

USE OF THE COMBINATION OF THE BRIEF AND BASC-2 IN ASSESSMENT OF ADHD

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ABSTRACT

ADHD is one of the most frequently diagnosed childhood disorders in the United States today; however, diagnostic specificity remains challenging. Accepted models of ADHD routinely highlight the role of executive function (EF) deficits as a core feature of ADHD. However, performance based measures of EF do not consistently discriminate between ADHD and no-ADHD clinical groups. Research has supported use of the Behavior Rating Inventory of Executive Function (BRIEF) in discriminating between ADHD and no-ADHD and between subtypes. However, EF deficits can occur for various reasons.

Broad range behavior rating scales help identify areas of behavioral concern that may aid clinicians in understanding EF deficits. The purpose of this study was to assess whether using the BRIEF in combination with the Behavior Assessment System for Children-2 (BASC-2) would better discriminate ADHD from no-ADHD in a clinical population than either measure alone. Participants included 115 children referred to an ADHD evaluation clinic. Contrary to hypotheses, a combination of scales from the BRIEF and BASC-2 did not result in higher diagnostic classification as compared to each measure alone. The best classification rate was found when combining the BRIEF-Behavior Regulation-parent and BRIEF-Metacognitive Index-teacher. This finding is in congruence with best practice guidelines that recommend using multiple raters when assessing for ADHD.

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CHAPTER 1

Overview

Attention-Deficit Hyperactivity Disorder (ADHD) is one of the most common presenting issues in child outpatient clinics (Barkley, 1997). It is characterized by difficulties due to inattention, impulsivity, and/or hyperactivity. These behaviors must be present in two or more settings and significantly impact functioning of the child in his or her environment. Symptoms congruent with ADHD are often present in children meeting criteria for disorders other than ADHD (e.g., learning disabilities, anxiety disorders). Therefore, both broad-range and narrow-range behavior rating scales are commonly used in assessment for ADHD. In addition, best practice recommendations suggest multiple raters, in order to assess for impairment across settings, as well as multiple methods of assessment.

Executive functions are cognitive processes that regulate a person's ability to perform a multitude of functions, including organizing thoughts, prioritizing tasks, time management, and decision making. Barkley's model of ADHD proposes that deficits in behavioral inhibition create secondary deficits in executive function which result in the impulsive and hyperactive symptoms of ADHD. He asserts that ADHD-Combined type and ADHD-Hyperactive type share similar mechanisms of symptom formation, but that ADHD-Inattentive type is inherently different in its development. Assessment of Executive Functions (EF) can be helpful both in diagnosis of ADHD and in developing interventions appropriate for specific areas of impairment. It has been suggested that utilizing a combination of an EF focused behavior rating scale with a broad behavioral rating scale may be particularly useful in assessment of ADHD (Jarratt, Riccio,

& Siekierski, 2005). However, measures of EF are often time-consuming and less cost effective than behavior rating scales, which have been a long standing staple of ADHD assessment.

The Behavior Rating Inventory of Executive Function (BRIEF; Gioia et al, 2000) is a behavior rating scale of EF designed to be completed by teachers and parents to assess cognitive neuropsychological deficits in children. The BRIEF enables clinicians to gain understanding of likely areas of deficit in executive functioning skills without the time and cost associated with neuropsychological assessment. Behavior rating scales such as the Behavior Assessment System for Children-2 (BASC-2) provide information about internalizing and externalizing behaviors yet do not provide more specific information about executive functions.

The present study sought to assess whether using the BRIEF and BASC-2 in combination would better discriminate between ADHD and no-ADHD in a clinical sample better than either measure alone. Additionally, it tested whether the combination of these two measures was able to discriminate between subtypes of ADHD and which scales on the BRIEF may be most useful in this discrimination.

Overview of ADHD

Attention Deficit Hyperactivity Disorder is one of the most common presenting issues in child outpatient clinics (Barkley, 1997; Fuggetta, 2006). The Diagnostic and Statistical Manual of Mental Disorders-Fourth Version, Text Revision (American Psychiatric Association, 2000, DSM-IV-TR) notes that the prevalence rate for ADHD in school-age children is somewhere between 3 and 7%. However, some estimates note a prevalence rate as high as 9.5 % (Melillo & Leisman, 2004). According to the DSM-TR-IV, the proportion of males to females with ADHD appears to range from 2:1 to 9:1, and fluctuates depending on the subtype of ADHD, as well as the setting in which prevalence is being measured. For example, in a community setting, ADHD

occurs three times more frequently in boys than girls, while in a clinical sample it occurs five to nine times more among boys than girls. ADHD has been found over time to be associated with greater risks for poor school performance, poor peer and family relations, anxiety and depression, aggression, conduct problems, early substance experimentation and risky driving habits, among other issues (Barkley, 1997).

According to Rafalovich (2004), symptoms of ADHD have been noted in medical literature for hundreds of years. However, most researchers in the field consider lectures by George Frederic Still in 1902 the true foundation for the formal study of ADHD (Rafalovich, 2004; Barkley, 1998). In these lectures, Still presented information on children in his practice who were excessively emotional, resistant to discipline, aggressive, and defiant. He proposed that these children suffered from a chronic “defect in moral control” (cited in Barkley, 1998, p.4). Still also reported that the defect was a result of mental retardation in around half of the children, but that the other half was of near normal intelligence. Deficits in inhibition of actions were thought to be due to abnormal brain functioning from a brain injury or a biological disposition according to Stills (Conners, 2000).

Since Still’s initial observations of children with deficits in moral control, there have been many names for what we now term Attention Deficit/ Hyperactivity Disorder, including minimal brain dysfunction and hyperkinetic reaction of childhood (Melillo & Leisman, 2004). As time passed, researchers began to note not only symptoms of hyperactivity, but also that many children studied displayed deficits in sustained attention. Diagnosis of ADHD has evolved with changes in the DSM classification system, resulting in a shifting focus from strictly hyperactive symptoms (DSM-II, 1968) to hyperactive and inattentive symptoms in the current DSM-IV-TR (APA, 2000).

The DSM-IV-TR includes three subtypes of ADHD: Predominantly Inattentive Type, Predominantly Hyperactive/Impulsive Type, and Combined Type. For a diagnosis of ADHD-Predominantly Inattentive Type, the individual must display at least six symptoms related to inattention and fewer than six symptoms of hyperactivity/impulsivity. In order to receive a diagnosis of ADHD-Predominantly Hyperactive/Impulsive Type, a child must display at least six symptoms from those given which involve hyperactivity and impulsivity and fewer than six symptoms of inattention. A child with ADHD-Combined Type will present with at least six symptoms of both inattention and hyperactivity/impulsivity. In all cases, symptoms must be present for at least six months, cause significant impairment in the child's life across multiple areas (i.e., school, home, etc.), have started before age seven, and not be the result of another psychological disorder. (See Appendix A for a listing of DSM-IV-TR symptoms).

Barkley's Model of ADHD

According to Barkley (1997), most, if not all, of the deficits associated with ADHD fall within the realm of executive functions or self-regulation. Barkley's model proposes that behavioral inhibition is the foundation for executive abilities. He defines behavioral inhibition as a person's ability to inhibit their first response to a situation, delay a decision to respond by pausing a response already in motion and, finally, the capacity to selectively inhibit attention to irrelevant information in a person's environment. Impairment in executive functions (e.g., working memory, internalization of speech, self-regulation) in turn affect the motor control-fluency-syntax, which involves the management of goal-directed behavior.

Barkley (1997) asserts that while deficits are created primarily within the brain's motor system in the service of goal directed behavior, impairment in EF may lead to dysfunction in other systems like the sensory-perceptual, linguistic, memory, and emotional systems. The

dysfunction in these areas may be extensive enough to also interrupt goal directed behavior. Barkley (1998) also asserts that the Predominantly Inattentive subtype of ADHD is qualitatively different from the Predominantly Hyperactive/Impulsive and Combined subtypes. He posits that symptoms associated with the Inattentive subtype are a result of insufficient information processing, rather than deficits in inhibition that cause symptoms in the Hyperactive/ Impulsive subtype and Combined subtype.

According to Barkley's model, children with the Inattentive subtype should have deficits in processing speed and focus, rather than behavioral inhibition and working memory. He explains that the inattentive symptoms in the Combined subtype are secondary to hyperactive symptoms and, as a result, it can be thought of in a similar manner to the Hyperactive/Impulsive subtype. Barkley's model of ADHD focuses on the Combined and Hyperactive/Impulsive subtypes, rather than on the Inattentive subtypes due to the noted differences.

Stevens, Quittner, Zuckerman, and Moore (2002) sought to investigate the behavioral inhibition, self-regulation of motivation, and working memory components of Barkley's model by comparing 76 children with ADHD to 76 children without ADHD. Children in both groups were, on average, 10 years old with an IQ in the average to above average range. Results of this study indicated that children in the ADHD group performed significantly worse on tasks associated with reaction time, vigilance, short term memory, and processing speed.

The authors note their findings support the notion that inhibitory control is a central problem for children with ADHD. They note that a diagnosis of ADHD was predictive of a lack of response inhibition even when controlling for other factors. However, they did not find a deficit in working memory after controlling for IQ, which is inconsistent with Barkley's model. This study appears to show some support for the increasingly accepted notion that Executive

Functions play a distinct role in ADHD consistent with Barkley's (1997) model, although support was not found for the working memory components of Barkley's model.

A study conducted by Fuggetta (2006) evaluated whether Barkley's model of ADHD best accounted for the noted EF differences in children with and without ADHD when compared to Sergeant's resource allocation/arousal model of ADHD. According to Sergeant, Oosterlaan, & van der Meere (1999), motor action in children without ADHD is preceded by an optimal state of arousal and activation to prepare for the action to be performed. Children with ADHD experience difficulty with the output stage of information processing, including a decreased state of activation and an inability to appportion and sustain an optimal state of arousal during tasks.

The author noted support for both models of ADHD but indicated that Barkley's model best accounted for the differences noted in EF. Fuggetta (2006) found that participants in an ADHD diagnosed group showed a number of control and monitoring process deficits when compared to controls, even after controlling for processing speed. These results are consistent with the theory that poor behavioral inhibition is the core deficit of ADHD and produces secondary deficits in EF.

The Role of Executive Functioning in ADHD

Based in large part on Barkley's model, ADHD is commonly viewed as involving dysfunction in Executive Functions (EF). For the purpose of this paper, EFs are defined as abilities that enable a person to develop and implement a plan for performing a task using problem solving, organization, working memory, and general thinking tasks (Barkley, 1997; Jarratt, Riccio, & Siekierski, 2005; Wicks-Nelson & Israel, 2003). Several studies found EF deficits in children with ADHD when compared to children with no ADHD diagnosis (Adams,

Derefinko, Milich, & Fillmore, 2008; Fuggetta, 2006; Halperin, Trampush, Miller, Marks, & Newcorn, 2008; Marzocchi et al., 2008; Wodka et al., 2008).

