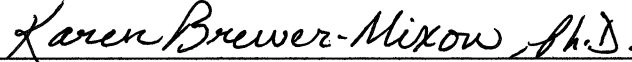EMOTIONAL CONTROL AND REACTION TIME IN CHILDREN WITH INTERNALIZING

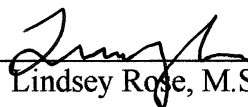DISORDERS AND ATTENTION-DEFICIT HYPERACTIVITY DISORDER

APPROVED BY SUPERVISORY COMMITTEE

Alison Wilkinson-Smith, Ph.D., ABPP

Karen Brewer-Mixon, Ph.D.

Lindsey Rose, M.S., CRC, LPC

DEDICATION

I am grateful for the opportunity to have worked with several individuals who were willing to

offer their time and to share their knowledge and expertise in the completion of this

investigation. First, I would like to thank my committee chair, Dr. Alison Wilkinson-Smith for

her patience and mentorship. Her expertise in pediatric neuropsychology and her respect for the

field motivated me through this investigation. I would also like to acknowledge the generous

support of Dr. Karen Brewer-Mixon. I would like to thank Dr. Daniel Brown for guiding me

through the challenges of the research process. His support and encouragement were invaluable.

A special thanks to goes out to Lindsey Rose and to the School of Health Professions faculty and

staff at the University of Texas Southwestern Medical Center for their commitment to the

University and to the students. Lastly, thank you to Connor and Claire for positive affirmation

post-it notes when I needed them the most.

EMOTIONAL CONTROL AND REACTION TIME IN CHILDREN WITH INTERNALIZING
DISORDERS AND ATTENTION-DEFICIT HYPERACTIVITY DISORDER

by

MELISSA DAWN TURNER

THESIS

Presented to the Faculty of the School of Health Professions

The University of Texas Southwestern Medical Center

Dallas, Texas

In Partial Fulfillment of the Requirements

For the Degree of

MASTER OF REHABILITATION COUNSELING

Abstract

BACKGROUND: Prior literature indicates that children with slower reaction times on neurocognitive attention measures are more likely to respond more slowly to stop signals in real world situations. Taking longer to respond may also suggest a tendency to take longer to process emotional cues in real time, thus possibly resulting in vulnerability towards emotional dyscontrol. The present study examined differences between reaction time and the parental ratings of emotional control and internalizing symptomatology in three distinct pediatric populations: those with Attention-Deficit Hyperactivity Disorder (ADHD), those with internalizing disorders such as anxiety and depression, and those with comorbid ADHD and internalizing disorders.

SUBJECTS: A sample of 64 children and adolescents who were patients at the Neuropsychology Service at Children's Medical Center Dallas Texas from November 2011 through July 2014 was derived. All patients received neuropsychological evaluations and were assessed for attentional and emotional disorders.

METHOD: Approval for the study was obtained from the Institutional Review Board at UT Southwestern Medical Center. Data was obtained via examination of medical records. Reaction time was measured via the Conners' Continuous Performance Test II (CPT II) Overall Hit Reaction Time (RT) variable. Parent rating forms from the Behavior Rating Inventory of Executive Function (BRIEF) Emotional Control subscale (EC) and the Behavioral Assessment Scale for Children, Second Edition (BASC-2) Internalizing Problems Composite score (IP) were used as a measure of participants' emotional control capacity. A multivariate analysis of covariance (MANCOVA) was employed to assess for significant differences between all three groups for CPT II RT, BRIEF EC, and BASC-2 IP, controlling for age, education, sex, and race.

RESULTS: The MANCOVA yielded a significant overall model for group [F (6, 26) = 6.89, p < .01], controlling for age (p = .08), education (p < .01), sex (p = .13), and race (p = .02). There was a significant main effect for CPT II RT [F (2) = 8.31, p < .01] and BASC-2 IP [F (2) = 3.96, p < .04], with respectable effect sizes ($\eta 2$ = .56 and .35, respectively). There was a moderately significant main effect for BRIEF EC [F (2) = 3.65, p = .051] with a moderate effect size ($\eta 2$ = .33). Post hoc analyses revealed significant differences between the internalizing disorder and comorbid groups (p = .048) for CPT II RT, with slower reaction times in the internalizing disorders than comorbid groups. Significant differences were also observed between the ADHD and internalizing disorders groups (p < .01) as well as between the ADHD and comorbid groups (p = .03) for BASC-2 IP, with greatest elevation in the internalizing disorders, followed by the comorbid and ADHD groups. There were significant differences between the ADHD and the internalizing disorder groups (p = .04) as well as between the ADHD and comorbid groups (p = .01) for BRIEF EC. Of note, mean CPT II RT performance was in the normal range across the groups. All other pairwise comparisons were nonsignificant.

DISCUSSION: In this study we explored associations between cognitive inefficiency and emotional dysregulation in order to further our understanding of the ways in which emotional and executive functions are related. We focused on differences between groups of three specific populations (i.e., ADHD, internalizing disorders and comorbid ADHD and internalizing disorders). The co-occurrence of ADHD and internalizing disorders may have important implications for assessment and treatment. Results such as these could be useful in determining whether treating one type of internalizing symptomatology may improve the other, and can allow providers to make more informed decisions about how to better assist children with comorbid conditions.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

LIST OF ABBREVIATIONS

ADHD – Attention-deficit hyperactivity disorder

BRIEF – Behavior Rating Inventory of Executive Function

BASC-2 – The Behavior Assessment System for Children, Second Edition

CPT II – Conners' Continuous Performance Test II

EC - Emotional Control subscale T score (from the BRIEF)

IP – Internalizing Symptoms Composite score T score (from the BASC-2)

RT – Overall Hit Reaction Time T score (from the CPT II)

CHAPTER ONE

Introduction

The purpose of this study is to examine the relationship between reaction time and emotional control in children with attention-deficit hyperactivity disorder (ADHD) and internalizing disorders. Emotional control in children has been studied in variety of ways, and while regulatory emotional patterns may be a critical component in development, they are not well understood in children and adolescents (Turpyn, Chaplin, Cook, & Martelli, 2015). Further exploration of the relationship between reaction time and emotional control may improve our ability to assess and treat children with deficits in processing speed and emotion regulation.

In this study, the term executive function will be used in the context of both socio-emotional and cognitive skills (Gonzalez et al., 2014). The concept of emotional control will refer to a child's ability to modulate emotional responses and to influence their own thoughts and behavior. Children with poor emotional control can have frequent mood changes, overblown reactions, or explosive angry outbursts (Gioia, Isquith, Guy, & Kentworthy, 2000). Emotional control will be measured by parental reports that capture parents' perspectives of their child's executive function ability with respect to mood regulation. These informant-report measures will be used as a proxy of emotional functioning in children with internalizing disorders and ADHD. Being easily frustrated and angered is indicative of problems with emotional control, and problems with emotional control tend to result in higher ratings of internalizing symptoms (A. Wilkinson-Smith, personal communication, 2015).

Reaction time is a measure of the amount of time between the presentation of a stimulus and an individual's response (Klotz, Johnson, Wu, Isaacs, & Gilbert, 2012). Children who have slower reaction times on various performance tasks are believed to be more likely to respond

more slowly to stop signals in real world situations. Taking longer to respond may also be indicative of a tendency to take longer to process real-time emotional cues. There is a dearth of literature examining the association between emotional control and reaction time. Elucidating the connection between cognitive inefficiency and emotional dysregulation in children with these problems can increase our understanding of how emotion regulation and executive functioning is related. This study investigates this relationship in three distinct pediatric populations: children diagnosed with ADHD, children diagnosed with internalizing disorders, and children with comorbid ADHD and internalizing disorders. The following chapter reviews the body of literature in this area.

CHAPTER TWO

Review of the Literature

Disorders Affecting Emotional Control

A number of prior studies have investigated the nature of internalizing and externalizing disorders in children. Externalizing behaviors are manifested outwardly (i.e., aggressive, disruptive and hyperactive behavior) and associated with a negative effect on the environment (Brunnekreef et al., 2007; Liu, 2004). Attention-Deficit Hyperactivity Disorder (ADHD) is considered an externalizing disorder due to the outward expression of symptoms (Bloemsma et al., 2012). Internalizing behavior (i.e., anxious, withdrawn, or depressive symptomatology) reflects an adverse adaptation to the environment and is indicative of internal psychological distress (Liu, 2004 as cited in Jacob et al., 2014). In this study, the term "internalizing disorders" refers to anxiety and depressive disorders only, and the term "attentional disorder" refers to ADHD only. When a child does not develop and utilize emotional control strategies effectively, such internalizing disorders may develop (Bradley, 2000). We begin with an investigation of the ways in which attentional and internalizing disorders interfere with emotional control and cognition in children.

Attentional Disorder: Diagnostic Features and Development. Attention-deficit hyperactivity disorder is a neurodevelopmental disorder with a persistent pattern of hyperactivity-impulsivity and/or inattention that interferes with daily functioning. There are three presentations of ADHD: Inattentive, Hyperactive-Impulsive, and Combined Inattentive and Hyperactive-Impulsive type (American Psychiatric Association, 2013). Children must have six or more symptoms of the disorder and present these symptoms in more than one setting in order to receive a diagnosis. Symptoms of ADHD are usually noticeable before the age of seven, but

because symptoms vary from child to child, the disorder can be hard to diagnose. It affects

approximately 5% to 7% of children in the United States, and is recognized as a chronic

childhood neuropsychiatric disorder with a strong genetic basis (Antshel & Barkley, 2008). It is

important to recognize that children all mature differently and have unique dispositions,

attitudes, and energy levels. Similarly, all children can get distracted, be impulsive, and may

struggle to concentrate at times. However, those with ADHD experience these problems in a

much more pronounced and chronic manner than their peers (NIMH, 2015). Children with

ADHD may quickly become bored with tasks, or have trouble listening or sitting still. They may

also talk excessively or have difficulty performing quiet tasks, taking turns, and following rules

(NIMH, 2015). The prevalence rate of ADHD has been increasing, and it is now the most

common mental health disorder of childhood in the U.S. (Houck, Kendall, Miller, Morrell, &

Wiebe, 2011).

