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Temperament, ADHD Symptoms, And Impairment In Middle Childhood

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ABSTRACT

Attention deficit/hyperactivity disorder (ADHD), a disorder first diagnosed in childhood that often persists into adulthood, is characterized by difficulty sustaining attention and controlling hyperactive and impulsive behaviors (Barkley & Murphy, 2006). ADHD is associated with impairment in numerous domains in both childhood (Hinshaw, 1992) and adulthood (Flory, Milich, Lynam, Leukefeld, & Clayton, 2003). Research suggests that temperament is associated with both ADHD and impairment (Martel, Gremillion, Roberts, Zastrow, & Tackett, 2014; Nigg, 2006), and the relation between ADHD and impairment is well established (Johnston & Mash, 2001). However, there has been very little research examining the relations among ADHD, temperament, and impairment together (De Pauw & Mervielde, 2011). The current study addresses this issue by investigating dimensions of temperament [surgency, negative affectivity (NA), and effortful control (EC)] as moderators of the relation between ADHD and impairment across multiple settings in a sample of children ages 8-10. We hypothesized that ADHD, surgency, and NA would be positively related to parent and teacher reported impairment, and that EC would be negatively related. We also hypothesized that the relations between ADHD and impairment would be stronger for individuals who were rated higher on surgency and NA and lower on EC.

Results demonstrated relations between ADHD, temperament, and parent reported impairment in the expected directions, although temperament dimensions were not a significant moderator. Results for teacher reported impairment showed moderating

effects of surgency and EC on the relations between impairment and ADHD, although some of these relations were not in the expected directions. Findings offer additional support for the literature on ADHD, temperament, and parent report impairment, and suggest a need for additional research into how surgency functions with regard to impairment, particularly in the academic setting. Findings additionally suggest a need for more complex analyses of the overlap between temperament and ADHD. Results may be utilized to inform intervention work, particularly related to problems in the classroom that may be associated with attention problems and aspects such as engagement and prosocial behavior.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

Attention-deficit/hyperactivity disorder (ADHD) is a common childhood behavioral disorder that affects an estimated 9.4% of US children (Danielson et al., 2018) and is characterized by problems with attention and elevated levels of hyperactivity and impulsivity (Barkley, 2006). According to the DSM-V, "the essential feature of ADHD is a persistent pattern of inattention and/or hyperactivity-impulsivity that interferes with functioning or development" (American Psychiatric Association, 2013, p. 61). The DSM-V criteria for ADHD include 18 possible symptoms – nine inattentive and nine hyperactive/impulsive. Inattentive symptoms include difficulty paying close attention or a tendency to make careless mistakes, problems sustaining focus, failure to follow through on tasks, and difficulty staying organized. Hyperactive/impulsive symptoms include fidgeting, frequently leaving one's seat, running around or climbing on things, excessive talking, blurting out, and trouble waiting for one's turn (American Psychiatric Association, 2013). In the DSM-V (American Psychiatric Association, 2013), ADHD is categorized into three subtypes – predominantly inattentive presentation (six or more inattentive symptoms and fewer than six hyperactive/impulsive symptoms), predominantly hyperactive presentation (six or more hyperactive/impulsive symptoms and fewer than six inattentive symptoms), and combined presentation (six or more inattentive symptoms and six or more hyperactive/impulsive symptoms). Additionally,

symptoms must have been present before age 12, must be present in multiple settings, and must cause impairment. However, there is ongoing debate in the ADHD literature that has called into question the accuracy, stability, and utility of ADHD subtypes, particularly for younger children (e.g., Chhabildas, Pennington, & Willcutt, 2001; Lahey, Pelham, Loney, Lee, & Willcutt, 2005; Willcutt et al., 2012). Researchers are, instead, increasingly examining ADHD symptoms continuously rather than categorically (e.g., Flory, Malone, & Lamis, 2011; Lahey & Willcutt, 2010; Van Eck, Flory, & Willis, 2015).

Research on childhood symptoms of ADHD has demonstrated associations with significant impairment in numerous areas, such as peer, parent, and sibling relations, emotion regulation, and academics (e.g., Barkley, 2006; Bunford, Evans, Becker, & Langberg, 2015; Hoza et al., 2005; Hinshaw, 1992; Johnston & Mash, 2001). For example, in a large, longitudinal, multisite study of children with ADHD, Hoza and colleagues (2005) found that children with ADHD were rated lower than children without ADHD on a number of social factors, including social preference and liking. They were also rated as having fewer friends, were more likely to fall into the "rejected" category, and were less likely to be classified as "popular" (Hoza et al., 2005). Bunford and colleagues (2015) found similar associations between ADHD and social skills in a sample of 171 adolescents with ADHD. Building on the extensive literature on the association between ADHD and social skills deficits, they investigated emotion dysregulation (ED) as a potential mediator of this relation. Their results demonstrated that the ED facets of self-awareness and emotional control mediated the significant, positive relation between ADHD and social skills deficits for non-clinically depressed adolescents.

With respect to family relationships, a 2001 review by Johnston and Mash found that parents of children with ADHD reported that they engaged in higher rates of controlling and negative behaviors; this work also highlights high levels of family stress and problems between siblings for families with a child with ADHD. However, the authors note that the body of research on parents, siblings, and families of children with ADHD suffers from methodological problems and should be interpreted cautiously (Johnston & Mash, 2001). Finally, in a 1992 review of the literature on externalizing disorders and academic problems, Hinshaw found support across multiple studies (Anderson, Williams, McGee, & Silva, 1989; Frick et al., 1991; McGee & Share, 1988) for a relation between ADHD and academic underachievement. This relation held true even when studies controlled for other externalizing disorders, including conduct disorder (CD).

In addition to causing impairment in childhood, ADHD symptoms often persist into adulthood for many individuals (Barkley, Fischer, Smallish, & Fletcher, 2002), where they continue to cause problems. A study by Kessler and colleagues (2006) found that 4.4% of adults meet criteria for ADHD. Moffitt and colleagues (2015) demonstrated a similar rate of adult ADHD (3%), but noted that the majority of those meeting criteria in adulthood did not meet childhood criteria. Other studies have considered rates of persistence of ADHD into adulthood for those diagnosed with childhood ADHD. While Agnew-Blais and colleagues (2016) found that only 2.5% of those with childhood ADHD continued to meet criteria in adulthood, Barbaresi and colleagues (2018) found persistence rates that ranged from 11.3% to 24.1% (depending on the measure(s) used to assess ADHD), and Sibley and colleagues (2017) found a persistence rate of 41%. For

those who show persistence of symptoms into adulthood, the types of impairment they experience are different than those experienced in childhood. In adulthood, ADHD symptoms are associated with outcomes such as a higher risk for substance use, engagement in risky driving and sexual behavior, and financial and legal problems (Biederman & Faraone, 2006; Flory, Milich, Lynam, Leukefeld, & Clayton, 2003; Flory, Molina, Pelham, Gnagy, & Smith, 2006; Fried et al., 2006; Mannuzza, Klein, & Moulton III, 2008).

Given the evidence that both ADHD symptoms and associated impairment persist from childhood into adulthood for many individuals, it is important to understand how ADHD symptoms are related to impairment, and whether there are additional factors, besides ADHD symptoms, that predict the degree of impairment present for an individual. The current study addresses this issue by investigating childhood temperament and symptoms of ADHD as predictors of impairment in multiple domains, and assesses whether temperament moderates the relation between ADHD symptoms and impairment. Results will inform both theory and clinical practice. Findings from this project will provide information about how ADHD and temperament are individually and jointly related to impairment. Results may also be used to advocate for more comprehensive ADHD assessment that focuses on both symptoms and impairment, as well as other relevant correlates such as temperament, and may influence directions for behavioral treatment of ADHD in children.

