12-1-2017

Validity and Diagnostic Accuracy of Broad Symptom Measures and ADHD Symptom Ratings for Identifying Individuals with ADHD Combined and ADHD Inattentive

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By

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Bachelor of Science – Psychology
Virginia Polytechnic Institute & State University
2011

A thesis submitted in partial fulfillment
of the requirements for the

Master of Arts – Psychology

Department of Psychology
College of Liberal Arts
The Graduate College

University of Nevada, Las Vegas
December 2017

UNLV | GRADUATE COLLEGE

Thesis Approval

The Graduate College
The University of Nevada, Las Vegas

August 9, 2017

This thesis prepared by

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entitled

VALIDITY AND DIAGNOSTIC ACCURACY OF BROAD SYMPTOM MEASURES AND ADHD SYMPTOM RATINGS FOR IDENTIFYING INDIVIDUALS WITH ADHD COMBINED AND ADHD INATTENTIVE

is approved in partial fulfillment of the requirements for the degree of

Master of Arts – Psychology
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Abstract

Neuropsychological assessments conducted with children with Attention Deficit Hyperactivity Disorder (ADHD) often includes broad measures of behavioral disturbances, as well as specific measures of ADHD symptomatology. However, it is unclear the extent to which these two types of measures share substantial common variance or are useful in improving diagnostic accuracy. In efforts to increase efficiency, the current study examined these matters to provide clinicians with information that might help improve the selection of behavioral ratings for evaluation purposes.

Participants included in this study were evaluated for clinical purposes at a community based private practice. Participants included 253 of these children diagnosed with ADHD-Inattentive (n=163) or ADHD-Combined (*n*=90). Children were an average of 10.4 years old (range = 6 – 16 years, *SD*=2.9), 70.4% male, and had an average Full Scale IQ of 98.7 (*SD* = 12.7). ADHD diagnoses were established through comprehensive evaluations, including administration of the Behavior Assessment System for Children, Second Edition (BASC-2) and DSM–IV ADHD Symptom Rating Scale (SRS).

Convergent and discriminate validity were examined between the respective mothers' ratings of Attention Problems/Inattention and Hyperactivity on the BASC-2 and SRS parent ratings by correlating the SRS and BASC-2 scores. Examination of the pattern of the correlations provides direct evidence for the convergent and discriminant validity of the SRS. Receiver Operating Characteristic (ROC) analysis was used to determine differences in sensitivity and specificity when the BASC-2 and SRS scores were used to differentiate ADHD Inattentive and Combined subtypes. Results indicated that SRS Impulsivity, SRS Hyperactivity, and BASC-2 Hyperactivity had significantly better classification accuracy than BASC-2 Attention Problems and SRS Inattention, although they did not differ from each other. Finally, mixed model

repeated measures ANOVA's were conducted to identify if there were significant interactions between ADHD Inattentive and Combined subtypes and the BASC-2 and SRS scores. Results of the analyses indicated the presence of significant interaction effects for the SRS and BASC-2 that were accounted for by both ADHD subtypes receiving similar scores on inattention but the Combined subtype demonstrating higher impulsivity and hyperactivity scores than the Inattentive subtype.

Results of the current study support using the BASC-2 and SRS in the evaluation of children of ADHD. Both measures appear to be sensitive to differences in symptomatology based on ADHD Inattentive and Combined subtypes. Both subtypes had elevated scores on ratings of inattention, although children who are diagnosed with ADHD inattentive subtype received lower scores on ratings of hyperactivity and impulsivity. These data suggest that scores reflecting hyperactive and impulsive symptoms from the SRS and BASC-2 have greater predictive discrimination than scores reflecting inattentive symptoms when diagnosing ADHD Combined and ADHD Inattentive subtypes.

From a clinical perspective, these results suggest that the selection of behavioral rating scales to evaluate children with ADHD should be guided by the reason for referral. In cases where the primary referral question is to establish a diagnosis of ADHD, the ADHD-SRS may be more efficient as its items map directly on DSM symptoms used to make a diagnosis of ADHD.

When a broader assessment of cognitive and behavior disturbances are required, the BASC-2 not only provides measures of inattention and hyperactivity, but additional information on behavioral disturbances that commonly occur in ADHD and are important for treatment and educational planning. Both scales may be used together when diagnostic questions and more general assessment is needed.

Acknowledgments

I would like to extend my sincerest appreciation to my committee chair and advisor, Dr. Daniel Allen, for his support and mentorship throughout this process. I would also like to thank my committee members, Drs. Paul, Freeman, and Putney for their time and meaningful contributions. Also, thank you to my fellow lab members for their hard work and dedication to complete this project. Lastly, I would like to thank my family and friends for their encouragement and emotional support throughout my academic pursuits.

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Chapter 1: Introduction

Attention Deficit Hyperactivity Disorder (ADHD) is a neurodevelopmental disorder defined by a persistent pattern of behaviors, which include inattention, hyperactivity, and impulsivity that interferes with functioning or development (American Psychiatric Association [APA], 2013). Children with ADHD are often referred for psychoeducational and neuropsychological evaluations in order to confirm diagnosis of ADHD and provide information about the nature and severity of cognitive and behavioral disturbances that might interfere with performance at school and in other environments. Because behavior is a primary consideration in the diagnosis of ADHD, it is commonplace for these evaluations to include behavioral rating scales designed to assess the severity of ADHD symptoms of inattention, hyperactivity and impulsivity, as described in the DSM-V, as well as other behavioral disturbances.

ADHD symptoms have historically been grouped according to three general constructs that include inattention, impulsivity, and hyperactivity (Glutting et al., 2005; Parke et al., 2015). Assessment may be informal and rely on data gained through clinical interviews with parents or teachers in order to make a diagnosis. Alternatively, more structured approaches may be used such as questionnaires or rating scales that are completed by teachers or parents and provide severity ratings for each of the 18 symptoms described in the DSM. This information is primarily used for diagnostic purposes but may also provide insights into behavioral disturbances that impair functioning at school, in the home, and with peers.

Among these assessment techniques, it is quite common for behavior to be assessed using behavioral rating scales such as the Behavior Assessment System for Children (BASC-2). Because of the prevalence of attentional disturbances, hyperactivity, and impulsivity across many psychiatric and neurodevelopmental disorders, these scales often include ratings for these

symptoms. They generally provide a much more comprehensive assessment of behavior than is required to make a diagnosis of ADHD. For example, the BASC-2 includes ratings for negative behaviors such as depression, anxiety, aggression and somatization (among others), as well as ratings for positive behaviors such as leadership, social skills, functional communication, and adaptability. Thus, behavior rating scales like the BASC-2 may be used to inform diagnosis but a main goal in using them is to develop a comprehensive picture of the child's functioning.

More focused rating scales are also available that assist in identifying the key symptoms of ADHD based on DSM-IV criteria. Rather than providing more general characterization of overall functioning, these scales provide information that is particularly useful in making a diagnosis of ADHD. One such scale, the DSM-IV ADHD Symptom Rating Scale (SRS), is an 18-item scale adapted from the ADHD Rating Scale-IV (DuPaul, Power, Anastopoules, & Reid, 1998). The SRS can be completed by parents or teachers and its 18 items map directly onto the criteria A symptoms from the DSM-IV for ADHD. Of course, symptoms noted on scales such as the SRS may also assist in educational planning and supplement other broader assessment procedures, but they are expected to have particular utility for making a diagnosis.

Despite the common use of behavioral ratings in the evaluation of children with ADHD, associations between the scores obtained with these different types of behavioral ratings scales have not been extensively examined. One would expect that considerable overlap would occur between, for example, ratings of inattention used to establish a diagnosis of ADHD and ratings of attention disturbance that are made on a more comprehensive behavioral rating scale. It may be that if they do share substantial common variance, one might be substituted for the other in order to decrease time and increase the efficiency of the evaluation. Alternatively, it may be that each of these measure reflect unique aspects of functioning so that when used together, they

provide a fuller picture of the client. It may also be that the type of assessment selected is determined by the referral question. For example, when diagnosis is the primary reason for referral and there is some indication that ADHD is probable, clinicians may opt for a rating scale focusing on diagnostic criteria. Such a scale could be anticipated to have greater sensitivity and specificity than a more general behavioral rating scale. When limited information is available that would suggest a potential diagnosis or when there are broader concerns related to social or academic functioning, clinicians may select a more comprehensive behavioral rating scale as part of the assessment process.

Thus, the lack of information regarding relations between available scales commonly used to assess symptoms in children with ADHD limits understanding of selection and application of these scales to address specific referral questions. To address this issue, the current study will investigate diagnostic and behavioral ratings in a large sample of children with ADHD who were referred for neuropsychological evaluation because of parent or teacher concerns about their behavior. The study was designed to address the following research questions:

Do SRS scores demonstrate convergent and discriminant validity based on correlations with BASC-2 subscale scores?

Will anticipated differences be present between ADHD subtypes on the BASC-2 and SRS attention, hyperactivity and impulsivity scores?

Will the SRS demonstrate better classification accuracy for ADHD subtypes when compared to the BASC-2?

The results of the current study may influence the way psychoeducational and neuropsychological evaluations are conducted for children with ADHD, and provide valuable

information regarding the constructs that are assessed by diagnostic and behavioral ratings. To provide background information for the current study, the following sections include information on ADHD including the factor structure, diagnostic criteria, behavior rating scales used for diagnostic information, and hypotheses for the study.

Chapter 2: Literature Review

Attention Deficit/Hyperactivity Disorder (ADHD) is a neurodevelopmental disorder that interferes with functioning or development and affects approximately 5% of children (Polanczyk et al., 2007). It is a behavioral disorder characterized by a persistent pattern of behavioral disturbances that includes abnormally high levels of inattention, hyperactivity, and/or impulsivity (American Psychiatric Association [APA], 2013). Symptoms are considered to be present and meaningful if they exceed what is considered normative behavior of a child of the same age and cognitive level (Cantwell, 1996). In order to capture inattention and/or hyperactivity symptoms, the diagnostic process typically includes thorough interviews with the patient and parents, diagnostic tests, and an in-depth review of the patient's developmental history.

Psychoeducational and neuropsychological assessment conducted with children who have ADHD often includes behavioral ratings of symptoms specific to ADHD as well as ratings of other behavioral disturbances (e.g., depression, anxiety). In these evaluations, behavioral and symptom ratings scales are among primary assessment measures used to diagnose ADHD and serve as efficient tools for assessing current symptom severity (Volpe, Briesch, & Gadow, 2011). Rating scales also provide useful information in helping predict future outcomes, including academic achievement (Weyandt et al., 2013), aggressive behavior (Diamantopoulou, Rydell, Thorell, & Bohlin, 2007), and later development of socio-economic problems (Moffitt et al., 2011).

For a child to be diagnosed with ADHD, the behavioral disturbance must be to a degree that is out of normal range when compared to same-age children without ADHD. To meet diagnostic criteria, symptoms of inattention, hyperactivity, and/or impulsivity must persist for at least 6 months. Diagnosis and early intervention in children with ADHD is associated with better

long-term academic and occupational functioning outcomes (Moffitt & Melchior, 2007; Moffit et al., 2011). Previous research has also found that higher levels of ADHD symptoms were significantly related to difficulty with academic adjustment, study skills, and GPA as well as lower levels of career decision-making and self-efficacy (Moffitt & Melchior, 2007; Norwalk, Norvilitis & MacLean, 2009).

The latent structure of ADHD symptomatology has been a heavily debated issue among researchers, centering around whether symptoms are best categorized by two dimensions consisting of inattention and hyperactivity/impulsivity (Barkley, 2014; Bauermeister et al., 2012; DuPaul, Reid, Anastopoulos, Lambert, Watkins & Power, 2016; Reiersen & Todorov, 2013; Toplak et al., 2012), or into three distinct dimensions of inattention, hyperactivity and impulsivity. To the extent that behavioral ratings scales are used to make distinction between symptoms domains, this controversy has some relevance. It is unclear from prior factor analytic studies whether identification of two versus three symptoms domains reflect measurement characteristics inherent to the scales used to assess symptoms, differences in the types of analyses employed, or other methodological issues (see Parke et al., 2015). However, previous literature conducting exploratory and confirmatory factor analyses has often found three distinct symptom dimensions of inattention, hyperactivity, and impulsivity, (Amador-Campos, Forns-Santacana, Guàrdia-Olmos & Peró-Cebollero,2006; Hardy et al., 2007; Ryser, Campbell & Miller, 2010), which is also the case for the SRS (Parke et al., 2015). Evaluation of the psychometric properties of the SRS also revealed good internal consistency and discriminant validity (Mayfield et al., 2016).