Nigg (2001) completed a review of literature to examine whether the inhibition dysregulation associated with ADHD is related to a deficit in executive functioning or in motivational inhibition. The author concluded that executive function deficits are likely the primary cause of ADHD, but the full pathway for the development of ADHD is likely so complicated that no model fully accounts for it. Nevertheless, some relatively recent research has begun to try to pinpoint specific areas of executive dysfunction that may be associated with ADHD.

Wodka et al. (2008) examined group, sex, and ADHD subtype differences in EF skills among 123 children (54 ADHD, 69 Control) ages 8-16 using selected tests from the Delis-Kaplan Executive Function System (D-KEFS). Additionally, this study explored possible sex differences in performance between male and female children with ADHD. Results indicated that children with ADHD performed significantly worse than those in the control group on a number of EF tasks from the D-KEFS that involved both “more executive” and “less executive” functions. Additionally, the researchers noted that children with the Inattentive Subtype of ADHD performed significantly worse than those with the Combined subtype on sequencing tests. The findings revealed no significant main effects for gender or group-by-sex interactions.

However, it should be noted that the performance of children in the ADHD group, although worse than control children, was still in the average range, thus there was not support for significant deficits in EF. The authors note that many of the children in the study performed in the above average range on a measure of cognitive ability, which may have contributed to better performance on EF tasks for both groups. In addition, few children in the ADHD group

had co-morbid diagnoses, which may limit the generalizability of results to many clinical populations.

Fuggetta (2006) conducted research in an effort to examine the efficiency of EFs in children with ADHD compared to a control group. Twenty-four children (ages 8 to 11) with ADHD were compared with 58 children in a control group (no DSM-IV diagnosis). Participants were administered three separate reaction time (RT) tasks shown to measure different components of EF, over the course of one 50-minute session. Overall results indicated problems with planning and coordinating, disengaging from one task and switching to the next and greater difficulty with inhibiting behavior among children with ADHD as compared to controls. Other research has examined differences in EF performance between children with ADHD and those with Reading Disorders (RD) as these two diagnoses are often comorbid (Bental & Tirosh, 2007). Multiple studies have noted that children with ADHD and/or RD display deficits in EFs; however the two groups display different types of EF deficits, and examination of the type of EF deficit may be useful in distinguishing between the two disorders.

Marzocchi and colleagues (2008) examined performance on EF tasks between 35 children diagnosed with ADHD, 22 with Reading Disorders, and 30 with no diagnosis. They found that children with ADHD did not show a generalized inhibitory control deficit as compared to the other groups but appeared to have deficits in planning, working memory, and set-shifting as measured by EF tasks. The authors suggest these results may indicate that children with ADHD specifically utilize a more impulsive problem-solving method as evidenced by deficits in planning, working memory, and set shifting, whereas the other groups used planning skills and made adjustments more readily. These results indicate that children with ADHD may not have generalized problems with inhibitory control but rather, very specific

deficits like those used in planning tasks. These may have a cascading effect on other functioning systems.

Other studies note similar results to those of Marzocchi et al. (2008). Willcutt et al. (2001) compared children with ADHD, RD, a combination of the two, or no diagnosis on various EF tasks (Willcutt et al., 2001). The authors noted that ADHD was associated with inhibition deficits, whereas RD was associated with significant deficits on verbal working memory. Pennington, Grossier, and Welsh (1993) found that children diagnosed with ADHD display greater deficits in EF than those with a RD diagnosis, lending support to the theory that EF deficits are central in ADHD.

Furthermore, other research has noted that children with a diagnosis of ADHD and those diagnosed with a RD show a highly inaccurate and variable response style during tasks measuring reaction time and accuracy, but that distinct EF factors seem to underlie the high error rates in each group. Specifically, children with ADHD appeared to have greater difficulties with error monitoring (versus the popular belief that response inhibition is the only problem). This may be the result of more difficulties with planning and executing plans, whereas children with RD may have more difficulties with working memory (Van De Voorde, Roeyers, Verté, & Wiersema, 2010).

The results of the previously noted studies suggest there are distinguishable differences in EF skills of children with ADHD and RD, suggesting that children and adults with ADHD may show a distinct pattern of EF deficits. In particular, many studies note that people with ADHD have more difficulties in planning and initiation than those without ADHD. While the majority of current research appears to be congruent with the research stated above, it should be noted that

there is at least one study that has found conflicting results, noting that both children with ADHD and RD show deficits in planning and execution (Pratt, 2000).

Additionally, some research suggests that a multiple deficits/pathways view of ADHD may be more appropriate given high co-morbidity between ADHD and other disorders (e.g. Learning Disorders) involving noted EF deficits (Van De Voorde, Roeyers, Verté, & Wiersema, 2010). These conflicting results suggest the need for further research to determine if children with ADHD display a specific pattern of EF deficits that can be used to differentiate ADHD from disorders with overlapping symptoms. Additionally, there appears to be a need for continued research into behavioral inhibition as described by Barkley due to the overall mixed support found for this specific executive function deficit.

Overall, research into the role of EF in ADHD shows support for emerging research that theorizes specific EF deficits exist in children with ADHD after taking into account potential confounding variables such as IQ, processing speed, and comorbid diagnoses. Executive function problems are seen in the majority of children diagnosed with ADHD rather than just the most serious cases suggesting EF deficits are a common characteristic in this group (Lambek et al., 2010). However, EF deficits may be present in multiple psychological disorders. Identifying unique as well as common EF deficits may be helpful for clinicians attempting to differentiate ADHD from other disorders which may have a similar clinical presentation.

As noted previously, ADHD is one of the most common diagnoses in children, meaning it is highly likely clinicians will see clients with this diagnosis. The ability to efficiently differentiate ADHD from other clinical disorders and specify subtype is important not only for accurate diagnosis, but also to develop appropriate treatment recommendations. One factor that can have an influence on the assessment and treatment of Attention Deficit Hyperactivity

Disorder is a person's intellectual functioning. As intellectual ability permeates many areas of one's functioning level, it is important to explore how it may interact with diagnosis ADHD and performance on EF measures.

Intelligence and ADHD

Some research has indicated that measures of EF may be less sensitive to deficits in persons with higher IQs. As Barkley (1998) notes, Executive Function deficits may present themselves in very different ways in people based upon the type of deficit occurring. For some individuals, EF deficits may result in lower performance on standardized measures of intelligence. Antshel (2008) notes a positive correlation usually occurs between attention and overall IQ score, but this may not be an accurate depiction of intelligence due to the types of tasks usually used to measure IQ (i.e., tasks requiring focus). Multiple studies have noted that children with ADHD span the range of intellectual functioning from disabled to gifted (Kaplan, Crawford, Dewey, & Fisher, 2000; Mahone et al., 2002; Schuck & Crinella, 2005).

Mahone et al. (2002) compared 51 children diagnosed with ADHD to 41 children in a control group on five measures of EF including the Rey Osterrieth Complex Figure task (ROCF), Tests of Variables of Attention (TOVA-V), and Letter Word Fluency. The researchers found that the full scale intelligence quotient (FSIQ) was uniquely and significantly associated with performance on the administered EF tasks. As IQ rose, performance on EF tasks improved independent of a ADHD diagnosis. Children in the control group with average intelligence outperformed those in the average intelligence ADHD diagnosed group.

However, among children that performed in the high average or superior range of intellectual functioning, there was no difference in performance on EF tasks between the ADHD and no ADHD groups. Mahone et al. report that these results suggest IQ is a powerful moderator

in understanding the impact of ADHD on a child's life and a child's ability to compensate for deficits associated with it. It may mean that those with lower levels of intelligence lack the capacity to meet the increased demands placed on their neurological system by ADHD and, therefore, are more affected overall. The results of Mahone et al.'s study also indicate that it is important to take a child's level of cognitive functioning into account when assessing for ADHD, as it likely has a significant moderating effect.

Assessment of ADHD

Best practices in assessing for ADHD suggest a multi-rater/multi-method approach (Barkley, 1997; American Academy of Pediatrics, 2000). The American Academy of Pediatrics (AAP, 2000) guidelines for assessment of ADHD propose using a DSM-based clinical interview with parents or caregivers and review of the child's school records at a minimum. These guidelines also suggest that a clinician may use narrow-band, norm-based behavior rating scales; however, they also suggest caution when using any rating scales due to rater subjectivity. The AAP guidelines do not recommend use of broad range rating scales or computerized tests of attention due to their lack of sensitivity and specificity.

The American Academy of Child and Adolescent Psychiatry (AACAP, 2007) guidelines for assessment of ADHD in preschoolers, children, and adolescents recommends completing a detailed interview with a parent or guardian focusing on each of the 18 symptoms of ADHD noted in the DSM-IV. Additionally, these guidelines note that a clinician should pay specific attention to differentiating the presence of impairment from the presence of symptoms. For example, a child may have symptoms in accordance with ADHD, yet only show impairment from these symptoms in one setting (i.e. impairment at school but not home), which could suggest a learning difficulty rather than ADHD. The AACAP (2007) guidelines also recommend

using a well-established standardized behavior rating scale with parents and teachers to assess for symptoms of ADHD and/or other disorders.

Current guidelines for ADHD assessment consistently recommend a thorough clinical interview and standardized behavior rating scales across settings. However, these guidelines do not suggest using continuous performance tasks or neuropsychological measures, since those have been found relatively ineffective in consistently differentiating between clinical groups. According to Wu et al. (2007), Continuous Performance Tasks lack the diagnostic power to be used as an exclusive determinant of ADHD. These tasks measure a person's ability to focus and complete certain tasks but are ineffective in determining how a person's abilities in these areas may differ from those with other diagnoses with similar symptoms (i.e. mental retardation, pervasive developmental disorders, learning disabilities, etc). Similarly, EF measures do not consistently differentiate between clinical groups and there is limited research into their usefulness in distinguishing subtypes of ADHD (Berlin, Bohlin, Nyberg, & Janois, 2004; Holmes et al., 2010)

Behavior Rating Scales

Behavior rating scales represent an efficient and effective way of gathering information about people that can be used for diagnosis and treatment planning (Angello et al., 2003). Additionally, behavior rating scales enable clinicians to evaluate parent/guardian and teacher report of child behavior in the context of age-based norms (Dupaul et al., 1997; Hosp, Howell, & Hosp, 2003). Behavioral rating scales have proved useful not only in clinical practice but are also used regularly in research to examine symptom patterns. Some research has noted behavioral rating scale accuracy rates as high as 79% when used in conjunction with information from a clinical interview to diagnose ADHD (Snyder, Horn, and Cornwell, 2006).

A criticism of behavior rating scales involves the potential for rater bias (Gomez, Burns, Walsh, & De Moura, 2003). Some researchers suggest that the variance between parent and teacher reports on behavior rating scales can be so great that it could have a negative effect on research into ADHD as a whole. Gomez et al. (2003) reported that this variance may be due to several factors including true difference in the behavior of the child depending upon setting, perceptual difference between parents and teachers, and simple measurement error that is often inherent in scales.

