaptability				11337.00	.373
Child	243	47.21	11.14		
Adolescent	99	48.33	11.60		
Social Skills				11649.60	.606
Child	243	47.97	10.65		
Adolescent	99	48.56	12.09		
Leadership				11448.50	.727
Child	243	47.94	9.76		
Adolescent	99	48.80	10.37		
Daily Living				11209.00	.296
Child	243	46.09	10.81		
Adolescent	99	47.40	9.60		
Functional Communication				11176.50	.278
Child	243	48.39	10.74		
Adolescent	99	47.06	11.30		

Race

Due to discrepant cell sizes, Kruskal-Wallis tests (the nonparametric equivalent of one-way analyses of variance; ANOVAs) were used to compare race using four groups (Caucasian, African American, Hispanic, and Other) on the BASC-2 PRS composites and scales. As shown in Table 14, analysis revealed a significant mean difference for race on the Internalizing Problems composite, $x^2(5) = 12.14$, $p = .033$, as well as on the Anxiety, $x^2(5) = 18.13$, $p = .003$, and Depression, $x^2(5) = 12.18$, $p = .032$, clinical scales. Follow-up Mann-Whitney *U* tests were conducted to examine the location of the group differences. Caucasian (*M* = 51.64, *SD* = 10.40) and Hispanic (*M* = 51.38, *SD* = 9.17) children scored significantly higher than African American (*M* = 50.53, *SD* = 10.30) children on the Internalizing Problems composite. Similarly, Caucasian (*M* = 53.41, *SD* = 11.90) and Hispanic (*M* = 54.15, *SD* = 8.87) children scored significantly higher than African American (*M* = 48.42, *SD* = 8.78) children on the Depression scale. Finally, on the Anxiety subscale, Caucasian children (*M* = 52.70, *SD* = 11.51) scored significantly higher than African American children (*M* = 47.89, *SD* = 9.96). However, Hispanic children (*M* = 58.27, *SD* = 10.66) scored significantly higher than Caucasian and African American children on this scale.

Table 14

Mean Differences of BASC-2 PRS Composites and Scales by Ethnicity (4 groups)

	n	*M*	*SD*	x^2	*p*
Externalizing Problems				8.25	.143
Caucasian	257	51.64	10.40		
African American	45	50.53	10.30		
Hispanic	26	51.38	9.17		
Other	12	46.83	8.94		
Internalizing Problems				12.14	.033
Caucasian	257	51.64 [a]	10.40		
African American	45	50.53 [b]	10.30		
Hispanic	26	51.38 [a]	9.17		
Other	12	46.83 [a,b]	8.94		
BSI				4.83	.437
Caucasian	257	54.14	12.17		
African American	45	51.04	8.34		
Hispanic	26	53.38	9.13		
Other	12	51.33	10.14		
Hyperactivity				5.05	.410
Caucasian	257	53.93	11.49		
African American	45	52.20	9.76		
Hispanic	26	53.88	10.74		
Other	12	51.08	10.29		
Aggression				9.82	.081
Caucasian	257	50.72	10.30		
African American	45	48.69	9.41		
Hispanic	26	50.62	8.17		
Other	12	45.33	8.82		
Conduct Problems				8.28	.142
Caucasian	250	49.97	9.84		
African American	45	50.47	10.67		
Hispanic	26	50.65	9.23		
Other	12	45.33	6.26		