Controversy also exists regarding the need to differentiate between ADHD subtypes. However, there is strong support that ADHD subtypes often present differently in clinical

settings (Parke et al., 2015). For example, children diagnosed with ADHD Combined subtype often have increased externalizing behaviors such as aggression and substance abuse (Hofvander et al., 2011; Wagner, 2012) while children with ADHD Inattentive subtype exhibited increased internalizing behaviors as well as neurocognitive deficits in the domains of processing speed (Goth-Owens, Martinez-Torteya, Martel, & Nigg, 2010), executive functioning (Willcutt et al., 2012), and fine motor skills (Egeland, Ueland, & Johansen, 2012).

In terms of comorbidity, children presenting with ADHD Combined are at increased risk for being diagnosed with Oppositional Defiant Disorder and Conduct Disorder than children with ADHD Inattentive subtype (Frick & Nigg, 2012). Children with predominantly inattentive symptoms are at increased risk for developing learning disorders and developing internalizing disorders such as anxiety and depression (Capdevila-Brophy et al., 2014). Furthermore, there are significant differences in functional impairment and treatment outcomes that warrant further investigation of ADHD subtypes.

Studies suggest children with a predominantly Combined presentation are more likely to have behavioral and social problems (Semrud-Clikeman, 2010) while those with a predominantly Inattentive subtype presentation demonstrate higher rates of social cognitive deficits (Maedgen & Carlson, 2000) and assertiveness (Solanto et al., 2009). Research has also found a positive association between an Inattentive subtype presentation and increased broad social functioning deficits, social withdrawal, and low leadership abilities (Marshall et al., 2014). Given the significant differences regarding clinical presentation, comorbidity, treatment recommendations, and neurocognitive functioning, it is informative to differentiate between ADHD subtypes. While the focus of the current paper is not to directly address the subtype controversy, results

that demonstrate differences in ADHD symptom profiles between subtypes could be viewed as indicating the subtypes distinctions are meaningful.

ADHD is frequently diagnosed by pediatricians and primary care providers, rather than by psychologists or psychiatrists (Langberg et al., 2008). One study reported that the American Psychiatric Association's DSM criteria were only used by 38% of the 3900 clinicians surveyed (Wasserman et al., 1999). It is presumed the other 62% based their diagnosis on a non-standardized form of assessment and clinical judgment. Relatedly, DSM criteria are often not used for diagnosis by primary care physicians. The common use of non-standardized assessment by physicians is likely related to the structure of the health care system, which does not adequately compensate primary care providers for extensive mental health evaluations. Therefore, there is little incentive for more extensive evaluations or follow-up care after assessment (Bussing et al., 1998; Goldman et al., 1998). In an effort to improve diagnostic accuracy and specificity, the American Academy of Pediatrics published practice guidelines suggesting that pediatricians should use DSM-IV based instruments and DSM-IV criteria when they conduct ADHD evaluations (Pliszka, 2007). The practice guidelines also aimed to reduce the rapid increase in prescribed stimulant medication to treat ADHD in children (Hoagwood, Kelleher, Feil & Comer, 2000).

Symptom ratings are highly weighted in diagnostic decisions as they are low-cost and efficient tools to gather information about a child's symptoms (Volpe, Briesch, & Gadow, 2011). Although parent rating scales are not the only diagnostic tool, parent-reported behavior ratings play a critical role in the diagnosis of ADHD because they assess behavior at home and at school (Barkley, 2015). Using multiple informants to obtain information is recommended when making a diagnosis of ADHD (Pliszka, 2007; Raiker et al, 2017). A

thorough review of ADHD symptoms in children and adolescents often includes obtaining rating scales from several sources, including the parent(s), teacher(s), and the child or adolescent. Significant differences have been found between parent and teacher ADHD behavior ratings (Burns et al., 2013; Burns, Servera, Bernard, Carrillo, & Geiser, 2014; Bussing et al., 2008; Shemmassian & Lee, 2012). While both informants are considered accurate, teacher and parent ratings may differ due to situational effects and differences in perception of the child's behavior (Gresham, Elliott, Cook, Vance, & Kettler, 2010; (Sigel, McGillicuddy-DeLisi, & Goodnow, 2014). For example, mothers often spend more time at home with children than fathers (Craig, 2006; Craig, 2011), and therefore may have a different perception on frequency and severity of ADHD symptoms (Parke, 2002; Phares, Lopez, Fields, Kamboukos, & Duhig, 2005).

Several factors are associated with variability in behavioral ratings, including the informants who provide the symptom ratings (teacher vs. parent), the setting in which the child is observed (classroom vs. home) and specificity of the rating scales to ADHD (Tripp, Schaughency & Clarke, 2006). Furthermore, Jarrett and colleagues (2016) found symptom rating scales that assess inattention separately from hyperactivity and impulsivity, such as the BASC-2 and SRS, provide increased diagnostic utility and validity when differentiating between ADHD subtypes.

Overestimates or underestimates of ADHD symptoms are likely to impact the probability that a child will be appropriately diagnosed (Mayfield et al., 2016). Research has found significant correlations between mother and father ratings of symptoms and that mothers' ratings are also significantly higher than fathers' ratings (Langberg et al., 2010). For example, mothers' higher ratings of inattention in their children is associated with

greater likelihood of a diagnosis of ADHD (Sollie et al., 2013), increased academic difficulties (Burns et al., 2008; Burns, de Moura, Beauchaine, & McBurnett, 2014), and differences in diagnosed ADHD subtype (Sollie et al., 2013). Parental perception of ADHD symptomatology has also been shown to significantly impact parent-child interactions (Johnston & Mash, 2001; Zisser & Eyberg, 2012). Specific to the current study, Langberg et. al found that parental agreement on ADHD symptom ratings were significantly lower than symptom ratings for broadband externalizing behaviors and oppositional defiant disorder. Since rating scales are often completed by mothers and fathers, it is critical for clinicians to consider the parent's gender when examining and utilizing ADHD symptom ratings in the diagnostic process.

Furthermore, the selection of evidence based assessment methods is critical for the evaluation of ADHD. Pelham and colleagues (2005) provided a selective review of the ADHD assessment literature and made a number of conclusions, including that rating scales designed to assess ADHD and that are completed by parents and teachers are the most efficient assessment methods. Brief rating scales for ADHD tend to be the most efficient and correlate well with DSM-based rating scales. Other empirically based procedures such as structured interviews do not appear to improve validity when added to ratings provided by parents and teachers. They argue that because DSM diagnosis does not impact treatment, time devoted to establishing a diagnosis should be limited and brief behavioral ratings scales, such as the SRS, may help increase efficiency during this phase of the evaluation.

Because ADHD is primarily diagnosed by ratings of behavior recorded on standardized behavioral rating scales, convergent validity of ratings from different scales is an important issue in assessment and diagnosis. Prior studies examining behavioral ratings scales have focused on

using scores to differentiate individuals with ADHD from normal control participants. While this type of comparison is important for establishing the overall validity and discriminant power of the tests when assessing ADHD, it is also important to understand how behavioral ratings might distinguish between various clinical populations, including between the different subtypes and presentations of ADHD. The current study examined the extent to which two ratings scales, the BASC-2 Parent ratings scales and the ADHD Symptom rating scale (SRS), share substantial common variance in rating of inattention, hyperactivity and impulsivity in order to establish convergent and discriminant validity of the SRS. Also, each scale's ability to discriminate between ADHD Inattentive and ADHD Combined subtypes was examined. Results may aid clinicians in selection of ratings scales for ADHD based on their unique contributions to the evaluation and diagnostic process. Based on the review of the current literature, the following hypotheses are made:

Hypothesis 1: The SRS hyperactivity, impulsivity, and inattention scores will demonstrate significant associations with corresponding BASC-2 subscale scores (Attention Problems and Hyperactivity) supporting convergent validity. The SRS scores will demonstrate non-significant correlations with BASC-2 Anxiety and Somatization subscales, supporting discriminant validity of the SRS scores.

Hypothesis 2: Children with Inattentive and Combined ADHD subtypes will not differ on attention ratings from the BASC-2 or SRS, but children with the combined subtype will receive higher hyperactivity and impulsivity ratings when compared to those with the inattentive subtype.

Hypothesis 3: The SRS will have greater sensitivity and specificity to differentiate ADHD-Inattentive subtype from ADHD-Combined subtype than the BASC-2 because its items

map directly on to the diagnostic criteria for ADHD while the BASC-2 is designed as a more general measure of behavioral disturbances.

Chapter 3: Methodology

Participants

The participants in the study included 253 children with diagnoses of ADHD. These children were selected from a consecutive series of 619 cases and were evaluated in a private psychological assessment practice over a twelve-year period. They were referred for a neuropsychological and psychoeducational evaluation for ADHD or another childhood disorder. Presenting symptoms were varied and included attention difficulties, academic problems, mood and anxiety symptoms, and behavior disturbances at school and home. Children were referred for neuropsychological evaluations by schools, pediatricians, and neurologists to address these concerns and many were subsequently diagnosed with ADHD.

Children will be included in this study if they: 1) were between the ages of 6 and 16 years, 2) have a DSM-IV diagnosis of ADHD, 3) had no comorbid intellectual disability, pervasive developmental disorder, or history of neurological disorder including traumatic brain injury, and 4) had a BASC-2 and SRS completed by their mothers as part of the evaluation.

Based on demographic characteristics of the entire sample of 619 cases, the children included in this study were on average 10.4 years old and had Full Scale IQ scores of 98.7. The current sample included 70.4% male children; and that 64.4% of the children were diagnosed with ADHD Inattentive subtype, with the remaining 35.6% diagnosed with ADHD Combined subtype. This breakdown by ADHD subtype allowed enough participants to evaluate hypotheses where between group differences were expected. The ADHD diagnoses were established by a pediatric neuropsychologist according to *DSM-IV* diagnostic criteria, based on child and parent interview, behavioral assessment, neuropsychological testing,

review of educational and medical history, and other relevant information. Research was conducted in accordance with local Institutional Review Board (IRB) policies.

Measures

DSM-ADHD-SRS. ADHD Symptoms were assessed with the DSM-IV ADHD Symptom Rating Scale (DSM-ADHD-SRS), which is an 18-item scale adapted from the ADHD Rating Scale-IV (DuPaul, Power, Anastopoules, & Reid, 1998). A copy of the scale is included in Appendix 1. The DSM-ADHD-SRS was completed by the child's parents. For the purposes of this study, we only considered the mother's ratings. The SRS operationalizes the 18 Criteria A symptoms from the DSM-IV for ADHD. Consistent with the DSM-IV, nine items were designed to explicitly capture symptoms of inattention, seven to capture hyperactivity, and three to capture impulsivity. Frequencies of behavioral symptoms were quantified using a four-point frequency scale including: 0 = never or rarely, 1 = sometimes, 2 = often, and 3 = very often. Subscale scores were derived from the sum of the items scores on each factor. Previous work demonstrated that the scale has high internal consistency (Cronbach's α = .88; Thaler, Bello, & Etcoff, 2013).

Behavior Assessment System for Children-2 (BASC-2). The BASC-2 is a behavioral assessment designed for use in evaluating children and adolescents with cognitive, emotional and learning disabilities (Reynolds & Kamphaus, 2004). The BASC-2 has comprehensive rating scales that assess the child's behavior from teacher, parent and self-report perspectives. For the purposes of this study we considered only questionnaires completed by a child's mother. The BASC-2 Anxiety and Somatization scores were included based on examination of correlations among BASC-2 subscale scores reported in the BASC-2 test manual for the standardization sample. The Anxiety and Somatization scores demonstrated the lowest correlations with the

BASC-2 Attention Problems (*r*'s = .06 and .09, respectively) and Hyperactivity (r's = .24 and .29, respectively) (Reynolds & Kamphaus, 2004). They were included in the analysis to evaluate the discriminant validity of the SRS hyperactivity, inattention, and impulsivity scores with the expectation that there would be negligible correlations between the SRS scores and the BASC-2 somatization and anxiety scores.