The Importance of Assessing Impairment

The assessment of ADHD should focus on a gaining a comprehensive understanding of not only the presence or absence of symptoms, but also the settings in

which symptoms are present and the impairment associated with these symptoms. Given that impairment across multiple settings is a necessary component of the diagnostic criteria for ADHD (APA, 2013), assessment measures or tools that only address symptom presence/absence may be inadequate for proper diagnosis. They also miss out on providing a useful understanding of how individuals are impacted by their symptoms. While impairment in multiple domains is a necessary criterion for a diagnosis of ADHD, individuals with the disorder vary widely with regard to the types of impairment they experience, as well as the severity of their impairment (Nigg, Willcutt, Doyle, & Sonuga-Barke, 2005; Wåhlstedt, Thorell, & Bohlin, 2009).

Some research has linked ADHD-related social impairment in childhood to the development of more significant functional problems in adulthood (Greene et al., 2001). Similarly, work examining peer rejection, a common experience for children with ADHD, demonstrates evidence that rejected children seek out friends in deviant peer groups, which may lead to behavioral and functional problems later on in development (Pritchard, Nigro, Jacobson, & Mahone, 2012). Still another line of research has considered the relations between childhood executive functioning problems and later impairment in individuals with ADHD (e.g., Dvorsky & Langberg, 2014; Miller & Hinshaw, 2010; Miller, Nevado-Montenegro, & Hinshaw, 2012; Rinsky & Hinshaw 2011). Overall, these studies highlight the pathways between the impairment seen in children with ADHD symptoms and lasting and potentially more significant problems later on in life. These associations further underscore the need to thoroughly assess and treat the problems associated with ADHD during childhood, not just the symptoms of the disorder.

A firm understanding of the types of impairment associated with ADHD also provides the foundation for choosing and tailoring behavioral interventions. For example, children who experience more social problems or difficulty in the classroom may benefit from interventions that increase skills in the areas of organization, time management, or focus, as well as support regarding their social skills and emotion regulation. Children who have more difficulties in the home may benefit from parent behavioral management training, with a focus on increasing frequent and consistent positive reinforcement for use of positive coping strategies and rule-following behavior.

It is important to note that ADHD symptoms may manifest differently in various settings, such as in the classroom compared to in the home (De Los Reyes et al., 2015; de Nijs et al., 2004; Papageorgiou, Kalyva, Dafoulis, & Vostanis, 2008). Therefore, assessment of impairment in the school setting using teacher ratings may allow for a more accurate understanding of how ADHD symptoms may negatively affect peer relationships and multiple facets of academic performance, associations which are well established in the childhood ADHD literature (e.g., Barkley et al., 2002; DuPaul, Reid, Anastopoulos, & Power, 2014). Similarly, parent report of impairment associated with ADHD symptoms may shed light on difficulties that are unique to the home environment and family context, such as problems with siblings (Mikami & Pfiffner, 2008), parents (Johnston & Mash, 2001), and organization (i.e., "… structure and planning in family responsibilities and daily activities"; Pressman et al., 2006, p. 347). The current study continues to expand on this literature by utilizing both parent and teacher report of ADHD symptoms and impairment, in order to gain a more comprehensive understanding of children's behavior and functioning across settings and reporters.

Other Influences on Impairment

While the association between ADHD symptoms and impairment in domains such as academics and social relationships is well established, these types of impairments are not unique to individuals with ADHD. Research has demonstrated that other factors such as attachment with parents (Bartholomew & Horowitz, 1991), general psychopathology (Beauchaine, 2001; Cicchetti & Cohen, 2006), and temperament (Nigg, 2006) are also associated with impairment in childhood across life domains. Temperament has specifically been linked with adjustment issues (Lengua & Kovacs, 2005), challenges with emotional regulation (Frick & Morris, 2004), academic difficulties (Rothbart, Derryberry, & Hershey, 2000), and problems with siblings (Cicirelli, 2012), among others. Further, research also suggests a clear link between temperament and symptoms of ADHD (e.g., Einziger et al., 2008; Martel, Gremillion, Roberts, Zastrow, & Tackett, 2014; Nigg, Goldsmith, & Sacheck, 2004). For example, in a study of 109 children that utilized both parent and teacher/daycare provider report, Martel and colleagues (2014) found that high ratings of neuroticism and high surgency and low ratings of effortful control were associated with ADHD.

Given the association between temperament and ADHD and their mutual relations with impairment across multiple contexts of functioning, it stands that research incorporating both ADHD symptoms and temperament in the prediction of impairment is likely to have important implications for understanding and addressing problems in functioning. Individuals with ADHD symptoms do all not experience the same types or severity of impairment, and gaining a better understanding of other relevant factors, such as temperament, will aid in identifying those who might be at greatest risk for adverse

outcomes. This, in turn, may allow for earlier preventative efforts and more effective interventions. The current study utilized data from multiple reporters to examine how both ADHD symptoms and temperament predict impairment in multiple domains in middle childhood. Additionally, temperament will be examined as a moderator of the ADHD/impairment relation.

Models of Temperament

Temperament refers to "… constitutionally based individual differences in reactivity and self-regulation…" (Rothbart, Ahadi, & Hershey, 1994, p. 22). Within this definition, "… constitutional refer[s] to the person's relatively enduring biological makeup, influenced over time by heredity, maturation, and experience … reactivity refers to arousability of affect, motor activity, and related responses… [and] self-regulation refers to processes such as attention, approach-withdrawal, behavioral inhibition, and self-soothing" (Rothbart, Ahadi, & Hershey, 1994, p. 22). Models of temperament have evolved substantially over time with the advancement of a scientific approach to research. The foundational New York Longitudinal Study (NYLS; Thomas, Chess, & Birch, 1970; Thomas, Chess, Birch, Hertzig, & Korn, 1963) was an early, landmark attempt to systematically categorize temperament types and associated variables. The study, which began in the early 1950s, informed Thomas and Chess' theory of temperament, an early and widely utilized model for understanding temperament in childhood. Research on temperament has continued to develop, resulting in a host of different models, including Rusalov's activity-specific approach, later adapted by Trofimova into the Functional Ensemble of Temperament (Rusalov, 1989; Rusalov &

Trofimova, 2007), and Rothbart's model of temperament (Rothbart, Ahadi, & Hershey, 1994), which is utilized in the current study.

Rothbart's model (1994), based on Fiske's earlier research (1966) is one of the most widely-utilized model of temperament in current psychological research. Rothbart's model includes three temperament dimensions – surgency, negative affectivity, and effortful control. Surgency includes traits such as high activity level, high-intensity pleasure seeking, low shyness, and impulsivity. Negative affectivity includes sadness, discomfort, frustration, fear, and difficulty with soothability. Effortful control includes traits such as good inhibitory control, attentional focus, low-intensity pleasure, and perceptual sensitivity (Rothbart & Putnam, 2002, in Berdan, Keane, & Caulkins, 2008). These dimensions closely resemble the constructs of extraversion/positive emotionality, neuroticism/negative emotionality, and psychoticism/constraint in Eysenck's model of personality (Rothbart, 1994), and bear resemblance to three of the "Big 5" personality factors (Rothbart, Posner, & Hershey, 2006).