Anxiety					18.13	.003
Caucasian	257	52.70	[a]	11.51		
African American	45	47.89	[b]	9.96		
Hispanic	26	58.27	[c]	10.66		
Other	12	52.33	[a,b,c]	11.69		
Depression					12.18	.032
Caucasian	257	53.41	[a]	11.90		
African American	45	48.42	[b]	8.78		
Hispanic	26	54.15	[a]	9.42		
Other	12	49.83	[a,b]	8.87		
Somatiziation					1.76	.881
Caucasian	257	51.43		11.93		
African American	45	49.49		10.01		
Hispanic	26	50.88		10.40		
Other	12	48.33		11.00		
Atypicality					3.40	.639
Caucasian	257	54.21		13.52		
African American	45	52.47		9.74		
Hispanic	26	54.00		9.85		
Other	12	54.00		9.77		
Withdrawal					4.07	.539
Caucasian	257	53.65		14.29		
African American	45	48.73		10.27		
Hispanic	26	52.31		12.01		
Other	12	49.58		10.02		
Attention Problems					6.55	.256
Caucasian	257	54.05		10.29		
African American	45	54.53		8.36		
Hispanic	26	52.92		9.51		
Other	12	56.25		11.31		
Adaptive Skills Composite					2.88	.718
Caucasian	257	47.41		10.92		
African American	45	48.53		10.25		
Hispanic	26	46.92		10.72		
Other	12	47.58		11.43		

Adaptability				3.00	.700
Caucasian	257	47.24	11.69		
African American	45	48.27	10.00		
Hispanic	26	48.04	9.37		
Other	12	50.42	11.69		
Social Skills				3.99	.552
Caucasian	257	47.78	10.90		
African American	45	48.24	11.83		
Hispanic	26	49.58	11.60		
Other	12	52.75	9.71		
Leadership				4.83	.437
Caucasian	250	48.30	10.10		
African American	45	49.11	9.97		
Hispanic	26	46.96	7.73		
Other	12	46.00	11.28		
Daily Living				4.11	.534
Caucasian	257	46.61	10.47		
African American	45	47.07	9.89		
Hispanic	26	44.69	11.86		
Other	12	45.42	11.03		
Functional Communication				7.05	.216
Caucasian	257	48.11	11.02		
African American	45	50.13	9.96		
Hispanic	26	45.77	10.78		
Other	12	45.17	10.55		

Note. Means with different superscripts differ significantly, $p < .05$.

Discriminant Function Analysis

A stepwise discriminant function analysis was conducted to determine the best predictors in the differential diagnosis of autism and ADHD based on BASC-2 PRS scale scores. The sample included only those participants with a diagnosis of autism or ADHD (n = 177). Participants with neurotypical development were excluded. Predictor variables included those scales that were significantly different for the autism and ADHD groups in the previous analysis and included Hyperactivity, Aggression, Anxiety,

Depression, Somatization, Atypicality, Withdrawal, Adaptability, Social Skills, Leadership, Daily Living, and Functional Communication. The α-level was set at .05. Assumptions were tested and met with the exception of Box's M, which was significant ($p < .001$), indicating unequal variances. Investigation of the standard deviations of the scale scores by group indicated that the autism group had greater within group variance than the ADHD group. However, this is not unexpected given the wide variability of level of functioning within individuals diagnosed with autism (APA, 2013). However, the subsequent results should be interpreted with this information in mind.

The first part of the analysis aimed to determine which BASC-2 PRS scales are the best predictors of group membership. In order to specify the role that each scale plays in predicting group membership, the function assigned a positive value (1.005) to the autism group and negative value (-.884) to the ADHD group. As shown in Table 15, analysis identified one discriminant function, which was significant ($\chi^2 = 107.71$, $p < .001$) and two significant predictor variables (*p*s < .001). These scales, which distinguish children with autism from children with ADHD, were Withdrawal (r = .780) and Atypicality (r = .352). As discussed previously, children in the autism group received higher ratings on these scales than children in the ADHD group, indicating more maladaptive behaviors.

Table 15

Discriminant Function Analysis Examining the Differential Diagnosis of Autism and ADHD

	r	Eigenvalue	Canonical Correlation	χ^2	*p*
Function 1 (Diagnosis)		.899	.688	107.71	< .001
Withdrawal	.780				
Atypicality	.352				

Note. Diagnosis = zWITHDRAW*.780 + zATYPIC*.352.