Procedure

Children with attention, academic, and behavioral concerns were referred for clinical evaluations to a pediatric neuropsychologist. Standard components of the evaluation included assessment of general intelligence, attentional difficulties, academic achievement, executive functioning skills and behavior. Test batteries varied based on specific clinical considerations for the children being evaluated. A pediatric neuropsychologist or clinical psychology doctoral candidate administered assessments according to standardized administration procedures under the supervision of the neuropsychologist. Assessments took place in a single session in a private practice setting.

Chapter 4: Results

Initial screening and evaluation of the data took place in order to ensure accuracy of the data and assumptions of ANOVA and regression were met. Demographic data and scores on the BASC-2 and SRS are provided in Table 1. Significant differences were present between groups on age, FSIQ and presence of comorbid diagnosis. Children with ADHD-Inattentive subtype were older, had lower IQs, and more comorbid adjustment disorders than youth with ADHD-Combined subtype. Groups did not significantly differ on age, gender, ethnicity, or gross household income, height, or weight.

SRS Convergent and Discriminant Validity

In order to examine convergent and discriminant validity for the SRS composite scores, correlations were calculated between the SRS hyperactivity, inattention, and impulsivity composite scores and BASC-2 subscale scores for Attention Problems, Hyperactivity, Anxiety, and Somatization. In order to compare correlations, Fisher's *r* to *z* procedure was used to transform each correlation to a z score (Fisher, 1915). *Z*-scores were then used to compare differences in dependent correlations using the equations 3 and 10 from Steiger (1980). These calculations were conducted using software designed by Lee and Preacher (2013). Table 2 includes abbreviated correlation results between the SRS and BASC-2 scores. A complete correlation matrix is provided in Appendix B, Table 6.

For convergent validity, it was predicted that the SRS Hyperactivity (SRS HP), Impulsivity (SRS IM), and Inattention (SRS IA) subscale scores would demonstrate a significant association with the corresponding BASC-2 Attention Problems (BASC-2 AP) and Hyperactivity (BASC-2 HP) subscale scores. Supporting convergent validity of the SRS IA score, a significant correlation was present between SRS IA and BASC-2 AP and this correlation was significantly

larger than comparable correlations between SRS HP and BASC-2 AP ($z = 4.83$, $n = 253$, $p < .0001$) or SRS IM and BASC-2 AP ($z = 5.48$, $n = 253$, $p < .0001$). For convergent validity of the SRS HP score, a significant correlation was observed between SRS HP and BASC-2 HP and this correlation was significantly larger than comparable correlations between SRS IA and BASC-2 HP ($z = 5.72$, $n = 253$, $p < .0001$). Finally, for convergent validity of the SRS IM score, a significant correlation was present between SRS IM and BASC-2 HP and this correlation was significantly larger than comparable correlations between SRS IA and BASC-2 HP ($z = 4.49$, $n = 253$, $p < .0001$).

For discriminant validity, it was expected that there would be non-significant correlations with BASC-2 Anxiety and Somatization subscales. As Table 2 indicates, the correlation between the SRS IA and BASC-2 AP scores was significantly larger than the correlation between SRS IA and BASC-2 AX ($z = 7.31$, $n = 253$, $p < .0001$) or SRS IA and BASC-2 SM ($z = 5.40$ $n = 253$, $p < .0001$). Similarly, the correlation between the SRS HP and BASC-2 HP was significantly larger than the correlation between SRS HP and BASC-2 AX ($z = 9.24$, $n = 253$, $p < .0001$) or BASC-2 SM ($z = 9.24$, $n = 253$, $p < .0001$). Finally, the correlation between SRS IM and BASC-2 HP was significantly larger than correlation between SRS IM and BASC-2 AX ($z = 8.23$, $n = 253$, $p < .0001$) or BASC-2 SM ($z = 8.56$, $n = 253$, $p < .0001$).

Group Differences in Inattention, Hyperactivity, and Impulsivity

Given support from the correlation analyses for the convergent and discriminant validity of the SRS scores, mixed model analysis of variance (ANOVA) was used to examine differences in ADHD symptoms between the Inattention and Combined subgroups. In these analyses, it was anticipated that the ADHD subgroups would differ on symptoms of hyperactivity and impulsivity, but not on symptoms of inattention. Separate analyses were conducted for the SRS

and BASC-2 scores. The ANOVAs included diagnosis as the between subjects factor and either SRS or BASC-2 symptom scores as the within subjects factor. Descriptive statistics for the SRS and BASC-2 scores by group are presented in Table 1.

For the SRS, the mixed model ANOVA indicated significant main effects for diagnosis, $F\ (1, 251) = 57.93, p < .001, \eta^2 = .188$, and for SRS scores, $F\ (2, 502) = 150.72, p < .001, \eta^2 = .375$, as well as a significant diagnosis by SRS interaction effect, $F\ (2,502) = 70.42, p < .001, \eta^2 = .219$. Figure 1 presents the interaction effect. Post hoc analyses indicated that there were significant differences between groups on Impulsivity, $t\ (251) = 9.68, p < .001$, and Hyperactivity, $t\ (251) = 9.50, p < .001$, but the groups did not differ on Inattention, $t\ (251) = 1.11, p = .27$. Including Age, FSIQ and comorbid diagnoses in the analyses resulted in a significant effect for diagnosis, $F\ (1, 242) = 45.55, p < .001, \eta^2 = .158$, and a significant diagnosis by SRS interaction effect, $F\ (2,484) = 51.58, p < .001, \eta^2 = .176$, although the main effect for SRS was not significant, $F\ (2,484) = 0.35, p = .71, \eta^2 = .001$ (see Figure 2 for interaction effect).

For the BASC-2, the mixed model ANOVA indicated significant main effects for diagnosis, $F\ (1, 251) = 43.27, p < .001, \eta^2 = .156$, and for BASC-2 scores, $F\ (1, 251) = 46.24, p < .001, \eta^2 = .375$, as well as a significant diagnosis by BASC-2 interaction effect, $F\ (2,502) = 88.68, p < .001, \eta^2 = .261$. Figure 1 presents the interaction effect. Post hoc analyses indicated that there were significant differences between groups on Hyperactivity, $t\ (251) = 9.48, p < .05$, but not on Attention Problems, $t\ (251) = 1.59, p > .05$. Including Age, FSIQ and comorbid diagnoses in the analyses resulted in similar findings with a significant effect for diagnosis, $F\ (1, 242) = 40.22, p < .001, \eta^2 = .143$, BASC-2, $F\ (1, 242) = 15.11, p < .001, \eta^2 = .059$, and a

significant diagnosis by BASC-2 interaction effect, $F\ (1, 242) = 78.78, p < .001, \eta^2 = .246$ (see Figure 2 for interaction effect).

Diagnostic Accuracy of BASC-2 and SRS Scores

Based on the result of the mixed model ANOVAs indicating differences between the ADHD Inattentive and ADHD Combined subtypes on the rating of inattention, hyperactivity and impulsivity, Receiver Operating Characteristic (ROC) analyses were used to determine the ability of each of the BASC-2 and SRS subscales to distinguish between the classify the ADHD combined and inattentive subtype groups (true state = combined). ROC analyses were conducted using Analyse-it for Microsoft Excel 4.84.4 (2009).

Because the SRS items map directly onto the diagnostic criteria for ADHD and the BASC-2 is designed as a more general measure of behavioral disturbances, SRS scores were expected to have better predictive discrimination than the BASC-2 scores. ROC analyses were used to examine differences in sensitivity and specificity between the SRS and BASC-2 scores for ADHD subtype diagnoses. In these analyses, values were predicted using the ADHD Inattentive subtype as the control, because they were expected to exhibit primarily symptoms of inattention, while the ADHD Combined subtype has inattentive, hyperactive and impulsive symptoms. The three SRS scores (IA, HYP, and IMP) and two BASC-2 scores (AP and HYP) were simultaneously entered into the ROC analyses. The area under the curve (AUC) was used to determine each test score's ability to distinguish between the groups. An AUC of 1.0 indicates perfect classification, and an AUC of 0.5 indicates classification that is no better than chance (Hosmer & Lemeshow, 2000). Thus, related to this study, a larger AUC indicated increased predictive discrimination between participants with ADHD Inattentive and ADHD Combined

subtypes. Comparisons between the AUCs for the BASC-2 and SRS scores were made using the method described by Hanley and McNeil (1983).

ROC curves for the BASC-2 and SRS scores are presented in Figure 3. Table 3 contains the AUCs, standard error of the AUCs, 95% confidence intervals and asymptotic significance levels for each AUC. Significance levels indicate each scores improvement over chance prediction. The results demonstrate that the SRS Impulsivity subscale had the highest AUC at 0.820, which is considered a good classification rate. Following this, in order of descending classification rate, were the BASC-2 Hyperactivity, SRS Hyperactivity, BASC-2 Attention Problems and SRS Inattention (see Figure 3 for the ROC curves). Asymptotic significance levels indicated the SRS Impulsivity, BASC-2 Hyperactivity, and SRS Hyperactivity provided significantly better classification than chance, although BASC-2 Attention Problems and SRS Inattention did not differ from chance.

When the AUCs for the SRS and BASC-2 scores were compared, no significant differences were present between the SRS Impulsivity, SRS Hyperactivity and BASC-2 Hyperactivity subscales. The SRS Impulsivity, BASC-2 Hyperactivity, and SRS Hyperactivity scores each had significantly larger AUC's compared to BASC-2 attention problems (p's $< .001$, z's = 6.44, 7.82, 6.04, respectively). Results suggest significantly better classification accuracy for the SRS Impulsivity, SRS Hyperactivity and BASC-2 Hyperactivity (Hanley & McNeil, 1983) compared to the BASC-2 Attention Problems and SRS Inattention.

Table 4 presents the sensitivity and specificity for each of the subscale scores included in the ROC analyses. Optimal cutoff scores to indicate the maximum likelihood of detecting ADHD combined while minimizing the likelihood of a false positive were estimated using two methods. The first involved summing the sensitivity and specificity for each score and identifying the

highest sum (see Sn+Sp column in Table 4). The highest value maximizes Youden's index (Sn + Sp – 1) and also maximizes the difference between the TP rate and FP rate (1-Sp) (Youden, 1950). The second was the Delong, Delong, and Clarke-Pearson method (1988), which is a nonparametric approach for determining optimal cutoff scores from correlated ROC curves. This approach considers the implicit correlations between the ROC curves when selecting an optimal cutoff. These cutoff scores are also presented in Table 4, and Figure 4 includes the decision thresholds for the test scores based on the Delong et al. (1988) method. Additionally, a full range of cutoff scores for each subscale are contained in Appendix B.

As can be seen from Table 4, for SRS Impulsivity, an average score of 0.67 had the highest Sn + Sp and correctly classified 186 participants (113 TP, 73 TN) or 73.5% of the sample. The Delong et al. cutoff score was 1.00 and correctly classified 195 participants (138 TP, 57 TN) or 78.3% of the sample. For BASC-2 Hyperactivity, a score of 52 had the highest Sn + Sp and correctly classified 164 participants (84 TP, 80 TN) or 64.8% of the sample. The Delong et al. cutoff score was 64 and correctly classified 188 participants (144 TP, 44 TN) or 74.3% of the sample. For SRS Hyperactivity, an average score of 0.67 had the highest Sn + Sp and correctly classified 169 participants (94 TP, 75 TN) or 66.8% of the sample. The Delong et al. cutoff score was 1.33 and correctly classified 193 participants (142 TP, 51 TN) or 76.3% of the sample. The SRS Inattention subscale and the BASC-2 Attention Problems subscales provided classification accuracies that were only slightly better than chance (AUC's < 0.56) so optimal cutoff scores were not identified for these scores.

Chapter 5: Discussion

Results of the current study provide support for using the BASC-2 and the DSM-ADHD-SRS in the evaluation of children with ADHD inattentive and combined subtypes in clinical evaluations. While these ratings share common variance, each measure provides unique information in establishing current levels of functioning. Findings with these measures are also consistent with prior research indicating that inattention and hyperactivity are related but unique symptom domains (Barkley, 2015; Bauermeister et al., 2012; Parke, 2015; Reiersen & Todorov, 2013).