Temperament and Personality

In some research, particularly earlier studies (e.g., Thomas & Chess, 1972), the terms "personality" and "temperament" are used interchangeably to describe the same traits and behaviors. However, it is now evident that personality and temperament represent related but distinct constructs, though theorists differ with regard to the specifics of their relation. For example, some researchers suggest that childhood temperament is a precursor to personality, and that personality in adulthood is influenced by experience and encompasses more social aspects (Gange, 2013; Goldsmith et al., 1987; Nigg & Goldsmith, 2006; Strelau, 1987). Others see temperament as the "core" of

personality, which encompasses a broader array of dimensions (Bates, Schermerhorn, & Petersen, 2014; Clark, Watson, & Mineka, 1994). Rothbart, in particular, has focused on identifying links between temperamental and personality traits (Rothbart et al., 1994; Rothbart et al., 2006). While the literature on the relation between temperament and personality is expansive, the scope of the current study focuses only on temperament, given the age range of the study participants.

Temperament and Psychopathology

Temperament/personality has long been linked to psychopathology, dating back to Hippocrates and Galen, with Darwin also taking an interest in this relation during the 1800s (Clark, 2005). Research on depression and neuroticism in the late 1980s and early 1990s appears to have re-ignited interest in the relation between personality and psychopathology, following the split of personality disorders and psychopathology into separate axes in DSM-III (American Psychiatric Association, 1980). The Five-Factor Model of personality was developed several years later (Clark, 2005).

Modern research has continued to explore how temperament/personality and psychopathology are related. Both Clark (2005) and Nigg (2006) summarize findings that assert that theories of the temperament/personality—psychopathology relation fall into four categories: the predisposition or vulnerability model (i.e., particular traits or disorders are a risk factor for the later onset of another disorder), the pathoplasty model (i.e., particular traits or disorders impact the course of development of a later-onset disorder), the shared factor model (i.e., particular traits or disorders have a shared genetic component with other disorders), and the spectrum model (i.e., disorders represent extremes on a continuum of traits of including personality/temperament or a more mild

form of the disorder). Within this body of work, there appears to be a general consensus that temperamental traits underlie both the development of personality in adulthood and psychopathology (e.g., Clark, 2005; Nigg, 2006). Clark (2005, p. 111) summarizes that, "… at least some disorders are phenomenologically more extreme manifestations of personality dimensions (spectra) and most, if not all, disorders are more likely to develop in individuals who are more extreme on relevant temperament–personality dimensions (predisposition vulnerability), particularly given adverse life experiences and/or the experience of another disorder (diathesis–stress)." This framework is echoed across the literature (e.g., De Pauw & Mervielde 2011; Muris & Ollendick, 2005; Nigg, 2006; Rothbart, Posner, & Hershey, 2006) and provides additional support for the inclusion of temperament when considering psychopathology (ADHD specifically in the present study) and its impact on functioning. The current study's focus on both symptoms and impairment, rather than diagnosis alone, is also in line with recent critique of ADHD subtyping. This focus continues to call attention to the importance of understanding the problems associated with ADHD, particularly given that functional impairment is so variable across individuals (Sjöwall & Thorell, 2014). Further, given the variability in impairment across the lifespan, the present study's more narrow age range (i.e., middle childhood) allows for the study of impairment as a more cohesive construct compared to studies that include children across a wider range of ages and developmental levels.

Temperament and ADHD

Given temperament and ADHD's shared relation with impairment in multiple domains in both childhood and adulthood, it is not surprising that a field of research linking ADHD with temperament has emerged (e.g., Bates et al., 2014; Lemery, Essex, &

Smider, 2002). Although there is some overlap with regard to constructs that are studied within both ADHD and temperament (e.g., impulsivity, attention), literature suggests that ADHD may represent an extreme on the continuum of temperamental traits and that some traits may represent precursors on one developmental pathway to ADHD. Further, some of the deficits associated with ADHD are specific to the disorder and are not associated with temperamental traits (Nigg, 2004). While various models of temperament and temperamental traits have been considered in this body of inquiry, some traits appear to be more related to ADHD than others across various models and studies. For example, using Eisenberg's model of temperament (Eisenberg et al., 2005), Martel and Nigg's 2006 study focused on the temperamental traits of reactive control, which they linked to hyperactive-impulsive symptoms of ADHD, and effortful control, which they linked to inattentive symptoms of ADHD. Their findings demonstrated an association between higher levels of hyperactivity-impulsivity and lower reactive control as assessed by parents and teachers, as well an association between higher levels of inattention and lower scores on effort control as rated by parents. Goldsmith and colleagues' (2004) research also supports the relation between inattention and effortful control. In a study of 451 children that utilized multiple informants and addressed the issue of overlap between temperament and attentional issues, Eisenberg and colleagues (2005) found associations between hyperactivity and inattention and each of the scales on Rothbart's Childhood Behavior Questionnaire (Rothbart, Ahadi, & Hershey, 1994), which comprise the factors of effortful control, as well as surgency and negative affectivity. Martel and colleagues' (2014) work also demonstrates links between ADHD and low levels of effortful control and high levels of surgency and negative affectivity.

Several researchers, including White (1999) and Martel (2009) have summarized the research on temperament and ADHD. In a review of the existing literature at the time, White (1999) highlighted evidence for the relation between ADHD and temperamental factors such as activity level, inhibition, and emotionality. Martel's summary, which came a decade later in 2009, showed relations between ADHD and a larger range of temperamental traits, including high negative emotionality, neuroticism, positive emotionality, and extraversion, as well as low agreeableness, effortful control, and conscientiousness. Overall, while research on ADHD and temperament continues to examine a range of temperamental traits, a focus on activity level, various types of control, and emotionality is present across much of the literature. These traits are encompassed within the three temperament dimensions of surgency/extraversion, effortful control, and negative affectivity that were examined in the current study, further adding to its strength and potential for contribution to the literature. Given the developmental trajectories of both temperament and ADHD, as well as the nature of their relation to each other and individual relations with impairment, temperament was investigated as a potential moderator of the relation between ADHD and impairment.

ADHD, Temperament, and Impairment

Individuals with ADHD are a heterogeneous group, with wide variation in symptom presentation, severity, and associated impairment (Wilens, Biederman, & Spencer, 2002), and the impairments seen in childhood both persist into adulthood and are associated with additional functional issues as youth age. Research on impairment in ADHD has implicated numerous factors outside of symptoms alone as important predictors of outcomes (Wilens, Biederman, & Spencer, 2002), further highlighting the

need to look beyond symptoms for a fuller understanding of ADHD-associated problems. Given that variation in temperamental traits, "… [is] hypothesized to affect the development of maladaptive behaviors and hence could partially explain the varying levels of *problem behaviors* in individuals with ADHD" (De Pauw & Mervielde, 2011, p. 277), temperament has emerged as one such facet that warrants additional consideration and research. In consideration of the research on the emergence of temperament very early in development, as well as the overlap between some aspects of temperament dimensions and ADHD (e.g., impulsivity within the dimension of surgency), it stands that temperament may serve as a moderator of the relation between ADHD and impairment. How ADHD impacts functioning may differ depending on children's temperament, specifically whether they show high or low levels of specific temperamental traits and associated behaviors. Certain aspects of temperament coupled with the high levels of symptoms may lead to even greater levels of impairment, as the traits may be manifested in more extreme ways behaviorally or may be interpreted by others, including parents and teachers, as more problematic. Therefore, the present study investigates temperament as a moderator of the ADHD/impairment relation.