The prevailing model of ADHD was popularized by Russell Barkley over the past two

decades, which describes ADHD not as a disorder of knowledge, but rather as a performance

deficit (Antshel & Barkley, 2008). It has been suggested that many children with ADHD do

indeed possess the social and relational skills that they need. However, deficiencies in executive

functioning may prevent them from fully maximizing this knowledge. Children with ADHD tend

to have significant deficits in frontal lobe functioning (e.g. processing speed, sustained attention,

and working memory), which can cause behavioral difficulties. Further, a number of previous

studies have found that children with ADHD report difficulties in various aspects of executive

functioning, including emotion regulation (Fischer, Barkley, Smallish, & Fletcher, 2005; Bodnar,

Prahme, Cutting, Denckla, & Mahone, 2007).

Emotional Control and ADHD. Individuals with ADHD often have difficulty regulating emotions and behavior. In addition, emotional and behavioral symptoms tend to increase as a function of ADHD symptom severity (Lopez et al., 2013; Connor & Ford, 2012). While inattention, hyperactivity, and/or impulsivity are common characteristics of ADHD, problems with negative emotionality (Sullivan et al., 2015), low frustration tolerance, irritability, and mood lability can also be seen (APA, 2013). Prior literature suggests that ADHD symptoms may cause emotional system dysfunction.

Individuals with ADHD may also have interpersonal difficulty secondary to problems effectively managing and regulating anger (Torrente et al., 2012). Further, the behavioral disturbances and emotional turmoil associated with ADHD can exacerbate negative self-evaluation and lower self-confidence as a result, leading to poor self-esteem. In many instances, it can directly influence a child's ability to interact with others. Strine and colleagues (2006) found that children with ADHD were much more likely to have emotional difficulties that interfered with friendships, as well as with home and school life. For instance, they were reported to be significantly more likely to become distressed or upset in the classroom, with their peers, and in their leisure activities. In a lab-based study of mothers with children aged six to 10 years, a facilitated play group design revealed that children with ADHD had significantly more problems dealing with peers, parents, and teachers (Griggs & Mikami, 2010). Similarly, children with ADHD were found to be more likely to engage in fewer organized activities than their normal control peers (Kofler et al., 2011).

It is well-established that many children with attentional disorders such as ADHD exhibit symptoms of emotional lability related to executive dysfunction (Villemonteix, Purper-Ouakil, & Romo, 2014). In a review of emotional impairments associated with the disorder, over one third

of 8681 children with ADHD endorsed elevated levels of emotional and behavioral dysregulation

(Strine et al., 2006). Difficulties with emotional control load on the same dimension as

symptoms of hyperactivity and impulsivity, suggesting that children with ADHD have reduced

capacity to suppress or otherwise modulate their emotional experiences (Wehmeier, Schacht, &

Barkley, 2010). In a similar study, investigators at Ohio University yielded results suggesting

that children with ADHD also have trouble recognizing emotions in both themselves and others,

across various situations (Serrano, Owens, & Hallowell, 2015). In this exploratory study,

children's visual attention was measured while being administered a number of emotion

knowledge tasks. The authors found that overall, children with ADHD had a tendency to view

less relevant areas and took longer to detect, determine and respond to depicted emotions

(Serrano, Owens, & Hallowell, 2015). Taking longer to respond in this scenario may be

indicative of a tendency to take longer to process real-time emotional cues (Serrano, Owens, &

Hallowell, 2015).

    Reaction Time and ADHD. Reaction time can be operationalized as psychomotor

response ability and has been measured in children with ADHD a number of ways. According to

Vaurio, Simmonds, and Mostofsky (2009), reaction time variability in ADHD can be assessed

using go/no-go tasks, in which the child is asked to respond or to withhold responses to various

stimuli. This can also be assessed via stop signal tasks, which require the child to continuously

respond to a signal until cued to stop (Vaurio, Simmonds, & Mostofsky, 2009). Hervey et al.

(2006) found that children with ADHD perform more poorly than normal controls on reaction

time tasks.

    Attention/concentration problems may be indicative of ADHD symptomatology and can

also be assessed via measures of processing speed and working memory (Klotz et al., 2012).

Prior examinations of the relationship between reaction time and behavior have provided additional information about these factors in children. For example, one study found that faster reaction time was predictive of higher levels of reported behavior and attention problems in preschool girls, while slower reaction time was found to be associated with more problematic behavior rating scores in preschool boys (Barnard et al., 2015). Sjöwall, Bohlin, Rydell, and Thorell (2015) suggested that reaction time variability, emotional reactivity, and emotion regulation in preschool predicted ADHD symptoms in late adolescence.

While children with ADHD may be faster to respond behaviorally in some situations, perhaps as a result of emotion regulation deficits, slower processing speed tends to negatively impact reaction time in this population overall (Tarantino, Cutini, Mogentale, & Bisiachhi, 2013). In particular, when tasks require a high degree of response control, children with ADHD may struggle to efficiently engage or to respond readily. Slow reaction times during sustained attention tasks have been well-documented in children with ADHD (Klotz et al., 2012). Logan and colleagues (1997) found that children with ADHD exhibited more inhibition difficulty and longer go signal reaction times than children in their control group. This suggests that failing to inhibit during a stop task, which translates to a long stop-signal reaction time, is indicative of inadequate impulse control in general (Logan, Schachar, & Tannock, 1997).

Internalizing Disorders: Diagnostic Features and Development. Internalizing disorders such as anxiety and depression have been studied extensively given the significant impact on affected children and their families (Rapee, 2015; Gale et al., 2015). Anxiety and depression can develop in early childhood or adolescence, and stressful life events, a tendency to worry, and a ruminative response style are common factors contributing to the manifestation of

mood symptomatology (Young & Dietrich, 2015). Often parents become concerned about

behavior changes at home or at school, which prompts psychological evaluation.

Individuals with internalizing disorders can experience different levels of symptom

severity, duration and frequency (APA, 2013). For instance, inhibited children may be unusually

shy, apprehensive, fearful and withdrawn. The inward expression of distress, common in

internalizing disorders, is typically associated with setbacks in early development and can affect

both social functioning and emotion regulation (Lassal et al., 2011).

Anxiety can be described as a state of negative arousal, comprised of apprehension and

concern about potential threats (Mathews, Kerns, & Ciesla, 2014). Children with anxiety may

worry excessively, be anxious or tense, and need substantial reassurance. They may also be shy

and avoid interacting with others (Wehmeier, Schacht, & Barkley, 2010; Bloemsma et al., 2012).

Approximately 25% to 50% of children diagnosed with ADHD exhibit an anxiety disorder

(Vloet et al., 2010). Inattention due to worry, rumination and restlessness in children with

anxiety is different than distraction due to symptoms of ADHD (APA, 2013). Broeren et al.

(2013) suggest that negative life events play a role in the development of anxiety disorders and

that children who are behaviorally inhibited may be at increased risk for developing anxiety.

According to the National Institute of Mental Health; NIMH (2015), depressed children

may think that they are sick, cling to parents, refuse to go to school, or worry unnecessarily.

3.3% of 13- to 18-year-olds have experienced a seriously debilitating depressive disorder

(NIMH, 2015). Children with depressive disorders often have difficulties with concentration but

their poor concentration becomes obvious only during depressive episodes (APA, 2013).

The symptom overlap between anxiety and depression is worthy of mention. Similar to

anxious children, depressed children may also seem irritable, unhappy, and find less pleasure in

activities they used to enjoy. All adolescents, but especially those with depression, are at higher

risk for behavioral problems at home or at school (NIMH, 2015). They may be "cranky," display

negative affect more often, and have a tendency to feel misunderstood. The National Institute of

Mental Health (2015) also reports that children who are anxious or depressed often report not

feeling well and may have problematic eating and sleeping patterns. For example, they may

experience frequent aches or pains, headaches, cramps, or digestive problems that are resistant to

traditional treatments.

     Emotional Control and Internalizing Disorders. The ability to control thoughts and

emotions develops primarily during early childhood (Rothbart, Posner, & Kieras, 2006). It is

commonly accepted that children with internalizing disorders are likely to be ineffective

regulators of their emotions (Trosper, Buzzela, Bennett, & Ehrenreich, 2009). Specifically, they

may use significantly more maladaptive strategies for coping with negative experiences than

their non-anxious counterparts (Carthy, Horesh, Apter, & Gross, 2010; Legerstee, Gamefski, &

Jellesma, 2009). Maladaptive patterns, cognitive distortions and difficulty with emotional

expression (e.g., holding back tears or lashing out) have all been linked to internalizing

pathology (Trosper et al., 2009).

     Parental responses to a child's emotions and regulation efforts have been linked to the

child's "emotional competency," which contributes to the child's temperament and affects social

development in early relationships (Trosper et al., 2009). Parental styles and parental reactions to

a child's negative emotions are important factors to consider in terms of how a child learns adjust

to stress and to self-regulate emotionally. For example, mothers of anxious children may react to

a child's negative emotions less supportively than mothers of non-anxious children (Hurrell,

Hudson, & Schniering, 2014).

Few studies with adolescents have assessed whether or not different mood symptoms are related to specific emotional regulation difficulties. However, one prior publication reported a correlation between social and generalized anxiety symptoms and regulation difficulties (Mathews, Kerns, & Ciesla, 2014). Emotional control can be problematic even for typically developing children at times, though Young and Dietrich (2015) noted that emotional control is especially troublesome for children with anxiety disorders due to their tendency toward cognitive distortions (e.g., assuming the worst and rumination).

Reaction Time and Internalizing Disorders. It is currently unknown whether slower reaction time is an effect of mood symptoms and/or is a risk factor for emotional disorders. However, a few studies have investigated whether reaction time in childhood may be a risk factor for both anxiety and depression later in life. In a preliminary longitudinal study, examining the relationship between reaction time, anxiety, and depression, adolescents with slower processing speed (measured by longer reaction times) were found to have higher levels of anxiety and depression 20 years later (Gale et al., 2015). Depressed children have been found to perform poorly on measures of processing speed (Cataldo, Nobile, Lorusson, Battaglia, & Molteni, 2005), though two smaller studies yielded no association between specific anxiety disorders and processing speed (Airaksinen, Larsson, & Forsell, 2005; Purcell, Maruff, Kyrios, & Pantelis, 1998). Additional empirical studies are needed in order to clarify and provide a better understanding of the relationship between processing speed and internalizing disorders, including anxiety and depression.

Comorbidity: Internalizing and Externalizing Disorders. As previously mentioned, ADHD is associated with both internalizing emotional symptoms and externalizing behavioral problems (Jacob et al., 2013; Connor & Ford, 2012). As a result, it is not uncommon for

individuals with ADHD to have comorbid disorders, and the connection between childhood emotional disorders and features of ADHD is well established. While there are clear distinctions between emotional and attentional disorders, symptoms such as restlessness, irritability and inattention, may often overlap (Bloemsma et al., 2012; APA, 2013).