Results of the correlation analyses between the BASC-2 and SRS scores provided evidence for the convergent and discriminant validity of the SRS scores. Convergent validity evidence was supported by significant positive correlations between the BASC-2 Hyperactivity subscale and the SRS Impulsivity and Hyperactivity subscales, but not the SRS Inattention subscale as expected. Similarly, the BASC-2 Attention Problems subscale was highly correlated with the SRS Inattention subscale but not the SRS Impulsivity or Hyperactivity subscales. These observed correlations are expected due to the related symptoms of hyperactivity and impulsivity, which are distinctly different from inattention symptoms. Support for discriminant validity was provided by the nonsignificant correlations between the BASC-2 Anxiety and Somatization subscales and the SRS Impulsivity, Hyperactivity or Inattention Subscales, with the exception of a weak correlation between the BASC-2 Somatization and SRS Inattention subscales.

Validity studies of other behavioral ratings scales report similar results. For example, Doyle and coauthors (1997) found significant correlations between the Child Behavior Checklist (CBCL) attention problems scale and the BASC-2 attention problems scale (r = .49) with smaller correlations with the BASC-2 anxiety and somatization subscales (r's = .33 and .24,

respectively). It is interesting to note that the CBCL does not include a separate scale measuring hyperactive behaviors, but combine hyperactive and inattentive symptoms, so the correlation between the BASC-2 hyperactivity subscale and the CBCL attention problems was high (r = .50) and comparable to its correlation with BASC-2 attention problems. Thus, the CBCL attention problems subscale does not differentiate well between the hyperactivity and inattention symptom of ADHD, at least as they are measure by the BASC-2, and so also has limited utility for differentiating ADHD subtypes. In contrast, the current results suggest that not only is the SRS capable of distinguishing between core symptom domains within ADHD, but also that it is not associated with some other behavioral disturbances that are sometimes present in children with ADHD or in more general child clinical populations. Although not directly examined here, these findings suggest that the BASC-2 and SRS may also be effective in discriminating between children with ADHD and those with anxiety, somatization, and possibly other symptoms as well.

Both measures appear to be sensitive to differences in symptomatology based on ADHD Inattentive and Combined subtypes. Both subtypes had elevated scores on ratings of inattention, although children who were diagnosed with ADHD inattentive subtype received lower scores on ratings of hyperactivity and impulsivity. Because the focus of this investigation was to determine the usefulness of behavioral ratings in differentiating ADHD subtypes, a control group was not included in the current study. Absent a control group, overall differences in sensitivity between the BASC-2 and SRS to the presence or absence of ADHD symptoms in normal children could not be directly evaluated. However, the BASC-2 is a well-validated measure shown in previous research to be sensitive to inattention and hyperactivity in children with ADHD (Doyle et al., 1997; Reynolds & Kamphaus, 2004). Examination of the BASC-2 scores in this sample were consistent with the existing research in that the ADHD combined group had clinically elevated

scores on both the Attention Problems and Hyperactivity subscales, while the ADHD Inattentive subtype group demonstrated elevated scores on the Attention Problems subscale only. The findings on the BASC-2 do suggest that the results of the current study are generalizable to ADHD populations, and also provide support for the generalizability of the SRS findings.

More specifically, results of the current study provide further support for the sensitivity of the SRS and BASC-2 in distinguishing between ADHD Inattention and Combined subtypes. Unlike prior studies evaluating the capability of ADHD symptom rating scales to discriminate between normal controls and children affected by ADHD, the analysis of both the SRS and BASC-2 subscales conducted in this study allowed for direct comparisons of individual subscale scores for ADHD inattentive and combined subtypes. Results generally reflect that the SRS Impulsivity subscale and the SRS and BASC-2 Hyperactivity subscales demonstrated better utility than BASC-2 Attention Problems and SRS Inattention subscales in predicting a diagnosis of ADHD combined. The SRS Impulsivity score was the most sensitive to ADHD as indicated by an AUC of .82. An SRS Impulsivity average score of 1.00 correctly classified 186 participants or 73.5% of the sample. This cut score yielded a sensitivity of .69 and a specificity of .81, which are generally comparable with estimates reported in some prior studies of children with ADHD (e.g., Matier-Sharma, Perachio, Newcorn, Sharma & Halperin, 1995). The BASC-2 and SRS Hyperactivity scores were comparable to each other with AUCs of .80, and were not significantly different from the AUC for the SRS Impulsivity score. Prior research has provided support for the BASC-2 Hyperactivity subscale having good diagnostic utility in differentiating children with ADHD from at risk controls (Doyle, 1997). The current results extend this finding by showing that the BASC-2 and SRS Hyperactivity scores are also particularly useful for identifying and distinguishing between ADHD subtypes.

A determination of a cut-off value should be made based on an understanding of the pretest probability and the cost of misdiagnosis of ADHD, as well as base rates of ADHD in the population being assessed. This means that for diagnostic tests such as the BASC-2 and SRS, the cut-off values identified in this study are not universal. In relation to the current study, suggestions are provided for cut scores for diagnostic classification of ADHD Inattentive and Combined subtypes using Youden's index and the Delong et al. method (Delong et al., 1998; Youden, 1950). However, when making clinical decisions on which optimal combinations of sensitivity and specificity to use, it is important to consider they will vary depending on the relevant costs and benefits given the referral question and clinical scenario. Also, is it very likely that different cut-off scores would be optimal under different conditions, as is the case when differentiating ADHD from normal samples, or differentiating between ADHD and other clinical disorders.

The ANOVA results provided additional evidence for the unique sensitivity of each scale to the symptoms of ADHD. In both cases, the scales differentiated the ADHD subtypes based on hyperactivity (and impulsivity) symptoms, which were selectively elevated in the Combined subtype when compared to the Inattentive subtype. These profile differences remained after group differences in age, IQ and comorbid diagnoses were considered, suggesting that the profile differences are robust to some common demographic, intellectual and diagnostic differences that occur between children with ADHD. This finding provides additional support for the application of the SRS and BASC-2 in the clinical evaluation of children with ADHD, since it is a group that is characterized by heterogeneity regarding these and other variables.

With regards to measure selection for evaluation purposes, the current results indicate that both the BASC-2 and SRS are useful for evaluating ADHD. Both scales show sensitivity to

hyperactivity and inattention symptoms when comparing Combined and Inattentive ADHD subtypes. From a clinical perspective, determining which of these two measures are used to evaluate children with ADHD should be guided by other consideration including the goal of the evaluation process, the reason for referral, as well as the use of evaluation results in clinical and educational planning, etc. For example, in cases where the primary referral question is to establish a diagnosis of ADHD, the SRS may be more efficient as its items map directly onto DSM symptoms used to make a diagnosis of ADHD. When a broader assessment of cognitive and behavior disturbances is required, the BASC-2 not only provides measures of inattention and hyperactivity, but also provides additional information on behavioral disturbances that commonly occur in ADHD and are important for treatment and educational planning.

Another consideration is that because the SRS has a relatively short administration time and has good classification accuracy, the examination of the symptom domain scores are expected to improve incremental validity of a more comprehensive assessment. This latter consideration may be particularly important when the goal of assessment is screening to identify children who are at increased risk for ADHD. In this application, the briefer SRS may be better suited when screening is the primary reason for evaluation.

Finally, the SRS allows for a distinction between impulsive and hyperactive symptoms. Research on the dimensional nature of ADHD symptoms has provided support for two dimensional models consisting of inattention and hyperactivity/impulsivity (Bauermeister et al., 2010; McLoughlin, Rijsdijk, Asherson & Kunstsi, 2011) and three dimensional models consisting of hyperactivity, impulsivity, and inattention dimensions (Burns et. al, 2008; Gomez, 2010; Mayfield et al., 2016; Parke et al., 2015). The usefulness in distinguishing between hyperactivity and impulsivity for clinical and research purposes is an area that warrants further

investigation, although some research suggests impulsivity has a greater impact on academic and social domains of functioning than hyperactivity, despite often being measured as one symptom domain (Bauermesiter, Canino, Polanczyk, & Rohde, 2010). Additionally, previous research has found hyperactivity and impulsivity symptoms may not be stable over time and therefore could provide additional diagnostic information if measured as independent diagnostic categories (Lahey, Pelham, Loney, Lee, & Willcutt, 2005; Lee, Lahey, Owens & Hinshaw, 2008). Confirmatory factor analysis of the SRS indicates that it is capable of assessment of the three ADHD symptom dimensions (Parke et al., 2015). This capability may make the SRS particularly useful in clinical and research applications where such distinctions are important.

It should also be mentioned that both scales may be used together when diagnostic questions and more general assessment is needed. The SRS is an efficient screening tool that can provide specific information about the severity of ADHD symptoms. When used together with behavioral information from the BASC-2 subscales, a more comprehensive understanding of the presentation of ADHD and its impact on functioning can be understood and allow for enhanced diagnostic decision-making and treatment planning.

The current study has several limitations. Attentional concerns in children are broader than ADHD. Since other clinical groups were not included, the ability of the SRS to distinguish ADHD subtypes from other clinical disorders remains unknown. However, it was apparent from the correlation analyses that the SRS scores were not strongly correlated with symptoms that characterize other types of childhood psychopathology (anxiety, somatization), which provides preliminary support for the SRS's ability to distinguish between ADHD and other disorders.

Another limitation of the current study is the use of the DSM-IV criteria for diagnoses. While the symptom criteria used to diagnose ADHD for the DSM-IV and DSM-5 is largely

unchanged, the DSM-5 allows clinicians to specify presentation of symptoms and has eliminated distinct subtypes (e.g., Combined Presentation; APA, 2013). Given that the diagnostic criteria are consistent between the DSM-IV and DSM-5, the current study findings will provide a basis for clinicians to specify symptom presentation and in this way will generalize to diagnosis of children and adolescents based on the DSM-5 criteria. Also, one of the sources used to provide a basis for clinical diagnoses in the current study were the BASC-2 and SRS. While this introduces a potential confound between the diagnosis based on the BASC-2 and SRS and the goal of this study to use these scales to the make the ADHD subtype diagnosis, the BASC-2 and SRS were one of many sources of information in the comprehensive evaluation. Results from cognitive tests, medical and educational records, clinical interviews with the parents and children, and observations of behavior made during the evaluation were also used to confirm diagnosis, which mitigates to some extent this concern.

Finally, the diagnoses of ADHD-Combined and ADHD-Inattentive subtype were based on clinical diagnoses rather than research diagnoses. However, as indicated before, these ADHD diagnoses were based on a comprehensive evaluation that took place over a full day and involved a multimethod assessment approach. This comprehensive evaluation improves diagnostic accuracy and mimics best-case clinical and research practice.

A more general concern for many symptom rating scales for childhood disorders is that parents who complete behavioral ratings are not typically trained to rate symptoms, which raises concerns about the reliability and validity of their ratings. While research indicates that there is consistency between ratings by trained clinicians and parents (Zhang, Faries, Vowles & Michelson, 2005), parent ratings are based on the child's behavior over an extended period of time and in multiple settings, while clinician ratings are often based on a sample of behavior

observed during a clinical evaluation. For the current study, parent ratings are viewed as a useful adjunct to clinical ratings completed by professional because they provide information on real world, day-to-day behaviors of the child, which are often not available to the professional. Unique contributions of clinician and parent ratings to the diagnostic and evaluation process are an area that would benefit from additional research.

Despite these limitations, the current study provides support that the SRS and BASC-2 are sensitive to differences in ADHD symptomatology. Overall, these findings support the validity of the SRS and the diagnostic utility of the SRS and BASC-2 in differentiating between ADHD subtypes in children. Future research may examine the SRS ability to distinguish ADHD from other clinical disorders, as well the occurrence of the ADHD symptoms as measured by the SRS in a non-clinical population.