The equation for the discriminant function was: Diagnosis = zWITHDRAW*.780 + zATYPIC*.352, where the variable names are the individual child's score on the associated scale (converted to a z-score) which is then multiplied by the factor loading. Z-scores provide a comparison to the mean scores of the sample. Positive values indicate ratings above the mean and negative values indicate lower than average ratings. In order to convert a *T* score to a z score, the child's actual score is subtracted from the mean score and then divided by the standard deviation. The directionality of the diagnosis equation score indicates the mostly likely diagnosis. Based on the values assigned by SPSS, a negative number indicates the individual is most likely in the ADHD group, while a positive number indicates the child is most likely to be in the autism group. The larger the value in either direction away from zero, the greater the probability that the diagnosis is correct. Further, based on the current sample, values of .65 or greater indicate a probability of at least 75% of a diagnosis of autism and values of -.50 or less indicate a probability of at least 75% of a diagnosis of ADHD.

In the second part of the analysis, the minimum amount of accuracy needed to determine if the model is useful was calculated. The by chance accuracy was determined to be 50%, since equal prior probabilities of being in either group were assumed. The standard chosen to characterize the discriminant model as useful was a 25% improvement over the rate of accuracy achievable by chance. Therefore, a minimum of a 62.5% cross-validated accuracy rate would be needed for the model to be deemed useful. The cross-validated accuracy rate computed by SPSS was 80.7%, which was greater than the by chance accuracy criteria of 62.5%. While the results of this analysis exceed the minimum by chance accuracy, there is still almost a 20% chance of misdiagnosis. This should be taken into account when using the discriminant function to assist in differential diagnosis of autism and ADHD. In addition, as always, multiple sources of data should be used when making diagnoses of any kind (American Psychological Association, 2010; NASP, 2010).

In summary, one statistically significant discriminant function was found, identifying Withdrawal and Atypicality as the strongest predictors of diagnostic group membership. Moreover, the cross-validated classification accuracy far surpassed the by chance accuracy criteria, supporting the utility of the model and making it possible to discriminate between autism and ADHD using the BASC-2 PRS.

Summary

The study sample consisted of information gathered from mothers of 343 children representing the child and adolescent forms of the BASC-2 PRS, both genders, and three

predominant racial categories (Caucasian, African American, and Hispanic). The average age of children in the study was approximately 10 years, and ranged from 6 to 18 years. For the whole sample, as well as the neurotypical and ADHD groups, the mean scores for all composites and scales indicated average levels of concern overall. For the autism group, the Externalizing Problems and Internalizing Problems composites as well as the Aggression, Conduct Problems, Anxiety, and Somatization subscales fell in the average range for the overall group, while the Behavioral Symptoms Index (BSI) composite as well as the Hyperactivity, Depression, Atypicality, Withdrawal, and Attention Problems subscales fell in the at-risk category. All scores on the adaptive composite and scales fell in the at-risk range for the autism group as well.

After establishing that significant differences existed on many of the composites and scales between children with and without a psychoeducational diagnosis, analysis was conducted to determine in what ways children in each diagnostic group (autism, ADHD, neurotypical) differed on the BASC-2 PRS composites and scales. Results revealed significant differences for diagnosis on all composites and adaptive scales, as well as on the Hyperactivity, Aggression, Anxiety, Depression, Somatization, Atypicality, Withdrawal, and Attention Problems clinical scales. Children in the autism group received significantly higher scores on the Externalizing Problems, Internalizing Problems, and BSI composites, as well as the Aggression, Anxiety, Depression, Atypicality, and Withdrawal clinical scales compared to children in the ADHD and neurotypical groups. Children in all three groups were rated significantly different on the

Hyperactivity scale, with children in the autism group receiving significantly higher scores than children in the ADHD group, who received significantly higher scores than children in the neurotypical group. Children in the autism and ADHD group both scored significantly higher than children in the neurotypical group on the Attention Problems subscale. Finally, children in the autism group received significantly higher scores than children in the ADHD group on the Somatiziation scale; however, children in the neurotypical group did not receive scores significantly different than either group. On the Adaptive Skills composite, each group was rated significantly different from one another with the autism group being rated as having the most severe problems, followed by the ADHD group, and the neurotypical group receiving the highest ratings of adaptive skills. For the adaptive scales, children in the autism group received significantly lower scores on the Adaptability and Social Skills scales compared to children in the ADHD and neurotypical groups. Children in all three groups were significantly different on the Leadership, Daily Living, and Functional Communication scales, with children in the autism group receiving significantly lower scores than children in the ADHD group, who received significantly lower scores than children in the neurotypical group. Overall, the autism group tended to have the most problematic behaviors, the neurotypical group tended to have the least problematic behaviors, and the ADHD group tended to fall somewhere in between.