Children's behavior can vary greatly based upon who is in charge, the structure of the environment, or the child's familiarity with the setting. For example, a child may display inattentive behavior when expected to focus on school work but displays good ability to focus on activities that interest him at home. Furthermore, parent and teacher perceptions of behavior may differ based on greater teacher experience in observing typical behavior of children at the same developmental level. Not all researchers believe that the discrepancies between rater reports are problematic. According to De Los Reyes (2011), clinicians may be able to use discrepancies in behavior rating scales between raters to assess how children express themselves in various environments. This information may be able to help assess meaningful treatment outcome patterns as certain techniques may be more successful at symptom reduction in one setting than another.

Behavior Assessment System for Children-2 (BASC-2). The BASC-2 is a behavioral rating scale designed to assess child emotional and behavioral disorders. The original BASC was updated in 2004 and new norms were developed to create the BASC-2. The BASC-2 has teacher, parent, and self-report forms for three age groups (preschool, school age, teen). It not

only assesses behavioral problems and emotional disturbance but also includes assessment of adaptive skills including functional communication, leadership skills and self-care skills.

Bonahue, Larmore, Harman, and Castillo (2009) used the BASC-2 to assess for symptoms of learning disorders (LD) and found evidence for use of the BASC-2 in differentiating ADHD from LD. This finding is important since the two disorders are frequently co-morbid and can involve similar symptoms (e.g., inattention). Parents rated children with comorbid ADHD and LD as higher on the hyperactivity scale and teachers rated this group higher on the attention problems and learning problems scales. The researchers note that the subscale differences that they found are likely due to the presence of ADHD because there were no differences seen in parent and teacher rating scales indicative of conduct and/or aggression problems.

Anastopolous and colleagues (as reported by Fox, 2008) examined the consistency between various rating among 158 children between the ages of 5 and 12 diagnosed with ADHD. The researchers found that ratings were highly correlated when from a single informant across both measures (e.g., parent rating on ADHD Rating scale and BASC-2); however, they consistently found lower correlations between parent and teacher ratings on the same measure (e.g., parent BASC-2 versus teacher BASC-2). Results also indicated that diagnosis made on the basis of results from the BASC-2 and ADHD Rating Scale-IV (a combination of parent and teacher ratings) were consistent with those made based on the DISC-IV and those made by an expert panel of diagnosticians.

Using the original BASC, Vaughn, Riccio, Hind, and Hall (1997) found that the BASC teacher rating scale (BASC-TRS) had better predictive validity than the Achenbach Child Behavior Checklist (CBCL) in ruling out ADHD. They also found the BASC-TRS and parent rating scale

(PRS) were found to be superior to the CBCL in differentiating subtypes of ADHD. August, Braswell, and Thuras (1997) used clinical interviews, the Conners Abbreviated Symptom Questionnaire, and the BASC to assess children in the school system for ADHD.

Those diagnosed at the first interview were assessed each year for the next five years with a clinical interview and the BASC. Overall, the BASC showed decreases in attention problems and hyperactivity during the course of the study. The authors noted this is likely due to interventions (behavioral, medication) given over that time period and concluded that parent and teacher ratings on the BASC were sensitive to these changes. There were no significant gender differences. The majority of children diagnosed with ADHD (65%) still met criteria for ADHD at the end of the study providing support for both the stability of ADHD as well as the diagnostic sensitivity of the clinical interview and BASC.

According to DiStefano, Kamphaus, and Mindrila (2010), the BASC-2 means for the externalizing and internalizing composite scales are significantly higher than the BASC, suggesting significant differences in the BASC versus BASC2 normative samples. However, one of the noted critiques of the BASC and BASC-2 in assessment for ADHD is that the items on the Inattention and Hyperactive/Impulsive scales do not reflect DSM-IV criteria. Some the items on the BASC-2 are too broad to effectively measure ADHD related behavior and behavior associated with EF dysfunction. In conjunction with a more narrow measure of EF, the BASC-2 may be even more useful in assessment for ADHD.

Executive Function Measures. As stated previously, executive functions (EF) are cognitive processes that regulate a person's ability to perform a multitude of functions, including organizing thoughts, prioritizing tasks, time management, and decision making. Measures of EF such as the Delis-Kaplan Executive Function System (D-KEFS), go/no-go tasks, Controlled Oral

Word Association Test (COWAT), and others can be effective tools in discriminating ADHD from no-ADHD. These traditional (i.e., performance based) measures of EF have relatively strong support for distinguishing ADHD from no-ADHD; however, EF measures do not consistently differentiate between clinical groups, and there is limited research into their usefulness in distinguishing subtypes of ADHD (Berlin, Bohlin, Nyberg, & Janois, 2004; Holmes et al., 2010). Additionally, Wodka et al (2008) noted that EF measures have less diagnostic sensitivity when used with children that have above average cognitive ability.

Traditional measures of EF are often time consuming, expensive and require specialized training to administer and interpret. For example, the D-KEFS takes approximately 90 minutes to administer the suggested battery for estimated cognitive ability. Other measures (i.e. COWAT, go/no-go tasks) may have shorter administration times when used alone, but multiple tests would need to be completed in order to offer a comprehensive view of a child's executive functioning. The time and cost involved in administering these performance based measures often discourages the average clinician from using them in assessment of ADHD. The BRIEF is a less costly measure of EF that can be completed easily by parents and teachers in a short period of time making it more plausible for regular use in ADHD assessment.

The Behavior Report Inventory of Executive Function (BRIEF). The BRIEF was developed as a standardized measure of behaviors associated with specific EF skills. Developers of the measure reviewed the current literature on EF and asked experts about their conceptualization of EF in order to develop item content. There is some research suggesting the BRIEF may tap into different elements of EF than those measured by performance-based measures (Mahone & Hoffman, 2007). Gioia et al. (2000) provide preliminary data supporting

the measure's use in clinical practice and research. The BRIEF can be used to assess EF in youth ages 5-18 and includes both teacher and parent rating forms.

The eight subscales and two global scales which reflect the various domains of EF were created through a factor analysis. The Global Executive Composite (GEC) is based on the sum of all eight subscales. The Behavioral Regulation Index (BR) assesses the ability to utilize one's inhibitory control to shift thinking and modulate emotions and behaviors. The Metacognitive Index (MI) is thought to assess one's ability to utilize working memory to initiate, plan, organize, and sustain future-oriented problem solving.

The BR score is composed of three of the eight subscales including Inhibit, Emotional Control, and Shift. The Inhibit subscale includes items related to hyperactive behavior and impulse control, or one's ability to stop one's behavior. The Emotional Control subscale assesses the ability to modulate emotions and the Shift subscale includes behaviors related to one's ability to change their mindset from one activity to another. The MI score includes five of the eight subscales: Initiate, Monitor, Organization of Materials, Plan/Organize, and Working Memory. One's ability to start a task and generate ideas is measured by the Initiate subscale. The Monitor subscale measures a person's ability to monitor personal performance (e.g., during a test in school). The Organization of Materials subscale measures a person's ability to organize themselves during work and/or play and the Plan/Organize subscale reflects one's ability to develop a goal and create a reasonable, strategic plan to achieve that goal. Finally, the Working Memory subscale score assesses one's ability to hold information in mind in order to complete a specific task.

Several studies have found that the BRIEF can be useful in discriminating ADHD from no-ADHD. Specifically, Semrud-Clikeman, Walkowiak, Wilkinson, and Butcher (2010) found

support for the GEC in distinguishing between ADHD and no-ADHD. Other studies have concluded that parents tend to rate children with ADHD as significantly more impaired than those without ADHD on most scales of the BRIEF when compared to control groups ("Behavior Ratings," 2007; Linder, Kroyzer, Maeir, Wertman-Elad, & Pollak, 2010; Mahone et al., 2002; Ying, Lan, Qingjiu, Chan, & Yufeng, 2010) and those with working memory deficits but no other impairment (Alloway et al., 2009).

Semrud-Clikeman et al. (2010) sought to evaluate group differences between children diagnosed with ADHD and those with no-ADHD using neuropsychological measures and behavioral rating scales. They administered multiple measures, including the BRIEF, to 96 children between the ages of 9 and 16. Twenty-one children were diagnosed with ADHD-Combined Type, 28 with ADHD-inattentive type, 15 with Asperger's Disorder, and 32 children were in the control group. Children in the ADHD-C group were rated significantly higher by parents and teachers on the Inhibit scale and Emotional Control scales as compared to children in the ADHD-I group, but showed no difference from the Asperger's group. The authors noted that symptoms of ADHD were positively correlated with the GEC scale on the BRIEF but with a small effect size.

Furthermore, this study found that 41% of the variance on the BRIEF was accounted for by the number of inattention symptoms endorsed by parents during a clinical interview, suggesting that the measure is sensitive to inattentive symptoms of ADHD and may be helpful in differentiating subtypes.

Additional research has sought to identify not only whether the BRIEF is useful in differentiating ADHD from no-ADHD but also if specific scales may be helpful in differentiating between ADHD subtypes. McCandless and O'Laughlin (2007) sought to evaluate

the clinical utility of the Parent and Teacher version of the BRIEF in diagnosis of ADHD and differentiation of ADHD subtypes. Parents of 70 children between the ages of 5 and 13 diagnosed with Inattentive Type ADHD, Combined Type ADHD or no ADHD diagnosis completed the BRIEF as part of an assessment battery. Results revealed that 77.1% of the group was classified correctly as ADHD or no-ADHD based upon the Inhibit parent scale and teacher report for the Metacognitive Index.

McCandless and O’Laughlin (2007) noted that parents rated children with ADHD-C significantly higher on the BR index than did parents of children in the other two groups. In addition, both parents and teachers rated children with ADHD-C significantly higher on the MI than the other two groups. Considering ADHD subtype, 62.9% of cases were correctly classified based on parent report on the Inhibit scale and teacher ratings on the MI composite. Specifically, the ADHD-C group was rated higher than the ADHD-I group on both the MI composite and Inhibit subscale.

Of interest, McCandless and O’Laughlin (2007) found minimal agreement between parent and teacher ratings on the BRIEF in their study. Other research (e.g. Gomez et al., 2003; Power et al., 1998) has also reported minimal agreement between parent and teacher behavior ratings of children. Gomez et al. (2003) note that source differences can happen for various reasons, including actual behavioral differences across settings or source bias based on experience with the studied population. Mares, McLuckie, Schwartz & Saini (2007) found that teachers tend to report more EF problems than parents, and also note that this finding is in contrast to previous research in which parents usually report more problems than teachers.

Given that previous research has found significant differences between parent and teacher reports of child behavior overall, and EF specifically, it appears that including both parent and

teacher ratings is important when considering the usefulness of behavior ratings in differentiating between diagnostic groups.