Despite evidence linking ADHD and temperament, as well as evidence for their individual connections to impairment, it appears that only one study – De Pauw and Mervielde, 2011 - has explicitly investigated the mutual roles of these three variables together. The authors examined the roles of both temperament and personality in impairment (termed "problem behaviors") in children with ADHD compared to their non-ADHD peers in a sample of 519 6- to 14-year-olds. The study assessed temperamental traits using two temperament measures derived from two different

theoretical models - Buss and Plomin's (1984) Emotionality, Activity, and Sociability (EAS) model, and Rothbart's model, which includes negative affectivity, surgency, and effortful control (Putnam, Ellis, & Rothbart, 2001). Their results showed that, compared to controls, children with ADHD were rated higher on measures of emotionality and negative affect and lower on measures of effortful control; the groups did not differ with regard to surgency. Children with ADHD also exhibited higher levels of both internalizing and externalizing behaviors compared to controls. Negative affect was associated with both types of problems, whereas surgency was linked to internalizing problems and effortful control was associated with externalizing problems. Findings revealed that temperament impacted children and wand without ADHD in similar manners with regard to impairment (De Pauw & Mervielde, 2011).

The Current Study

Although De Pauw and Mervielde's 2011 study began to examine the relations among ADHD, temperament, and impairment, additional research is needed in this area. The current study builds on their work in a number of ways. First, the present study oversampled for individuals with higher levels of ADHD symptoms, whereas De Pauw and Mervielde's study was heavily comprised of community participants without ADHD (54 ADHD participants compared to 465 typically developing participants). Second, the present study utilizes data from multiple informants in order to capture a more comprehensive understanding of symptoms and impairment across domains. The present study also examined ADHD and temperament within participants 8 to 10 years old, the vast majority of which were elementary school students, whereas De Pauw and Mervielde's participants ranged in age from 6 to 14 years old. This age range spans

elementary through high school, and participants' levels of development, as well as the types of impairment they may experience, are likely to be quite heterogeneous. A strength of the present study's more focused age range is that it allows us to examine symptoms and impairment at a specific point in development – middle childhood. Given these strengths, the present study adds to the literature by analyzing whether symptoms of ADHD and temperament dimensions predict impairment, including examining their unique predictive contributions. Further, we investigate temperament as a moderator of the relation between ADHD and impairment. We collected both teacher and parent report of ADHD symptoms and impairment, which allows for both within and cross-informant and setting examinations of the research questions. The present study addresses two main research questions:

Research Question 1: Do symptoms of ADHD and temperament dimensions predict overall impairment?

1a: Do combined parent and teacher report of ADHD symptoms and parent report of temperament dimensions predict overall parent/caregiver (hereafter referred to as parent) reported impairment?

We predict that, controlling for key covariates, higher ratings of ADHD symptoms, surgency (SU), and negative affectivity (NA) and lower ratings of effortful control (EC) will be associated with higher levels of impairment.

1b. Do combined parent and teacher report of ADHD symptoms and parent report of temperament dimensions predict overall teacher reported impairment?

We predict that, controlling for key covariates, higher ratings of ADHD symptoms, surgency (SU), and negative affectivity (NA) and lower ratings of effortful control (EC) will be associated with higher levels of impairment.

Research Question 2: Do temperament dimensions moderate the relation between ADHD and impairment?

2a: Do temperament dimensions moderate the relation between ADHD and parent reported impairment?

We predict that, controlling for key covariates, temperament will moderate the relation between ADHD and impairment such that this relation will be stronger at higher levels of Surgency and NA and lower levels of EC.

2b: Do temperament dimensions moderate the relation between ADHD and teacher reported impairment?

We predict that, controlling for key covariates, temperament will moderate the relation between ADHD and impairment such that this relation will be stronger at higher levels of Surgency and NA and lower levels of EC.

Several covariates, including age, sex, stimulant medication use, household income, and symptoms of oppositional defiant disorder (ODD) were considered in our analyses. Age may be relevant from a developmental standpoint, as children at different developmental points may show varying levels of ADHD symptoms (Biederman, Mick, & Faraone, 2000; Hill & Schoener, 1996). ADHD is more common in male versus female children (Faraone, Sergeant, Gillberg, & Biederman, 2003) and therefore sex was also considered as a potential covariate. Although children who use stimulant medications completed study procedures on

a medication hiatus, medication status was considered, given that a change in behavior and symptom severity when medicated may influence how raters (primarily teachers, but also parents) may view children, potentially impacting their report on various measures (Swanson, McBurnett, Christian, & Wigal, 1995). Parent reported household income is used as a proxy for socioeconomic status (SES), given the data on its association with ADHD (e.g., Lasky-Su et al., 2007; Russell, Ford, Williams, & Russell, 2016). Finally, symptoms of ODD were included as a potential covariate, as they often present comorbidly with symptoms of ADHD, and are associated with similar types of impairment (e.g., Deault, 2010; Kolko & Pardini, 2010).

CHAPTER 2

METHOD

Participants

Participants were 233 boys and 139 girls (N = 372) who were between 8 and 10 years old (M = 8.88 years, SD = .811) at the time of data collection. With regard to race and ethnicity, 42.7% of participants' parents identified them as Caucasian, 43.3% as Black or African-American, and 12.4% as biracial or multiracial; 6.2% of parents also identified their children as Hispanic/Latino. According to parent reported data, mean annual household income for the sample fell in the $25,000-$49,000 range. Slightly more than half of parents (56.9%) reported that their annual household income was below $50,000/year. Most parents (74.2%) who completed measures for the study reported that they were the participant's biological parent. The remaining parents who responded to this item identified as adoptive parents (1.9%) or legal guardians (4.8%). Sixty-seven percent (67%) of caregivers who completed study measures identified as the participant's biological mother.

Recruitment was targeted such that approximately half of the study participants met criteria for ADHD, and recruitment also oversampled for male participants, given the higher rates of ADHD in males (Faraone et al., 2003). ADHD status was determined by a group of clinicians who reviewed data from several measures of ADHD symptoms and associated impairment, including the Disruptive Behavior Disorders Rating Scale (DBD;

Pelham, Gnagy, Greenslade, & Milich, 1992), Children's Interview for Psychiatric Syndromes--Parent Version (PChIPS; Weller, Weller, Fristad, & Rooney, 1999), and Impairment Rating Scale (IRS, Fabiano et al., 2006), as well as information about previous diagnostic history as reported by parent.

Study eligibility requirements included English language fluency and a score of 80 or above on the Wechsler Abbreviated Scale of Intelligence - Second Edition (WASI-II; Wechsler, 2011), which was administered during the study. Children were not eligible to participate if they were homeschooled. Additional eligibility requirements included the absence of significant medical conditions that could impact relevant areas of functioning (e.g., head injuries, severe visual or hearing impairments). Children with diagnoses of bipolar disorder, schizophrenia, and pervasive developmental disorders, as well as those taking any psychotropic medications aside from stimulant medications to treat ADHD were not eligible. Information regarding medical conditions, current medication use, and comorbid psychiatric disorders was ascertained via parent report on various measures collected during the study. Children with learning disorders, (CD), and oppositional defiant disorder (ODD), and those taking stimulant medications were not excluded from participation.