Racial differences were found on the BASC-2 PRS composites and scales as well. For the Internalizing Problems composite and Depression scale, Caucasian and Hispanic

children were rated significantly higher than African American children and for the Anxiety subscale, Caucasian children were rated significantly higher than African American children, but Hispanic children scored significantly higher than Caucasian and African American children. While some gender differences were found for children in the neurotypical (Externalizing Problems and Adaptive Skills composites; Hyperactivity, Anxiety, Attention Problems, Social Skills, and Activities of Daily Living scales) and ADHD (Externalizing Problems composite and BSI; Hyperactivity scale) groups, the means scores for all of the variables remained in the average range.

Finally, discriminant function analysis was used to determine how well the BASC-2 PRS scales predict diagnosis. The predictors included the Hyperactivity, Aggression, Anxiety, Depression, Somatization, Atypicality, Withdrawal, Adaptability, Social Skills, Leadership, Daily Living, and Functional Communication scales. Analysis identified one significant discriminant function consisting of two significant predictor variables, Withdrawal and Atypicality, which distinguish children with autism from children with ADHD with a cross-validated accuracy rate of 80.7%, supporting the utility of the model in its ability to discriminate between autism and ADHD on the BASC-2 PRS.

CHAPTER V

DISCUSSION

Autism and Attention-Deficit/Hyperactivity Disorder (ADHD) are two distinct disorders that share many overlapping symptoms (Mayes, Calhoun, Mayes, & Molitoris, 2012). Previous research has shown that the disorders share characteristics and deficits in attention problems, hyperactivity, behavior problems, and social skills deficits (APA, 2000; Calhoun & Mayes, 2005) as well as co-occurring problems, including mood disorders, emotional lability, anger, and conduct problems (Mayes & Calhoun, 2011). However, these symptoms tend to be less severe in children with ADHD than in children with autism (Hattori et al., 2006).

The BASC-2 is the most frequently used broad-based rating scale by school personnel (Hass, Brown, Brady, & Johnson, 2010). However, there is limited research on the use of the BASC-2 comparing the behavioral profiles of children with autism and ADHD (Hass et al., 2010; Manning & Miller, 2001) and the available research is flawed by methodological issues, including small or discrepant sample sizes, limitation of focus only on children with higher-functioning autism, and the use of outdated research instruments. Additionally, almost all of the research utilizing the BASC-2 has examined autism or ADHD relative to neurotypical development rather than examining differential diagnosis between the two disorders. Given the potential of the BASC-2 PRS to assist in differential diagnosis, this study aimed to compare children diagnosed with ADHD and

autism to each other and to children with neurotypical development using the BASC-2 PRS. Group profiles were compared to determine which composites and scales were significantly different between diagnostic groups and which of the composites and scales were most predictive of diagnosis.

Hypotheses

Analysis revealed significant differences between children with and without a diagnosis of autism or ADHD, as well as differences between the disorder groups and neurotypical controls. Gender and ethnic differences were also indicated on some composites and subscales. These findings have important implications in the use of the BASC-2 PRS to assist in the differential diagnosis of autism and ADHD.