Using a Combination of Behavior Rating Scales and Measures of EF. Research on the BRIEF supports its utility in distinguishing ADHD from no-ADHD and distinguishing between subtypes (e.g. Berlin, Bohlin, Nyberg, & Janois, 2004; Holmes et al., 2010; McCandless & O’Laughlin, 2007). Taking into account the current research in the area, it appears that the MI, BR index, and GEC scales have the most research support in assessment for ADHD. There is, however, minimal information regarding what combination of subscales and /or index scores may be most useful in diagnosis of ADHD. Although the BRIEF provides useful information regarding EF, information on specific symptoms of ADHD as well as possible comorbid disorders is necessary to determine a diagnosis of ADHD.

Currently there is minimal research examining the combined use of the BRIEF and BASC-2 in the assessment for ADHD. Jarrat, Riccio, and Siekierski (2005) compared the results of the BRIEF and BASC in 42 children (age 9-15) with an ADHD diagnoses (14 Inattentive Type, 27 Combined Type; 1 ADHD NOS) versus 26 children who received no clinical diagnosis. The researchers found children diagnosed with ADHD had higher parent ratings on the hyperactivity, attention problems, aggression, conduct problems, and atypicality subscales as well as the Externalizing Problems composite score on the BASC.

Additionally, significant between-group differences emerged on the Teacher version of the BASC, with children with ADHD rated higher than the no diagnosis group on the hyperactivity and attention problems subscales. Teachers also rated the ADHD group as having more deficits in adaptive skills than those in the control group. When looking at scales that typically relate to the diagnosis of ADHD (BASC-EXT, BASC-Attention), analyses indicated

that the BASC-EXT had the highest inter-rater correlations between parent and teacher ratings across the most ratings. This scale also displayed a good ability to differentiate between ADHD and no-ADHD groups.

Considering group differences on the BRIEF, parent ratings were significantly higher for the ADHD group as compared to no diagnosis for all eight subscales and three composite scales. Jarrat, Riccio, and Siekierski (2005) reported the largest effect sizes (moderate) for the Working Memory Scale, MI, and GEC. Likewise, teacher ratings were also higher for the ADHD group for all sub-scales with the exception of organization. Overall, correlations between parent and teacher ratings on the BRIEF ranged from a low of .46 for the Initiate subscale to a high of .72 for the BRI scale.

Jarrat, Riccio, and Siekierski (2005) completed a correlational analysis to determine the extent that the BRIEF and BASC measure similar constructs. They reported the highest correlations were between the clinical scales of the BASC and the BRI on the BRIEF, and the adaptive skills on the BASC and the MI on the BRIEF. They suggest that the results indicate that the BRIEF and BASC measure similar but different constructs. In addition, Jarrat, Riccio, and Sikierski (2005) suggest that the use of the BASC and BRIEF in combination may be effective in ADHD diagnosis and treatment planning.

Present Study

According to the American Academy of Child and Adolescent Psychology (2010), up to 84% of children and adolescents with ADHD will meet diagnostic criteria for another clinical disorder. Thus effective assessment for ADHD will include consideration of disorders that may co-occur and/or mimic ADHD symptoms. In addition, use of a clinical sample that includes

children with diagnoses other than ADHD will provide a more robust evaluation of a measure's effectiveness in discriminating ADHD from other clinical groups. The present study evaluated use of the BRIEF and BASC-2 in combination with a clinical sample of children referred for an ADHD evaluation. It was predicted that the combination of these two measures would better discriminate between ADHD and no-ADHD than either measure alone.

Additionally, this study considered the extent to which the combination of these two measures was able to discriminate between subtypes of ADHD. This study extends previous research completed by Jarrat, Riccio, and Siekierski (2005) by using the BASC-2 instead of the BASC and including teacher ratings in addition to parent ratings. The present study also examined the ability of the BASC-2 and BRIEF to discriminate between ADHD and no-ADHD groups in a community sample (with co-morbid and other diagnoses) sample, as opposed to Jarrat, Riccio, and Siekierski (2005), who compared children with ADHD with a no-diagnosis group. Jarrat, Riccio, and Siekierski (2005) reported a moderate effect size for the Global Executive Composite scale of the BRIEF in differentiating ADHD from a no-ADHD group and noted the highest correlations between the clinical scales of the BASC-2 and the BRI on the BRIEF.

McCandless and O'Laughlin (2007) found parents rated children with ADHD-Combined type significantly higher on the BR index than did parents of children in the control group or children with ADHD-Inattentive Type. Additionally, parents and teachers rated children with ADHD-C significantly higher on the MI than the ADHD-I and no ADHD groups. This study also evaluated the diagnostic efficiency of the BR and MI scales as well as the GEC in combination with the BASC-2 Externalizing subscale (BASC-EXT).

Hypotheses

1. The combination of the Global Executive Composite (GEC) from the BRIEF Parent form and Externalizing (EXT) subscale from the BASC-2 Parent form will better discriminate between ADHD and no-ADHD groups than either scale individually in a clinical population.
2. The combination of the GEC from the BRIEF Teacher form and EXT subscale from the BASC-2 Teacher form will better discriminate between ADHD and no-ADHD groups than either scale individually in a clinical population.
3. ADHD subtypes (Combined Type, Inattentive Type) will be better identified by the combination of the Behavior Regulation composite (BR) from the BRIEF Parent form and EXT subscale from the BASC-2 Parent form than either scale individually in a clinical population.
4. ADHD subtypes (Combined Type, Inattentive Type) will be better identified by the combination of the BR from the BRIEF Teacher form and EXT subscale from the BASC-2 Teacher form than either scale individually in a clinical population.
5. ADHD subtypes (Combined Type, Inattentive Type) will be better identified by the combination of the Metacognitive Index (MI) from the BRIEF Parent form and EXT subscale from the BASC-2 Parent form than either scale individually in a clinical population.
6. ADHD subtypes (Combined Type, Inattentive Type) will be better identified by the combination of the MI from the BRIEF Teacher form and EXT subscale

from the BASC-2 Teacher form than either scale individually in a clinical population.

CHAPTER 2

METHOD

Design

The current study utilized sequential discriminant analysis to assess the ability of specific BASC-2 and BRIEF scales to discriminate between ADHD and no-ADHD groups categorized by a research diagnosis (criteria for research diagnosis presented in Procedures section).

Archival data from consecutive children presenting to an ADHD evaluation clinic over a period of approximately 24 months was used. The grouping variable for the primary analyses are the research diagnosis of ADHD (ADHD, no-ADHD), and the criterion variables are the BASC-EXT subscale and the BRIEF-GEC. Several discriminant analyses will be conducted in evaluating ability of the BRIEF and BASC-2 in discriminating between ADHD subtypes. For these analyses, the predictor variable was ADHD subtype (ADHD-I, ADHD-C, No-ADHD) and the criterion variables were the BASC-EXT (parent and teacher in separate analyses), and either the BRIEF BR index or MI index (in separate analyses).

Participants

Participants included 115 children (34 female and 81 male) between the ages of 5 and 12 ($M = 7.38$ years, $SD = 1.55$). Consistent with results from Jarrat et al.'s (2005) study, a medium effect size was anticipated, requiring a minimum of 60 participants. Thus, sample size was more than sufficient. Racial make-up of participants was as follows: 91.3% Caucasian children, 7%

Biracial children, 0.9% African American children, 0.9% Hispanic children. See Table 1 for additional participant information.

Exclusion criteria

Children with a full scale IQ of under 75 were excluded from the study. Additionally, those with a documented neurological disorder and/or a history of brain injury were excluded due to this study's strong emphasis on the BRIEF, a neuropsychological measure. Children with comorbid disorders (e.g., ADHD and Oppositional Defiant Disorder or ADHD and Learning Disorder) were not excluded, as the majority of children diagnosed with ADHD are also diagnosed with other comorbid DSM-IV disorders (Spencer, Biederman, & Wilens, 1999; Wilens, Biederman, Brown et al., 2002)

Research Diagnosis Measures

Attention Deficit Hyperactivity Disorder Rating Scale-IV (DuPaul et. al., 1998)

The Attention Deficit Hyperactivity Disorder Rating Scale-IV (parent and teacher version) is a brief questionnaire created to measure behaviors consistent with the DSM-IV criteria for ADHD (See Appendix B). It was designed to be used with children between ages 5 and 18 and was standardized on a nationally representative sample that included 2000 participants. The measure includes a Total ADHD scale as well as two subscales (Inattention and Hyperactivity/Impulsivity). According to DuPaul et al. (1998), both the parent and teacher versions of the measure have good support for validity and strong test-retest reliability and internal consistency.

The authors suggest a cut-off score of the 90th percentile for teacher-reported Inattention, 93rd percentile for parent-reported Inattention for diagnosis of ADHD-Inattentive type. They suggest the same cut-offs for parent and teacher inattention plus 98th percentile or higher for

hyperactivity to rule in a diagnosis of ADHD-Combined type. The authors do not note a recommended cut-off score for parent-reported Hyperactivity/Impulsivity.

Zhang, Faries, Vowles, and Michelson (2005) conducted research which included 14 different countries and more than 600 participants to assess the psychometric properties of the ADHD Rating Scale-IV. They found the measure to have acceptable convergent and divergent validity, discriminant validity, factor structure, internal consistency, test-retest reliability, and inter-rater reliability. Additionally, they found correlations with other parent and clinician measures of ADHD (Conners Parent Rating Scale; Clinical Global Implications Scale) to be moderate to high, but the teacher form of the ADHD Rating Scale-IV had only low to moderate correlations with other teacher rated measures.

Impairment Rating Scale (IRS, Fabiano et al., 2006)

The IRS is a research measure intended to determine impairment in a child's day to day functioning. The scale includes items that correspond to areas of functioning known to be impaired in children with ADHD and is typically completed by the child's parent/legal guardian and primary teacher. The IRS is a 5-item measure that assesses impairment in the child's relationships with peers, siblings, parents, teachers, academic progress, self-esteem, and overall impairment in family and classroom functioning. Fabiano et al. (2006) report that the IRS has good concurrent, convergent, and discriminant validity when used to assess functioning impairment in children suspected of having ADHD. They also note that both the parent and teacher IRS forms have good inter-rater reliability. In the present study, an adapted version of the IRS was administered verbally with parent/caregivers as part of the diagnostic interview.

While the IRS asks parents to broadly rate child impairment in each domain, the adapted version asks parents to rate impairment specifically related to inattention and/or

hyperactive/impulsive behavior in each domain. Additionally, the adapted version, unlike the IRS, did not include a total impairment rating. Teachers were asked to rate child impairment related to inattention and/or hyperactive/impulsive behavior on a 7-point Likert scale (1 = not at all, 4 = somewhat negative impact, 7 = very negative impact) in three domains (peer relationships, student-teacher relationship, learning/academic performance); these items were included in the teacher questionnaire packet. Parents were asked to rate impairment (e.g., Have your child's attention or hyperactivity problems affected his or her relationship with playmates?) on a 10-pt Likert scale (to be consistent with earlier questions in the interview) with 0 = no problem and 10 = extreme problem. For the present study, ratings above the median score (e.g., 5 or above on teacher 7-point Likert scale; 6 or above for parent rating on 10-point Likert scale) are part of the criteria for the research diagnosis for ADHD (see Procedures section below for more information about research diagnosis criteria).