Appendix A: Tables and Figures

Table 1

Demographic and clinical information for participants with ADHD Inattentive and Combined

	ADHD-I (*n*=163)	ADHD-C (*n*=90)	Total (*N*= 253)	*F* *(df=1,252)*	*p*
	M (*SD)*	*M (SD)*	*M* (*SD)*		
Age (years)	11.0 *(2.9)*	9.3 *(2.5)*	10.4 *(2.9)*	24.96	<.001
FSIQ	97.0 (*11.9*)	101.8 *(13.5)*	98.7 *(12.7)*	8.12	.005
PRI	99.8 (*12.5*)	103.0 (*14.0*)	100.9 *(13.1)*	3.36	.068
WMI	94.2 (*10.7*)	97.2 (*13.9*)	95.3 *(12.0)*	3.57	.060
PSI	92.0 (*11.4*)	99.1 (*12.5*)	94.5 *(12.2)*	20.71	<.001
BASC-2 Hyperactivity	51.2 *(9.3)*	63.9 *(11.6)*	55.7 *(11.9)*	89.89	<.001
BASC-2 Attention Problems	60.6 *(9.4)*	62.4 *(7.4)*	61.2 *(8.7)*	2.53	.11
BASC-2 Anxiety	53.9 *(11.8)*	52.5 *(11.1)*	53.4 *(11.6)*	0.85	.36
BASC-2 Somatization	48.0 *(9.3)*	47.5 *(9.3)*	47.8 *(9.3)*	0.16	.69
SRS Impulsivity (average)	0.6 *(0.7)*	1.6 *(0.9)*	1.0 *(0.9)*	93.73	<.001
SRS Hyperactivity (average)	0.6 *(0.6)*	1.4 *(0.7)*	0.9 *(0.7)*	90.33	<.000
SRS Inattention (average)	1.8 *(0.7)*	1.7 *(0.7)*	1.8 *(0.7)*	1.22	.27
				χ^2	*p*
Gender % (*df* = 1)				0.59	0.44
Male *(n* = 178)	68.7%	73.3%	70.4%		
Female *(n* = 75)	31.3%	26.7%	29.6%		
School % (*df* = 1)				1.32	0.25
Public *(n* = 84)	30.7%	37.8%	33.2%		
Private *(n* = 169)	69.3%	62.2%	66.8%		
Comorbid Diagnoses % (*df* =				17.35	<.001
ODD (*n* = 15)	2.5%	10.0%	5.1%		
DCD *(n* = 46)	21.5%	12.2%	18.2%		
Anxiety Disorder (*n*=15)	4.9%	7.8%	5.9%		
Mood Disorder (*n* = 2)	0.6%	1.1%	0.8%		
Adjustment Disorder (*n* =	29.4%	13.3%	23.7%		

Note. BASC-2 = Behavioral Assessment System for Children; SRS = Symptom Rating Scale; FSIQ = Full Scale Intelligence Quotient; PRI = Perceptual Reasoning Index; WMI = Working Memory Index; PSI = Processing Speed Index; ODD = Oppositional Defiant Disorder; DCD = Developmental Coordination Disorder.

Table 2

Correlations between ADHD Symptom Ratings Scale (SRS) composite scores and Behavioral Assessment Scale for Children (BASC-2) subscale scores

SRS scores	**Convergent Validity**		**Discriminant Validity**	
	BASC AP[a]	BASC HYP[b]	BASC AX	BASC SM[d]
SRS IMP[c]	.24*	.63*	.03	.05
SRS HYP[d]	.30*	.68*	.03	.08
SRS IA[e]	.60*	.35*	.06	.24*

Note. * $p < .01$. $N = 253$. SRS IA = SRS Inattention; SRS HYP = SRS Hyperactivity; SRS IMP = SRS Impulsivity; BASC AP = BASC-2 Attention Problems; BASC HYP = BASC-2 Hyperactivity; BASC AX = BASC-2 Anxiety; BASC SM = BASC-2 Somatization.

a. SRS IA > SRS HYP, SRS IMP

b. SRS IMP, SRS HYP > SRS IA

c. BASC HYP > BASCAX, BASC SM

d. BASC HYP > BASC AX, BASC SM

e. BASC AP > BASC AX, BASC SM

Table 3

Receiver Operating Characteristic (ROC) Area under the ROC Curve (AUC) differences between BASC-2 and SRS scores, Ordered from Greatest to Least Area Under the ROC Curve (AUC)

Subscale Score	AUC	95% CI of AUC	SE of AUC	*p**
SRS IMP	0.820	0.767 to 0.872	0.027	<0.001
BASC HYP	0.804	0.749 to 0.860	0.028	<0.001
SRS HYP	0.801	0.744 to 0.857	0.029	<0.001
BASC AP	0.555	0.483 to 0.627	0.038	.15
SRS IA	0.443	0.370 to 0.517	0.037	.14

Note. **p* value indicates asymptotic significance with null hypothesis = .05. BASC HYP = BASC-2 Hyperactivity; BASC AP = BASC-2 Attention Problems; SRS IMP = SRS Impulsivity; SRS HYP = SRS Hyperactivity; SRS IA = SRS Inattention.

Table 4

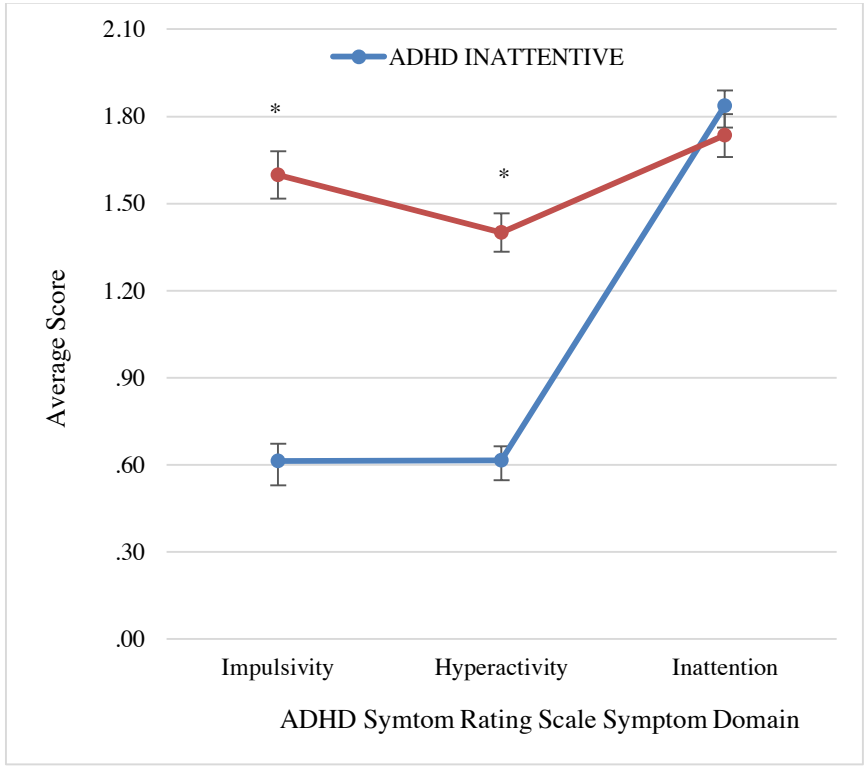
Classification Accuracy Statistics and Different Optimal Threshold Values for the Behavior Assessment System for Children (BASC-2) and ADHD Symptom Rating Scale (SRS)

SRS and BASC-2 Subscales	Score	Sn+Sp	Sn	Sp	PLR	NLR	Youden's Index
SRS Impulsivity	0.27	1.35	0.97	0.38	1.56	0.08	0.35
	0.33	1.46	0.89	0.57	2.07	0.19	0.46
Sn+SP cutoff score	**0.67**	**1.50**	**0.81**	**0.69**	**2.61**	**0.28**	**0.50**
Delong cutoff score	**1.00**	**1.48**	**0.63**	**0.85**	**4.20**	**0.44**	**0.48**
	1.67	1.33	0.41	0.92	5.13	0.64	0.33
	2.33	1.13	0.18	0.96	4.50	0.85	0.13
	2.67	1.09	0.11	0.98	5.50	0.91	0.09
BASC-2 Hyperactivity	38	1.05	0.99	0.06	1.05	0.17	0.050
	44	1.24	0.97	0.28	1.35	0.11	0.243
	49	1.35	0.90	0.45	1.64	0.22	0.348
Sn+SP cutoff score	**52**	**1.48**	**0.87**	**0.61**	**2.23**	**0.21**	**0.480**
	57	1.43	0.67	0.77	2.91	0.43	0.434
Delong cutoff score	**64**	**1.37**	**0.46**	**0.91**	**5.11**	**0.59**	**0.370**
	73	1.21	0.22	0.99	22.00	0.79	0.210
SRS Hyperactivity	0.17	1.27	0.94	0.33	1.40	0.18	0.270
	0.47	1.35	0.91	0.44	1.63	0.20	0.347
Sn+SP cutoff score	**0.67**	**1.46**	**0.78**	**0.69**	**2.52**	**0.32**	**0.465**
	0.93	1.41	0.67	0.74	2.58	0.45	0.409
Delong cutoff score	**1.33**	**1.42**	**0.52**	**0.90**	**5.20**	**0.53**	**0.424**
	1.83	1.22	0.26	0.96	6.50	0.77	0.219
	2.33	1.12	0.12	0.99	12.00	0.89	0.116
BASC-2 Attention Problems	41	1.04	1.00	0.04	1.04	0.00	0.04
	58	1.09	0.77	0.33	1.15	0.70	0.09
	63	1.09	0.51	0.58	1.21	0.84	0.09
	67	1.01	0.22	0.79	1.05	0.99	0.01
	71	1.00	0.11	0.89	1.00	1.00	0.00
	81	1.00	0.00	1.00	--	1.00	0.00
SRS Inattention	0.78	1.01	0.90	0.11	1.01	0.91	0.01
	1.22	1.05	0.78	0.27	1.07	0.81	0.05
	1.67	1.08	0.60	0.49	1.18	0.82	0.08
	2.00	1.10	0.44	0.67	1.33	0.84	0.10
	2.33	1.09	0.26	0.83	1.53	0.89	0.09
	2.56	1.01	0.13	0.88	1.08	0.99	0.01
	2.89	0.97	0.02	0.96	0.50	1.02	0.03

Note. SRS = Symptom Rating Scale; BASC-2 = Behavior Assessment System for Children; Sn = Sensitivity; Sp = Specificity; PLR= Positive Likelihood Ratio; NLR= Negative Likelihood Ratio.

Figure 1

Mixed Model ANOVA interaction effects for the ADHD Symptom Rating Scale (SRS) and Behavior Assessment System for Children (BASC-2) scores and diagnosis



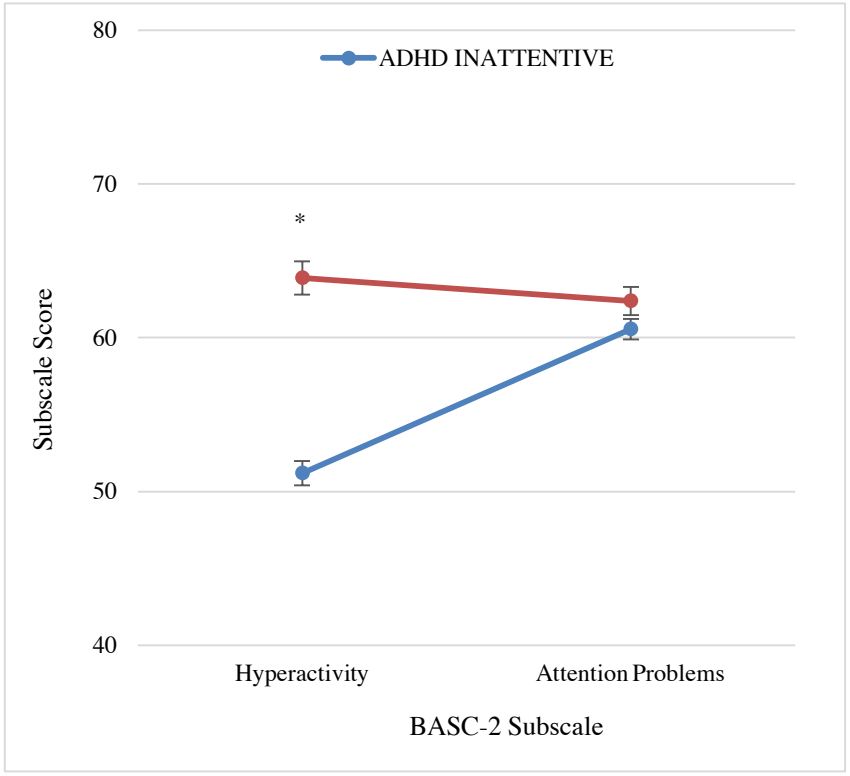
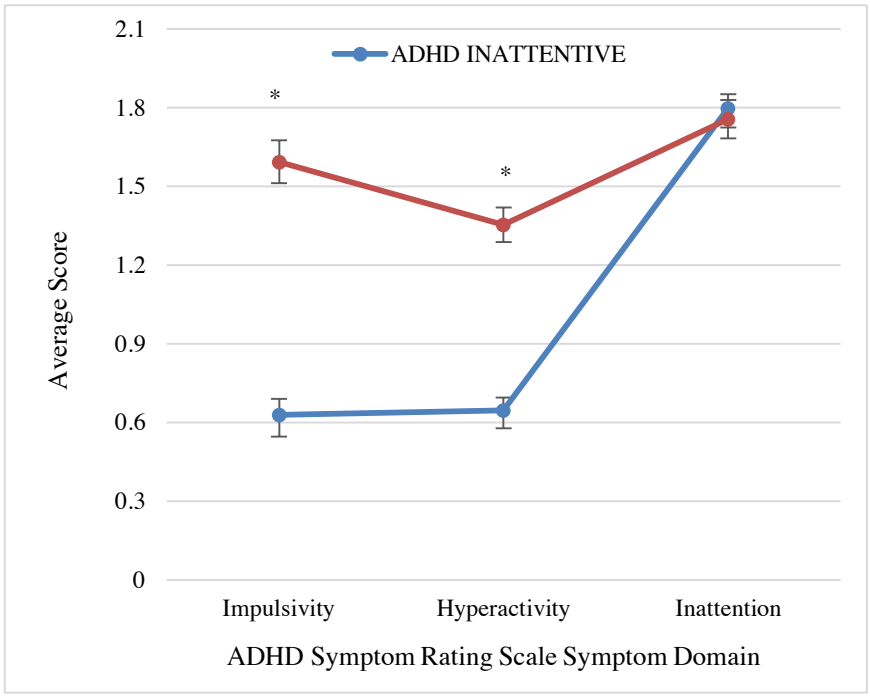