Emotional Control and Comorbidity. Evidence suggests that comorbid psychiatric disorders such as anxiety and depression are associated with increased levels of distress, avoidance and somatic complaints (Melton, Croarkin, Strawn, & McClintock, 2016). There is a large body of literature focusing on the co-occurrence of ADHD and internalizing disorders such as anxiety or depression (Lopez et al., 2013; Mohapatra, Agarwal, Sitholey, & Arya, 2014; Joo et al., 2012; Shea, Lee, Lai, Luk, & Leung, 2015). In addition, many studies focus primarily on ADHD and externalizing disorders such as Conduct Disorder or Oppositional Defiant Disorder (Jarrett & Ollendick, 2008). Previous investigations on internalizing and externalizing behavior in children (Brunnekreef et al., 2007), and in adults with ADHD (Jacob et al., 2014), have suggested that response time variability and working memory may serve as potential markers for identifying children at risk for developing maladaptive behavior.

Reaction Time and Comorbidity. Children with both internalizing and externalizing problems may perform less efficiently on processing tasks (Brunnekreef et al., 2007). Pliszka (1989) also found that children with comorbid ADHD and anxiety had longer ("sluggish") reaction times. Daily life necessitates quick and complex reactions. As such, needing more processing time than children without behavior problems places impacted children at a clear disadvantage, and often results in sacrificing accuracy for speed (Brunnekreef et al., 2007).

Prior literature examining whether comorbid anxiety has a mitigating effect on symptoms is mixed. Children with both attentional and emotional disorders may present with greater

deficits in overall functioning, more severe symptoms, and have lower treatment success than children with only one disorder (Joo et al., 2012). It has been suggested that in ADHD, the inhibition system is underactive, causing faster and more impulsive response styles, whereas in anxiety disorders, the inhibition system is overactive, leading to slower responding and better inhibitory control (Bloemsma et al., 2012; Quay, 1988; Quay, 1993). Indeed, it is possible that having both disorders results in a better inhibition system balance as a function of slower responding, than having one of the disorders alone (Bloemsma et al., 2012). Vloet and colleagues (2010) also suggest that comorbid anxiety may modulate cognitive performance by enhancing behavioral inhibition and attentional abilities in children with ADHD, though at the expense of reduced reaction time. Further, anxiety may actually act as a protective factor against the development of ADHD (Nigg, 2006). Despite a number of previous studies investigating comorbid ADHD and anxiety, no prior study to our knowledge has attempting similar explorations with respect to depression.

Summary and Rationale for the Present Study

There is a large body of literature on the nature of reaction time in children with ADHD. Similarly, the presence of emotional dyscontrol in this population is also well-established. A number of studies have examined emotional control and reaction time in children with internalizing disorders. However, while the comorbidity of attentional and internalizing disorders is well known, the clinical picture is complex, and prior literature on symptom presentation is mixed (Jarret & Ollendick, 2008; Wender, Wolf, Wasserstein, 2001). Little is known about the relationships between reaction time and emotional control in children with comorbid ADHD and internalizing disorders. As such, further investigation is needed.

The present investigation uniquely examines these variables within and between three distinct pediatric populations: those with ADHD, those with internalizing disorders, and those with comorbid ADHD and internalizing disorders. Doing so may assist with informing clinicians whether children with both internalizing and attention-deficit hyperactivity disorders have slower reaction times and/or are more emotionally disinhibited than either condition alone.

Understanding the associations between reaction time, emotional control and internalizing symptoms in these populations could lead to knowledge regarding whether treating one type of symptomatology improves the other. This investigation could also assist researchers, clinicians, parents, and other caregivers in improved targeting of attention of services to populations of children at higher risk for behavioral difficulty.

AIM AND HYPOTHESES

Aim: To examine differences for reaction time, emotional control, and internalizing symptoms between three pediatric populations: those with ADHD, those with internalizing disorders, and those with comorbid ADHD and internalizing disorders.

Hypothesis 1 (H1): Reaction time will be significantly slower in the comorbid group than in the other two groups.

Hypothesis 1A: Reaction time will be significantly slower in the comorbid group than in the ADHD group.

Hypothesis 1B: Reaction time will be significantly slower in the comorbid group than in the internalizing disorder group.

Hypothesis 1C: Reaction time will be significantly slower in the ADHD group than in the internalizing disorder group.

Hypothesis 2 (H2): Emotional control will be significantly worse in the comorbid group than in the other two groups.

Hypothesis 2A: Emotional control will be significantly worse in the comorbid group than in the ADHD group.

Hypothesis 2B: Emotional control will be significantly worse in the comorbid group than in the internalizing disorder group.

Hypothesis 2C: Emotional control will be significantly worse in the ADHD group than in the internalizing disorder group.

Hypothesis 3 (H3): Internalizing symptoms will be significantly worse in the comorbid group than in the other two groups.

Hypothesis 3A: Internalizing symptoms will be significantly worse in the

comorbid group than in the ADHD group.

Hypothesis 3B: Internalizing symptoms will be significantly worse in the

comorbid group than in the internalizing disorder group.

Hypothesis 3C: Internalizing symptoms will be significantly worse in the

internalizing group than in the ADHD group.

CHAPTER THREE

Method

Participants

For convenience, the term "children" denotes both children and adolescents unless otherwise specified. Approval for the study was obtained from the Institutional Review Board at UT Southwestern Medical Center. Data were derived from the Neuropsychology Service at Children's Medical Center Dallas Texas between November 2011 and July 2014, via review of participants' medical records. All patients received neuropsychological evaluations and were assessed for attentional and emotional disorders. A sample of 64 children and adolescents was acquired. Participants were categorized into three groups: children with ADHD, children with internalizing disorders, and children with both ADHD and internalizing disorders (comorbid group).

Inclusion criteria for this study were (i) pediatric patients between the ages of 6 and 17 years of age; (ii) DSM-IV-TR clinical diagnosis of Attention-Deficit/Hyperactivity Disorder (ADHD) only; or (iii) DSM-IV-TR clinical diagnosis of ADHD and/or DSM-IV-TR diagnosis of an internalizing disorder (i.e., anxiety disorder NOS, social anxiety disorder, generalized anxiety disorder, obsessive-compulsive disorder, adjustment disorder, major depressive disorder, disruptive mood dysregulation disorder, or persistent depressive disorder (dysthymia)). Exclusion criteria included missing data for reaction time, emotional control, and/or internalizing symptoms. In addition, children with primary medical conditions that could adversely impact the results, intellectual disabilities, and/or bipolar disorder were excluded.

Variables

Descriptive information, including age, education, sex, ethnicity, and current medications was obtained. Internalizing disorder and ADHD diagnoses were made at the time of testing by licensed psychologists using Diagnostic and Statistical Manual of Mental Disorders, 4th Edition (DSM-IV-TR; American Psychiatric Association, 2000) criteria. Reaction time was measured using the Conners' Continuous Performance Test II (CPT II) Overall Hit Reaction Time variable T score (RT; Conners, 2000). Emotional control was measured by the Behavior Rating Inventory of Executive Function (BRIEF) Emotional Control subscale T score (EC; Gioia, Isquith, Guy, & Kentworthy, 2000). Internalizing symptoms were measured using the Behavioral Assessment Scale for Children, Second Edition (BASC-2) Internalizing Problems Composite scale T score (IP; Reynolds & Kamphaus, 2004). Parent rating forms were used for the BRIEF and BASC-2.

Conners' Continuous Performance Test II. The CPT-II is a 14-minute, computerized assessment of visual information processing and visual-motor abilities. Unlike other continuous performance tests, the CPT-II requires the participant to continuously respond, inhibiting when presented with a particular target, instead of responding to targets within a certain set of distractors (McGee, Clark, & Symons, 2000). Specifically, it requires participants to rapidly identify letters by pressing a specific key when a target stimulus appears (i.e., any letter except "x"), and to refrain from pressing the key when a non-stimulus appears (i.e., "x"). The RT variable is a measure of how quickly the participant responds to the target stimuli. Upon completion of the task, raw scores are generated and T-scores are computed based on a normative sample. T scores below 40 are considered unusually fast/above average, T scores from 40 to 59 are considered average, and T scores over 59 are considered unusually slow/impaired.

Behavior Rating Inventory of Executive Function. The BRIEF is an 86-item, three-point ("Never," "Sometimes," "Often") Likert-type parent-report scale used to assess everyday

executive functioning behaviors in children and teens (Gomez-Guerrero et al., 2010). According to Steward, Tan, Delgaty, Gonzales, and Bunner (2012), children may overestimate their abilities and deny difficulties, or depending on their developmental stage, they may lack awareness of their deficits in executive functioning. As such, children may rate themselves as better off emotionally than their parents rate them, supporting the need to utilize an assessment based on the parent's perceptions of their child's behavior and abilities.

The BRIEF is a well-validated measure of executive functioning, particularly with regard to capturing pertinent aspects of a child's ability to regulate behavior, perform, and solve problems, and to exert emotional control in everyday conditions (Blijd-Hoogewys, Bezemer, & van Geert, 2014; Skogan et al., 2015). There are a total of eight clinical scales, though the present study only utilized the EC. The EC (see Appendix A) captures parental ratings of the child's emotional regulation capacity (Gioia, G.A., Isquith, P.K., Guy S.C., & Kentworthy, 2000). Raw scores from the BRIEF are compared to normative data and T scores are generated. T scores over 65 are indicative of elevated emotional symptomatology.

The Behavior Assessment System for Children – 2nd Edition. Behavior and personality characteristics data for this study will be obtained using the 134-item, four-choice response format Parent Rating Scales-Child and Adolescent BASC-2 forms. The BASC-2 is a measure of positive (adaptive) and negative (clinical) dimensions of psychological functioning at home, school, and in the community (Barnard et al., 2015). For this study, the internalizing problems composite score (IP) will be utilized as a measure of internalizing symptomatology (see Appendix B), as it is considered indicative of a child's display of anxiety and depressive behaviors, as well as their complaints of health-related problems. Raw scores from item

responses are compared to normative data to calculate associated T scores. T scores above 60 are considered impaired or atypical and are indicative of more internalizing problems.