Based on parent reported data, 11.8% of the sample had been previously diagnosed with a learning disorder, 7.2% met criteria for CD, and 17.7% met criteria for ODD. Parents reported that 15.9% of participants were prescribed a stimulant medication; however, those who were prescribed stimulants did not take these medications on the days they were participating in study procedures. Overall, 372 children completed assessments. Of these 372, 29 were ineligible as a result of IQ and 11

were ineligible due to medication status; an additional 10 participants were ineligible for other reasons. Of the 372 eligible participants, data from 322 were used in the final analyses.

Procedure

All procedures were reviewed and approved by the University's Institutional Review Board (IRB) prior to the start of data collection. Participants were recruited from two sites - a small Midwestern town and a medium-sized Southeastern city. Recruitment took place via letters and flyers in public and private schools, pediatric doctors' offices, parent support groups, and via media advertisements. Interested parents called the respective research office and were screened for preliminary study eligibility for their child before a laboratory appointment was scheduled.

Parents provided informed consent, and assent was obtained from participants before data collection began. Self-report data were collected, along with data from one parent/caregiver and one teacher. Parent/child dyads completed measures and individual tasks in a laboratory setting over the course of one two-hour session or two one-hour sessions. For dyads that chose to complete two sessions, attempts were made to schedule the appointments no more than two weeks apart. Parents and children completed tasks and measures in separate rooms to encourage honest responding and to protect their privacy. Measures and tasks were administered by psychology graduate students, undergraduate research assistants, and other research staff. After receiving consent to contact participants' teachers from parents, teachers were asked to complete measures, either via mail or online using REDCap (Research Electronic Data Capture), a secure web-based data collection and management application hosted at Ohio University (Harris

et al., 2009). Parent/child dyads and teachers were each compensated monetarily for their time.

Measures

Demographics. Demographic data were collected from each parent using a measure designed for the study. The measure includes questions about variables such as age, sex, race/ethnicity, grade, and family make up. In the current study, age, sex, and household income were considered as potential covariates. Descriptive data for these items, including means and standard deviations, are presented in Table 2.1.

Stimulant Medication Usage. Information regarding current use of stimulant medications was collected using the Services for Children and Adolescents-Parent Interview (SCAPI; Jensen et al., 2004). Stimulant medication use was considered as a potential covariate in the present study, and descriptive data for this item are presented in Table 2.1.

ADHD Symptoms. The Disruptive Behavior Disorders Rating Scale (DBD; Pelham et al., 1992) was used to measure symptoms of ADHD. The DBD includes 45 questions that assess symptoms of ADHD, oppositional defiant disorder (ODD), and conduct disorder (CD) based on based on DSM-IV (American Psychiatric Association, 2000) criteria. This measure was completed by parents and by teachers. Items were rated on a 4-point Likert scale ranging from 0 = "Not at All" to 3 = "Very Much". The items measuring ADHD symptoms demonstrate excellent internal consistency ($\alpha = .96$, Pelham et al., 1992; $\alpha_{ADHDparent} = .953$, $\alpha_{ADHDteacher} = .954$, current study) and the measure significantly correlated with other measures of ADHD symptoms ($r = .44$ - $.55$, $p < .05$; Massetti et al., 2003).

The 18 items that measure symptoms of ADHD were dichotomized such that ratings of 2 ("Pretty much") or 3 ("Very much") were coded as "1", indicating the presence of a symptom, and ratings of a 0 ("Not at all") or 1 ("Just a little") were coded as "0", indicating the absence of a symptom, as suggested by the measure's developers (Pelham et al., 1992). Items that were coded as a "1" by either parent or teacher (i.e., the "or" method) were included in the final, continuous count of total symptoms of ADHD. The "or" method has been utilized by other researchers and demonstrates greater utility in correctly identifying ADHD than does a single informant approach (De Los Reyes et al., 2015; Power et al., 1998; Tripp, Schaughency, & Clarke, 2006). Parent report alone was utilized when teacher report was not available (27 of 322 participants). Means and standard deviations for this scale are presented in Table 2.1.

Symptoms of ADHD were examined continuously for a number of reasons. First, research indicates that subthreshold ADHD symptoms may still cause significant impairment (Overbey, Snell, & Callis, 2011). Second, the use of a continuous symptom count allowed us to better capture symptom information about all participants, not just those who meet diagnostic criteria for ADHD. Given that ADHD was assessed continuously rather than categorically, diagnostic subtypes were not assigned to participants and therefore, symptoms were not separated into the domains of inattention and hyperactivity/impulsivity, as research has suggested that the subtypes of inattentive, hyperactive/impulsive, and combined may not appropriately and/or fully represent the structure of ADHD (e.g., McBurnett, Pfiffner, & Frick, 2001; Willcutt et al., 2012). Furthermore, in the present study, inattentive items were strongly correlated with hyperactive/impulsive items for both parents ($r(368) = .743$, $p < .01$) and teachers ($r(306)$

= .661, $p < .01$), further providing support for examining total ADHD symptom count, rather than the examining the symptom dimensions separately.

Oppositional Defiant Disorder. The Disruptive Behavior Disorders Rating Scale (DBD; Pelham et al., 1992) was also used to measure symptoms of ODD. The eight items measuring ODD symptoms were completed by both parents and by teachers. Items were rated on a 4-point Likert scale ranging from 0 = "Not at All" to 3 = "Very Much". The ODD items on the DBD demonstrate excellent internal consistency (α_{ODD} = .95, Pelham et al., 1992; $\alpha_{ODDparent}$ = .872, $\alpha_{ADHDteacher}$ = .933, current study). This variable was created by using the same "or" method described above regarding the items measuring ADHD symptoms, and parent report alone was utilized when teacher report was not available (27 of 322 participants). Means and standard deviations for this scale are presented in Table 2.1.

Temperament. The Temperament in Middle Childhood Questionnaire (TMCQ; Simonds & Rothbart, 2004) was used to measure temperament. Parents completed this measure. The TMCQ contains 157 items that comprise 17 scales; one scale, activation control, is experimental and is often excluded from analyses in the literature (e.g., Karalunas et al., 2014). Prior factor analytic results show that 13 of the scales cluster into three temperament dimensions - negative affectivity (NA), surgency (SU), and effortful control (EC; Nystrom & Bengtsson, 2017; Simonds & Rothbart, 2004); the current study focuses on these three dimensions. See Table 2.2 for a list of scales and their associated dimensions. Parents were asked to consider their child's reactions within the past 6 months. Items were rated on a 5-point Likert scale ranging from 1 = "Almost always untrue" to 5 = "Almost always true." In addition, there was a "Does not apply" option for

each item. Items contained within each scale were summed to create a score for each of the 17 scales; relevant scales were then summed to create a score for each of the three dimensions. The TMCQ demonstrates adequate internal consistency ($\alpha = 0.71$ to 0.94 for the 16 non-experimental scales in Karalunas et al., 2014; $\alpha > 0.70$ for 16 of 17 scales in Nystrom & Bengtsson, 2017; $\alpha = 0.69$ to 0.90 for 16 of 17 scales in Simonds & Rothbart, 2006). In the present study, internal consistency for 12 of the 13 scales utilized in our analyses was acceptable or better ($\alpha = .772$ to $\alpha = .952$); internal consistency for the low intensity pleasure scale was $\alpha = .654$. Means and standard deviations for the three temperament domains are presented in Table 2.1.

