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Running Head: NEUROPSYCHOLOGICAL PROFILE OF INATTENTION IN CHILDREN

THE UTILITY OF NEUROPSYCHOLOGICAL MEASURES ON THE DIFFERENTIAL DIAGNOSIS OF ADHD-INATTENTIVE TYPE VERSUS ANXIETY IN A PEDIATRIC OUTPATIENT BEHAVIORAL HEALTH POPULATION

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Introduction

Anxiety, Attention-Deficit/Hyperactivity Disorder, and Inattention

In the *Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition* (American Psychiatric Association, 2013), Attention-deficit/hyperactivity disorder (ADHD) is classified as a disorder with deficits in attention and/or the presence of hyperactivity/impulsivity, with three subtypes of the disorder: ADHD-Inattentive Type (ADHD-I), ADHD-Hyperactive/Impulsive Type (ADHD-H) and ADHD-Combined Type (ADHD-C) (American Psychiatric Association, 2013). The subtypes of ADHD-I and ADHD-C are characterized by deficits in attention (Mayes, Calhoun, Chase, Mink, & Stagg, 2009); however, deficits in attention also are common in anxiety disorders (Jarrett & Ollendick, 2008; Weissman et al., 2012). The symptomology present in both anxiety disorders (i.e., disorders characterized by excessive worry) and ADHD-I/ADHD-C diagnoses include poor concentration, difficulty in sustaining attention, and restlessness (American Psychiatric Association, 2013).

Although the symptoms of inattention present in ADHD-I/ADHD-C and anxiety disorders are similar, the etiology of each differs (Jarrett, Wolff, Davis, Cowart, & Ollendick, 2016; Toplak, Bucciarelli, Jain, & Tannock, 2009; Weissman, Chu, Reddy, & Mohlman, 2012; Yurtbasi et al., 2015). Symptoms of inattention in ADHD-I/ADHD-C are believed to be secondary to deficits in executive functioning skills, including poor inhibitory control, working memory, and selective/sustained attention (Hurtig et al., 2007; Weissman et al., 2012). In contrast, anxiety disorders are characterized by excessive concern or fear of a situation or stimulus that causes intrusive thoughts, worry, heightened arousal, or somatic complaints. These symptoms of anxiety can cause increased attentional bias toward threats in the internal and/or external environment that can manifest as symptoms of inattention in children with anxiety

disorders (Jarrett & Ollendick, 2008; Weissman et al., 2012). The overlap of symptoms of inattention and distractibility between ADHD-I/ADHD-C and anxiety disorders often make it difficult for clinicians to pinpoint the etiology behind the inattention, leading to both misdiagnosis and overdiagnosis of the disorders (Bruchmüller, Margraf, & Schneider, 2012; Elkins, Carpenter, Pincus, & Comer, 2014; Lahey & Carlson, 1991).

ADHD-I and ADHD-C

Diagnostically, children with ADHD-I and ADHD-C exhibit significant symptoms of inattention that cause functional impairment, and children with ADHD-C exhibit a persistent pattern of hyperactivity or impulsivity. Although children with ADHD-I and ADHD-C differ in terms symptoms of hyperactivity, difficulties with attention underlie the two presentations. Inattention has been found to be relatively stable across developmental stages, with remittance of hyperactive symptoms with age and a transition from ADHD-C to ADHD-I in adolescence (Hurtig et al., 2007). Based on the similarities in symptoms of inattention between ADHD-I and ADHD-C, these diagnoses will be combined in this study in order to compare inattention rooted in ADHD with inattention from anxiety disorders.

Children with ADHD-I and ADHD-C demonstrate deficits in executive functions, including working memory, response inhibition, planning, and vigilance (Martinussen, Hayden, Hogg-Johnson, & Tannock, 2005; Willcutt, Doyle, Nigg, Faraone, & Pennington, 2005). Results from studies that compare children with ADHD-I and children with ADHD-C on neuropsychological measures vary. Several studies have found differences between these two disorders on measures of executive functioning, including measures of impulsivity on a continuous performance test (i.e., Gordon Diagnostic System), processing speed (i.e., Coding and Symbol Search subtests of the Weschler Intelligence Scale for Children, Third Edition and

Fourth Edition [WISC-III and -IV]), and inhibition (i.e., Inhibit scale of the BRIEF-PRS) (Mayes et al., 2009; McCandless & O’Laughlin, 2007).

Whereas, nonsignificant differences between ADHD-I and ADHD-C on measures of executive functioning have also been found, including attention measures vigilance and distractibility on a continuous performance test (i.e., Gordon Diagnostic System) and measures of working memory (i.e., Digit Span and Arithmetic of the WISC-III/IV and Working Memory scale of BRIEF-PRS) (Mayes et al., 2009; McCandless & O’Laughlin, 2007). Geurts, Verté, Oosterlaan, Roeyers, and Sergeant (2005), however, found no statistical differences on measures of executive functioning, specifically, cognitive flexibility (i.e., Wisconsin Card Sorting Test), verbal fluency (i.e., Controlled Word Association Task), planning (i.e., Tower of London), and visual memory (i.e., Self-Ordered Pointing task), between ADHD-I and ADHD-C groups. In addition, a meta-analysis of the differences between groups on several measures of executive functioning found few significant differences between inattentive and combined types of ADHD (Willcutt et al., 2005).