Statistical Methods

All statistical analyses were performed using the Statistical Package for Social Sciences, version 23 (SPSS, Inc., Chicago IL). Means, standard deviations, medians, ranges, and histograms were generated for all continuous variables, and frequencies and percentages were generated for all categorical variables. The level of statistical significance was set at $\alpha = .05$ and the level of marginal significance was set at $\alpha = .15$. A p value up to .15 was considered to be indicative of marginal meaningfulness or of a trend toward a finding that would likely be replicated in another sample. A three (reaction time, emotional control, and internalizing symptoms) by three (groups) multivariate analysis of covariance (MANCOVA) was performed to assess for significant differences between groups for the three aforementioned factors, controlling for age, education, sex, and race. These covariates were selected because they were available demographic variables well-known to impact neuropsychological and psychological assessment scores. Covariates that contributed at least marginally to the overall model were retained in the final analysis. We covaried for age and education, despite using normative data, in order to add further refinement to the model, given that the norms were not based on our sample. We also covaried for race and sex, as these demographic variables were not reflected in the norms and are known to affect neuropsychological assessment data. We did not control for medication effects due to our relatively small sample size. The Tukey HSD post hoc method was employed to examine pairwise comparisons for variables with a significant main effect.

CHAPTER FOUR

Results

Descriptive Statistics

The sample included 64 children. 19 were diagnosed with ADHD, 25 were diagnosed with internalizing disorders, and 20 were diagnosed with comorbid ADHD and internalizing disorders. Descriptive information is displayed in Table 1 and Table 2. For the overall sample, the mean age was 9.39 ($SD = 2.59$) years with an average 3.16 ($SD = 2.28$) years of education completed. The sample was primarily male (65.6%) and Caucasian (71.9%).

Mean CPT-II RT scores for all three groups fell in the average range. Mean BRIEF EC scores fell in the average range for the ADHD group [$M = 60.00$ (10.57)], and were elevated in both the internalizing disorders [$M = 68.84$ (11.47)] and in the comorbid [$M = 70.90$ (12.84)] groups. Mean BASC-2 IP scores were average in the ADHD group [$M = 52.16$ (11.57)], and elevated in both the comorbid [$M = 62.05$ (12.82)] and internalizing disorders [$M = 68.92$ (16.96)] groups.

Primary Analysis

Overall Model. All hypotheses were tested via the primary analysis (MANCOVA), which revealed a significant overall model for reaction time, emotional control, and internalizing symptoms by group [$F(6, 26) = 6.89$, $p < .01$], controlling for age ($p = .08$), education ($p < .01$), sex ($p = .13$), and race ($p = .02$). Table 3 displays the overall model.

Hypothesis Testing. In order to test each hypothesis, main effects were examined to assess for significance for each respective variable. See Table 4. For main effects that were at least marginally significant ($p < .15$), pairwise comparisons along with group means were

examined to assess for significant and marginally significant differences between specific

groups. See Table 5.

Results by Hypothesis

   Analysis of Hypothesis 1. Hypothesis 1 was that reaction time would be significantly

slower in the comorbid group than in the other two groups. Hypothesis 1A was that reaction time

would be significantly slower in the comorbid group than in the ADHD group. Hypothesis 1B

was that reaction time would be significantly slower in the comorbid group than in the

internalizing disorders group. Hypothesis 1C was that reaction time would be significantly

slower in the ADHD group than in the internalizing disorders group. While all CPT II RT values

were with the average range, there was a significant main effect for CPT II RT [$F(2) = 8.31$, $p <$

.01], with a moderate effect size ($\eta^2 = .56$). Follow-up pairwise comparisons revealed that CPT II

RT was marginally different ($p < .15$) between the comorbid group and the ADHD group ($p =$

.13). Specifically, CPT II RT was marginally slower in the comorbid group than the ADHD

group. As such, Hypothesis 1A was partially supported. Pairwise comparisons further revealed

that RT was significantly slower in the comorbid group than in the internalizing disorders group

($p < .048$). As such, Hypothesis 1B was supported. Hypothesis 1C was not supported as no

significant difference was found between the ADHD and internalizing disorders groups ($p = .93$).

Thus, Hypothesis 1 was partially supported overall. See Figure 1.

   Analysis of Hypothesis 2. Hypothesis 2 was that emotional control would be

significantly worse in the comorbid group than in the other two groups. Hypothesis 2A was that

emotional control would be significantly worse in the comorbid group than in the ADHD group.

Hypothesis 2B was that emotional control would be significantly worse in the comorbid group

than in the internalizing disorder group. Hypothesis 2C was that emotional control would be

significantly worse in the ADHD group than in the internalizing disorders group. There was a marginally significant main effect for BRIEF EC [F (2) = 3.65, p = .051] with a moderate effect size (η^2 = .33). Follow-up pairwise comparisons revealed significant differences for BRIEF EC between the comorbid and ADHD groups (p = .01), with greater symptom elevation in the comorbid group. As such, Hypothesis 2A was supported. Pairwise comparisons further indicated that no significant difference was found between the comorbid and the internalizing disorders groups (p = .60). As such, Hypothesis 2B was not supported. There was additionally a significant difference between the ADHD and internalizing disorders groups (p = .04), with greater symptom elevation in the internalizing disorders group. Therefore, Hypothesis 2C was not supported. Thus, Hypothesis 2 was partially supported overall. See Figure 2.

Analysis of Hypothesis 3. Hypothesis 3 was that internalizing symptoms would be significantly higher in the comorbid groups than in the other two groups. Hypothesis 3A was that internalizing symptoms would be significantly higher in the comorbid group than in the ADHD group. Hypothesis 3B was that internalizing symptoms would be significantly higher in the comorbid group than in the internalizing disorder group. Hypothesis 3C was that internalizing symptoms would be significantly higher in the internalizing disorders group than in the ADHD group. There was a significant main effect for BASC-2 IP [F (2) = 3.96, p < .04] with a moderate effect size (η^2 = .35). Follow-up pairwise comparisons revealed significant differences for BASC-2 IP between the comorbid and ADHD groups (p = .03), with greater symptom elevation in the comorbid group. As such, Hypothesis 3A was supported. Pairwise comparisons further indicated there was a marginally significant difference between the internalizing disorders and comorbid groups (p = .14), though with greater symptom elevation in the internalizing disorders group. As such, Hypothesis 3B was not supported. Of note, there was additionally a significant

difference between the ADHD and internalizing disorders groups ($p < .01$), with greater

elevation in the internalizing disorders group. Therefore, Hypothesis 3C was supported. Thus,

Hypothesis 3 was partially supported overall. See Figure 3.

CHAPTER FIVE

Discussion

Summary of Findings

The current study sought to investigate associations between pediatric ADHD, internalizing disorders, and comorbid ADHD and internalizing disorders groups for reaction time, emotional control and internalizing symptoms. Previous research suggests that it is not uncommon for children with ADHD to have comorbid internalizing disorders and the connection between childhood emotional disorders and features of ADHD has been established. Children with internalizing and externalizing problems typically perform less efficiently on reaction time tasks and may regulate emotion ineffectively. Moreover, children with both ADHD and internalizing disorders have more severe symptoms and lower treatment success rates than children with one disorder. This study presented additional information about the relationships between reaction time and emotional control in children with comorbid ADHD and internalizing disorders in order to increase our understanding of the relationship between cognitive inefficiency and emotional dysregulation.

Reaction Time Findings

Prior literature suggested that slower processing speed negatively impacts reaction time in children with ADHD as well as in children with internalizing disorders. Therefore, we hypothesized that reaction time would be slower in children with comorbid conditions. The results indicated that reaction time (as measured by the CPT II RT) was marginally slower for the ADHD group and significantly slower for the comorbid group than the internalizing disorders group, though performance fell in the average range across all three groups.

Hypothesis 1. Hypothesis 1A was partially supported, as reaction time was marginally slower in the comorbid group than in the ADHD group. Hypothesis 1B was supported, as reaction time was significantly slower in the comorbid group than in the internalizing disorder group. Hypothesis 1C was not supported, as there was not a significant difference between the ADHD group and the internalizing group for reaction time. While not significantly different from the ADHD group, reaction time was slowest in the comorbid group. These findings are consistent with previous research that reported children with ADHD and internalizing disorders are less efficient on processing speed tasks (Brunnekreef et al., 2007; Pliszka, 1998; Bloemsma et al., 2012; Tarantino, Cutini, Mogentale, & Bisiachhi, 2013). The lack of more explicit (i.e., significant versus marginally significant) findings with regard to processing speed (i.e., abnormally slow reaction time) may be at least partially due to the fact that mean CPT II RT performance was in the normal range across groups. Children with ADHD, with or without an internalizing disorder, may be slower or more inefficient than those with just an internalizing disorder. However, data regarding reaction time suggest that there are no clinically significant differences in terms of functioning between any of the groups as all three groups were average, despite statistical significance. The statistically significant differences are not clinically meaningful, because none of the groups were impaired with respect to reaction time. These findings could also at least partially reflect that symptoms potentially affecting reaction time (e.g., attention deficits) are well-controlled (e.g., via ADHD medication).

Emotional Control Findings

Previous research indicates that individuals with ADHD or internalizing disorders were likely to have difficulty with emotional control. We posited that children with both disorders would have the most emotional control problems. There were notable findings with regard to

emotional control, given the marginally significant main effect. Specifically, emotional control symptoms were significantly higher in the comorbid group than in the ADHD group as well as significantly higher in the internalizing disorders group compared to the ADHD group. However, there was not a significant difference between the comorbid and internalizing disorder groups for emotional control.

Hypothesis 2. Hypothesis 2 was partially supported, suggesting that children with both ADHD and internalizing disorders may have more emotional control problems than children with ADHD alone. Prior research suggests that children with ADHD are less capable of modulating their emotional experiences than children without ADHD (Wehmeier, Schacht, & Barkley, 2010), and that children with anxiety and depression have greater symptom severity (Melton, Croarkin, Strawn, & McClintock, 2016). Indeed, children with internalizing disorders evidenced elevated emotional dyscontrol as expected. These findings suggest that children with internalizing disorders have worse emotional control regardless of whether they have ADHD or not. The data suggest that there is no statistical difference between the comorbid and the internalizing groups in terms of emotional control problems. The present study furthers this body of literature by directly comparing the three groups, and our findings trended in a direction that indicates children with both ADHD and internalizing disorders or children with just an internalizing disorder have worse emotional control than children with ADHD alone.

Internalizing Symptoms Findings

Internalizing symptomatology was investigated in this study as it is indicative of a child's display of internalizing behavior as well as their complaints of health-related problems. We hypothesized that the participants in the comorbid group would have more of these complaints than those in the other two groups. Internalizing symptoms (as measured by the

BASC-2 IP) were significantly higher in the internalizing disorders group than the ADHD group

as well as significantly higher in the comorbid group compared to the ADHD group. The

children in the ADHD group were just below the cutoff for unusually high internalizing

problems. Children with internalizing disorders may have worse internalizing symptoms

regardless of whether they have ADHD or not.