Impairment. The Impairment Rating Scale (IRS, Fabiano et al., 2006) was used to measure impairment across several areas of functioning. Parents and teachers completed this measure. The IRS contains items that assess the extent to which a child's problems impact his/her functioning in various domains. The parent version of the measure contains eight items that ask about the child's relationship with playmates, whether or not s/he has a best friend, his/her relationship with siblings (if applicable), his/her relationship with parents, academic performance, self-esteem, the child's impact on the family, and the overall impact of the child's problems. The teacher version of the measure contains seven items asking about the child's relationship with other children, whether or not s/he has a best friend, his/her relationship with teachers, academic performance, self-esteem, the child's impact on his/her classroom, and the overall impact of the child's problems. For both versions, the item that asks about having a best friend is rated with a yes or no. The remaining items are rated on a scale ranging from "No problem/definitely does not need treatment or special services" to "Extreme

problem/definitely needs treatment or special services". Raters are asked to "… mark an X on the lines at the points that you believe reflect the impact of the child's problems on this area and whether he or she needs treatment or special services for the problems." Responses are converted to a numerical scale by measuring where marks fall on the lines; the parent version of the measure is scored from 0-6 and the teacher version is scored from 0-14. The IRS demonstrates excellent internal consistency (α = .91, Lee et al., 2017; α_{parent} = .912, $\alpha_{teacher}$ = .936, current study), as well as adequate temporal stability, interrater reliability, and concurrent, convergent, and discriminant validity (Fabiano et al., 2006). Scores on the scale-scored items were averaged, as suggested by the measure's developers (Fabiano et al., 2006). The item assessing whether or not participants have a best friend was not utilized in the current study. Means and standard deviations for this scale are presented in Table 2.1.

Table 2.1. *Sample Demographics and Descriptive Statistics*

Variable	M (*sd*)	Percentage
ADHD symptoms	8.61 (6.17)	
Surgency	128.08 (18.86)	
Effortful Control (EC)	105.61 (17.85)	
Negative Affectivity (NA)	121.80 (17.62)	
ODD symptoms	2.07 (2.41)	
Age	9.31 (.85)	
Sex		
Male		64%
Female		36%
Household income		
up to $10,000		14.8%
$10,001 - 14,999		8.1%
$15,000 - 24,999		15.6%
$25,000 - 49,999		18.3%
$50,000 - 74,999		14.6%
$75,000 - 99,999		10.8%
$100,000 - 149,000		12.4%
$150,000 - 199,999		4.3%
$200,000 or more		1.1.%
Stimulant medication use		
Yes		15.9%
No		81.7%
Impairment - Parent	1.65(1.59)	
Impairment - Teacher	4.43(3.18)	

Table 2.2. *TMCQ Scales and Temperament Dimensions*

Temperament Dimensions			Other Scales
Surgency	Effortful Control	Negative Affect	
Activity Level	Attention	Anger/Frustration	Activation Control*
High Intensity Pleasure	Inhibitory Control	Discomfort	Affiliation
Impulsivity	Low Intensity Pleasure	Fear	Assertiveness/Dominance
Shyness (reversed)	Perceptual Sensitivity	Sadness	Fantasy/Openness
		Soothability (reversed)	Smiling/Laughter

* Experimental scale conceptually associated with Effortful Control; excluded from analyses for the current study

CHAPTER 3

RESULTS

Power analyses

Power analyses were conducted using G*Power 3 (Faul, Erdfelder, Buchner, & Lang, 2009) to determine our power to detect effects given our design, sample size, and number of predictors. With a multiple regression model including seven predictors (ADHD, temperament dimension, and five covariates (the maximum number being considered for any single analysis in the present study), a sample size of 300 participants (a conservative estimation of the number of participants whose data would be retained after listwise deletion) would yield a power of .80 to detect an effect size of $f^2 = .05$. Given these results, our sample yields adequate power to detect even small effects.

Missing Data

Substantial efforts were taken to ensure that a minimum amount of data was missing. Parents and teachers were encouraged (though not required) to answer all questions, and they were contacted to inquire about the status of unanswered questions. Analyses revealed that less than 2% of the total data for the predictor and outcome variables were missing. Given the small amount of missing data, listwise deletion was used for participants whose data from the predictor and outcome variable measures is missing for a given analysis (Cheema, 2014; Graham, 2009). Primary analyses were completed using SPSS Statistics version 25.0 (IBM Corp, 2017).

Covariates

Age, sex, SES, stimulant medication use, and symptoms of ODD were considered as potential covariates. To test their influence on the model, correlations between potential covariates and outcomes were conducted; see Table 3.1 for results. Factors that were significantly correlated ($p < .05$) with the outcome variable of interest were included in the final model.

Preliminary Analyses

Regression assumptions (i.e., linear relationship, multivariate normality, lack of multicollinearity, lack of autocorrelation, and homoscedasticity) were assessed. A visual examination of scatterplots of the data was not suggestive of curvilinear relationships, thus satisfying the assumption of linear relationship among variables. Regarding multivariate normality, results from Shapiro-Wilk tests were non-significant for most values of the variables of interest, and significant results may be an artifact of our relatively large sample size; an examination of Q-Q plots also suggested that the data were normally distributed (Royston, 1982). Given that none of the variables were correlated above .624, tolerance calculations did not indicate the presence of multicollinearity (Mansfield & Helms, 1982). Regarding autocorrelation, most Durbin-Watson values were around two, suggesting an independence of residuals (Durbin & Watson, 1950) Finally, an examination of the residuals showed a relatively even distribution across the regression line, suggesting that homoscedasticity is not a concern for the present study (Goldfeld, & Quandt, 1965).

Descriptive analyses were conducted to gain an understanding of the distribution of study variables. Results of these analyses are presented in Table 2.1.

Bivariate correlations among variables of interest, including ADHD symptoms, temperament dimensions, and impairment, as well as potential covariates (i.e., age, sex, household income, stimulant medication use, ODD symptoms) were assessed, and variables were correlated in the expected directions. Full results of these analyses are presented in Table 3.1. ADHD symptoms showed strong, positive correlations with both parent and teacher (*r*s = .62, $p < .001$) report of impairment. They were moderately, negatively correlated with effortful control ($r = -.59$, $p < .001$) and showed a moderate positive correlation with surgency ($r = .53$ $p < .001$) and a weak positive correlation with negative affectivity ($r = .20$, $p < .001$). Regarding correlations with potential covariates, ADHD symptoms showed significant, negative correlations with household income, stimulant medication use, and sex ($r = -.17$ to $-.41$, $p < .001$ to $p = .002$). ADHD symptoms also demonstrated a significant, positive correlation with ODD symptoms ($r = .587$, $p < .001$), but were not significantly correlated with age ($r = .04$, $p = .513$).

Analyses also revealed some significant correlations among temperament dimensions, and between the temperament and impairment. Surgency showed a weak, negative correlation with EC ($r = -.35$, $p < .001$) and a weak positive correlation with NA ($r = .32$, $p < .001$). EC and NA were uncorrelated ($r = .02$, $p < .744$). Surgency showed weak to moderate positive correlations with parent and teacher impairment (*r*s = .43 & .27, $p < .001$) and NA was very weakly to weakly correlated with both parent ($r = .26$, $p < .001$) and teacher ($r = .14$, $p = .019$) impairment. EC was weakly to moderately negatively correlated with both parent and teacher reported impairment (*r*=-.47 and -.29, $p < .001$).