Measures of Focus in Present Study

Behavioral Ratings Inventory of Executive Function (Gioia et al., 2000)

The BRIEF was designed to assess components of executive functioning in children between ages 5 and 18. The general normative sample includes more than 13,000 teachers and parents and presents norms in one year increments. The BRIEF is an 86-item measure that has both teacher and parent versions and requires 15 to 20 minutes to complete. Respondents are asked to respond to items using a 3-point Likert scale (never, sometimes, often). Results are reported using t-scores ($M = 50$; $SD = 10$), and scores of 65 or above are considered clinically significant. Based upon results of a factor analysis, the BRIEF scales include two index scores and several subscales associated with each index. Emotional Control, Inhibit, and Shift Scales

are part of the Behavior Regulation Index (BRI). Initiate, Monitoring, Organization of Materials, Plan/Organize, and Working Memory scales compose the Metacognitive Index (MI).

Gioia et al. (2000) indicated the BRIEF has strong content and construct validity including good convergent validity based upon significant correlations between selected scales on the BRIEF and Child Behavior Checklist (REF), a broad range behavior rating scale. Furthermore, the authors found moderate correlations between the BRIEF and the ADHD-Rating Scale-IV and Conner's Rating Scale. On the parent form of the BRIEF, the BRI scales correlated strongly with aggression and hyperactivity scales on the parent form of the BASC ($r = .76$, and $r = .63$, respectively). Working Memory, Initiate, Plan/Organize, and Monitor scales on the BRIEF parent form were strongly correlated with the Attention Problems on the BASC-PRS.

Mahone et al. (2002) also report support for both convergent and discriminant validity of the BRIEF. They state that the MI shows a high degree of correlation with others measures of inattention and that the BRI is strongly associated with other more direct measures of hyperactivity (i.e. ADHD Rating Scale-IV-Hyperactivity scale) (See Appendix D for sample items from the BRIEF).

Considering predictive validity, Gioia et al. (2000) found that children with ADHD-I or ADHD-C diagnosis received significantly higher ratings from both parents and teachers on the Working Memory scale as compared to children with no ADHD diagnosis. While the Working Memory Scale did not distinguish between subtypes, the Inhibit scale was able to do so in 65-68% of cases.

Gioia et al. (2000) report that internal consistency, as measured by Cronbach's alpha, ranged from .80 to .98 for both parent and teacher forms in clinical and general populations. The

lowest alpha coefficients were found for the Initiate and Shift scales. They report moderate parent-teacher interrater reliability ($r = .32$) that ranged from .15-.50 across the scales. According to the authors, parents tend to rate children as more impaired than teachers across all scales. Gioio et al. report good test-retest reliability of $r = .81$ for parents and $r = .87$ for teachers over two weeks.

Behavioral Assessment System for Children-2 (BASC-2, Reynolds & Kamphaus, 2004)

The BASC-2 system has four different normative samples including general norms, clinical norms, learning disability norms, and ADHD norms. For the purpose of this study, general norms will be used. Norms are presented for children from age 2-21:11. For both the parent and teacher version for the BASC-2, respondents are asked to rate the frequency of behaviors on a 4-point scale (never, sometimes, often, almost always). The BASC-2 Teacher Rating Scale (BASC-2-TRS) has 139 items and provides standard scores for five broad domains (Externalizing Problems, Internalizing Problems, School Problems, Adaptive Skills, and the Behavioral Symptoms Index) and 24 single factor subscales (Attention Problems, Hyperactivity, Learning Problems, etc.). The results are presented as *T*-scores ($M=50$, $SD=10$) and the suggested cut-off for clinical significance is a *T*-score of 70 (See Appendix E).

Reynolds and Kamphaus (2004) report that the BASC-2-TRS has strong concurrent validity based on strong correlations with similar child behavior measures. Additionally, the BASC-2-TRS composite scores display strong internal consistency (high .80's to low .90's) and test-retest reliability (middle .80's to low .90's). The authors note that interrater reliabilities for the BASC-2-TRS are significantly lower than the PRS ranging from .19 to .82 ($M=.56$). All ratings are based on the general norm sample.

The BASC-2-Parent Rating Scale (BASC-2-PRS, Reynolds & Kamphaus, 2004) has 160 items and provides standard scores in the same broad domains and single factor subscales as the Teacher Rating Scale with the addition of a single factor scale measuring “Activities of Daily Living”. Results are presented as T-scores ($M = 50$, $SD = 10$) and a T-score of 70 is the suggested cut-off for clinical significance.

The BASC-2 PRS has strong concurrent validity with various other child behavior measures. According to Reynolds and Kamphaus (2004), the BASC-2-PRS composite scores display strong internal consistency (middle .80s to middle .90s) and test-retest reliability (low .80s to low .90s). The authors report a somewhat low but acceptable interrater reliability ($r = .69$).

Procedure

Parents of children seen at the ADHD Evaluation Clinic completed an informed consent for services as well as consent allowing assessment data to be used for research purposes (See Appendix F). Only data from parents that completed the research consent was used for the present study. Each participant was identified by a unique numeric code in the database to assure confidentiality of the responses. All client information was kept in a locked file.

Data for the present study was gathered and entered into a database by a graduate clinician who was been trained in data entry. For the purpose of this study, a research diagnosis was used to determine the ADHD and no-ADHD groups in order to reduce the effects of clinician error. In addition, given that the present study examined contributions of the BRIEF and BASC-2 in diagnosis of ADHD, and both measures were considered in the clinical diagnosis, it was necessary to use a research diagnosis that did not include consideration of these two measures.

Inclusion in the ADHD group required evidence of child impairment in more than one setting as indicated by a parent or teacher rating above the median value on the Likert scale (e.g., 5 or above for teacher ratings, 6 or above for parent ratings) for two or more domains (e.g., academics family relationships, peer relationships). For example, a teacher rating of 5 or above on academic impairment combined with a parent rating of 6 or above on peer relationship impairment would meet impairment criteria for the ADHD diagnosis group.

However, teacher rating of impairment (5 or greater) for academic impairment combined with no parent ratings of impairment over 6 would not meet impairment criteria for the ADHD diagnosis group. In addition to information regarding impairment, the following criteria were used to determine the ADHD-Inattentive, ADHD-Combined and No-ADHD groups. The criteria below are based on suggested cut-offs proposed by DuPaul et al. for the ADHD-IV rating scale, however criteria for this study are somewhat more inclusive (e.g., parent or teacher ratings above 90th percentile), given that diagnostic criteria also considered parent and teacher ratings of impairment. Children must have met criteria for impairment (as described above) before cut off scores (below) were considered for diagnostic classification.

- 1) ADHD Rating scale 90th percentile or higher for parent or teacher Inattention scale and < 85th percentile on parent and teacher ratings on the Hyperactivity/Impulsivity scale = ADHD-Inattentive Type.
- 2) ADHD Rating Scale 90th percentile or higher for parent and/or teacher Inattention scale and 90th percentile or higher for parent and/or teacher Hyperactivity/Impulsivity scale = ADHD-Combined.
- 3) ADHD Rating scale < 90th percentile for parent AND teacher Inattention scale and < 90th percentile for Hyperactivity/Impulsivity scale = NO-ADHD Group.

CHAPTER 3

RESULTS

Preliminary Analyses

Using the research diagnosis procedures outlined above, 64 children met research criteria for the ADHD group (10 Inattentive Type; 54 Combined Type) and 51 were classified in the no-ADHD group. This classification differs from the clinical diagnosis (85 ADHD, 30 no-ADHD), which was based on a broader range of information. One reason for the lower number of children in the ADHD group based on research diagnosis is that children with a clinical diagnosis of ADHD-Not Otherwise Specified ($n = 18$) were grouped in the no-ADHD category based upon the research diagnosis criteria.

Four children were elevated on the hyperactivity scale but were slightly below the research diagnostic criteria cut-off for inattention. Consistent with literature noting common neural pathways and profiles in children with ADHD-Hyperactive type and Combined type (e.g., Barkley, 1997), these children were included in the ADHD-Combined type group. See Table 1 for participant demographic information as well as BASC and BRIEF scores for each diagnostic group. There was a statistically significant difference in age between children in the ADHD-I and ADHD-C groups. Consistent with previous research, children in the ADHD-I group tended to be slightly older than children in the ADHD-C group.

Correlational analyses were used to examine the relationship between the BASC-EXT (parent and teacher), BRIEF indexes (parent and teacher. Considering parent ratings, the BASC-

EXT-P was significantly correlated with all parent-rated BRIEF indexes (i.e. BRIEF-GEC, BRIEF-BR, Brief-MI) but not with teacher rated variables. In reference to teacher ratings, the BASC-EXT-T was significantly correlated with all teacher-rated BRIEF-indexes ranging from .32 (BRIEF-MI-T) to .58 (BRIEF-BR-T). See Table 2 for correlational analysis.

Discriminant Analyses

A series of discriminant analyses was used to assess the usefulness of using the BRIEF and BASC together to classify ADHD and no-ADHD groups as well as ADHD-C and ADHD-I groups. Discriminant function (DF) analyses, predicting first ADHD and no-ADHD groups and then ADHD subtypes, was conducted using a Leave One Out estimator (L-O-O). Using this method cross-validation is done by classifying each case according to functions derived from all cases other than that case.

Prediction of ADHD vs. no-ADHD

In order to explore the individual and combined influence of the BRIEF and BASC in classifying ADHD versus No-ADHD, discriminant analyses were completed in a sequential manner, with the researcher determining the order of entry for predictors, and using ADHD/No-ADHD as the grouping variable. See Table 3 for classification rates for the ADHD versus no-ADHD discriminant analyses. In the first model (A1), the BASC-EXT parent rating scale score was entered. The model was not significant (Wilks' $\lambda = .99, p = .24$) and 55.7% of cases were correctly classified. The second model (A2) included only the BRIEF-GEC parent rating scale as a predictor. This model was significant (Wilks' $\lambda = .95, p = .01$) and resulted in 62.6% correct classification.

Finally, both scales (BASC-EXT and BRIEF-GEC) were entered together. Although this 3rd model (A3) was significant (Wilks' $\lambda = .94, p = .04$), the percentage of correctly classified

cases dropped to 60.9% as compared to model A2. As can be seen in Table 2, model A2 (BRIEF-GEC) resulted in the highest overall classification rate; however for the percentage of cases correctly classified was very similar for all three models. Taking all factors into account, the BRIEF-GEC had the strongest discriminatory power among the parent rating scales considered in classifying ADHD vs. No-ADHD.