Furthermore, Power, Costigan, Eiraldi, and Leff (2004) found no statistical differences in levels of anxiety between children with ADHD-I and those with ADHD-C, with both exhibiting similar non-clinical levels of anxiety on the Behavioral Assessment System for Children (BASC), a report-based measure that assists in the evaluation of children’s emotional and behavioral functioning.

Anxiety

Symptoms of anxiety negatively affect cognitive performance. Because anxious individuals are highly motivated to perform well and, thus, invest significant cognitive resources to tasks, greater impairment in functioning is observed as the complexity and attentional

demands of the task increase (Berggren & Derakshan, 2013; Derakshan & Eysenck, 2009). Specifically, individuals with anxiety demonstrate impairments in inhibition, working memory, and monitoring, as well as shifting mental sets, which hinder processing efficiency due to an overall deficit in attentional control, similar to the deficits seen in children with ADHD (Derakshan & Eysenck, 2009; Eysenck, Derakshan, Santos, & Calvo, 2007; Miyake et al., 2000). Processing efficiency is measured by examining response rates and physiological correlates (e.g., heart rate) to understand the relationship between performance and effort (Wong, Mahar, & Titchener, 2015).

Attentional control theory asserts that anxious individuals tend to distribute attentional resources to threat-related stimuli, whether they are perceived threats in the environment or internal worrisome thoughts (Eysenck et al., 2007). The theory also posits that:

Anxiety impairs processing efficiency because it reduces attention control (especially in the presence of threat-related distracting stimuli). As a result, the probability that processing resources will be diverted from a task-relevant stimuli to task-irrelevant ones on tasks involving the inhibition and/or shifting functions is increased. (Eysenck et al., 2007, p. 339)

Attentional control theory also posits impairments in “updating” functions, which involve the executive functions of monitoring and working memory. Miyake et al. (2000) noted that the “updating” function “requires monitoring and coding incoming information for relevance to the task at hand and then appropriately revising the items held in working memory by replacing old, no longer relevant information with newer, more relevant information” (p. 56). Support for this theory is provided by Owens, Stevenson, Norgate, and Hadwin (2008), who also found deficits in working memory when studying performance on cognitive tests in a group of children with

anxiety. Moreover, increased cognitive demands in anxious individuals have been shown to affect processing speed, as demonstrated by decreased response rates (Fox & Georgiou, 2005).

Importance of Targeted Treatment

The work of Salla et al. (2016) suggests that symptoms of inattention in childhood predict long-term academic difficulties, including academic achievement in reading, writing, and mathematics, as reflected by lower scores on government exams and teacher-reported academic performance. Children with significant symptoms of inattention demonstrate overall worse academic outcomes, higher levels of academic difficulties, and decreased high school graduation rates (Masseti et al., 2008; Pingault et al., 2011; Salla et al., 2016; Sayal, Washbrook, & Propper, 2015; Washbrook, Propper, & Sayal, 2013). In addition, untreated childhood anxiety disorders predict anxiety and depressive disorders in adulthood (Beesdo et al., 2007; Kendall et al., 2010).

Treatment of childhood ADHD and anxiety are distinct from each other, with different therapeutic needs and pharmacological interventions for each disorder and poorer outcomes and negative effects if the individual goes untreated or the inappropriate treatment modality is selected (Hammerness et al., 2010). Henriksen et al. (2015) found that young children with common mental disorders (i.e., nonbipolar and nonpsychotic depression, anxiety, and substance use) should be targeted for treatment because they have a much lower likelihood of remittance without such treatment.

Furthermore, untreated ADHD is associated with long-term difficulties with self-esteem, social relationships, and academic outcomes (Arnold, Hodgkins, Kahle, Madhoo, & Kewley, 2015; Harpin, Mazzone, Raynaud, Kahle, & Hodgkins, 2013; Shaw et al., 2012). Untreated anxiety is associated with difficulties in school, social challenges, and the emergence of more

serious mental and physical health problems, such as headaches and recurrent abdominal pain (Beidel, Christ, & Long, 1991; Bernstein, Borchardt, & Perwien, 1996; Coplan & Ooi, 2013; Liakopoulou-Kairis et al., 2002; Wolk, Kendall, & Beidas, 2015). Moreover, Wolk et al. (2015) found that individuals with untreated childhood anxiety had more chronic and enduring patterns of suicidal ideation throughout their lifetime. Thus, correctly identifying the cause of inattention is vital to positive outcomes.

Cognitive behavioral therapy (CBT) has been established as an effective first-line treatment of anxiety disorders in childhood (Creswell & Waite, 2016; James, James, Cowdrey, Soler, & Choke, 2015; Wolk et al., 2015). Treatment of childhood anxiety through antidepressant medications (i.e., selective serotonin reuptake inhibitors and selective norepinephrine reuptake inhibitors) also has been found to be effective (Creswell & Waite, 2016; Dobson & Strawn, 2017; The Research Unit on Pediatric Psychopharmacology Anxiety Study Group, 2001). In contrast, treatment via stimulant medications (e.g., methylphenidate) is regarded as the first line of pharmacological treatment in ADHD (Shaw et al., 2012). Nevertheless, CBT and multimodal treatments have been associated with improved outcomes for ADHD, especially regarding social functioning (Harpin et al., 2013; Shaw et al., 2012).