Hypothesis One

The first study hypothesis indicated that distinct behavioral profiles exist for children and adolescents in each diagnosis group, specifically on the Withdrawal and Atypicality clinical scales, as well as on the Adaptive Skills composite. Results showed that children in the autism group received significantly higher scores on the Withdrawal and Atypicality scales compared to children in the ADHD and neurotypical groups. However, there was no significant difference between the ADHD group and the neurotypical group on the Withdrawal or Atypicality scales. On the Adaptive Skills composite, there were significant differences in ratings between each group. The autism group was rated as having the most maladaptive functioning followed by the ADHD group, and the neurotypical group received the highest ratings of adaptive skills. Since

there were no significantly differences between the ADHD and neurotypical groups on the Withdrawal and Atypicality scales, study Hypothesis 1 is partially rejected.

Hypothesis Two

The second study hypothesis indicated that children diagnosed with a disorder (autism or ADHD) would receive significantly higher ratings on the Anxiety, Depression, Hyperactivity, and Attention Problems scales, as well as on the Externalizing Problems composite compared to children with neurotypical development. Results showed that children with a psychoeducational diagnosis received significantly higher scores than the neurotypical group on the Anxiety, Depression, Hyperactivity, and Attention Problems scales, as well as on the Externalizing Problems composite. Therefore, study Hypothesis 2 is not rejected.

Hypothesis Three

The third study hypothesis indicated that scores on the significantly different scales of the BASC-2 PRS could be used to effectively predict diagnostic group membership (autism or ADHD). Analysis revealed that the significant scales of the BASC-2 PRS accurately predicted diagnostic group in 80.7% of cases. Therefore, study Hypothesis 3 is not rejected.

Gender and Ethnicity

Results from the current study indicate the existence of ethnic differences in maternal ratings on the BASC-2 PRS. In the study sample, Caucasian and Hispanic children tended to receive more maladaptive ratings compared to African American

children on the Internalizing Problems composite and the Depression scale. Additionally, Caucasian, Hispanic, and African American children received significantly different ratings on the Anxiety scale, with Hispanic children receiving the most maladaptive ratings followed by Caucasian children, and African American children received the least maladaptive maternal ratings on the Anxiety scale. While the cause for these discrepancies is unknown, it could be due to differences in cultural norms and levels of acceptance of these types of behaviors. For example, research indicates that differences in parental perceptions of maladaptive behavior exist. In one study, parents of Caucasian children were more likely to endorse items than were parents of African American children whose children had comparable levels of behavioral maladjustment (Hillemeier et al., 2007). Additionally, parents of African American children are less likely to attribute mental illness to genetic or medical origins or to use mental health labels (Bussing, Schroenberg, & Perwein, 1998).

While some gender differences were found for children in the neurotypical and ADHD groups, the means scores for all of the significant composites and scales remained in the average range. Interestingly, females received higher scores for Hyperactivity in the ADHD group, which is in contrast to previous research stating that males tend to be rated as having higher levels of hyperactivity compared to females (APA, 2013; Anastopoulos et al., 2011; Barkley, 2006). It is also interesting to note that no significant differences were found in maternal ratings of male and female children in the autism group as one might expect based on existing data (APA, 2013; CDC, 2013).

Limitations of the Study

The results of the current study should be interpreted while considering the following limitations. First, it is impossible to obtain a pure sample in this type of study. The diagnoses for the children and adolescents in the study came from a variety of practitioners, bringing into question the reliability and validity of the diagnoses themselves, since psychoeducational diagnoses are, at least in part, subjective. Additionally, the neurotypical sample cannot be confirmed to be absolutely free of any atypical development or subclinical symptoms since their freedom from symptoms was based on parent report and not verified by an independent clinician. Second, the children and adolescents rated in the study were diagnosed using the DSM-IV-TR (2000) criteria, which were modified somewhat in the DSM-5 (2013). This could impact the generalizability of the study and limit the ability to compare children in this sample to those collected in future samples. This study could, however, prime the field for a comparison study using the DSM-5 criteria.

A further limitation of the study includes the use of parent report measures in diagnosis. Despite the many positive features of behavior rating scales, several limitations do exist (McConaughy & Ritter, 2008). First, rating scales typically measure behaviors that are occurring at the present time as opposed to providing information about the history (e.g., age of onset, duration, etiology) of the symptoms. In addition, behavior rating scales completed by others (such as parents) provide only a perception of

the frequency and intensity of the behaviors and these individuals may over- or underreport behavior in the child.