Discriminant analyses were completed in a sequential manner with ADHD/No-ADHD as the grouping variable utilizing teacher rating scales. In the first model (B1), the BASC-EXT teacher rating scale score was entered. The model was significant (Wilks' $\lambda = .87, p < .001$) and 68.7% of cases were correctly classified. The second model (B2) included only the BRIEF-GEC teacher rating scale as a predictor. This model was again significant (Wilks' $\lambda = .85, p < .001$) and resulted in 63.5% correct classification. Finally, both scales (BASC-EXT and BRIEF-GEC) were entered together. The combined model (B3) was also significant (Wilks' $\lambda = .81, p < .001$), with 67.8% of cases classified correctly. As can be seen in Table 3, model B1 (BASC-EXT) resulted in the highest overall classification rate; however, the percentage of cases correctly classified was very similar for all three models. Contrary to predictions, combining the BASC-2 EXT scale with the BRIEF-GEC scale did not result in greater discrimination between groups.

Prediction of ADHD subtype

BRIEF-BR. In order to explore the individual and combined influence of the BRIEF-BR and BASC-EXT in classifying ADHD subtypes, discriminant analyses were conducted in a sequential manner with ADHD subtype (Combined, Inattentive, No-ADHD) as the grouping variable.

In the first model (C1), the BASC-EXT parent rating scale score was entered. The model was significant (Wilks' $\lambda = .94, p = .038$) and 33% of cases were correctly classified. The second

model (C2) included only the BRIEF-BR parent rating scale as a predictor. This model was also significant (Wilks' $\lambda = .92, p = .009$) and resulted in 41.7% correct classification. Finally, both scales (BASC-EXT and BRIEF-BR) were entered together. The combined model (C3) was also significant (Wilks' $\lambda = .92, p = .04$), although the percentage of correctly classified cases dropped to 36.5%. As can be seen in Table 4, model C2 (BRIEF-BR) resulted in the highest overall classification rate; classification rates, however, were very similar for all three models.

Analyses were completed in the same manner utilizing teacher rating scales.

Discriminant analyses were conducted in a sequential manner with ADHD subtype (Combined, Inattentive, No-ADHD) as the grouping variable. In the first model (D1), the BASC-EXT teacher rating scale score was entered. The model was significant (Wilks' $\lambda = .85, p < .001$), and 60.9% of cases were correctly classified. The second model (D2) included only the BRIEF-BR teacher rating scale as a predictor. This model was also significant (Wilks' $\lambda = .94, p = .03$) and resulted in 48.7% correct classification. Finally, both scales (BASC-EXT and BRIEF-BR) were entered together. The combined model (D3) was also significant (Wilks' $\lambda = .84, p = .001$) with 60.0% of cases correctly classified. As can be seen in Table 4, model D1 (BASC-EXT) resulted in the highest overall classification rate. Taking all factors into account, models D1 and D3 had similar discriminatory power when using teacher rating scales in classifying ADHD subtypes.

BRIEF-MI. In order to explore the individual and combined influence of the BRIEF-MI and BASC in classifying ADHD subtypes, discriminant analyses were conducted in a sequential manner with ADHD subtype (Combined, Inattentive, No-ADHD) as the grouping variable. In the first model (E1), the BASC-EXT parent rating scale score was entered. The model was significant (Wilks' $\lambda = .94, p = .038$), and 33% of cases were correctly classified.

The second model (E2) included only the BRIEF-MI parent rating scale as a predictor. This model was also significant (Wilks' $\lambda = .94, p = .03$), and resulted in 36.5% correct classification. Finally, both scales (BASC-EXT and BRIEF-MI) were entered together. The combined model (E3) was also significant (Wilks' $\lambda = .88 = .005$), and the percentage of correctly classified cases increased to 46.1%. As can be seen in Table 4, the combined model (BASC-EXT x BRIEF-MI) resulted in the highest overall classification rate. As hypothesized, the combined model had the strongest discriminatory power when using parent rating scales in classifying ADHD subtypes.

Analyses were completed in the same manner utilizing teacher rating scales. Discriminant analyses were conducted in a sequential manner with ADHD subtype (Combined, Inattentive, No-ADHD) as the grouping variable. In the first model (F1), the BASC-EXT teacher rating scale score was entered. The model was significant (Wilks' $\lambda = .85, p < .001$), and 60.9% of cases were correctly classified. The second model (F2) included only the BRIEF-MI teacher rating scale as a predictor. This model was also significant (Wilks' $\lambda = .80, p < .001$) and resulted in 43.5% correct classification. Finally, both scales (BASC-EXT and BRIEF-MI) were entered together. The combined model (F3) was also significant (Wilks' $\lambda = .72, p < .001$) with 57.4% of cases correctly classified. As can be seen in Table 4, model F1 (BASC-EXT) resulted in the highest overall classification rate. However, model F3 (BASC-EXTx BRIEF-MI) had a lower Wilk's Lambda, with only a slightly lower percent of cases categorized correctly.

Additional Analyses

The planned analyses considered the predictive value of the BASC-2 and BRIEF scales individually and in combination for each rater (parent and teacher) separately. The following analyses considered the combined influence of parent and teacher ratings for each measure

individually and then in combination. Specifically, three discriminant analyses were conducted to examine the predictive value of 1) parent and teacher BASC-EXT only; 2) parent and teacher GEC only; 3) parent and teacher BASC-EXT and BRIEF-GEC together. If indeed the combination of the BASC-2 and BRIEF subscales provides greater predictive value than either scale alone, it was predicted that the third model (combined BASC-2 and BRIEF parent and teacher scales) would provide the highest classification rate.

ADHD vs. No-ADHD. Discriminant analyses were completed in a sequential manner with ADHD/No-ADHD as the grouping variable, utilizing parent and teacher BASC-EXT and BRIEF-GEC. In the first model (G1), the BASC-EXT parent and teacher rating scales were entered. The model was significant (Wilks' $\lambda = .87, p < .001$), and 66.1% of cases were correctly classified. The second model (G2) included the BRIEF-GEC parent and teacher rating scale as a predictor. This model was again significant (Wilks' $\lambda = .81, p < .001$) and resulted in 65.2% correct classification. Finally, parent and teacher ratings on both scales (BASC-EXT and BRIEF-GEC) were entered together. The combined model (G3) was also significant (Wilks' $\lambda = .75, p < .001$), with 68.7% of cases classified correctly. As predicted, the Combined model (G3) resulted in the highest overall classification rate

ADHD Subtypes. Similar to the above analyses, a series of discriminant analyses were conducted to assess the relative predictive value of BRIEF parent and teacher scales, BASC-2 parent and teacher scales, and both BRIEF and BASC-2 parent and teacher scales in assessment of subtypes of ADHD. In the first model (H1), the BASC-EXT parent and teacher rating scales were entered. The model was significant (Wilks' $\lambda = .81, p < .001$), and 43.5% of cases were correctly classified. The second model (H2) included the BRIEF-GEC parent and teacher rating scale as a predictor. This model was again significant (Wilks' $\lambda = .81, p < .001$) and resulted in

48.7% correct classification. Finally, parent and teacher ratings on both scales (BASC-EXT and BRIEF-GEC) were entered together. The combined model (H3) was also significant (Wilks' $\lambda = .69, p < .001$), with 55.7% of cases classified correctly. As predicted, the Combined model (H3 in Table 3 resulted in the highest overall classification rate.

CHAPTER 4

DISCUSSION

Attention-Deficit Hyperactivity Disorder (ADHD) is one of the most common presenting issues in child outpatient clinics (Barkley, 1997). Effective and efficient assessment of ADHD is imperative as the number of children referred for evaluation grows while time available for assessment is reduced due to rising costs of health care. Best practices in assessing for ADHD suggest a multi-rater/multi-method approach (Barkley, 1997; American Academy of Pediatrics, 2000). Behavior rating scales such as the Behavior Assessment System for Children-2 (BASC-2) provide information about internalizing and externalizing behavior yet do not provide specific information about executive functions associated with attention deficit/hyperactivity disorder. There is a discrepancy between accepted models of ADHD, which highlight the role of executive function deficits in those with ADHD, and performance based measures that do not consistently discriminate between ADHD and no-ADHD in clinical groups.

The Behavior Rating Inventory of Executive Function (BRIEF) is a behavior rating scale which enables clinicians to gain an understanding of cognitive neuropsychological functioning in children in a time and cost effective manner (Gioia et al., 2000). The purpose of this study was to assess whether using the BRIEF in combination with the BASC-2 would better discriminate ADHD from no-ADHD within a clinical population than either measure alone. This study also sought to test whether the combination of specific scales from these two measures was able to discriminate between subtypes of ADHD.

Contrary to prediction, the combination of the BRIEF and BASC-2 scales did not better discriminate between ADHD and no-ADHD when taking parent and teacher ratings into account separately. The first hypothesis posited that a combination of the BRIEF-GEC and BASC-EXT (parent forms) would better discriminate ADHD from no-ADHD than either scale individually. This hypothesis was not supported as analyses revealed that the BRIEF-GEC-P was the best discriminator when compared to the BASC-EXT-P individually and the two scales together. The discriminatory power of the BRIEF-GEC-P was actually reduced when the BASC-EXT-P was added to the model, as the BASC-EXT-P alone was not a significant predictor.

The second hypothesis stated that a combination of the BASC-EXT and BRIEF-GEC (teacher forms) would better discriminate ADHD from no-ADHD than either scale individually. Similarly to the analyses involving parent rating forms, the combination did not end up discriminating more successfully than the individual scales. While all three models (BASC-EXT, BRIEF-GEC, BASC-EXT x BRIEF-GEC) were significant, the BASC-EXT had a slightly higher classification rate as compared to the combination of measures and the BRIEF-GEC alone.

It was also predicted that the combination of the BRIEF Behavioral Regulation Index (BR) with the BASC-EXT (parent scales) would better classify ADHD subtypes than either scale individually. Similar to the ADHD versus No-ADHD analyses, the combination of measures did not yield the best results. The BRIEF-BR-P yielded better classification accuracy than the BASC-EXT-P or a combination of the two measures. Similarly, the prediction that the combination of the BRIEF-BR and BASC-EXT (teacher scales) would better classify ADHD subtypes was also not supported. The BASC-EXT-T and combination of the BRIEF and BASC yielded similar results when taking classifications rates and Wilks' Lambda into account.

The lack of support for these hypotheses may be due to reliance on a single rater (e.g., parent or teacher) in the analyses. An examination of the parent versus teacher means on the BRIEF and BASC scales (See Table 1) shows that parents ranked children higher on the BASC-EXT and teachers rated children higher on the BRIEF-GEC scales. These findings would seem to support situation specific behavior, perhaps prompted by situation specific demands (i.e. more executive function demands in school setting), which contributes to rater discrepancies in child behavior ratings (i.e., Dirks et al, 2012). Further examination of parent and teacher means on the two measures shows that the highest overall mean score was on the BRIEF-MI-T (69.14) whereas the lowest mean was on the BASC-EXT-T (59.75), suggesting teachers may have had the most opportunity to observe MI related behaviors and the least opportunity to observe externalizing behaviors. Means for parent ratings on the two scales fell between these two values. The BRIEF-MI relates to a child's ability to problem solve as well as many skills often required in the school setting which may not be as commonly required outside of school. Thus, it is not surprising teachers endorsed more difficulties on the BRIEF-MI scale than parents.