Use of Diagnostic Tools in Differential Diagnosis of ADHD and Anxiety Disorders

Several studies have shown that ADHD and anxiety disorders have distinct presentations on neuropsychological tests with regard to attention and other aspects of executive functioning. For example, difficulties in working memory and response speed have been observed in both ADHD and anxiety populations (Jarrett et al., 2016). Findings also indicate increased variability in response rate and deficits in inhibition and selective/sustained attention in ADHD groups, and selective attentional processing of threat cues in anxiety disorders (Jarrett et al., 2016; Weissman

et al., 2012; Yurbasi et al., 2015). Given the differences in performance by ADHD and anxiety groups on measures of attention and executive functioning, the diagnostic profiles of the populations can be refined to provide cutoff scores or other criteria in screening measures as a means to aid in the differential diagnosis of anxiety disorders and ADHD. For example, Elkins et al. (2014) determined a cutoff score on the Attention Problem Scale of the Child Behavior Checklist to distinguish inattention secondary to ADHD from inattention secondary to Generalized Anxiety Disorder.

Research on the utility of the continuous performance tests, like the Conners Continuous Performance Test (CPT), in identifying deficits in attention have yielded mixed results, “with low to moderate convergent validity with other measures, fair sensitivity in ruling out ADHD, and poor specificity when differentiating among children with ADHD and groups with other clinical disorders” (Holmack & Reynolds, 2005, p. 7). A meta-analysis of CPT studies by Holmack and Reynolds, however, showed that discrepancies across the literature could be secondary to poorly controlled studies; differences in diagnostic criteria, including ADHD definitions; varying parameters of significance between different continuous performance tests; and group characteristics (2005).

Despite the above-noted limitations, studies have demonstrated the utility of the CPT to differentiate between ADHD and non-ADHD populations (Advokat, Martino, Hill, & Gouvier, 2007; Holmack & Reynolds, 2005). Jarrett et al. (2016) compared performance on the CPT of an anxiety disorder-only group, comorbid anxiety and ADHD group, and ADHD-only group. They found significant differences in attentional abilities between the ADHD-only and anxiety disorder-only groups. Specifically, children in the ADHD-only group were more impaired in their performance on the CPT than the anxiety disorder-only group, including greater impairment

in overall attention and significant variability in response speed, indicating difficulties with vigilance and sustained attention. These results suggest greater deficits in sustained attention in ADHD than in anxiety. Further, all CPT indicators showed greater attentional impairments in the ADHD group than in the Anxiety group. In addition, studies have demonstrated the utility of the CPT in differentiating between ADHD and comorbid depression (Advokat et al., 2007; Mesquita et al., 2016), providing support for the use of CPT as a diagnostic tool for ADHD based symptoms of inattention, and, thus prompting the inclusion of the measure in our study. Given the mixed support for the use of the CPT as a standalone diagnostic tool, there is a need for multi-method assessment, including objective (e.g., performance based) and subjective (e.g., parent-/teacher-report measures) means to enhance the accuracy of psychiatric diagnoses (Meyer et al., 2001).

A structured clinical interview allows clinicians to collect information and to assess the presence of symptoms. However, clinicians are unable to determine symptom severity in accordance with the child's age and gender via this method alone due to variable agreement among informants and potential concerns for validity, such as underestimation or overestimation of the severity of symptoms or functional impairment, intentional dishonesty, influences of respondent stress and emotional difficulties, and inadequate familiarity with the child being evaluated (American Academy of Child and Adolescent Psychiatry, 2007; Reynolds & Kamphaus, 2015). Thus, there is the need to incorporate normative assessments for an accurate diagnosis. Behavior rating scales provide additional information about the child's symptoms based on normative samples, thereby also providing information about the severity of the symptoms.

Research supports the value of multiple diagnostic measures, including performance based and parent-/teacher-report measures, in the diagnoses of ADHD (Toplak et al., 2009; Yurtbasi et al., 2015). Toplak et al. (2009) found modest correlations between the Behavior Rating Inventory of Executive Functioning (BRIEF) and several performance-based measures of inhibition (i.e., The Stop Task – stop-signal reaction time variable), working memory (i.e., Digit Span and Spatial Span subtests of WISC-III), shifting (i.e., Trail Making Test – Part B), and planning (i.e., Stockings of Cambridge task from the Cambridge Neuropsychological Test Automated Battery). Given the ability of the BRIEF to highlight deficits in executive functioning, it is a useful tool for distinguishing children with ADHD from controls (McCandless & O’Laughlin, 2007; Skogan et al., 2015; Toplak et al., 2009). Moreover, it can provide diagnostic clarification in regard to what underlies inattention in terms of the deficits in executive functions seen in ADHD (i.e., working memory, response inhibition, planning, and vigilance) or anxiety (i.e., monitoring, working memory, and processing speed).

Additionally, ratings on the BRIEF were found to be significantly associated with scales of attention on the Behavior Assessment System for Children (BASC), a behavior rating measure that evaluates various aspects of children’s behavioral and emotional functioning, and also with a performance-based measure of executive functioning (Integrated Visual and Auditory Continuous Performance Test) (McCandless & O’Laughlin, 2007). The BASC has also demonstrated good reliability in the identification of anxiety and a shows a moderate to high correlation with scales of anxiety and internalizing behaviors on the Child Behavior Checklist (CBCL) (Reynolds & Kamphaus, 2015).