Figure 2

Estimated Marginal Means Mixed Model ANOVA interaction effects for the ADHD Symptom Rating Scale (SRS) and Behavior Assessment System for Children (BASC-2) scores and diagnosis including Age, IQ and comorbid diagnoses as covariates



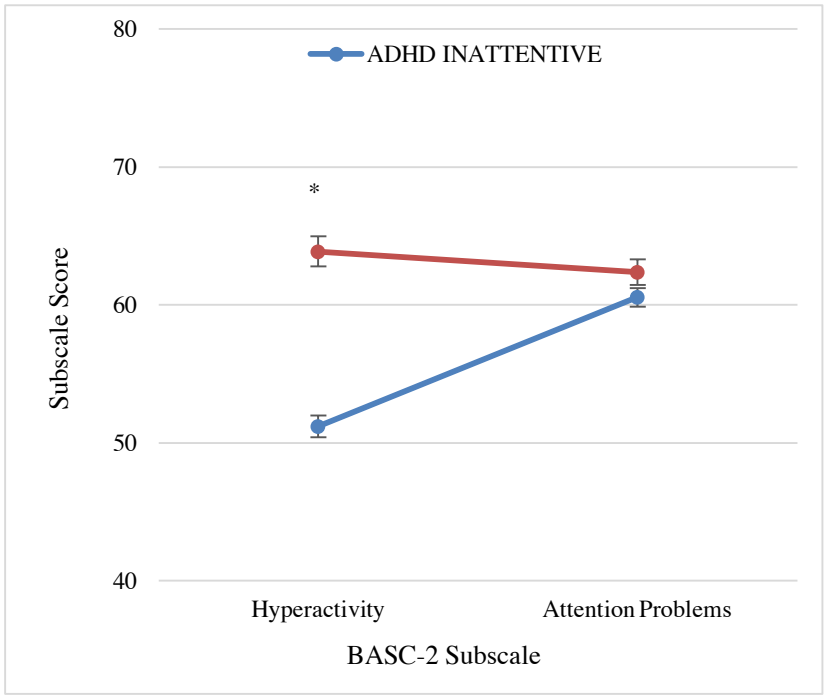
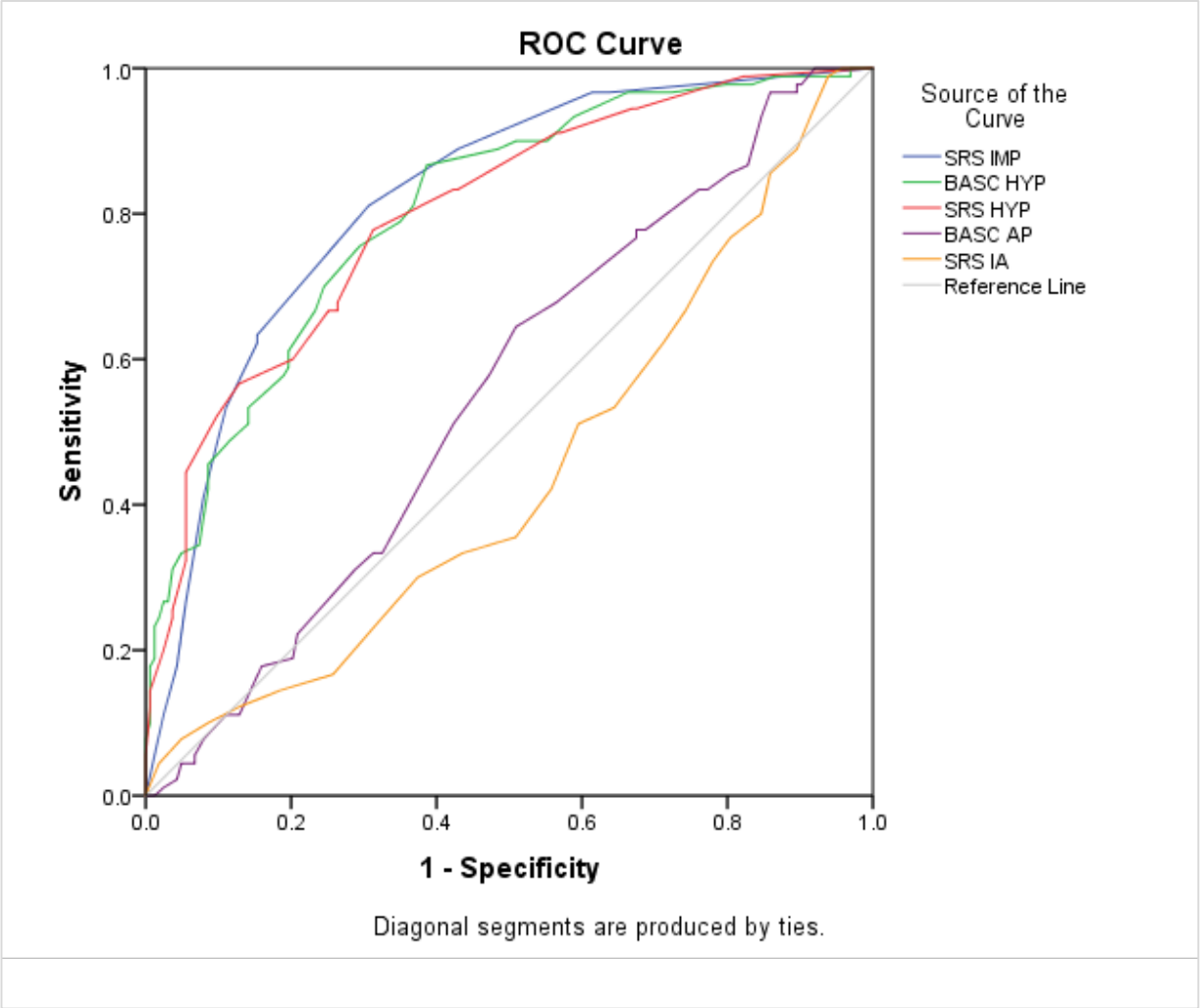


Figure 3

Receiver-operating characteristic curves for the Behavior Assessment System for Children (BASC-2) and Symptom Rating Scale (SRS) scores

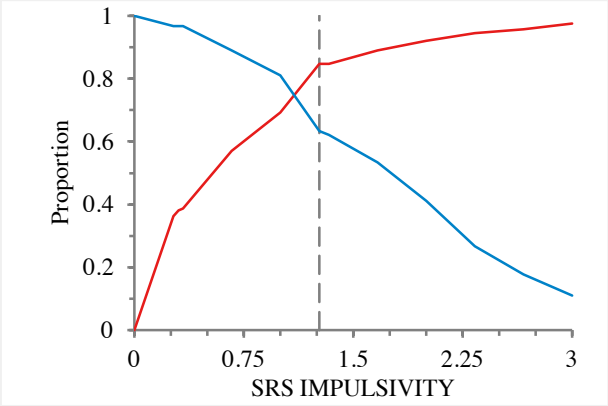


Note. SRS IMP = SRS Impulsivity; BASC HYP = BASC-2 Hyperactivity; SRS HYP = SRS Hyperactivity; BASC AP = BASC-2 Attention Problems; SRS IA = SRS Inattention.

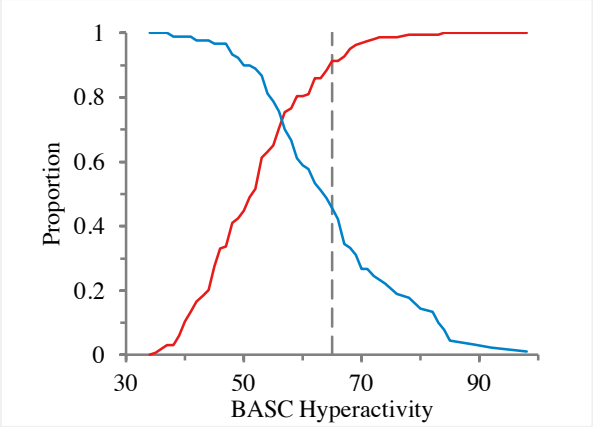
Figure 4

Delong Optimal Cutoff Decision Thresholds for the Behavior Assessment System for Children (BASC-2) and Symptom Rating Scale (SRS) scores

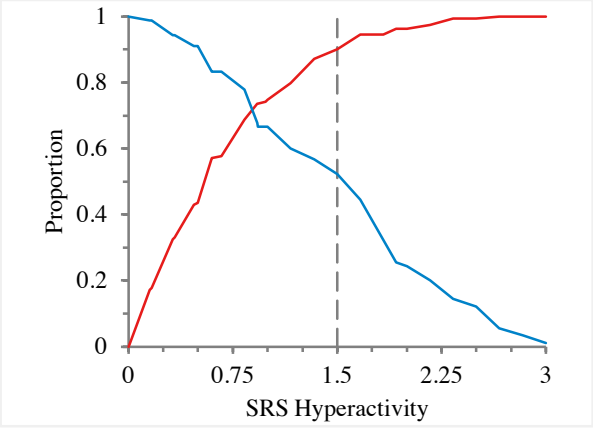
Panel A



Panel B



Panel C



Appendix B: Extended Tables

Table 5

DSM-IV ADHD Symptom Rating Scale

For each item, circle the number that best describes the child's behavior.				
	Never or Rarely	Sometimes	Often	Very Often
1. Child fails to give close attention to details or makes careless mistakes in schoolwork, or other activities.	0	1	2	3
2. Child has difficulty sustaining attention in tasks or play activities.	0	1	2	3
3. Child does not seem to listen when spoken to directly.	0	1	2	3
4. Child does not follow through on instructions and fails to finish schoolwork, chores, or other duties (not due to oppositional behavior or failure to understand directions).	0	1	2	3
5. Child has difficulty organizing tasks and activities.	0	1	2	3
6. Child avoids, dislikes or is reluctant to engage in tasks that require sustained mental effort (such as schoolwork or homework).	0	1	2	3
7. Child loses things necessary for tasks or activities (e.g., toys, school assignments, pencils, books, or tools).	0	1	2	3
8. Child is easily distracted by extraneous stimuli.	0	1	2	3
9. Child is forgetful in daily activities.	0	1	2	3
10. Child fidgets with hands or feet or	0	1	2	3

squirms in seat.				
11. Child leaves seat in classroom or in other situations in which remaining in seat is expected.	0	1	2	3
12. Child runs about or climbs excessively in situations in which it is inappropriate.	0	1	2	3
13. Child has difficulty playing or engaging in leisure activities quietly.	0	1	2	3
14. Child is "on the go" or acts as if "driven by a motor."	0	1	2	3
15. Child talks excessively.	0	1	2	3
16. Child blurts out answers before questions have been completed.	0	1	2	3
17. Child has difficulty awaiting his / her turn.	0	1	2	3
18. Child interrupts or intrudes on others (e.g., butts into conversations or games)	0	1	2	3

Table 6

Correlations between all ADHD Symptom Ratings Scale (SRS) scores and Behavioral Assessment Scale for Children (BASC-2) scores

	BASC HYP	BASC AP	BASC AX	BASC SM	SRS IMP	SRS HYP	SRS IA
BASC HYP	1.0	.54*	.08	.21*	.63*	.68*	.35*
BASC AP	.54*	1.0	.08	.21*	.24*	.30*	.60*
BASC AX	.08	.08	1.0	.37*	.03	.03	.06
BASC SM	.22*	.21*	.37*	1.0	.05	.08	.24*
SRS IMP	.63*	.24*	.03	.05	1.0	.74*	.23*
SRS HYP	.68*	.30*	.03	.08	.74*	1.0	.30*
SRS IA	.35*	.60*	.06	.24*	.23*	.30*	1.0

Note. * $p < .01$. $N = 253$. SRS IA = SRS Inattention; SRS HYP = SRS Hyperactivity; SRS IMP = SRS Impulsivity; BASC AP = BASC-2 Attention Problems; BASC HYP = BASC-2 Hyperactivity; BASC AX = BASC-2 Anxiety; BASC SM = BASC-2 Somatization.