Hypothesis 3. The results partially supported Hypothesis 3, and suggest that children

with comorbid ADHD and internalizing disorders have more highly elevated internalizing

symptoms than children with ADHD alone. Contrary to what was hypothesized, internalizing

symptoms were highest in the internalizing disorders group but not significantly higher than the

comorbid group. However, internalizing symptoms were significantly higher in the internalizing

disorders group than they were in the ADHD group. This suggests that ADHD may not be a

compounding factor for children with internalizing disorders with regard to internalizing

symptoms.

Overall Summary of Findings

In the present study, we explored associations between cognitive inefficiency and

emotional dysregulation in order to further our understanding of the ways in which emotional

and executive functions are related. We discovered that children with internalizing disorders

demonstrated faster processing speed than those with ADHD or ADHD and an internalizing

disorder combined. We also found that those with both ADHD and internalizing disorders had

significantly higher elevations of emotional dyscontrol compared to those with ADHD. We

further found that internalizing symptoms were highest in the internalizing disorders group.

Implications

The current study is meaningful because it focused on differences between three specific pediatric populations (i.e., ADHD, internalizing disorders and comorbid ADHD and internalizing disorders) with regard to reaction speed and emotional regulation, in an effort to further previous research examining these constructs within the respective groups alone (Silver, 2014). Based on the results of previous studies we expected our results to suggest an additional slowing of reaction time in children with comorbid disorders. The results of this study are in line with other studies which concluded that children with comorbid internalizing and externalizing problems perform least efficiently of performance tasks. Our comorbid group demonstrated the slowest reaction time and the most emotional control difficulty. It is important to know if children with comorbid conditions require more time to complete tasks or have more vulnerability toward increased symptomatology. It is possible that this population of children may need differential treatment with respect to learning, such as more accommodations for time than children with ADHD or a mood disorder alone. It is also possible that ADHD symptoms may be exacerbated by the mood symptoms associated with an internalizing disorder in children with comorbid disorders.

The present study partially supports the notion that children with comorbid ADHD and emotional disorders have higher levels of internal distress and therefore worse internalizing symptomatology (Joo et al., 2012). Parental reports of emotional control impairment highlight where difficulties are, and can direct future assessment and interventions. By capturing and understanding the feeling states of children with internalizing and comorbid disorders, clinicians are better able to offer treatments best suited to reduce specific emotional control and internalizing symptoms. Interestingly, the results of this study suggest that while reaction time is slower, and emotional control is worse, internalizing symptoms may not necessarily be worse in

children with comorbid disorders. Our review of the literature suggests that comorbidity may increase symptom severity and lead to complicated treatment methods (Melton, Croarkin, Strawn, & McClintock, 2016). Based on our findings, having a comorbid disorder may make the ADHD symptoms (but not necessarily the mood symptoms) worse. In comorbid groups, treating mood symptoms could have less of an impact than treating the ADHD symptoms. However, mood symptoms may not go away with treatment of ADHD alone. Children with comorbid ADHD and an internalizing disorder appear to have a marginal reduction in internalizing symptoms than those with just internalizing disorders. It is possible that these children were diagnosed and treated early and have perhaps learned to effectively use coping skills to manage internalizing and externalizing symptoms. Alternatively, it is possible that the presence of ADHD may reduce a depressed or anxious childs' awareness of their internal states so they report less distress.

Results such as these are significant because they can be useful in determining whether treating one type of symptomatology may improve the other, and can allow providers to make more informed decisions about how to better assist children with comorbid conditions. This type of investigation adds to the literature by assisting researchers, clinicians, parents, and other caregivers in improved targeting of attention of services to populations of children at higher risk. If caretakers of children with emotional control and internalizing problems are better informed about the signs and symptoms of these conditions, the difficulties and impairments associated with the disorders can be minimized and better managed. In this light, providers could use such information to offer children, parents and other caregivers more specific and individualized recommendations accordingly.

Limitations

The current study is not without limitations. A limitation in this study was the influence of stimulant medication and its undoubted effect on the reaction time performance task. We did not exclude or control for current ADHD or mood medication use. In the ADHD group, 19 (74%) were taking a medication for ADHD. In the internalizing disorders group, 25 (28%) were taking a medication for anxiety and/or depression. In the comorbid group, 20 (45%) were taking medication for ADHD, (.05%) for mood only, and (25%) for both ADHD and mood symptoms.

A relatively small sample size should be considered when interpreting the findings of this study, as we included only 20 subjects with comorbid ADHD and an internalizing disorders. Also, because the data was collected at only one site, generalizability to children in other geographic regions is limited. Data accrued from one site may not be representative of all children with ADHD and/or internalizing disorders. Further, while results and implications may be true in general, they may not directly apply to a given individual.

Lastly, while parents have a unique ability to recognize signs of distress in their children, parent reports can represent a limitation as they can be influenced by many factors, including parental stress levels and other potentially biasing factors (Joyner, Silver, & Stavinoha, 2009).

Future Directions

Additional research is needed to replicate and extend these findings with larger sample sizes. In particular, the complexities associated with attentional disorders, internalizing disorders, and their comorbidity needs further elucidation and confirmation. This in turn could result in improved evidence-based treatment and care for children with these difficulties. Additional research is needed for cross-validation using samples with a variety of demographic differences, to address the generalizability issue. A larger sample population could provide a better foundation for making predictions and determinations about the probability of claims. The

findings of this study did not compare ADHD subtypes or internalizing subtypes to each other. It would be important to know whether performance and emotional symptomatology vary based on subtype. Furthermore, due to the inward expression of distress associated with anxiety and depression, parents likely lack awareness of aspects of their child's internally-expressed symptomatology. As such, future research could also consider incorporating child self-report and teacher report in the methodology. Future studies should also control for medication use.

Concluding Statement

The need for early and accurate diagnosis and intervention is especially important and this study highlights the current lack of and need for studies focused on the assessment of comorbid ADHD and internalizing disorders in children. These results offer additional insight into the nature of reaction time, emotional control, and internalizing symptoms in children with ADHD, internalizing disorders, and comorbid ADHD and internalizing disorders. This may ultimately lead to improved interventions and outcomes in these populations.

References

Airaksinen, E., Larsson, M., & Forsell, Y. (2005). Neuropsychological functions in anxiety

disorders in population-based samples: Evidence of episodic memory dysfunction.

Journal of Psychiatric Research, *39*(2), 207-214. doi:10.1016/j.jpsychires.2004.06.001

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders*

(5th ed.). Washington, D.C: American Psychiatric Association.

Antshel, K.M., & Barkley, R. (2008). Psychosocial interventions in attention deficit

hyperactivity disorder. *Child and Adolescent Psychiatry Clinics of North America, 17*(2),

421-437. doi:10.1016/j.chc.2007.11.005

Barnard, H., Rao, R., Xu, Y., Froehlich, T., Epstein, J., Lanphear, B.P., & Yolton, K. (2015).

Association of the Conners' Kiddie Continuous Performance Test (K-CPT) Performance

and Parent-Report Measures of Behavior and Executive Functioning. *Journal of Attention

Disorders*. doi:10.1177/1087054715578271

Bloemsma, J. M., Boer, F., Arnold, R., Banaschewski, T., Faraone, S. V., Buitelaar, J. K., . . . &

Oosterlaan, J. (2012). Comorbid anxiety and neurocognitive dysfunctions in children

with ADHD. *European Child and Adolescent Psychiatry, 22*(4), 225-234.

doi:10.1007/s00787-012-0339-9

Blijd-Hoogewys, E. M., Bezemer, M. L., & Geert, P. L. (2014). Executive Functioning in

Children with ASD: An Analysis of the BRIEF. *Journal of Autism and Developmental

Disorders, 44*(12), 3089-3100. doi:10.1007/s10803-014-2176-9

Bodnar, L. E., Prahme, M. C., Cutting, L. E., Denckla, M. B., & Mahone, E. M. (2007).

Construct validity of parent ratings of inhibitory control. *Child Neuropsychology, 13*(4),

345-62. doi:10.1080/09297040600899867

Bradley, S. J. (2000). *Affect regulation and the development of psychopathology.* New York:

    Guilford Press.

Broeren, S., Newall, C., Dodd, H. F., Locker, R., & Hudson, J. L. (2014). Longitudinal

    investigation of the role of temperament and stressful life events in childhood anxiety.

    Development and Psychopathology, 26(2), 437-449. doi:10.1017/S0954579413000989

Brunnekreef, J. A., Sonneville, L. M., Althaus, M., Minderaa, R. B., Oldehinkel, A. J., Verhulst,

    F. C., & Ormel, J. (2007). Information processing profiles of internalizing and

    externalizing behavior problems: Evidence from a population-based sample of

    preadolescents. *J Child Psychol & Psychiat Journal of Child Psychology and Psychiatry,

    48*(2), 185-193. doi:10.1111/j.1469-7610.2006.01695.x

Cataldo, M. G., Nobile, M., Lorusso, M. L., Battaglia, M., & Molteni, M. (2005). Impulsivity in

    depressed children and adolescents: a comparison between behavioral and

    neuropsychological data. *Psychiatry Research, 136*(2-3), 123-133.

    doi:10.1016/j.psychres.2004.12.012

Carthy, T., Horesh, N., Apter, A., & Gross, J. J. (2010). Emotional reactivity and cognitive

    regulation in anxious children. *Behaviour Research and Therapy*, *48*(5), 384-393.

    doi:10.1016/j.brat.2009.12.013

Conners, C. K. & MHS Staff (Eds.) (2000). *Conners' Continuous Performance Test II:

    Computer Program for Windows Technical Guide and Software Manual.* North

    Tonwanda, NY: Mutli-Health Systems.