Two additional methodological limitations of the study include the use of convenience sampling and lack of randomization. Since convenience sampling was used to obtain participants for the study, is most likely not representative of the entire population, which limits the generalizability of the study (Gravetter & Forzano, 2012). Another methodological limitation is a lack of random assignment. Because it is not possible to use random assignment to minimize individual differences between groups, there is no guarantee that the groups are equivalent (Gravetter & Forzano, 2012). However, these issues are not uncommon in research conducted in the social sciences.

Suggestions for Future Research

Considering that this was one of the few studies to examine profile differences between children with autism and ADHD using the BASC-2 PRS, additional research validating the results should be conducted to test the generalizability of the findings. In addition, studies comparing children with autism and/or ADHD to other clinical groups, such as children with anxiety or mood disorders would be beneficial for practitioners, given the high number of comorbid symptoms associated with autism and ADHD. Additional research on the discrepancies in responses according the child's gender or ethnicity, as well as with raters in addition to mothers, would also be useful information for practitioners. Finally, with the publication of the DSM-5 (2013), a comparison study using a sample of children and adolescents diagnosed using the DSM-5 criteria would

also be useful for validation and generalization of the findings of this study. Specifically, examining how the DSM-5 criteria allowing for a comorbid diagnosis of autism and ADHD impacts the use of the BASC-2 with these populations.

Summary

Given the large number of overlapping characteristics of autism and ADHD, clinicians are in need of tools, such as behavior rating scales, that can assist in the differential diagnosis of these disorders. This study was conducted to document the behavioral and adaptive profiles of children with autism and children with ADHD, and to compare them to each other as well as to children with neurotypical development using the BASC-2 PRS. Profiles were generated for each group of children, and the profiles were examined to determine the extent to which the groups can be discriminated from each other using this instrument and which scales are most efficacious in differentiation.

Overall, children with a psychoeducational diagnosis were rated as having more maladaptive behavior compare to children without a diagnosis. However, the level of severity of behavior differed between the autism group and the ADHD group. In general, children and adolescents with autism received ratings indicating more maladaptive behavior, both clinical and adaptive, than children with ADHD or neurotypical children. These finding support previous research indicating that children with autism tend to have more exaggerated behavioral problems than children with ADHD (de Bruin et al., 2007; Gadow et al., 2005; Leyfer et al., 2006; Sanders, 2009). Practitioners should also take into consideration that gender and ethnic differences do exist as well, with mothers

tending to rate males with more maladaptive behaviors than females, especially in their level of adaptive functioning. Additionally, the tendency for ethnic groups to report internalizing symptoms differently should also be taken into consideration when examining and utilizing BASC-2 PRS data.

While it appears that the BASC-2 PRS can be effective in discriminating between both autism and ADHD compared to neurotypical children and adolescents, it is important to note that information should come from multiple sources and caution should be taken to avoid overemphasizing any single score or scale in the assessment process (American Psychological Association, 2010; NASP, 2010). Clinicians and school-based personnel can easily apply the findings of this study when conducting assessments with children suspected of having these disorders.

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APPENDIX A

[redacted] Independent School District Proposal

July 22, 2013

To Whom It May Concern:

I am a doctoral student in the School Psychology program in my 4th year at Texas Woman's University. I completed a year-long practicum in [redacted] ISD under the supervision of Dr. Kristen Belloni and Ms. Ashley Owens in the 2012-2013 school year and will be continuing my work with the district in the fall.

I would like permission to use data collected in [redacted] ISD for my doctoral dissertation. The topic of my dissertation is Investigating the Efficacy of the Behavior Assessment System for Children, 2nd edition; Parent Rating Scales (BASC-2 PRS) in the Differential Diagnosis of Autism Spectrum Disorders and Attention Deficit/Hyperactivity Disorder in Children and Adolescents.