Enhancing Diagnostic Clarity

Considering the challenges of the differential diagnosis of inattention due to ADHD versus anxiety disorders, it is important to understand the value of both performance-based and parent-report measures. Combining performance-based and parent-report measures of anxiety, inattention, and executive functioning on the CPT, BRIEF-P (Parent) and BASC-PRS (Behavior Assessment System for Children-Parent Rating Scale) could improve differential diagnoses of inattention secondary to ADHD-I and ADHD-C, specifically, and anxiety disorders.

The purpose of this retrospective study is to examine differences in inattentive symptoms due to ADHD-I and ADHD-C as distinct from anxiety disorders to aid in the differential diagnoses of inattention in a pediatric population. Through the combined use of parent-report and performance-based measures of inattention and anxiety, this study seeks to enhance diagnostic clarity for differential diagnoses. While a limited number of studies have considered the differences between pediatric ADHD and anxiety without comorbid psychiatric diagnoses on neuropsychological measures (Jarrett et al., 2016; Yurtbasi et al., 2015), this is the first study to measure inattention in the two populations, using both performance-based measures (CPT) and parent-report measures (BRIEF and BASC). Through retrospectively evaluating these parent-report and performance-based measures of inattention, differential diagnosis of inattention rooted in executive function versus in anxiety may be improved.

For the performance-based test, we hypothesize that children with ADHD will have higher scores for inattention on the CPT than will children with anxiety disorders. Because the variables of omission and variability in the CPT are measures of sustained attention, and both ADHD and Anxiety groups demonstrate difficulties with inattention, both groups are expected to demonstrate elevated omission and variability scores. However, because children with ADHD are shown to demonstrate greater overall impairments in inattention, we expect the ADHD group

to have significantly higher scores on the variables of omission and variability than those diagnosed with anxiety. Furthermore, we hypothesize that, due to difficulties in both groups with processing efficiency, both groups will demonstrate a slow reaction speed, but with greater impairment in the ADHD group than the Anxiety group.

For parent-report, we hypothesize that on the BRIEF-P the Anxiety group will demonstrate challenges in shifting, working memory, and inhibition. In contrast, the ADHD group will demonstrate more severe executive dysfunction across all domains of the BRIEF-P. This hypothesis is based on evidence that ADHD is a disorder characterized by deficits in executive functioning. When comparing the group scores on the BASC-PRS, we expect the ADHD group to demonstrate significantly higher impairment from the Anxiety group on the attention problems subscale, while the Anxiety group will have higher scores on subscales of anxiety and internalizing behaviors than the ADHD group.

Methods

Sample and Participant Selection

A total of 58 patients were selected from past neuropsychological assessments conducted at a leading academic hospital in Denver, Colorado, by a senior neuropsychologist. With approval from the institutional review board, a retrospective chart review of the electronic medical records was conducted to select patients who met the criteria for an anxiety disorder or for ADHD-C and ADHD-I at the completion of the neuropsychological assessment. Due to the small sample of children in the retrospective chart review with generalized anxiety disorder (GAD), additional diagnoses containing anxiety symptoms as the predominant feature (e.g., unspecified anxiety disorder and adjustment disorder with anxiety) were included in the Anxiety group. Similarly, due to the small sample of children in the retrospective chart review with

ADHD-I, children with ADHD-C were also included in the ADHD group. Exclusion criteria for the sample included: comorbid ADHD and anxiety diagnoses, and participants with comorbid depressive disorders. Participants were between the ages of 6 and 18 years ($M = 10.05$, $SD = 3.40$). In total, 58 participants were selected, with 32 in the Anxiety group and 26 in the ADHD group.

Diagnoses were based on diagnostic impressions, following a comprehensive neuropsychological evaluation by a licensed psychologist. The evaluation included a semi-structured interview with the parents, completion of questionnaires and rating scales completed by parents and teachers, review of educational and medical records, administration of psychological tests (IQ, achievement, and behavioral rating scales) and neuropsychological tests (attention, executive functioning, memory, and language), and clinical observations during testing.

The patients' sex, age, diagnosis, and scores from the CPT, BRIEF-P, and BASC-PRS were obtained from electronic medical records. Data obtained from reviews were de-identified. The legal guardians of all participants provided consent for assessment. A waiver of informed consent for research was granted by the institutional review board, given this was an archival study using de-identified information.

Neuropsychological Measures

Conners Continuous Performance Test. The CPT is a computer-based performance test that assesses inattention, sustained attention, vigilance, and impulsivity. The test involves a 14-minute administration of 360 trials for which the participant is required to respond to any letter of the alphabet, except the X, when present (Conners, 2014a). Participants were administered three versions of the CPT, depending on age and when the neuropsychological

assessment was completed. The Conners Continuous Performance Test, Second Edition (CPT-II) is for ages six and older. The Conners Continuous Performance Test, Third Edition (CPT-3) and Conners Kiddie Continuous Performance Test, Second Edition (K-CPT 2) were subsequently adopted by the outpatient behavioral health clinic for neuropsychological testing during the time of the data collection to replace the CPT-II.