Connor, D. F., & Ford, J. D. (2012). Comorbid symptom severity in Attention-

    Deficit/Hyperactivity Disorder: A clinical study. *The Journal of Clinical Psychiatry,

    73*(5), 711-717. doi:10.4088/JCP.11m07099

Fischer, M., Barkley, R.A., Smallish, L., & Fletcher, K. (2005). Executive functioning in
hyperactive children as young adults: Attention, inhibition, response perseveration, and
the impact of comorbidity. *Developmental Neuropsychology*, *27*(1), 107-33.
doi:10.1207/s15326942dn2701_5

Gale, C. R., Batty, G. D., Cooper, S., Deary, I. J., Der, G., McEwen, B. S., & Cavanagh, J.
(2015). Reaction time in adolescence, cumulative allostatic load, and symptoms of
anxiety and depression in adulthood: the West of Scotland Twenty-07 Study.
Psychosomatic Medicine. 77(5), 493-505. doi:10.1097/PSY.0000000000000189

Gioia, G. A., Isquith, P. K., Guy S. C., & Kentworthy, L. (2000). Behavior rating inventory of
executive function. *Psychological Assessment Resources, Inc*.; Lutz, FL.

Gonzalez, C. L., Mills, K. J., Genee, I., Li, F., Piquette, N., Rosen, N., & Gibb, R. (2014).
Getting the right grasp on executive function. *Frontiers in Psychology, 5, 285.*
doi:10.3389/fpsyg.2014.00285

Griggs, M.S., & Mikami, A. Y. (2010). The role of maternal and child ADHD symptoms in
shaping interpersonal relationships. *Journal of Abnormal Child Psychology*, *39*(3), 437-
449. doi:10.1007/s10802-010-9464-4

Hervey, A. S., Epstein, J. N., Curry, J. F., Tonev, S., Arnold, L.E., Conners, C.K., . . . Hechtman,
L. (2006). Reaction time distribution analysis of neuropsychological performance in an
ADHD sample. *Child Neuropsychology, 12*(2), 125-40.
doi:10.1080/09297040500499081

Houck, G., Kendall, J., Miller, A., Morrell, P., & Wiebe, G. (2011). Self-concept in children and
adolescents with attention deficit hyperactivity disorder. *Journal of Pediatric Nursing,
26*(3), 239-247. doi:10.1016/j.pedn.2010.02.004

Hurrell, K. E., Hudson, J. L., & Schniering C.A. (2015). Parental reactions to children's negative

emotions: Relationships with emotion regulation in children with an anxiety disorder.

Journal of Anxiety Disorders, *29*, 72-82. doi:10.1016/j.janxdis.2014.10.008

Jacob, C., Gross-Lesch, S., Jans, T., Geissler, J., Reif, A., Dempfle, A., & Lesch, K. (2014).

Internalizing and externalizing behavior in Adult ADHD. *Attention Deficit Hyperactivity

Disorders, 6*(2), 101-110. doi:10.1007/s12402-014-0128-z

Jarrett, M. A., & Ollendick, T. H. (2008). A conceptual review of the comorbidity of attention-

deficit/hyperactivity disorder and anxiety: Implications for future research and practice.

Clinical Psychology Review, 28(7), 1266-1280. doi:10.1016/j.cpr.2008.05.004

Joo, E-J., Lee, K.Y., Choi, K-S., Kim, S. E., Song, J.Y., Bang, Y. W., . . . & Kim, Y. S. (2012).

Childhood attention deficit hyperactivity disorder features in adult mood disorders.

Comprehensive Psychiatry, 52, 217-223. doi:10.1016/j.comppsych.2011.05.002

Joyner, K. B., Silver, C. H., Stavinoha, P.L. (2009). Relationship between parenting stress and

ratings of executive functioning in children with ADHD. *Journal of Psychoeducational

Assessment*, 27, 452-464. doi:10.1177/0734282909333945

Klotz, J. M., Johnson, M. D., Wu, S. W., Isaacs, K. M., & Gilbert, D. L. (2012). Relationship

between reaction time variability and motor skill development in ADHD. *Child

Neuropsychology: A Journal on Normal and Abnormal Development in Childhood and

Adolescence, 18*(6), 576-585. http://doi.org/10.1080/09297049.2011.625356

Kofler, M. J., Rapport, M. D., Bolden, J., Sarver, D. E., Raiker, J. S., & Alderson, R. M. (2011).

Working memory deficits and social problems in children with ADHD. *Journal of

Abnormal Child Psychology, 39*(6), 805-817. doi:10.1007/s10802-011-9492-8

Lassal, R., Laurent, M., & Purper-Ouakil, D. (2011). Early signs of mental disorders in children aged 3-12 years. *La Revue du praticien*, *61*(4), 501-505.

Legerstee, J. S., Garnefski, N., Jellesma, F. C., Verhulst, F. C., & Utens, E. M. (2009). Cognitive coping and childhood anxiety disorders. *European Child and Adolescent Psychiatry*, *19*(2), 143-150. doi:10.1007/s00787-009-0051-6

Liu, J. (2004). Childhood externalizing behavior: Theory and implications. *Journal of Child and Adolescent Psychiatric Nursing, 17*(3), 93-103. doi:10.1111/j.1744-6171.2004.tb00003.x

Logan, G. D., Schachar, R. J., & Tannock, R. (1997). Impulsivity and inhibitory control. *Psychological Science, 8*(1), 60-64. doi:10.1111/j.1467-9280.1997.tb00545.x

Lopez, P. L., Torrente, F. M., Ciapponi, A., Lischinsky, A. G., Cetkovich-Bakmas, M., Rojas, J. I., ... & Manes, F. F. (2013). Cognitive-behavioural interventions for attention deficit hyperactivity disorder (ADHD) in adults. *Protocols Cochrane Database of Systematic Reviews*. doi:10.1002/14651858.cd010840

Mathews, B. L., Kerns, K. A., & Ciesla, J. A. (2014). Specificity of emotion regulation difficulties related to anxiety in early adolescence. *Journal of Adolescence*, *37*(7), 1089-1097. doi:10.1016/j.adolescence.2014.08.002

McGee, R.A., Clark, S.E., Symons, D.K. (2000). Does the Conners' Continuous Performance Test aid in ADHD diagnosis? *Journal of Abnormal Child Psychololgy*, 28(5), 415-424. doi:10.1023/A:1005127504982

Melton, T. H., Croarkin, P. E., Strawn, J. R., & McClintock, S. M. (2016). Comorbid anxiety and depression symptoms in children and adolescents: A systematic review and analysis. *Journal of Psychiatric Practice*, *22*(2) 84-98. doi:10.1097/pra.0000000000000132

Mohapatra, S., Agarwal, V., Sitholey, P., & Arya, A. (2014). A clinical study of anxiety

disorders in children and adolescents from North Indian children and adolescents clinic.

Asian Journal of Psychiatry, 8, 84-8. doi:10.1016/j.ajp.2013.12.005

Nigg, J. T., (2006). Temperament and developmental psychopathology. *Journal of Child*

Psychology and Psychiatry, 47 (3-4), 395-422. doi:10.1111/j.1469-7610.2006.01612.x

National Institute of Mental Health (NIMH). (2015). Retrieved July 22, 2015 from

https://www.nimh.nih.gov/health/topics/attention-deficit-hyperactivity-disorder-adhd.

Pisula, E., Kawa, R., Danielewicz, D., & Pisula, W. (2015). The relationship between

temperament and autistic traits in a non-clinical students sample. *PLoS One,* 10(4).

doi:10.1371/journal.pone.0124364

Pliszka, S. R. (1989). Effect of Anxiety on Cognition, Behavior, and Stimulant Response in

ADHD. *Journal of the American Academy of Child & Adolescent Psychiatry, 28*(6), 882-

887. doi:10.1097/00004583-198911000-00012

Purcell, R., Maruff, P., Kyrios, M., & Pantelis, C. (1998). Neuropsychological deficits in

obsessive-compulsive disorder: A comparison with unipolar depression, panic disorder,

and normal controls. *Archives of General Psychiatry*, *55*(5), 415.

doi:10.1001/archpsyc.55.5.415

Quay, H. C. (1988). The behavioral reward and inhibition system in childhood behavior disorder.

Attention deficit disorder, 3, 176-186.

Quay, H. C. (1993). The psychology of undersocialized aggressive conduct disorder: a

theoretical perspective. *Development and Psychopathology, 5*(1-2)*,* 165.

doi:10.1017/s0954579400004326

Rapee, R. M. (2015). Nature and psychological management of anxiety disorders in youth. *Journal of Paediatrics and Child Health*, *51*(3), 280-284. doi:10.1111/jpc.12856

Reynolds, C. R., & Kamphaus, R. W. (2004). BASC-2 *behavioral assessment system for children manual,* (2nd ed.). doi:10.1037/e661772011-001

Rothbart, M. K., Posner, M. I., & Kieras, J. (2006). Temperament, attention, and the development of self-regulation. In K. McCartney & D. Phillips (Eds.), *Blackwell handbook of early childhood development,* 338-357. doi:10.1002/9780470757703.ch17

Serrano, V. J., Owens, J. S., & Hallowell, B. (2015). Where children with ADHD direct visual attention during emotion knowledge tasks: Relationships to accuracy, response time, and ADHD symptoms. *Journal of Attention Disorders.* doi:10.1177/1087054715593632

Shea, C. K., Lee, M. M., Lai, K. Y., Luk, E. S., & Leung, P. W. (2014). Prevalence of anxiety disorders in hong kong chinese children with ADHD. *Journal of Attention Disorders*. doi:10.1177/1087054714562830

Silver, C. H. (2014). Sources of data about children's executive functioning: review and commentary. Child Neuropsychology, *20*(1), 1-13. doi:10.1080/09297049.2012.727793

Sjöwall, D., Bohlin, G., Rydell, A. M., & Thorell, L. B. (2015). Neuropsychological deficits in preschool as predictors of ADHD symptoms and academic achievement in late adolescence. *Child Neuropsychology*, 1-18. doi:10.1080/09297049.2015.1063595

Skogan, A. H., Egeland, J., Zeiner, P., Øvergaard, K. R., Oerbeck, B., Reichborn-Kjennerud, T., & Aase, H. (2015). Factor structure of the behavior rating inventory of executive functions (BRIEF-P) at age three years. *Child Neuropsychology: 22*(4), 472-492. doi:10.1080/09297049.2014.992401

Steward, K. A, Tan, A., Delgaty, L., Gonzales, M. M., & Bunner, M. (2014). Self-awareness of

    executive functioning deficits in adolescents with ADHD. *Journal of Attention Disorders*.

    doi:10.1177/1087054714530782

Strine, T. W., Lesesne, C. A., Okoro, C. A., McGuire, L. C., Chapman, D. P., Balluz, L. S., . . .

    & Mokdad, A. H. (2006). Emotional and behavioral difficulties and impairments in

    everyday functioning among children with a history of attention-deficit/hyperactivity

    disorder. *Preventing Chronic Disease, 3*(2), A52.