In my work with Dr. Belloni and Ms. Owens, I noticed that the BASC-2 rating scales are routinely used in assessments in the district and would provide a large sample size to help ensure more valid results. If provided access, all of the students' identifying information would be removed before taking the data from the building. I would work with Dr. Belloni and Ms. Owens to determine which students received educational diagnoses of Autism or ADHD and gather their BASC-2 data from the scoring computers located in the Administration building of Frisco ISD. Once the appropriate students' BASC-2 PRS data is collected, it will be deidentified, with only the students' age, gender, ethnicity, and BASC-2 PRS scale scores to be saved on an external drive in a separate file. In my dissertation, the specific school district from which the data was gathered will not be revealed, only that it came from a large public school district in north Texas.

Access to this data would help advance the knowledge base of the field of school psychology as a whole and provide practitioners with valuable data to aid them in assessing students regarding differential diagnosis of autism and ADHD using an instrument already widely used in assessment.

Once approval has been granted, I need a letter of approval to submit to the IRB committee at Texas Woman's University.

Thank you for your time,

Amanda M. Smith, M.S.
Doctoral Student in School Psychology
Texas Woman's University

APPENDIX B

Texas Woman's University IRB Approval Letter

TEXAS WOMAN'S UNIVERSITY
DENTON DALLAS HOUSTON

Institutional Review Board
Office of Research and Sponsored Programs
P.O. Box 425619, Denton, TX 76204-5619
940-898-3378 FAX 940-898-4416
e-mail: IRB@twu.edu

July 15, 2013

Ms. Amanda Smith

[redacted]

Dear Ms. Smith:

Re: Investigating the Efficacy of the BASC-2 PRS in the Differential Diagnosis of Autism Spectrum Disorders and Attention Deficit/Hyperactivity Disorder in Children and Adolescents (Protocol #: 17408)

The above referenced study has been reviewed by the TWU Institutional Review Board (IRB) and was determined to be exempt from further review.

If applicable, agency approval letters must be submitted to the IRB upon receipt PRIOR to any data collection at that agency. Because a signed consent form is not required for exempt studies, the filing of signatures of participants with the TWU IRB is not necessary.

Any modifications to this study must be submitted for review to the IRB using the Modification Request Form. Additionally, the IRB must be notified immediately of any unanticipated incidents. If you have any questions, please contact the TWU IRB.

Sincerely,

Rhonda Buckley

Dr. Rhonda Buckley, Chair
Institutional Review Board - Denton

cc. Dr. Dan Miller, Department of Psychology & Philosophy
Dr. Kathy DeOrnellas, Department of Psychology & Philosophy
Graduate School

APPENDIX C

Agreement Statement from Pearson Education, Inc.

From: Altmann, Rob [redacted]@pearson.com]
Sent: Monday, July 01, 2013 9:50 AM
To: Smith, Amanda
Subject: Re: FW: FW: BASC-TRS article question

Hi Amanda

Yes, I should be able to help you out with that. Based on your email, it sounds like you are in the process of collecting your data. When you are done with data collection, then we can talk about what demographics you want matched, and how to match them. As part of the standardization, we collected sex, region, race/ethnicity, parent education level, and "clinical" status (i.e., whether or not the child had been identified with a DSM condition, an educational classification, etc.).

Do you have a time frame on when your data will be collected?

Rob

On Sat, Jun 29, 2013 at 9:24 PM, Smith, Amanda <[redacted]@mail.twu.edu> wrote:
Hello,

I got your contact information from Dr. Michael Hass after contacting him about a research study he conducted related to my dissertation topic. I am using BASC-2 PRS data to determine profile differences between children with autism spectrum disorders and nonclinical children. He said he received the data for his nonclinical sample from you and I was wondering if it would be possible to get similar data for the PRS. My autism group data will most likely be coming from several school districts in north Texas. Any assistance you can provide would be greatly appreciated.

Thank you for your time!

Amanda Smith, M.S.
Doctoral Student
Department of Psychology and Philosophy
Graduate Assistant
Office of Research and Sponsored Programs
Texas Woman's University