Differences across versions include recommended age range for administration, duration, stimulus, and proportion of non-targets. The CPT-II was the original measure that was recommended for ages 6 and older, was 14-minutes long, and had a higher proportion of targets. Due to difficulties with the administration length for younger children and to increase psychometric properties of the Commissions variable, the CPT-3 and K-CPT were developed. The CPT-3 is used for children ages eight and older, and the K-CPT assesses attention in children four to seven years of age via a 7-minute-long administration. The K-CPT differs from the CPT-II and CPT-3 because it uses simple pictures in lieu of letters of the alphabet for the visual stimuli. The CPT-3 and K-CPT also have a higher proportion of non-targets, because the previous editions of the CPT (i.e., CPT-II) was susceptible to ceiling effects and range restriction on the Commissions variable. Differences across some variables exist between versions. The following variables consistent across versions were selected for this study: Omissions, Commissions, and Hit Reaction Time (HRT). Variability was also selected to provide a measure of sustained attention; however, it is only present in the CPT-II and CPT-3, since Variability cannot be calculated in the K-CPT due to the shorter duration (Conners, 2014a).

Thus, Omissions, Commissions, Variability, and Hit Reaction Time (HRT) were included in this study. Omissions measures the number of times the target stimulus was presented, but the child did not respond; whereas, Commissions is the number of times the child responded in the

absence of the target stimulus. HRT is the mean response speed of correct responses for the entire administration. Finally, Variability is a “within respondent” measure of response speed consistency. For Omissions, Commissions, and Variability, *t*-scores <45 are considered low, 45–54 are considered average, 55–59 are high average, 60–69 are elevated, and 70+ are very elevated. For HRT, *t*-scores <40 are considered atypically fast, 40–44 are a little fast, 45–54 are average, 55–59 are a little slow, 60–69 are slow, and 70+ are atypically slow (Conners, 2014a).

Internal consistency of the CPT is reported via split-half reliability. On the CPT-II, reliability is considered in the excellent range for HRT (.95) and Omissions ($r = .94$), in the good range for Commissions ($r = .83$), and questionable range for Variability ($r = .66$) (Conners, 2004a). On the CPT-3, reliability is in the excellent range for Commissions ($r = .94$), HRT (.99), and Omissions ($r = .94$), and in the good range for Variability ($r = .80$) (Conners, 2014a). On the K-CPT, reliability is in the good range for Commissions ($r = .83$) and Omissions ($r = .88$) and in the acceptable range for HRT ($r = .72$) (Conners, 2014b).

Behavior Rating Inventory of Executive Functioning. The BRIEF-P is a parent-report measure that assesses the behaviors related to executive functioning in children ages 5 to 18 years. Two of the BRIEF-P were included in the study (BRIEF and BRIEF-2), as the BRIEF-2 was adopted by the outpatient behavioral health clinic for neuropsychological testing during the time of the data collection. The clinical scales of the BRIEF are inhibit, shift, emotional control, initiate, working memory, plan/organize, organization of material, and monitor, and they form two broader clinical scales, behavioral regulation and metacognition, as well as the overall global executive composite. The clinical scales of the BRIEF-2 are inhibit, self-monitor, behavior regulation index, shift, emotional control, initiate, working memory, plan/organize, task-monitor, and organization of material, and they form three broader clinical scales, behavioral regulation,

emotional regulation, and cognitive regulation, as well as the overall global executive composite. For all clinical scales and indexes, *t*-scores from 60 to 64 are considered mildly elevated; scores from 65 to 69, potentially clinically elevated; and at or above 70, clinically elevated (Gioia, Isquith, Guy, & Kenworthy, 2015).

Scales consistent across editions were selected for this study, including: Inhibit, Shift, Emotional Control, Initiate, Working Memory, Plan/Organize, Organization of Materials, and Global Executive Composite. Correlations between BRIEF editions on all scales examined ranged between .80 and .97. Alpha coefficients for the selected scales on the BRIEF are in the excellent range, with the exception of Shift and Organization of Materials which demonstrate good reliability (Gioia, Isquith, Guy, & Kenworthy, 2000). Alpha coefficients for the selected scales on the BRIEF-2 are in the good range, with the exception Emotional Control which demonstrates excellent reliability (Gioia, Isquith, Guy, & Kenworthy, 2015).

Behavior Assessment System for Children-Parent Rating Scale. The BASC-PRS is a parent-report measure that evaluates various aspects of behavior, emotions, and adaptive functioning in children between the ages of 2.5 and 18 years. For the clinical scales on the BASC-PRS, scores that from 60–69 are considered to be in the at-risk range, and scores of 70 or higher are considered clinically significant. The BASC-PRS has versions for three age levels—preschool (**ages** 2 years to 5 years), child (**ages** 6 years to 11 years), and adolescent (**ages** 12 years to 21 years). Both the child and adolescent versions were used in the study.