However, teachers also tended to rate lower levels of externalizing behavior on the BASC-2 as compared to parents. In fact, more than 50% of children in the total sample were rated in the clinical range in terms of externalizing behavior by parents, whereas only 31% of children were in the clinical range for externalizing behavior based on teacher ratings.

Clinical significance on the BASC-2 scales is defined as a t-score at or above 70. Teachers rated 23.4% of children in the ADHD group in the clinical range; children in the no-ADHD group were rated by teachers in the clinical range 7.8% of the time. Alternatively, parents rated children in the ADHD group in the clinical range 29.1% of the time and rated children in the no-ADHD group in the clinical range for externalizing behavior 27.5% of the

time. These percentages would suggest that teacher endorsement of externalizing behavior in the clinical range was very likely to predict membership in the ADHD-group, whereas parent endorsement of externalizing behavior in the clinical range was less likely to predict membership in the ADHD group.

It was also predicted that utilizing a combination of the BASC-EXT and the BRIEF-MI (parent scales) would better predict subtypes of ADHD than either scale individually. This hypothesis was supported when considering parent ratings, as the combination of scales resulted in a classification rate that was almost 10-13% higher than the models using each scale individually. However, when considering teacher ratings, the combination of the BASC--EXT and BRIEF-MI did not result in a higher classification rate than the BASC-EXT scale. While the combination was more effective when using parent ratings, the overall classification rate was still poor (46.1%) and only slightly higher than the lowest classification rate for teacher scales (BRIEF-MI-T, 43.5%).

Jarrat et al (2005) found that the BRIEF and BASC appear to measure similar but separate constructs. Considering the pattern of correlations between the subscales on the two measures in the present study (see Table 2), the BASC-EXT and BRIEF-BR are strongly correlated for both parent (.75) and teacher (.58) ratings, suggesting the two scales are measuring a similar construct, likely resulting in less benefit when the two are combined. The BASC-EXT is less strongly correlated with the BRIEF- MI scale. Thus, the combination of the BRIEF-MI and BASC-EXT may improve classification rates since they appear to measure more distinct constructs.

Given the likelihood that parent and teacher ratings in combination better capture situation specific behavior, additional analyses were conducted to consider the combined

influence of parent and teacher ratings on each measure separately, and then in combination. As predicted, the combination of parent and teacher ratings on both measures resulted in a higher classification rate as compared to parent and teacher ratings for each measure separately.

However, the classification rate for the combined model (both rater and both measures) was only slightly higher than the classification rates for parent and teacher ratings combined for each measure individually.

In addition, the combined model predicting ADHD vs. No-ADHD had the same classification rate (68.7%) as the BASC-EXT-T by itself. This was also the highest classification rate found across all the analyses conducted. Similarly, when considering ADHD subtype, the combined model (both raters, both measures) had a slightly higher classification rate than parent and teacher ratings for each measure separately. However, the combined classification rate (55.7%) was lower than the classification rate produced by the BASC-EXT-T by itself (60.9%).

As the BASC-EXT measures externalizing behaviors, it is likely particularly sensitive to differentiating between the ADHD-C and ADHD-I groups. Given that the research diagnosis for this study required evidence of impairment in more than one setting, cases in which teachers endorsed higher externalizing behavior (as opposed to parents only endorsing higher externalizing behavior) were very likely to end up in the ADHD diagnosis group. Thus, when examining ratings from one source (parent or teacher), the scale less commonly elevated (i.e. BASC-EXT by teacher) tended to have a higher percentage of correctly diagnosed of each group.

The results of the present study are somewhat consistent with the American Academy of Pediatrics guidelines recommending the use of multiple raters in assessment of ADHD, as the combination of parent and teacher ratings for each measure separately was consistently higher than parent ratings alone using both measure in combination. This suggests that multiple raters

produce greater classification accuracy than multiple measures with the same rater. However, the classification rates for parent and teacher combined were not higher than the classification rate for teacher ratings alone on the BASC-EXT scale. This may be a finding specific to this study, due to the high frequency that parents rated externalizing behavior.

In terms of ADHD subtypes, the BASC-EXT and BRIEF-BR did a better job of discriminating those diagnosed with ADHD-C, whereas the BRIEF-MI had a higher rate of success for those diagnosed with ADHD-I (See Table 4). These results are consistent with Barkley's (1997) model of ADHD which asserts children with ADHD-C have different primary deficits in executive function than those with ADHD-I. Specifically, it is to be expected that those with the inattentive type of ADHD should be distinguished more readily by a scale measuring metacognitive skills than one measuring behavior dysregulation, as this is more indicative of specific executive function deficits associated with ADHD-I.

Clinical Implications

This study examined the usefulness of the BRIEF and BASC-EXT in the diagnosis of ADHD since there has been little research concerning the diagnostic utility of combining these two rating scales. In the DSM-V, ADHD has been moved to the category of neurodevelopmental disorders. As the diagnostic category now reflects this pathway, it is important for evaluative protocols to do so as well. Rating scales provide a time and cost efficient means of gathering information for assessment. Minimal support was found for the combination of the BRIEF and BASC-EXT in this study. While results were not in support of hypotheses, the findings from this study may be useful in better understanding what particular scales from the BRIEF in conjunction with the BASC-EXT may be helpful in ADHD assessment.

In addition, results of this study support recommendations for multiple raters in assessment of ADHD. Present results particularly support the importance of including teacher ratings when assessing for ADHD, as teacher ratings on the BASC-EXT scale resulted in the highest classification rate. The present findings further suggest the BASC-2 may be a more useful measure of ADHD than the BRIEF, although additional research is needed to support this premise.

Consistent with previous research, classification rates were greater for both measures when distinguishing ADHD from no-ADHD than when determining subtypes. This finding suggests that rating scales such as the BASC or BRIEF may be useful for ruling in or ruling out ADHD, whereas other types of information, such as the diagnostic interview, may be needed to distinguish ADHD subtype.

Some support was found for the sensitivity of particular scales from the BRIEF in assessing varying types of ADHD (e.g. BR for ADHD-C, MI for ADHD-I), which could help direct a clinician to specific scales when considering differential diagnosis. For example, the BRIEF-MI scale appears to be more sensitive to those with the inattentive type of ADHD. For example, a clinician may benefit from utilizing the BASC-EXT to identify the presence of ADHD and the MI-scale, along with a clinical interview, may help provide clarification about the type.

Limitations

The research diagnosis process used in the present study likely had a significant impact on the results. In order to reduce the influence of possible rater bias, it was required that children met the impairment cut-off score in at least one parent rated area (i.e. peer relationships, sibling relationship, family relationship, learning/academic performance, child self-esteem) and one

teacher rated area (i.e. peer relationships, teacher-student relationship, learning/academic performance). While this assured that both raters acknowledged there was some sort of impairment due to symptoms of ADHD, it likely filtered some children into the no-ADHD category when they, in fact, may have met criteria for ADHD according to rating scales and displayed impairment in multiple areas within the same setting (i.e. impairment at school in relationship with peers and ability to complete school work).

In fact, 31% (16) of cases diagnosed as no-ADHD ($n = 51$) would have met criteria for impairment based on parent ratings alone (i.e. met impairment in 2 or more areas of functioning), whereas only 8% (4) would have met criteria based solely on teacher ratings. Multiple studies have found low parent-teacher agreement about symptoms of ADHD. This study had the added difficulty that referrals to the clinic were made over the course of the school year, which may have influenced teacher ratings in particular. For example, teachers may have rated lower levels of impairment earlier in the school versus later in the school year after they became more familiar with the child's typical behavior.

Another limitation of the current study is the use of the BASC-EXT scale rather than a combination of the externalizing and internalizing scales. While the most consistent support was found in utilizing the BASC-EXT scale in previous research (i.e. Jarrat et. al, 2005), it may have been beneficial to consider the BASC Internalizing scale as well as perhaps the ADHD-specific subscales (i.e., Attention Problems, Hyperactivity scales). This may have been particularly important when identifying ADHD subtypes, considering there was some support in the current study for the use of particular BRIEF subscales in identifying subtypes (i.e. BRIEF-MI for ADHD-I).

A final limitation of this study involves the generalizability of results as there was a lack of diversity among participants. The majority of children in this sample were Caucasian and from families with a yearly income of less than \$30,000 (59%). Another factor that must be taken into consideration is the lack of diversity among raters which may have influenced perceptions of child behavior. Parent ratings were predominantly from mothers (versus fathers or other caretakers) who were mainly Caucasian and living in low-to-moderate income households. Although information about the ethnicity of teachers that provided ratings used in this study was not available, it is estimated that the majority of teachers were Caucasian, based upon census data for the area in which the data was collected. The vast majority of teachers that provided ratings were also female.

Future Research

Future research should continue to consider the usefulness of the combination of the BRIEF and BASC-2 while addressing some of the limitations noted in this study. For example, it may be useful for future research to examine multiple scales from the BASC-2 in combination with scales from the BRIEF, from both parents and teacher, to further consider the best combination of specific parent and teacher-rated scales. Additionally, utilizing the full spectrum of scales in future research may be useful in gaining knowledge about comorbid diagnoses and differential diagnoses.

It may also be useful for future studies to use a different method of diagnostic classification to avoid the potential confound of rater bias and rater differences on different types of measures. A common method of diagnostic classification for research purposes is to base diagnosis on a structured diagnostic interview conducted by an individual with clinical expertise who is not familiar with the hypotheses of the study. In addition, consideration of impairment

across raters and settings (i.e. peer relationship, parent relationship, academic/learning, etc.) rather than across areas (i.e. home, school) or rater (i.e. parent, teacher) is suggested.

Finally, future consideration should be taken to utilize a more diverse sample, including participants of various cultures and races, ratings from both mothers and fathers, and ratings from a more diverse group of teachers. Previous studies (de Ramirez & Shapiro, 2005; Epstein et. al, 2005) have found that ethnicity (child) has an effect on ratings of ADHD in that children from minority cultures tend to be rated higher on scales measuring ADHD-type behaviors. Parent and teacher discrepancies were also seen in some analyses in this study. It may be useful for future research to consider ethnic and/or parent-teacher discrepancies when examining what combination of raters and scales best differentiate ADHD from no-ADHD as well as subtypes.