An examination of correlations between temperament and potential covariates

revealed that age was not significantly correlated with any of the temperament dimensions. Results showed very weak to weak, negative correlations between surgency and sex, household income, and stimulant medication use (*r*s = -.19 to -.24, $p \leq .001$). Surgency was positively correlated ($r = .45$, $p < .001$) with ODD symptoms. EC showed correlations in the opposite directions, as analyses demonstrated a very weak, positive correlation with income ($r = .14$, $p = .016$) and weak positive correlations with sex and stimulant medication use (*r*s = .25 to .33, $p < .001$); EC was also weakly, negatively correlation with ODD symptoms ($r = -.29$, $p < .001$). Finally, analyses revealed weak positive correlations between NA and sex and ODD symptoms (*r*s = .24 to .25, $p < .001$), as well as a very weak, negative correlation with household income ($r = -.15$, $p = .007$). NA was not significantly correlated with stimulant medication use ($r = -.09$, $p = .114$).

The outcome variables of parent and teacher reported impairment showed similar patterns of correlation across several potential covariates. Both were moderately correlated with symptoms of ODD (*r*s = .54 to .57, $p < .001$), and were very weakly to weakly negatively correlated with household income and stimulant use (*r*s = -.14 to -.32, $p < .001$ to $p = .016$). Age was very weakly, positively correlated with parent reported impairment ($r = .12$, $p = .033$) and uncorrelated with teacher reported impairment ($r = -.02$, $p = .784$). Sex was very weakly, negatively correlated with teacher reported impairment ($r = -.12$, $p = .043$) and uncorrelated with parent reported impairment ($r = -.55$, $p = .343$). Given that age was uncorrelated with teacher reported impairment and sex was uncorrelated with parent reported impairment, they were not included as covariates in analyses with these variables, respectively.

Main Analyses

All main analyses were tested at a significance level of $p < .05$ using SPSS Statistics version 25.0 (IBM Corp, 2017). Given the robustness of the literature supporting the relations among the variables of interest and the relatively small number of separate analyses (six) being conducted corrections for the number of analyses being tested were not utilized (Gelman, Hill & Yajima, 2012). All analyses were conducted separately for the two outcome variables of parent reported and teacher reported impairment, as well as for each of the temperament dimensions, resulting in six analyses total, in addition to any further analyses for models with significant moderation results.

Research Question 1: Do symptoms of ADHD and temperament dimensions predict overall impairment?

Hierarchical linear regression analyses were used to assess relations between ADHD, temperament dimensions, and parent and teacher reported impairment. Covariates [age (parent analyses only), sex (teacher analyses only), stimulant medication use, household income, and ODD symptoms] were entered into the model in the first step, followed by ADHD symptoms and the temperament dimension of interest in the second step. Impairment was entered as the outcome variable. This process was repeated for each temperament dimension (surgency, EC, and NA) for both parent and teacher reported impairment.

For surgency, results of the overall model were significant for both parent and teacher reported impairment. Full results are presented in Table 3.2. The model explained 44.8% of the total variance in parent reported impairment ($R^2 = .45$, $F(6, 314) = 42.45$, $p < .001$). ADHD symptoms ($\beta = .41$, $SE = .02$, $p < .001$) were significantly predictive of parent reported impairment, whereas surgency was not ($\beta = .09$, $SE = .01$, $p = .075$).

Regarding covariates, only symptoms of ODD were significant (β = .23, *SE* = .04, p < .001); age (β = .07, *SE* = .08, p = .110), income (β = .00, *SE* = .03, p = .967), and stimulant medication use (β = -.07, *SE* = .19, p = .122) were unrelated to parent reported impairment. For teacher reported impairment, the model explained 47.6% of the total variance (R^2 = .48, F(6, 294) = 45.58, p < .001). In contrast to the parent model, both ADHD symptoms (β = .55, *SE* = .03, p < .001) and surgency (β = -.17, *SE* = .01, p = .001) were significantly predictive of teacher reported impairment. Symptoms of ODD (β = .34, *SE* = .07, p < .001) and stimulant medication use (β = .13, *SE* = .38, p = .006) were significant, while sex (β = -.03, *SE* = .29, p = .489) and income (β = -.08, *SE* = .07, p = .081) were not.

For effortful control (EC), results of the overall model were significant for both parent and teacher reported impairment. Full results are presented in Table 3.3. The model explained 46% of the total variance in parent reported impairment (R^2 = .46, F(6, 314) = 44.63, p < .001). Both ADHD symptoms (β = .35, *SE* = .02, p < .001) and EC (β = -.17, *SE* = .01, p = .001) were significantly predictive of parent reported impairment. Regarding covariates, symptoms of ODD were significant (β = .26, *SE* = .04, p < .001), while age (β = .07, *SE* = .08, p = .097), income (β = .00, *SE* = .03, p = .959), and stimulant medication use (β = -.06, *SE* = .19, p = .226) were unrelated. For teacher reported impairment, the model explained 47.2% of the total variance (R^2 = .47, F(6, 294) = 42.86, p < .001). ADHD symptoms (β = .53, *SE* = .03, p < .001) were significantly predictive of teacher reported impairment, while EC (β = .09, *SE* = .01, p = .104) was not. Regarding covariates, symptoms of ODD (β = .30, *SE* = .07, p < .001) and stimulant

medication use (β = .13, *SE* = .38, *p* = .007) were significant, while sex (β = -.03, *SE* = .29, *p* = .573) and income (β = -.07, *SE* = .07, *p* = .131) were not.

Finally, for negative affectivity (NA) results of the overall model were also significant for both parent and teacher reported impairment. Full results are presented in Table 3.4. The model explained 45.5% of the total variance in parent reported impairment (R^2 = .45, $F(6, 314) = 43.55$, $p < .001$). Both ADHD symptoms (β = .44, *SE* = .01, $p < .001$) and NA (β = .11, *SE* = .01, *p* = .009) were significantly predictive of impairment. Symptoms of ODD (β = .22, *SE* = .04, $p < .001$) were the only significant covariate, as income (β = .01, *SE* = .03, *p* = .987), age (β = .07, *SE* = .08, *p* = .108), and stimulant medication use (β = -.07, *SE* = .19, *p* = .113) were unrelated. For teacher reported impairment, the model explained 46.8% of the total variance (R^2 = .47, $F(6, 288) = 42.15$, $p < .001$). ADHD symptoms (β = .48, *SE* = .03, $p < .001$) were significantly predictive of teacher reported impairment, while NA was not (β = -.03, *SE* = .01, *p* = .52). Regarding covariates, symptoms of ODD (β = .32, *SE* = .07, $p < .001$) and stimulant medication use (β = .14, *SE* = .38, *p* = .005) were significant, while sex (β = -.01, *SE* = .31, *p* = .894) and income (β = -.06, *SE* = .07, *p* = .149) were not.

Research Question 2: Do temperament dimensions moderate the relation between ADHD and impairment?

Hierarchical linear regression analyses were used to assess temperament as a moderator of the relation between ADHD and parent and teacher reported impairment. Covariates [age (parent analyses only), sex (teacher analyses only), stimulant medication use, household income, and ODD symptoms] were entered into the model in the first step, followed by ADHD symptoms and the temperament dimension of interest in the

second step, and the interaction of ADHD and the temperament dimension of interest in the third step. Impairment was entered as the outcome variable. This process was repeated for each temperament dimension (surgency, EC, and NA) for both parent and teacher reported impairment.