Two editions of the BASC-PRS were used in the study, the BASC-2 and BASC-3, as the BASC-3 was adopted by the outpatient behavioral health clinic for neuropsychological testing during the time of the retrospective study. The BASC-3 contains all of the items found on the BASC-2, with the addition of several new items. As such, correlations between the

corresponding scales are extremely high. Our study only included the Anxiety and Attention Problems subscales, as well as the Internalizing Problems composite. Correlations between BASC versions on all scales examined ranged between .98 and .99. The Anxiety subscale has good reliability across different age levels, ranging from .81 to .84 on the BASC-2 and ranging from .83 to .89 on the BASC-3. The Attention Problems subscale has good to excellent reliability across different age levels, ranging from .85 to .88 on the BASC-2 and ranging from .88 to .90 on the BASC-3. Moreover, the Internalizing Behaviors composite demonstrates excellent reliability across age levels, with coefficient alpha ranging from .90 to .91 on the BASC-2 and .92 to .96 on the BASC-3 (Reynolds & Kamphaus, 2015).

Statistical Analysis

The study used a group causal-comparative/ex post facto design. Analyses compared the ADHD group and the Anxiety group. The two groups were compared on all scales and subscales of the measures of anxiety, attention, and executive functioning via an independent samples *t*-test and analysis of covariance (ANCOVA), with age included as a covariate.

ADHD group. The ADHD group comprised eight ADHD-I and 18 ADHD-C, including ten females and 16 males, with a confirmed clinical diagnosis of ADHD based on DSM-5 criteria (American Psychiatric Association, 2013). The age of the group participants ranged from 6 to 14.5 years ($M = 8.59$, $SD = 2.76$). In this group, 26 participants were administered the CPT (9 K-CPT, 13 CPT-II, 4 CPT-3), 23 were administered the BRIEF-P, and 22 were administered the BASC-PRS (13 BASC-2, 9 BASC-3).

Anxiety group. The Anxiety group comprised 18 individuals with Generalized Anxiety Disorder, 11 individuals with Unspecified Anxiety Disorder, and three individuals with Adjustment Disorder with Anxiety, including 15 females and 17 males. All participants in the

Anxiety group had a confirmed DSM-5 clinical diagnosis (American Psychiatric Association, 2013). The age of the group participants ranged from 6.08 to 17.75 years ($M = 11.24$, $SD = 3.79$). In this group, 30 participants were administered the CPT (11 CPT-II, 19 CPT-3), 33 were administered the BRIEF-P (31 BRIEF, 2 BRIEF-2), and 25 were administered the BASC-PRS (19 BASC-2, 6 BASC-3).

Results

An independent samples t -test was performed to examine differences in attention, executive functioning, and emotional and behavioral functioning between the Anxiety and the ADHD groups. In the sample, there were significant differences between groups based on age ($p = 0.00$), but no significant differences based on gender ($p = 0.53$). Clinical characteristics and distributional properties (i.e., n , M , and SD) of all performance-based and parent-report measures of attention, executive function, and anxiety (i.e., CPT, BRIEF-P, and BASC-PRS variables) were examined across the Anxiety and ADHD groups and are summarized in Table 1.

Table 1

Clinical Characteristics of the ADHD and Anxiety Groups (Age, Gender, t -scores)

Variable	ADHD	Anxiety
Age	8.59 (2.76)	11.24 (3.79)
Male/Female	16/10	17/15
CPT	$n = 26$	$n = 30$
Omissions	73.73 (31.83)	56.48 (12.39)
Commissions	51.50 (10.39)	52.90 (8.67)
HRT	60.15 (13.75)	51.55 (8.89)
Variability	65.69 (11.57)	55.21 (10.78)
BRIEF-P	$n = 23$	$n = 32$
Inhibit	68.19 (10.88)	51.77 (13.96)
Shift	64.31 (10.11)	56.74 (13.28)
Emotional Control	62.50 (12.29)	57.32 (14.65)
Initiate	65.56 (10.64)	56.90 (9.82)

Working Memory	70.64 (8.60)	59.76 (12.60)
Plan/Organize	70.73 (10.74)	60.87 (14.37)
Organization of Materials	68.20 (11.13)	55.26 (10.41)
Global Executive Composite	70.81 (8.98)	58.34 (9.87)
BASC-PRS	<i>n</i> = 22	<i>n</i> = 25
Anxiety	52.50 (11.89)	58.08 (13.99)
Attention Problems	67.12 (6.61)	56.03 (11.44)
Internalizing Behaviors	52.65 (9.24)	54.42 (10.09)

As predicted, the ADHD group demonstrated clinical impairment on Omissions and moderate impairment in Variability. This group also demonstrated a slowed HRT. In contrast, the Anxiety group did not demonstrate significant difficulties in any of the variables of attention examined on the CPT. On the BRIEF-P, the Anxiety group demonstrated mildly elevated levels on only the Planning and Organization variable. The ADHD group, however, had impairments in the mildly elevated range for Emotional Control and Shifting, as well as impairments at the moderately elevated range for Initiate, Inhibit, and Organization of Materials. The ADHD group demonstrated elevations at the clinically significant level for the domains of Working Memory, Planning and Organization, and the Global Executive Composite. This finding supports the hypothesis that the ADHD group would demonstrate broad impairments in executive functioning. On the BASC-PRS, the Anxiety group did not meet clinically significant levels for the variables, whereas the ADHD group met the at-risk criteria for Attention Problems. An ANCOVA was conducted to evaluate differences between the Anxiety group and ADHD group on all measures, with age included as a covariate (Table 2).