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APPENDIX A: DIAGNOSTIC CRITERIA FOR ADHD (DSM-IV-TR)

A. Either (1) or (2)

- (1) Six (or more) of the following symptoms of **inattention** have persisted for at least 6 months to a degree that is maladaptive and inconsistent with developmental level:

Inattention

- (a) Often fails to give close attention to details or makes careless mistakes in schoolwork, work, or other activities
 - (b) Often has difficulty sustaining attention in tasks or play activities
 - (c) Often does not seem to listen when spoken to directly
 - (d) Often does not follow through on instructions and fails to finish schoolwork, chores, or duties in the workplace (not due to oppositional behavior or failure to understand instructions)
 - (e) Often has difficulty organizing tasks and activities
 - (f) Often avoids, dislikes, or is reluctant to engage in tasks that require sustained mental effort (such as schoolwork or homework)
 - (g) Often loses things necessary for tasks or activities (e.g. toys, school assignments, pencils, books, or tools)
 - (h) Is often easily distracted by extraneous stimuli
 - (i) Is often forgetful in daily activities
- (2) Six (or more) of the following symptoms of hyperactivity-impulsivity have persisted for at least 6 months to a degree that is maladaptive and inconsistent with developmental level:

Hyperactivity

- (a) Often fidgets with hands or feet or squirms in seat
- (b) Often leaves seat in classroom or in other situations in which remaining seated is expected
- (c) Often runs about or climbs excessively in situations in which it is inappropriate (in adolescents or adults, may be limited to subjective feelings of restlessness)
- (d) Often has difficulty playing or engaging in leisure activities quietly
- (e) Is often “on the go” or often acts as if “driven by a motor”
- (f) Often talks excessively

Impulsivity

- (g) Often blurts out answers before questions have been completed
 - (h) Often has difficulty awaiting turn
 - (i) Often interrupts or intrudes on others (e.g., butts into conversations or games)
- B. Some hyperactive-impulsive or inattentive symptoms that caused impairment were present before age 7 years
 - C. Some impairment from the symptoms is present in two or more settings (e.g., at school [or work] and at home).
 - D. There must be clear evidence of clinically significant impairment in social, academic, or occupational functioning.
 - E. The symptoms do not occur exclusively during the course of a Pervasive Developmental Disorder, Schizophrenia, or other Psychotic Disorder and are not better accounted for by another mental disorder (e.g. Mood Disorder, Anxiety Disorder, Dissociative Disorder, or Personality Disorder).

Code based on type:

314.01 Attention-Deficit/Hyperactivity Disorder, Combined Type:

if both Criteria A1 and A2 are met for the past 6 months

314.00 Attention-Deficit/Hyperactivity Disorder, Predominantly Inattentive Type: If Criterion A1 is met but Criterion A2 is not met for the past 6 months

314.01 Attention-Deficit/Hyperactivity Disorder, Predominantly Hyperactive-Impulsive Type: If Criterion A2 is met but Criterion A1 is not met for the past 6 months

APPENDIX B: ATTENTION DEFICIT HYPERACTIVITY DISORDER RATING SCALE-IV

Sample Items from the ADHD Rating Scale-IV

Rating scale: 0-Never or Rarely, 1-Sometimes, 2-Often, 3-Very Often

1. Fails to give close attention to details or makes careless mistakes in schoolwork
2. Fidgets with hands or feet or squirms in seat
9. Has difficulty organizing tasks or activities
10. Is “on the go” or acts as if “driven by a motor”

APPENDIX D: BEHAVIOR RATING INVENTORY OF EXECUTIVE FUNCTION (BRIEF)

Sample Items from Behavior Regulation and Metacognitive Indices

Rating Scale: N=Never; S=Sometimes; O=Often

Behavioral Regulation Index

- 8. Tries the same approach to a problem over and over even when it does not work
- 20. Becomes tearful easily
- 38. Acts wilder or sillier than others in groups (birthdays, parties, recess)
- 62. Angry or tearful outbursts are intense but end suddenly

Metacognitive Index

- 14. Does not check work for mistakes
- 18. Does not connect doing tonight's homework with grades
- 57. Has trouble remembering things even for a few minutes
- 71. Lies around the house a lot ("couch potato")

APPENDIX E: BEHAVIOR ASSESSMENT SYSTEM FOR CHILDREN-2

Sample items from the BASC-2 Externalizing Problems Subscale

- 6. Cannot wait to take turn
- 38. Disrupts other children's activities
- 84. Is overly active
- 148. Has poor self control

TABLE 1. PARTICIPANT DEMOGRAPHIC INFORMATION

	ADHD-I (N=10)		ADHD-C (N=54)		No-ADHD (N=51)		Overall (N=115)
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>
FSIQ	96.60	7.55	94.35	12.57	96.96	10.24	95.70
Age (yrs)	8.59 ^{ba}	2.11	7.16 ⁿ	1.40	7.36	1.49	7.38
BASC-EXT (Parent)	56.40	11.03	67.43	13.35	62.55	14.92	64.30
BASC-EXT (Teacher)	57.40	12.33	65.17 ^a	10.99	54.47 ^b	13.33	59.75
BRIEF-GEC (Parent)	65.90	10.71	68.98 ^c	11.20	63.22 ^b	10.84	66.16
BRIEF-GEC (Teacher)	73.20	5.07	71.65	11.68	62.69	11.03	67.81
BRIEF-BR (Parent)	56.00 ^b	13.06	66.93 ^{ac}	12.43	60.92 ^b	12.45	63.31
BRIEF-BR (Teacher)	62.30	9.84	66.33 ^c	12.94	59.47 ^b	14.04	62.94
BRIEF-MI (Parent)	70.40	8.75	68.09 ^c	11.18	63.00 ^b	10.99	66.03
BRIEF-MI (Teacher)	62.30	4.50	73.06	10.60	63.45	11.09	69.14

Note. *M* = mean, *SD* = standard deviation, FSIQ = Full Scale Intelligence Quotient, BASC-EXT=Behavior Assessment System for Children-Externalizing Scale, BRIEF-GEC=Behavior Rating Inventory of Executive Function-Global Executive Composite, BRIEF-BR=BRIEF Behavior Regulation, BRIEF-MI=BRIEF Metacognitive Index, Different subscripts indicate significant group different at $p < .05$

Table 2. BASC-2 AND BRIEF PARENT AND TEACHER SCALE CORRELATIONS

Scales	EXT P	EXT T	BR P	MI P	GEC P	BR T	MI T	GEC T	FSIQ
EXT P	--								
EXT T	.18	--							
BR P	.75**	.14	--						
MI P	.39**	-.14	.56**	--					
GEC P	.61**	-.02	.84**	.92**	--				
BR T	.14	.58**	.17	-.08	.02	--			
MI T	.05	.32**	.00	.22*	.13	.51**	--		
GEC T	.14	.47**	.10	.12	.12	.79**	.90**	--	
FSIQ	-.10	.00	-.09	-.11	-.12	.10	-.12	-.14	--

Note. BASC-EXT=Behavior Assessment System for Children-Externalizing Scale, BRIEF-GEC=Behavior Rating Inventory of Executive Function-Global Executive Composite, BRIEF-BR=BRIEF Behavior Regulation, BRIEF-MI=BRIEF Metacognitive Index, P=Parent, T=Teacher, Y/N ADHD=ADHD/no-ADHD classification, Sub ADHD=ADHD subtype classification * $p < .05$, ** $p < .01$

TABLE 3. PERCENTAGE AND TOTAL NUMBER OF CHILDREN CORRECTLY CLASSIFIED ADHD/No-ADHD IN THE DISCRIMINANT ANALYSIS

Model	Rating Scale(s) Entered	No-ADHD (N=51)	ADHD (N=54)	Overall (N=115)
A1	BASC-EXT-P	60.8% (31)	51.6% (33)	55.7% (64)
A2	BRIEF-GEC-P	56.9% (29)	77.8% (43)	62.6% (72)
A3	BASC-EXT-P & BRIEF-GEC-P	56.9% (29)	64.1% (41)	60.9% (70)
B1	BASC-EXT-T	70.6% (36)	67.2% (43)	68.7% (79)
B2	BRIEF-GEC-T	66.7% (34)	60.9% (39)	63.5% (73)
B3	BASC-EXT-T & BRIEF-GEC-T	72.5% (37)	64.1% (41)	67.8% (78)
G1	BASC-EXT-P & BASC-EXT-T			66.1%
G2	BRIEF-GEC-P & BRIEF-GEC-T			65.2%
G3	BASC-EXT-P&T & BRIEF-GEC-P&T			68.7%

Note. BASC-EXT=Behavior Assessment System for Children-Externalizing Scale, BRIEF-GEC=Behavior Rating Inventory of Executive Function-Global Executive Composite, BRIEF-BR=BRIEF Behavior Regulation, BRIEF-MI=BRIEF Metacognitive Index, P=Parent, T=Teacher

TABLE 4. PERCENTAGES AND TOTAL NUMBER OF CHILDREN CORRECTLY CLASSIFIED BY ADHD SUBTYPE IN THE DISCRIMINANT ANALYSIS

Model	Rating Scale(s) Entered	No-ADHD (N=51)	ADHD-C (N=54)	ADHD-I (N=10)	Overall (N=115)
C1	BASC-EXT-P	7.8% (4)	53.7% (29)	50.0% (5)	33.0% (38)
C2	BRIEF-BR-P	17.6% (9)	61.1% (33)	60.0% (6)	41.7% (48)
C3	BASC-EXT & BRIEF-BR-P	11.8% (6)	57.4% (31)	50.0% (5)	36.5% (42)
D1	BASC-EXT-T	60.8% (31)	66.7% (36)	2 (20.0%)	60.9% (69)
D2	BRIEF-BR-T	54.9% (28)	51.9% (28)	0% (0)	48.7% (56)
D3	BASC-EXT-T & BRIEF-BR-T	56.9% (29)	68.5% (37)	30.0% (3)	60.0% (69)
E1	BASC-EXT-P	7.8% (4)	53.7% (29)	50.0% (5)	33.0% (38)
E2	BRIEF-MI-P	54.9% (28)	14.8% (8)	60% (6)	36.5% (42)
E3	BASC-EXT & BRIEF-MI-P	49.0% (25)	38.9% (21)	70.0% (7)	46.1% (53)
F1	BASC-EXT-T	60.8% (31)	66.7% (36)	2 (20.0%)	60.9% (69)
F2	BRIEF-MI-T	62.7% (32)	22.2% (12)	60.0% (6)	43.5% (50)
F3	BASC-EXT & BRIEF-MI-T	58.8% (30)	53.7% (29)	70.0% (7)	57.4% (66)
H1	BASC-EXT-P & BASC-EXT-T				43.5%
H2	BRIEF-GEC-P & BRIEF-GEC-T				48.7%
H3	BASC-EXT-P&T & BRIEF-GEC-P&T				55.7%

Note. BASC-EXT=Behavior Assessment System for Children-Externalizing Scale, BRIEF-GEC=Behavior Rating Inventory of Executive Function-Global Executive Composite, BRIEF-BR=BRIEF Behavior Regulation, BRIEF-MI=BRIEF Metacognitive Index, P=Parent, T=Teacher