Table 7

Classification Accuracy Statistics for the SRS Impulsivity subscale

Score	Sn+Sp	Sn	Sp	Youden's Index
0.00	1.33	0.97	0.36	0.33
0.27	1.35	0.97	0.38	0.35
0.30	1.35	0.97	0.39	0.35
0.33	1.46	0.89	0.57	0.46
0.67*	**1.50**	**0.81**	**0.69**	**0.50**
1.00**	**1.48**	**0.63**	**0.85**	**0.48**
1.27	1.47	0.62	0.85	0.47
1.33	1.42	0.53	0.89	0.42
1.67	1.33	0.41	0.92	0.33
2.00	1.21	0.27	0.94	0.21
2.33	1.13	0.18	0.96	0.13
2.67	1.09	0.11	0.98	0.09
3.00	1.00	0.00	1.00	0.00

Note. SRS = Symptom Rating Scale; Sn = Sensitivity; Sp = Specificity; * Sn+SP cutoff score; **

Delong cutoff score.

Table 8

Classification Accuracy Statistics for the BASC-2 Hyperactivity subscale

Score	Sn+Sp	Sn	Sp	Youden's Index
34	1.01	1.00	0.01	0.006
35	1.02	1.00	0.02	0.018
36	1.03	1.00	0.03	0.031
37	1.02	0.99	0.03	0.020
38	1.05	0.99	0.06	0.050
39	1.09	0.99	0.10	0.093
40	1.12	0.99	0.13	0.124
41	1.14	0.98	0.17	0.143
42	1.16	0.98	0.18	0.162
43	1.18	0.98	0.20	0.180
44	1.24	0.97	0.28	0.243
45	1.30	0.97	0.33	0.298
46	1.30	0.97	0.34	0.304
47	1.34	0.93	0.41	0.344
48	1.35	0.92	0.42	0.346
49	1.35	0.90	0.45	0.348
50	1.39	0.90	0.49	0.391
51	1.40	0.89	0.52	0.404
52*	**1.48**	**0.87**	**0.61**	**0.480**
53	1.44	0.81	0.63	0.443
54	1.44	0.79	0.65	0.439
55	1.46	0.76	0.71	0.461
56	1.45	0.70	0.75	0.455
57	1.43	0.67	0.77	0.434
58	1.41	0.61	0.80	0.415
59	1.39	0.59	0.80	0.393
60	1.39	0.58	0.81	0.388
61	1.39	0.53	0.86	0.392
62	1.37	0.51	0.86	0.370
63	1.37	0.49	0.88	0.372
64**	**1.37**	**0.46**	**0.91**	**0.370**
65	1.34	0.42	0.91	0.336
66	1.27	0.34	0.93	0.271
67	1.28	0.33	0.95	0.284
68	1.27	0.31	0.96	0.274
69	1.24	0.27	0.97	0.236
70	1.24	0.27	0.98	0.242

71	1.23	0.24	0.98	0.226
72	1.22	0.23	0.99	0.221
73	1.21	0.22	0.99	0.210
74	1.18	0.19	0.99	0.177
76	1.17	0.18	0.99	0.172
78	1.14	0.14	0.99	0.138
80	1.13	0.13	0.99	0.127
82	1.09	0.10	0.99	0.094
83	1.08	0.08	1.00	0.078
84	1.04	0.04	1.00	0.044
85	1.03	0.03	1.00	0.033
86	1.00	0.00	1.00	0.000

Note. BASC-2 = Behavior Assessment System for Children; Sn = Sensitivity; * Sn+SP cutoff score; ** Delong cutoff score.

Table 9

Classification Accuracy Statistics for the SRS Hyperactivity subscale

Score	Sn+Sp	Sn	Sp	Youden's Index
0.00	1.16	0.99	0.17	0.161
0.15	1.17	0.99	0.18	0.167
0.17	1.27	0.94	0.33	0.270
0.32	1.28	0.94	0.33	0.276
0.33	1.34	0.91	0.43	0.341
0.47	1.35	0.91	0.44	0.347
0.50	1.40	0.83	0.57	0.404
0.60	1.41	0.83	0.58	0.410
0.67*	**1.46**	**0.78**	**0.69**	**0.465**
0.83	1.41	0.68	0.74	0.414
0.93	1.40	0.67	0.74	0.403
0.93	1.41	0.67	0.74	0.409
0.99	1.42	0.67	0.75	0.415
1.00	1.40	0.60	0.80	0.398
1.17	1.44	0.57	0.87	0.438
1.33**	**1.42**	**0.52**	**0.90**	**0.424**
1.50	1.39	0.44	0.94	0.389
1.67	1.27	0.32	0.94	0.267
1.83	1.22	0.26	0.96	0.219
1.93	1.21	0.24	0.96	0.208
2.00	1.18	0.20	0.98	0.175
2.17	1.14	0.14	0.99	0.138
2.33	1.12	0.12	0.99	0.116
2.50	1.06	0.06	1.00	0.056
2.67	1.03	0.03	1.00	0.033
2.83	1.01	0.01	1.00	0.011
3.00	1.00	0.00	1.00	0.000

Note. SRS = Symptom Rating Scale; Sn = Sensitivity; Sp = Specificity; * Sn+SP cutoff score; **

Delong cutoff score.

Table 10

Classification Accuracy Statistics for the BASC-2 Attention Problems subscale

Score	Sn+Sp	Sn	Sp	Youden's Index
40	1.03	1.00	0.03	0.03
41	1.04	1.00	0.04	0.04
42	1.05	1.00	0.05	0.05
43	1.06	1.00	0.06	0.06
44	1.08	1.00	0.08	0.08
45	1.08	0.98	0.10	0.08
46	1.08	0.98	0.10	0.08
47	1.07	0.97	0.10	0.07
48	1.11	0.97	0.14	0.11
50	1.09	0.93	0.15	0.09
51	1.04	0.87	0.17	0.04
53	1.05	0.86	0.20	0.05
54	1.06	0.83	0.23	0.06
55	1.07	0.83	0.24	0.07
56	1.09	0.78	0.31	0.09
57	1.10	0.78	0.33	0.10
58	1.09	0.77	0.33	0.09
59	1.11	0.68	0.44	0.11
60	1.14	0.64	0.49	0.14
61	1.11	0.58	0.53	0.11
62	1.10	0.54	0.55	0.10
63	1.09	0.51	0.58	0.09
64	1.01	0.33	0.67	0.01
65	1.02	0.33	0.69	0.02
66	1.02	0.31	0.71	0.02
67	1.01	0.22	0.79	0.01
68	0.99	0.19	0.80	0.01
69	1.02	0.18	0.84	0.02
70	0.98	0.11	0.87	0.02
71	1.00	0.11	0.89	0.00
72	1.00	0.08	0.92	0.00
73	0.99	0.06	0.93	0.01
74	0.98	0.04	0.93	0.02
75	1.00	0.04	0.95	0.00
76	0.98	0.02	0.96	0.02
77	0.99	0.01	0.98	0.01
78	0.99	0.00	0.99	0.01
81	1.00	0.00	1.00	0.00

Note. BASC-2 = Behavior Assessment System for Children; Sn = Sensitivity; Sp = Specificity.

Table 11

Classification Accuracy Statistics for the SRS Inattention subscale

Score	Sn+Sp	Sn	Sp	Youden's Index
0.00	0.99	0.99	0.00	0.01
0.11	0.99	0.99	0.00	0.01
0.22	0.97	0.97	0.00	0.03
0.33	0.96	0.96	0.00	0.04
0.56	0.95	0.94	0.01	0.05
0.67	0.98	0.91	0.07	0.02
0.78	1.01	0.90	0.11	0.01
0.89	1.00	0.86	0.14	0.00
1.00	1.05	0.85	0.20	0.05
1.11	1.04	0.80	0.23	0.04
1.22	1.05	0.78	0.27	0.05
1.33	1.08	0.74	0.33	0.08
1.44	1.09	0.71	0.38	0.09
1.56	1.11	0.64	0.47	0.11
1.67	1.08	0.60	0.49	0.08
1.78	1.14	0.56	0.58	0.14
1.89	1.15	0.51	0.64	0.15
2.00	1.10	0.44	0.67	0.10
2.11	1.07	0.37	0.70	0.07
2.22	1.08	0.33	0.76	0.08
2.33	1.09	0.26	0.83	0.09
2.44	1.04	0.18	0.86	0.04
2.56	1.01	0.13	0.88	0.01
2.67	0.99	0.09	0.90	0.01
2.78	0.97	0.05	0.92	0.03
2.89	0.97	0.02	0.96	0.03
3.00	1.00	0.00	1.00	0.00

Note. SRS = Symptom Rating Scale; Sn = Sensitivity; Sp = Specificity.

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Weyandt, L., DuPaul, G. J., Verdi, G., Rossi, J. S., Swentosky, A. J., Vilardo, B. S., ... & Carson, K. S. (2013). The performance of college students with and without ADHD: Neuropsychological, academic, and psychosocial functioning. *Journal of*

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Zisser, A. R., & Eyberg, S. M. (2012). Maternal ADHD: Parent-child interactions and relations with child disruptive behavior. *Child & Family Behavior Therapy*, *34*, 33-52. doi:10.1080/07317107.2012.654450

Curriculum Vitae

Stacy J. Graves
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Education

Clinical Psychology Doctoral Program Student, August 2013- Present
PhD Anticipated Fall 2020
University of Nevada, Las Vegas, Las Vegas, NV
GPA: 3.87/4.00

B.S., Psychology, Magna Cum Laude, December 2011
Virginia Polytechnic Institute and State University, Blacksburg, VA
Honors Scholar Diploma
GPA: 3.65/4.00

Clinical Experience

SNAMHS Rawson-Neal Psychiatric Hospital and Muri Stein Forensic Hospital, August 2017- Present

- Developed a Dialectical-Behavior Therapy skill-based group psychotherapy curriculum for a population of adults in both a community and forensic inpatient setting with severe mental illnesses
- Facilitated a Liebermann-module community-reentry psychotherapy group for acutely psychotic adults in a forensic inpatient setting
- Provided brief, skill-based individual therapy with adults in a community and forensic inpatient setting
- Conducted neuropsychological, psychodiagnostic and forensic competency assessments with adults with cognitive and neurodevelopmental disorders, under the supervision of a licensed neuropsychologist.
- Assessed the nature and severity of high-risk patients suicidality and provided crisis intervention to through individual therapy and psychodiagnostic assessment to assist in diagnosis and treatment
- Conducted intakes with recently admitted patients, including justifying and discussing diagnosis and treatment planning from integrative therapeutic approach with clinical supervisor
- Attended weekly interdisciplinary treatment team meetings to consult and provide diagnostic considerations and treatment recommendations

Graduate Assistant and Student Clinician, PRACTICE Clinic at UNLV, August 2016-Present

- Provided weekly integrative psychotherapy sessions to adult clients with a range of mental illnesses
- Assisted in the development and co-facilitation of a skill-based psychotherapy group for adults with chronic illness and participated as a process observer for an interpersonal process group for adults coping with depression and anxiety