Table 2

Results of ANCOVA Analysis by Variable

Variable	Sum of Squares	<i>df</i>	<i>F</i>	<i>p</i>	<i>Partial Eta Squared</i>
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CPT						
Omissions	3602.688	2	3.232	0.047*	0.129	
Commissions	123.410	2	0.693	0.504	0.20	
HRT	1282.733	2	5.0756	0.001**	0.191	
Variability	1343.470	2	5.203	0.009**	0.237	
BRIEF-P						
Inhibit	4292.648	2	14.180	0.000**	0.325	
Shift	1235.719	2	4.572	0.015**	0.148	
Emotional Control	2790.431	2	9.722	0.000**	0.261	
Initiate	1151.538	2	5.511	0.007**	0.170	
Working Memory	1786.363	2	7.209	0.002**	0.248	
Plan/Organize	1288.037	2	0.029	0.029*	0.141	
Organization of Materials	2614.406	2	11.762	0.000**	0.276	
Global Executive	2197.530	2	12.179	0.000**	0.316	
Composite						
BASC-PRS						
Anxiety	701.739	2	2.109	0.131	0.072	
Attention Problems	1624.310	2	8.661	0.001**	0.273	
Internalizing Behaviors	189.740	2	1.033	0.362	0.046	

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

As predicted, the ADHD group demonstrated poorer sustained attention skills relative to the Anxiety group on the CPT, as evidenced by greater omissions and variability. In contrast to our hypothesis, however, the Anxiety group demonstrated significantly slower HRT, indicating greater impairments in processing efficiency. Also as predicted, the ADHD group demonstrated greater impairment across all selected domains of executive functioning on the BRIEF-P. Specifically, the ADHD group demonstrated greater difficulties with Inhibition, Shifting, Emotional Control, Initiation, Working Memory, Planning and Organization, and Organization of Materials. They also demonstrated greater overall difficulties on the Global Executive Composite. Regarding the BASC-PRS, the ADHD group reported significantly greater Attention Problems; however, the groups did not differ significantly on Anxiety and

Internalizing Behaviors. Thus, the hypothesis that the Anxiety group would demonstrate greater difficulties with Anxiety and Internalizing Behaviors was not supported.

Discussion

This study aimed to examine differences in inattentive symptoms secondary to ADHD-I/ADHD-C as distinct from anxiety, as well as enhance diagnostic clarity in the differential diagnoses of inattention in a children. The study hypothesized that the ADHD group would demonstrate greater impairment on parent-report and on performance-based measures of attention and executive functions than the Anxiety group, and that the Anxiety group would demonstrate significantly higher scores on measures of anxiety. Furthermore, it hypothesized that the ADHD group would demonstrate deficits in attention and executive functions at a clinically significant level across variables (e.g., working memory, processing speed), whereas the Anxiety group would only demonstrate elevations on variables associated with inattention (i.e., CPT: Omissions, Variability, HRT; BRIEF: Shift, Working Memory, Inhibit).

This study supports previous findings that show ADHD as a cluster of symptoms that result from overarching deficits in executive functioning skills (Hurtig et al., 2007; Willcutt et al., 2005). It also provides evidence for impairments in attention via both performance and report-based measures. Taken together, findings are consistent with previous studies that show that inattention in ADHD is linked to impairments in working memory, inhibition, and sustained attention (Hurtig et al., 2007; Martinussen et al., 2005; Weissman et al., 2012; Willcutt et al., 2005). This study also suggests slowed response rates, which supports previous research that found that individuals with ADHD possess deficits in processing speed and efficiency (Nielsen & Wiig, 2011).

Results did not show evidence of difficulties with attention or executive functioning in the Anxiety group, and, thus, the hypothesis that the Anxiety group would demonstrate difficulties with inattention was not supported. Specifically, this study did not support the contention that deficits in the executive functions of inhibition, shifting, working memory, processing speed, and processing efficiency are prominent in those diagnosed with anxiety, which had previously been reported (Eysenck et al., 2007; Derakshan & Eysenck, 2009; Miyake et al., 2000). As processing efficiency in anxious individuals is inversely related to increased cognitive demands (Berggren, Richards, Taylor, & Derakshan, 2013; Eysenck et al., 2007; Mandrick, Peysakhovich, Rémy, Lepron, & Causse, 2016), these results raise the question as to whether the CPT has a sufficiently high cognitive demand to cause difficulties with attentional control and inhibition. Hepsomali, Hadwin, Liversedge, Degno, and Garner (2019) suggest a curvilinear relationship between anxiety and inhibitory control, whereby moderate levels of anxiety increase inhibitory control, thus allowing anxious individuals to inhibit responses to worrisome thoughts and/or distractions in the environment on low cognitive demand tasks. In the presence of greater task demands and, thus, increased levels of anxiety, however, such individuals exhibit reduced response inhibition (Hepsomali et al., 2019). Our findings were consistent with those of Hepsomali et al., who did not find impairments in processing efficiency on a go/no-go test, similar to the CPT.