Sullivan, E. L., Holton, K. F., Nousen, E. K, Barling, A. N., Sullivan, C. A., Propper, C. B., &

    Nigg, J. T. (2015). Early identification of ADHD risk via infant temperament and

    emotion regulation: a pilot study. *Journal of Child Psychology and Psychiatry*.

    doi:10.1111/jcpp.12426

Tarantino, V., Cutini, S., Mogentale, C., & Bisiacchi, P. S. (2013). Time-on-task in children with

    ADHD: an ex-Gaussian analysis. *Journal of the International Neuropsychology Society*,

    19(7), 820-828. doi:10.1017/S1355617713000623

Toplak, M. E., Bucciarelli, S. M., Jain, U., & Tannock, R. (2009). Executive functions:

    Performance-based measures and the behavior rating inventory of executive function

    (BRIEF) in adolescents with attention deficit/hyperactivity disorder (ADHD). *Child

    Neuropsychology*, *15*(1), 53-72. doi:10.1080/09297040802070929

Torrente, F., López, P., Alvarez Prado, D., Kichic, R., Cetkovich-Bakmas, M., Lischinsky, A., &

    Manes, F. (2014). Dysfunctional cognitions and their emotional, behavioral, and

    functional correlates in adults with attention deficit hyperactivity disorder (ADHD): is the

    cognitive-behavioral model valid? *Journal of Attention Disorders, 18*(5), 412-24.

    doi:10.1177/1087054712443153

Turpyn, C. C., Chaplin, T. M., Cook, E. C., & Martelli, A. M. (2015). A person-centered

    approach to adolescent emotion regulation: Associations with psychopathology and

    parenting. *Journal of Experimental Child Psychology, 136,* 1-16.

    doi:10.1016/j.jecp.2015.02.009

Trosper, S. E., Buzzella, B. A., Bennett, S. M., & Ehrenreich, J. T. (2009). Emotion regulation in

    youth with emotional disorders: implications for a unified treatment approach. *Clinical*

    Child and Family Psychology Review, *12*(3), 234-354. doi:10.1007/s10567-009-0043-6

Vaurio, R. G., Simmonds, D. J., & Mostofsky, S. H. (2009). Increased intra-individual reaction

    time variability in attention-deficit/hyperactivity disorder across response inhibition tasks

    with different cognitive demands. *Neuropsychologia*, *47*(12), 2389-2396.

    doi:10.1016/j.neuropsychologia.2009.01.022

Vloet, T. D., Konrad, K., Herpertz-Dahlmann, B., Polier, G. G., & Günther, T. (2010). Impact of

    anxiety disorders on attentional functions in children with ADHD. *Journal of Affective*

    Disorders, 124(3), 283-290. doi:10.1016/j.jad.2009.11.017

Villemonteix, T., Purper-Ouakil, D., & Romo, L. (2015). [Is emotional dysregulation a

    component of attention-deficit/hyperactivity disorder (ADHD)?]. L'*Encephale*,

    41(2),108-114. doi:10.1016/j.encep.2013.12.004.

Wender, P. H., Wolf, L. E., & Wasserstein, J. (2001). Adults with ADHD. An overview. *Annals*

    of the New York Academy of Sciences, *931*(1)*,* 1-16. doi:10.1111/j.1749-

    6632.2001.tb05770.x

Wehmeier, P. M., Schacht, A., & Barkley, R. A. (2010). Social and emotional impairment in

    children and adolescents with ADHD and the impact on quality of life. *Journal of*

    Adolescent Health, 46(3), 209-217. doi:10.1016/j.jadohealth.2009.09.009

Young, C. C., & Dietrich, M. S. (2015). Stressful life events, worry, and rumination predict

depressive and a anxiety symptoms in young adolescents. *Journal of Child and

Adolescent Psychiatric Nursing*, *28*(1), 35-42. doi:10.1111/jcap.12102

Table 1

Descriptive Statistics for Demographic Variables

Variable	ADHD ($n = 19$)			Internalizing Disorders ($n = 25$)			Comorbid ($n = 20$)			Overall ($N = 64$)		
	M	(SD)	range	M	(SD)	range	M	(SD)	range	M	(SD)	range
Education (years)	2.89	(2.75)	1-9	3.44	(2.20)	1-7	3.05	(1.93)	1-6	3.16	(2.28)	1-9
Age (years)	9.11	(3.05)	6-16	9.72	(2.56)	6-13	9.25	(2.20)	6-13	9.39	(2.59)	6-16
	n	(%)		n	(%)		n	(%)		n	(%)	
Sex (n male; %)	12 (63.2)			13 (52.0)			17 (85.0)			41 (65.6)		
Ethnicity												
Caucasian	15 (78.9)			18 (72.0)			13 (65.0)			46 (71.9)		
African-American	2 (10.5)			3 (12.0)			3 (15.0)			8 (12.5)		
Latino	0 (0.0)			3 (12.0)			1 (5.0)			4 (6.3)		
Other	0 (0.0)			0 (0.0)			2 (10.0)			2 (3.1)		
Unknown	2 (10.5)			1 (4.0)			1 (5.0)			4 (6.3)		

ADHD = Attention-Deficit Hyperactivity Disorder

Table 2

Descriptive Statistics for Study Variables

Variable	ADHD (*n* = 19)			Internalizing Disorders (*n* = 25)			Comorbid (*n* = 20)			Overall (*N* = 64)		
	M (*SD*)	range		*M* (*SD*)	range		*M* (*SD*)	range		*M* (*SD*)	range	
CPT-2 RT	48.04 (12.53)	30-72		47.86 (11.90)	24-65		54.25 (11.22)	39-79		49.91 (12.06)	24-79	
BRIEF EC	60.00 (10.57)	38-80		68.84 (11.47)	42-85		70.90 (12.84)	45-91		66.86 (12.36)	38-91	
BASC-2 IP	52.16 (11.57)	35-72		68.92 (16.96)	45-104		62.05 (12.82)	41-97		61.80 (15.67)	30-104	

ADHD = Attention-Deficit Hyperactivity Disorder; CPT-II = Conners' Continuous Performance Test II; RT = Overall Hit Reaction Time T score; BRIEF = Behavior Rating Inventory of Executive Function; EC = Emotional Control subscale T score; BASC-2 = Behavior Assessment System for Children, Second Edition; IP = Internalizing Symptoms Composite score T score

Table 3

Overall Model for Group (ADHD versus INTDX versus Comorbid)

Variables	F	df	p	Partial η^2
Group	6.89	6, 26.00	< .01	.61
Covariates				
Age (years)	1.67	21, 37.88	.08	.47
Education (years)	2.58	18, 37.26	< .01	.53
Sex	2.29	3, 13.00	.13	.35
Race	4.85	3, 13.00	.02	.53

ADHD = attention-deficit hyperactivity disorder; INTDX = internalizing disorders; Sex = male versus female; Race = African American versus not African American

Table 4

Main Effects

Variables	F	df	p	Partial η²
Conners' Continuous Performance Test II, RT	8.31	2	< .01	.56
Behavior Rating Inventory of Executive Function, EC	3.65	2	.05	.33
Behavior Assessment System for Children, Second Edition, IP	3.96	2	.04	.35

RT = Overall Hit Reaction Time T score; EC = Emotional Control subscale T score; IP = Internalizing Symptoms Composite score T score

Table 5

Pairwise Comparisons of Significant Main Effects

Dependent Variable	Group 1	Group 2	$M_{difference}$	SE	p	95% CI
Conners' Continuous Performance Test II, RT	ADHD	INTDX	.10	.29	.93	-.64 to .85
	ADHD	Comorbid	-.65	.31	.13	-1.46 to .16
	INTDX	Comorbid	-.76	.29	.048	-1.51 to -.01
Behavior Rating Inventory of Executive Function, EC	ADHD	INTDX	-.77	.29	.04	-1.51 to -.03
	ADHD	Comorbid	-1.05	.31	.01	-1.85 to -.25
	INTDX	Comorbid	-.28	.29	.60	-1.02 to .46
Behavior Assessment System for Children, Second Edition, IP	ADHD	INTDX	-1.15	.23	< .01	-1.74 to -.56
	ADHD	Comorbid	-.69	.25	.03	-1.33 to -.06
	INTDX	Comorbid	.46	.23	.14	-.13 to 1.05