- Participated in supervision of group therapy program and assisted in the development and implementation of a group therapy program at a community-based mental health clinic
- Provided crisis intervention to high-risk clients, including assessing the nature and severity of the client's suicidality and safety-planning in session
- Conducted intakes for new clients as well as justifying and discussing diagnosis and treatment planning from integrative therapeutic approach with clinical supervisor
- Attended weekly case round meetings with an interdisciplinary treatment team to consult and provide diagnostic considerations and treatment recommendations
- Presented detailed case-presentations to other clinicians to assist in treatment planning
- Responsible for managing billing, scheduling and administrative tasks at the clinic

Neuropsychological Assessment Practicum Clinician, Center for Applied Neuroscience, Las Vegas, NV, August 2016- May 2017

- Conducted comprehensive neuropsychological evaluations twice weekly with adults and children with cognitive and developmental disorders, under the supervision of a licensed neuropsychologist.
- Wrote neuropsychological reports weekly with diagnostic information and treatment recommendations
- Participated in supervision with didactic training on various psychological and cognitive disorders

Student Clinician, Sandstone Private Practice, Henderson, NV, August 2015-August 2016

- Provided weekly integrative psychotherapy sessions to adolescent and adult clients with severe depression, anxiety and related mental health conditions
- Co-facilitated weekly interpersonal group therapy sessions for adolescent girls with social anxiety
- Specialized in psychodynamic and interpersonal therapeutic interventions while also integrating other cognitive and behavioral interventions as needed for each client
- Discussed diagnosis, treatment planning and case conceptualization from psychodynamic therapeutic approach with clinical supervisor during weekly supervision sessions
- Specialized in providing psychotherapy for grief from a psychodynamic and interpersonal approach
- Provided crisis intervention to high-risk clients, including assessing the nature and severity of the client's suicidality and providing safety-planning in session

- Conducted psychodiagnostic testing to adolescent and adult clients with learning and personality disorders, including scoring assessments, writing psychodiagnostic reports and providing feedback to clients
- Conducted intake interviews for new testing and therapy clients to assess appropriate level of treatment and provide provisional diagnosis
- Participated in weekly group supervision and case consultation meetings with other licensed and student clinicians

Student Clinician, PRACTICE Clinic at UNLV, August 2014- August 2015

- Provided weekly integrative psychotherapy sessions to adult clients with a range of mental illnesses (5-7 client caseload)
- Provided crisis intervention to high-risk clients, including assessing the nature and severity of the client's suicidality and safety-planning in session
- Conducted intakes for new clients as well as justifying and discussing diagnosis and treatment planning from integrative therapeutic approach with clinical supervisor
- Conducted psychodiagnostic testing to clients with various mental health concerns, including writing integrative psychodiagnostic reports and providing feedback to clients, under the supervision of a licensed psychologist
- Conducted psychotherapy sessions through tele-communication services to provide mental health care for underserviced populations

Administrative Assistant, Family First Psychological Services, September 2012- April 2013

- Assisted in various administrative tasks for the practice including organizing and managing client invoices, payments and accounts
- Scored psycho-educational assessment measures
- Attended weekly peer consultation meetings for therapy cases

Adult Day Services Recreational Therapy Assessment, September 2011- November 2011

- Wrote progress notes for interviewed participants under supervision of therapist
- Actively observed and assisted with group activities in Adult Day Services
- Independently administered geriatric recreational therapy assessments
- Administered and developed an understanding of the MMSE, GDS, LSS, MARCC
- Interacted with dementia patients on a weekly basis in group and individual settings

Caregiver Support Group Meeting, October 2011 – November 2011

- Student organized support group meetings for caregivers of elderly with dementia
- Assisted in planning of activities and helped distribute marketing materials
- Assisted in activities and care of elderly dementia patients during meeting

Research Experience

UNLV Neuropsychology Graduate Research Assistant, January 2015-Current

- Administer neuropsychological assessments and assist in participant recruitment, screening and report writing with children and adolescents diagnosed with ADHD
- Attend weekly lab meetings and contribute to discussion about current and future research projects
- Combine large archival data sets in SPSS and Excel for data analysis
- Assist in data entry of APA self-study material for accreditation visit

UNLV Doctoral Graduate Research Assistant, August 2014-December 2014

- Project coordinator for a qualitative interview project with Latino caregivers that received services from Nathan Adelson hospice in Las Vegas.
- Responsible for creating and distributing interview materials as well as delegating various research tasks to undergraduate research assistants
- Coordinated financial compensation for participants
- Tracked progress of interviews and collection of interview materials
- Primary correspondent between the principal investigators

UNLV Stressful Transitions and Aging Lab Research Assistant, August 2013-June 2014

- Primary investigator of electronic problem-solving therapy computer program with older adults pilot study and responsible for scheduling and conducting sessions with participants
- Actively involved in writing sections for research manuscripts with other lab members
- Attended weekly lab meetings and shared responsibility of leading meeting discussion about current and future research projects
- Assisted in organizing and managing lab resources

Research Assistant for Dr. Shannon Jarrott, December 2011- June 2012

- Assisted in various administrative tasks for research projects evaluating effectiveness of intergenerational education
- Performed data analysis and presented findings in an organized report
- Drafted activity guides for intergenerational activity instructors

Independent Research Contractor, Generations United, December 2011- March 2012

- Responsible for online survey design using Qualtrics Survey software
- Conducted background research on childcare accreditation standards and intergenerational programming
- Analyzed data using statistical methodology and SPSS software
- Responsible for the design, production and distribution of survey materials
- Prepared statistical reports for the research team to present in evaluation

Undergraduate Honors Research with Human Development Dept., August 2011- December 2011

- Researched attitudes on aging in college students and semantic age priming effects
- Primary researcher responsible for developing research question and experimental design
- Attended weekly research discussion meetings including review of research literature and ongoing review of experiment design
- Gained experience with the IRB process and involved with editing IRB amendments
- Responsible for data collection and analysis using SPSS
- Research findings were presented at Quint State Research Conference, February 2012

Virginia Tech Cognition, Emotional and Self-Regulation Lab Research Assistant, September 2010- August 2011

- Assisted in grant-funded research project on psychopathology in college students
- Administered several common cognitive lab tasks and clinical diagnostic interviews
- Administered galvanic skin response and electrocardiogram tests
- Participated in weekly lab meetings to review current literature on psychopathy and Antisocial Personality Disorder as well as discuss research design and progress of research
- Gained experience with SONA experiment system, E-Prime, and M.I.N.I
- Attended lectures and presented research poster at APS 2011 psychology conference

Banner Sun Health Research Institute: Summer Intern, June 2010- August 2010

- Longevity research program in Arizona aimed at understanding the psychosocial, cognitive, medical and physical factors contributing to healthy aging

- Completed 33 direct interviews and brief cognitive status assessments with 50-104 year olds
- Developed skills for administration and scoring of psychometric tests
- Responsible for scheduling, phone screening and completing in-person interviews with participants
- Transcribed script of focus group on geriatric life satisfaction and intervention methods
- Attended geriatric education lecture series 2-3 hours a week
- Assisted in teaching 5-week memory improvement course for geriatric population
- Shadowed geriatric medical physicians during medical visits with dementia patients
- Observed psychometric testing and group counseling sessions
- Observed a brain autopsy of healthy elderly person
- Presented research in student symposium to professionals from the gerontology field

Virginia Tech Behavioral Neuroscience Lab Research Assistant, October 2009- May 2010

- Assisted in grant-funded research project entitled "Risk of Fall in the Elderly: A Neuropsychological Approach to Vestibular Function"
- Administered questionnaires and neuropsychology tests of executive functions
- Assisted in fitting and application of electroencephalography (EEG) cap
- Assisted in data collection and analysis of quantitative EEG

Department of Defense Education Activity, Research and Evaluation Intern, June 2009- August 2009

- Coded and analyzed data from school evaluation surveys from schools internationally
- Researched background information for various grant-funded research proposals on the prevalence of bullying in DoDEA international schools
- Attended and participated in DoDea executive director's meetings

Teaching Experience

Introductory Psychology Part-time Instructor, Fall 2015- Spring 2016

- Design introductory psychology course for two class sections
- Present lectures twice weekly based on textbook and required course material
- Design, administer and grade examinations and written assignments to assess understanding of students' understanding of course material
- Attend bi-weekly teaching course with other introductory psychology teachers to provide supplemental material and discuss course concepts

Graduate Teaching Assistant, August 2013- December 2013

- Assist professor with grading and lecture preparation
- Attend *Psychology of Aging* class lectures weekly
- Host office hours to assist students with course material

Student Athlete Academic Support Services, August 2010- December 2011

- Paid tutor position working with student athletes
- Responsible for supplementary instruction in psychology and related courses
- Help student athletes with time management, study skills and note-taking skills
- Responsible for scheduling and evaluating tutor sessions with student-athletes

Articles in Preparation

Graves, S. J., Freeman, A. J., Paul, M. G., Etcoff, L. M., Allen, D.N. (2017). Improving accuracy of ADHD-inattentive diagnoses with symptom rating scales. Manuscript in preparation.

Parke, E. M., Becker, M. L., Graves, S. J., Mayfield, A. R., Paul, M. G., Freeman, A. J., Allen, D. N. (2017). Social cognition in children with attention-deficit/hyperactivity disorder. Manuscript in preparation.

Published Works

Holland, J. M., Graves, S., Klingspon, K. L., & Rozalski, V. (2016). Prolonged grief symptoms related to loss of physical functioning: Examining unique associations with medical service utilization. *Disability and Rehabilitation: An International, Multidisciplinary Journal*, *38*(3), 205-210. DOI:10.3109/09638288.2015.1031830

Graves, S.; Embler, S. & Watkins, S. (2010). *Status Report: Implementation of DoDEA Graduation Requirements* [White paper].

Conference Presentations

Graves, S. J., Parke, E. M., Mayfield, A. R., Call, E. T., & Allen, D. N. (2017, October). *Social Cognitive Deficits in Children with Attention Deficit Hyperactivity Disorder.* Poster session presented at the Annual Meeting of the National Academy of Neuropsychology, Boston, MA.

Graves, S. J., Parke, E. M., Etcoff, L. M., & Allen, D. N. (2017, April). *The relationship between ADHD symptomatology and BASC-2 ratings.* Poster session presented at the American Academy of Pediatric Neuropsychology, Las Vegas, NV.

Graves, S. J., Parke, E. M., Etcoff, L. M., San Miguel, L., & Allen, D. N. (2016, October). *The Relationship between the Woodcock-Johnson-III and the Batteria-III in Children with ADHD and Learning Disorders.* Poster session presented at the Annual Meeting of the National Academy of Neuropsychology, Seattle, WA.

Graves, S. J., Parke, E. M., Etcoff, L. M., & Allen, D. N. (2015, November). *The relationship between ADHD symptomatology and BASC-2 parent ratings.* Poster session presented at the Annual Meeting of the National Academy of Neuropsychology, Austin, TX.

Holland, J.M., Graves, S.J., Thompson Kara L., Rozalski, V. (2014, February). *Prolonged Grief Symptoms Related to Loss of Physical Functioning: Examining Unique Associations with Medical Service Utilization.* Lecture presentation at American Association of Behavioral and Social Sciences Conference, Las Vegas, NV.

Graves, S.J., Burns, M., & Jarrott, S.E. (2012, February). *The effects of age priming on images of future older selves.* Poster session presented at the Southeastern Symposium on Child and Family Development, Blacksburg, VA.

Comer, C. S., Carmona, J. E., Oladosu, F., Golden, L. L., Grim, T. W., Graves, S. J., Rayher, D. A., & Harrison, D. W. (2010). *Performance on an Extended Written Verbal Fluency Test as a Predictor of Trait Anxiety.* Poster session presented at the Spring Conference of the Virginia Psychological Association, Norfolk, VA.

Honors and Awards

UNLV Access Grant, $2000, Fall 2017
GPSA Travel Award, February 2016, October 2016 & October 2017
GPSA Outstanding Poster Award, March 2016, Honorable Mention
Mary Nolen Blackwood Endowed Scholarship in Psychology, $1000, Fall 2010 – Spring 2011
Virginia Tech Honors Program, Spring 2009 – Fall 2011
Virginia Tech Dean's List, Fall 2008- Fall 2011

Professional Affiliations

Nevada Psychological Association, Student Member, UNLV Campus Representative (May 2016- present)
American Group Psychotherapy Association, Student Member
National Academy of Neuropsychology, Student Member
American Psychological Association, Student Affiliate
Society of Clinical Psychology, Division 12 of APA, Student Member