Of note, the Anxiety group did not demonstrate clinically significant levels of anxiety and/or internalizing behaviors on the BASC-PRS. This finding is surprising, as the BASC-PRS demonstrates good reliability across versions (Reynolds & Kamphaus, 2002; Reynolds & Kamphaus, 2015). This may indicate a poor representative sample of individuals with anxiety, or this may be due to the mixture of various clinical and subclinical anxiety disorders in the

Anxiety group, as our sample was comprised of children with generalized anxiety disorder, unspecified anxiety disorder, and adjustment disorder with anxiety. The overall low parent-reported levels of anxiety in the Anxiety group may account for the lack of significant findings for the attentional and executive functioning measures. Thus, the severity of anxiety symptoms may not have been sufficiently clinically impairing to affect performance-based measures during the assessment. Despite not meeting clinical levels of anxiety on the BASC-PRS, the Anxiety group's overall performance during the neuropsychological assessment indicated symptom severity consistent with an anxiety disorder, thus earning the diagnosis. Therefore, one would expect to see some difficulties with attentional control and associated measures of executive functioning.

Notably, the diagnosis of ADHD occurred at a significantly younger age (8.59 years) than did anxiety (11.24 years). The younger age of diagnosis for ADHD could be secondary to the severity of deficits and impairments in functioning, which caused the child to be brought in for neuropsychological testing sooner than children with anxiety. The functional impairment of the Anxiety group may have been less severe, and, thus, one would not expect to see the same level of severity on measures of inattention.

The present study assisted in clarifying the diagnostic profile of inattention due to ADHD on measures of executive functioning, showing significant differences between the ADHD and anxiety populations on rating scales and performance-based measures. The findings indicate that children with inattention due to ADHD exhibit clear deficits on measures of executive functioning, which highlights the importance of measures of executive functioning when assessing inattention due to an unknown etiology.

Limitations and Future Research

The results of this study should be considered in light of several methodological limitations. First, the present study had a small sample size and limited diversity in sampling, as all of the children came from a homogeneous population of neuropsychological assessments conducted at a hospital-based outpatient behavioral health clinic. Second, due to the small sample of ADHD-I children from the retrospective chart review, ADHD-C children were also included in the ADHD group. Given that individuals with ADHD-C demonstrate additional behavioral symptoms secondary to over-arching executive dysfunction (i.e., impulsivity), and previous studies have found differences between ADHD-I and ADHD-C on measures of executive functioning, further studies might focus solely on ADHD-I in order to draw conclusions about inattention itself due to executive functioning. Third, due to the small sample of GAD children from the retrospective chart review, the Anxiety group included clinical (i.e., GAD) and subclinical (i.e., unspecified anxiety disorder and adjustment disorder with anxiety) disorders of anxiety in the group. Further research could focus on differentiating subtypes of anxiety. Fourth, the lack of a control group prevents firm conclusions about the implications of cognitive differences between clinical groups. Fifth, due to the retrospective nature of the study, another limitation was the changes in assessment tool versions across the sample. Different editions of measures can contain additional and/or omitted test items and scales, and they are normed on different populations. Thus, causing differences in reliability and validity, and potentially affecting consistency of results (e.g., scores on various domains) and diagnostic interpretations. Although a complication of retrospective studies, to support validity in diagnostic classification and statistical analysis, future studies should aim to include only one version of each measure.

Sixth, our study included only parent-report behavior rating scales, whereas research has shown integration of both parent- and teacher-report measures are important components in the diagnosis of ADHD and anxiety (American Academy of Child and Adolescent Psychiatry, 2007; Kendall et al., 2007; Gail, Schaughency, & Clarke, 2006; Power et al., 1998). For example, Power et al. (1998) found that both parent and teacher reports on rating scale measures were predictive of the diagnoses and that the combination of parent and teacher reports is superior to that of a single informant when diagnosing ADHD-I. Moreover, parent and teacher reports also are used to discriminate children with anxiety from those without (Kendall et al., 2007) (American Academy of Child and Adolescent Psychiatry, 2007; Kendall et al., 2007). Therefore, future research should incorporate both parent- and teacher-report behavior rating scales.

Lastly, although the authors were examining processing efficiency in both groups, the authors included only a measure of response rate, did not include a physiological measure, such as pupillary response, and drew conclusions about processing efficiency based on previous research on the cognitive demands of various neuropsychological measures. As such, future research should include a measure of physiological monitoring when conducting performance-based measures. This is important when examining inattention and deficits in executive functioning secondary to anxiety, because greater task demands require increased effort. Thus, greater task demand may increase levels of anxiety in individuals prone to anxiety, impairing attention and executive functions. Individuals with ADHD-I and ADHD-C exhibit deficits in attention and executive functions regardless of the level of cognitive demand, making processing efficiency a valuable measurement in determining the etiology of inattentive symptoms.

Summary

This study examined differences in inattention and executive function between a group of children diagnosed with ADHD and a group diagnosed with anxiety disorders to establish differential profiles for these two disorders. The findings provide support for distinct profiles of inattention and executive functioning abilities between children with ADHD and those with anxiety.

This study evaluated the differences among children with ADHD and anxiety disorders, using parent-report and performance-based measures of inattention and anxiety. On the basis of cognitive test performances and parent-report measures, results suggest significant differences with respect to profiles of inattention and executive functioning abilities between children with ADHD and anxiety. The ADHD group demonstrated deficits in attention, processing speed, and efficiency, whereas the Anxiety group did not demonstrate these deficits. This study further clarifies the profiles of inattention in ADHD and anxiety, aiding in the differential diagnosis and treatment of the disorders. The study also supports the use of the Conners Continuous Performance test as a useful tool in the differentiation of the two presentations.

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