SE = Standard Error; CI = Confidence Interval; RT = Overall Hit Reaction Time T score; ADHD = attention-deficit hyperactivity disorder; INTDX = internalizing disorders; EC = Emotional Control Composite score T score; IP = Internalizing Symptoms Composite score T score; note: pairwise comparisons were conducted using the Tukey HSD post hoc test
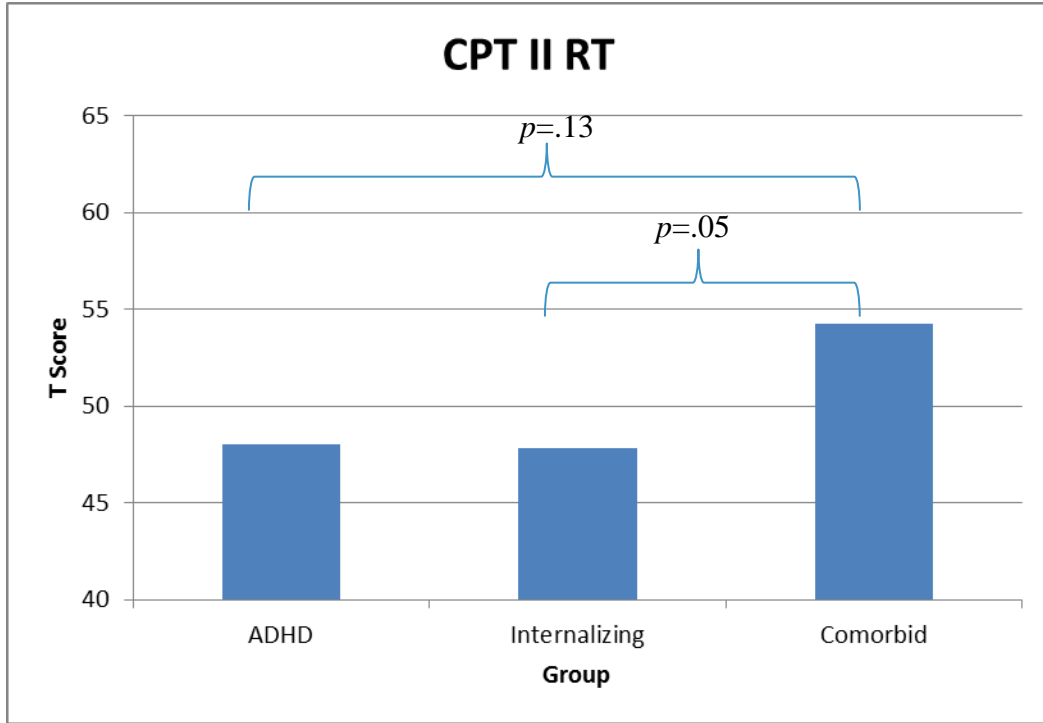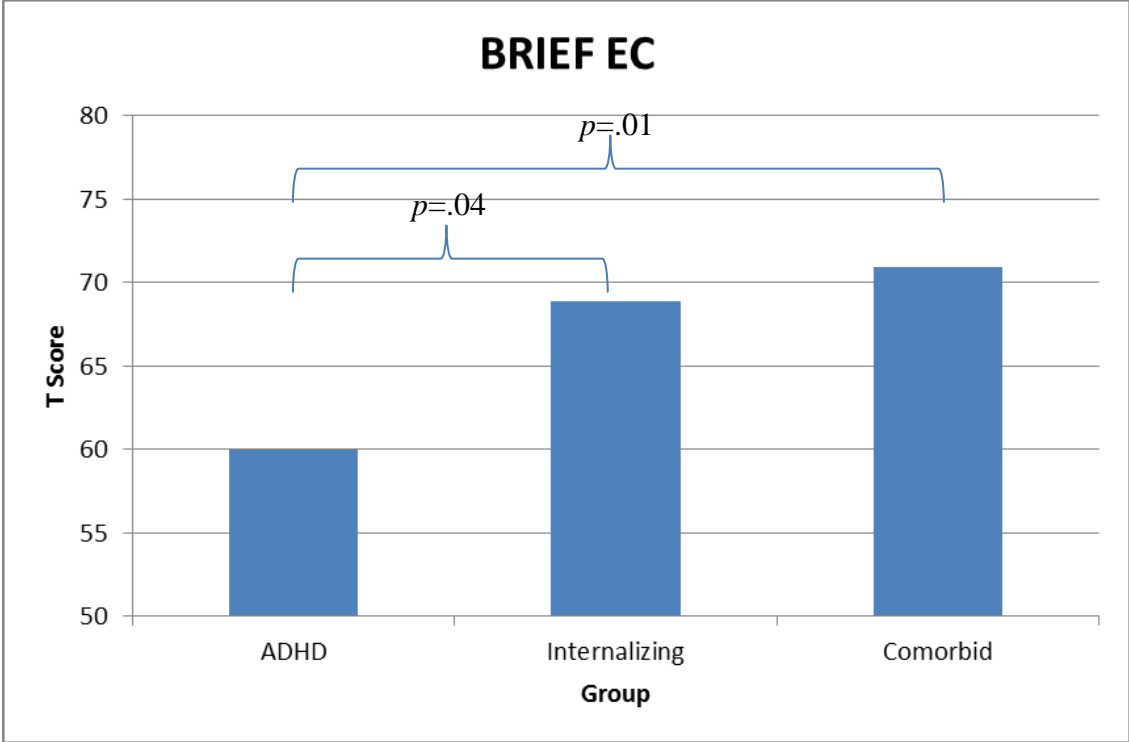
Figure 1. Representation of hypothesis 1 results

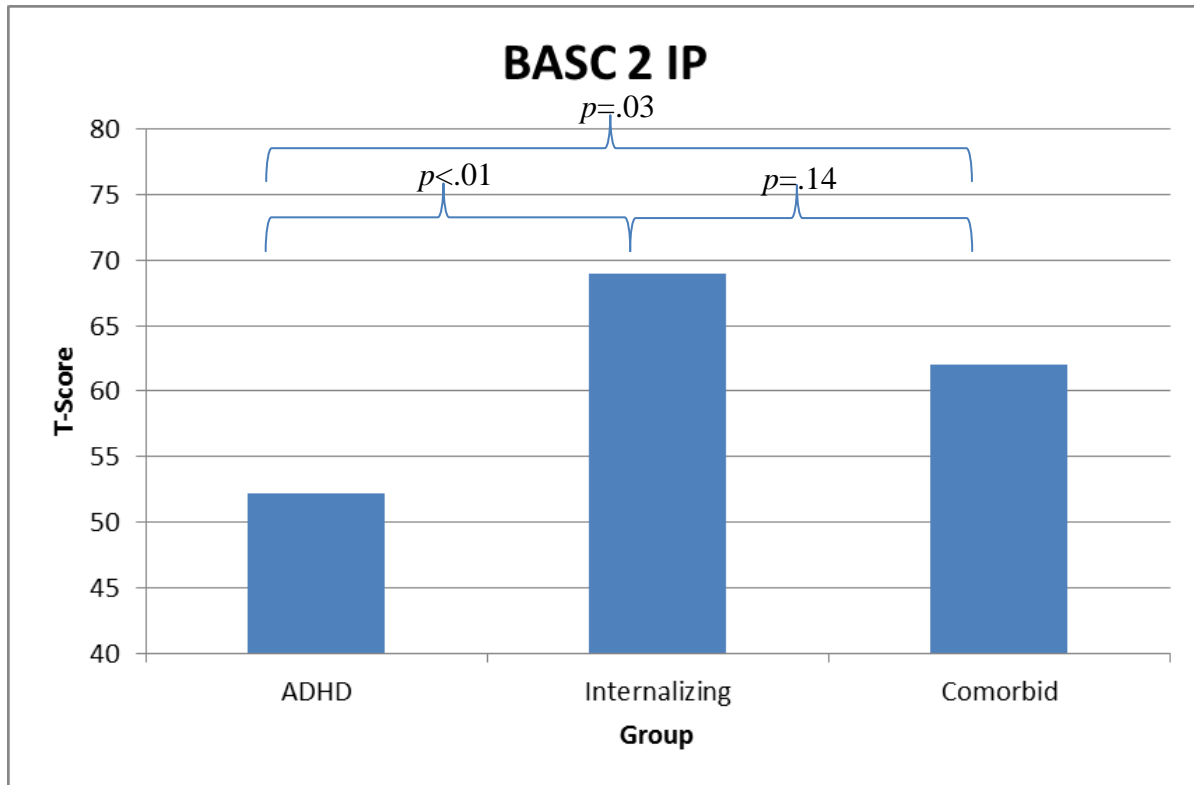*Figure 2.* Representation of hypothesis 2 results

Figure 3. Representation of hypothesis 3 results

Appendix A

Emotional Control Scale Items for the BRIEF Parent Form

Scale/Item no.
1. Overreacts to small problems
7. Has explosive, angry outbursts
20. Becomes tearful easily
25. Has outbursts for little reason
26. Mood changes frequently
45. Reacts more strongly to situations than other children
50. Mood is easily influenced by the situation
62. Angry or tearful outbursts are intense but end suddenly
64. Small events trigger big reactions
70. Becomes upset too easily

Gioia, Isquith, Guy, & Kentworthy (2000)

Appendix B

Internalizing Composite Scale Items for the BASC-2 Parent Rating Scales - Child Form

Anxiety Scale Items

Worries.

Worries about what teachers think.

Is to serious.

Worries about making mistakes.

Worries about what parents think.

Worries about schoolwork.

Is fearful.

Tries to hard to please others.

Is nervous.

Worries about things that cannot be changed.

Says, "I'm afraid I will make a mistake."

Says, "I'm not very good at this."

Says, "It's all my fault."

Worries about what other children think.

Depression Scale Items

Is easily upset.

Complains about being teased.

Cries easily.

Says, "Nobody understands me."

Complains about not having friends.

Says, "Nobody likes me."

Is negative about things.

Says, "I don't have any friends."

Says, "I want to die," or "I wish I were dead."

Says, "I hate myself."

Is sad.

Seems lonely.

Says, "I want to kill myself."

Changes mood quickly.

Somatization Scale Items

Expresses fear of getting sick.

Complains of pain.

Has stomach problems.

Says, "I think I'm sick."

Has headaches.

Complains about health.

Gets sick.

Has fevers.

Is afraid of getting sick.

Complains of being sick when nothing is wrong.

Vomits.

Complains of shortness of breath.

BIOGRAPHICAL SKETCH
Melissa Turner
MDTURNER123@HOTMAIL.COM

EDUCATION/TRAINING

INSTITUTION AND LOCATION	DEGREE	YEAR(s)	FIELD OF STUDY
Texas Woman's University	B.S.	2013	Psychology
The University of Texas Southwestern School of Allied Health Science	M.R.C.	2016	Rehabilitation Counseling Psychology
Commission on Rehabilitation Counselor Certification (CRCC)	CRC	2015	Certified Rehabilitation Counselor

Positions and Employment

Dec 2015 - present   **Sunspire Health** Behavioral Healthcare Technician (PRN)

Nov 2015 - present   **McKinney Independent School District** (Substitute Teacher PRN)

Sep 2015 - June 2016   **Hallmark** Sales Associate/key holder

June 2001 to   **MCLANE FOODSERVICE –** Carrollton, Texas
Feb 14, 2004   **Systems Developer** Planning/Procurement, JDE software support, training, maintenance.

July 1999 to   **INTEGRATION SERVICES INC.** (consultant) – Dallas, Texas
Nov. 2000   **TIME WARNER CABLE** - San Antonio
Responsible for in-house development, maintenance, system support.

           THE ASSOCIATES INC. - Las Colinas, TX
Support of Imaging/Optical storage system.

December 1998	**UGLY DUCKLING CAR SALES** - Dallas, TX
to July 1999	**Programmer/Analyst**
	Highly instrumental in Y2K conversion.

September 1996	**AHLERS AND ASSOCIATES INC**. - Waco, Texas
December 1998	**Computer Programmer**

Areas of	
Expertise:	**Computer Programmer / Systems Developer / Project Manager**
	Application development and maintenance on AS/400.
	Needs assessment, proposal development and presentation.

Clinical Experience

Clinical Interviewing. Intelligence, Academic, Personality, Adaptive functioning assessment. Vocational support. Individual counseling experience using CBT, DBT, motivational interviewing, REBT, and person centered therapy. Addiction, recovery programs.

Intermships:

08/2014 - 02/2015	Pate Rehabilitation Center
02/2015 – 08/2015	URS –Supported Employment

Presentations and Publications

Symposium – Behavior Therapy and the Treatment of Addiction
Texas Women's University (2012).