For surgency, results of the overall model were significant for both parent and teacher reported impairment. Full results are presented in Table 3.2. The model explained 43.7% of the total variance in parent reported impairment (R^2 = .44, F(7, 313) = 36.58, p < .001). ADHD symptoms (β = .42, SE = .02, p < .001) were significantly predictive of parent reported impairment, whereas surgency was not (β = .09, SE = .01, p = .084). Surgency was not a significant moderator of the ADHD/impairment relation (β = .05, SE = .01, p = .269). Regarding covariates, only symptoms of ODD were significant (β = .22, SE = .04, p < .001); age (β = .07, SE = .08, p = .101), income (β = .00, SE = .03, p = .984), and stimulant medication use (β = -.07, SE = .19, p = .137) were unrelated to parent reported impairment. For teacher reported impairment, the model explained 49.9% of the total variance (R^2 = .50, F(7, 294) = 40.81, p < .001). In contrast to the parent model, both ADHD symptoms (β = .55, SE = .03, p < .001) and surgency (β = -.18, SE = .01, p = .001) were significantly predictive of teacher reported impairment, and surgency significantly moderated the relation between ADHD and impairment (β = -.11, SE = .01, p = .010). Regarding covariates, symptoms of ODD (β = .34, SE = .07, p < .001), stimulant medication use (β = .12, SE = .37, p = .010) was significant, while sex (β = -.03, SE = .28, p = .560) and income (β = -.07, SE = .07, p = .088) were not.

Simple slopes analyses were conducted to probe the interaction of ADHD and surgency in predicting teacher reported impairment at high (one standard deviation above

the mean) and low (one standard deviation below the mean) levels of surgency. The relation between ADHD and teacher reported impairment was significant at both low (β = .64, *SE* = .04, $p < .001$) and high (β = .41, *SE* = .04, $p < .001$) levels of surgency, and this relation was stronger at lower levels of surgency. Full results of this model are presented in Table 3.8 and the interaction is depicted in Figure 3.1.

For effortful control (EC), results of the overall model were significant for both parent and teacher reported impairment. Full results are presented in Table 3.6. The model explained 46.1% of the total variance in parent reported impairment (R^2 = .48, $F(7, 313) = 38.27$, $p < .001$). Both ADHD symptoms (β = .35, *SE* = .02, $p < .001$) and EC (β = -.17, *SE* = .01, $p = .001$) were significantly predictive of parent reported impairment. However, EC did not moderate the relation between ADHD symptoms and impairment (β = -.17, *SE* = .01, $p = .001$). Among the included covariates, only symptoms of ODD were significant (β = .26, *SE* = .04, $p < .001$); age (β = .07, *SE* = .08, $p = .109$), income (β = .00, *SE* = .03, $p = .968$), and stimulant medication use (β = -.06, *SE* = .19, $p = .201$) were unrelated. For teacher reported impairment, the model explained 48.6% of the total variance (R^2 = .49, F (7, 287) = 38.79, $p < .001$). ADHD symptoms (β = .51, *SE* = .03, $p < .001$) were significantly predictive of teacher reported impairment, while EC (β = .08, *SE* = .03, $p = .141$) was not. There was a significant moderating effect of EC on the relation between ADHD and impairment (β = .12, *SE* = .01, $p = .055$). Regarding covariates, only symptoms of ODD (β = .31, *SE* = .07, $p < .001$) were significant, while sex (β = -.04, *SE* = .30, $p = .370$), income (β = -.06, *SE* = .07, $p = .158$), and stimulant medication use (β = .12, *SE* = .38, $p = .012$) were not.

Simple slopes analyses were conducted to probe the interaction of ADHD and EC in predicting teacher reported impairment at high (one standard deviation above the mean) and low (one standard deviation below the mean) levels of EC. The relation between ADHD and impairment was significant at both low (β = .38, *SE* = .04, $p < .001$) and high (β = .64, *SE* = .04, $p < .001$) levels of EC. This relation was stronger at higher levels of EC. Full results of this model are presented in Table 3.9, and the interaction is depicted in Figure 3.2.

Finally, for negative affectivity (NA), results of the overall model were significant for both parent and teacher reported impairment. Full results are presented in Table 3.7. The model explained 45.6% of the total variance in parent reported impairment (R^2 = .46, $F(7, 313) = 37.55$, $p < .001$). Both ADHD symptoms (β = .43, *SE* = .01, $p < .001$) and NA (β = .12, *SE* = .01, p = .006) were significantly predictive of parent reported impairment. However, NA did not moderate the relation between ADHD symptoms and impairment (β = -.05, *SE* = .01, p = .258). Among the included covariates, only symptoms of ODD were significant (β = .23, *SE* = .04, $p < .001$); age (β = .07, *SE* = .08, p = .105), income (β = .00, *SE* = .03, p = .994), and stimulant medication use (β = -.08, *SE* = .19, p = .102) were unrelated. For teacher reported impairment, the model explained 46.8% of the total variance (R^2 = .47, $F(7, 287) = 36.01$, $p < .001$). ADHD symptoms (β = .48, *SE* = .03, $p < .001$) were significantly predictive of teacher reported impairment, while NA (β = -.03, *SE* = .01, p = .534) was not. NA did not moderate the relation between ADHD symptoms and impairment (β = .00, *SE* = .01, p = .975). Analyses revealed significant effects for symptoms of ODD (β = .32, *SE* = .07, $p < .001$)

and stimulant medication use (β = .14, *SE* = .39, p = .005), while sex (β = -.01, *SE* = .31, p = .893) and income (β = -.06, *SE* = .07, p = .150) were unrelated.

Post Hoc Analyses

Given the discrepancies in our hypotheses and results, particularly the direction of the relations between surgency and EC and teacher reported impairment, we conducted several post hoc analyses in order to gain a fuller understanding of the relations among these variables. We conducted hierarchical linear regression analyses in which each temperament dimension alone was entered into the model with impairment as the predictor. This approach allowed us to gain an understanding of how surgency and EC predict impairment when other relevant variables are not controlled for. Adding in ADHD at a later step allowed us to specifically determine its impact on the relations between these temperament dimensions and impairment. These analyses yielded relations in the same directions as our bivariate correlations and hypotheses. Specifically, surgency was positively associated with teacher reported impairment (β = -.05, *SE* = .01, p < .001) and EC was negatively associated with teacher reported impairment (β = -.05, *SE* = .02, p = .004). When ADHD symptoms were added into the model with surgency alone predicting teacher reported impairment, the direction of this relation was reversed, (β = -.02, *SE* = .01, p = .057), although just beyond significance. When ADHD symptoms were added into the model with EC alone predicting teacher reported impairment, the direction of this relation was also reversed, (β = .05, *SE* = .02, p = .003). Overall, our post hoc analyses demonstrated that when accounting for the effects of ADHD, the relations between surgency and EC and teacher reported impairment were not aligned with our hypotheses.

Given that our initial post hoc analyses revealed a change in relations when controlling for additional variables (i.e., the change in the direction of the surgency and EC/teacher reported impairment relations when controlling for ADHD), we also conducted analyses in which all relevant covariates and temperament dimensions were entered into models predicting parent or teacher reported impairment.

Results of the overall model were significant for both. The model explained 47.7% of the total variance in parent reported impairment (R^2 = .48, F(8, 312) = 35.61, p < .001). ADHD symptoms (β = .08, SE = .02, p < .001), EC (β = -.02, SE = .01, p < .001), and NA (β = .01, SE = .01, p = .022) were all significant, while surgency was not (β = .01, SE = .01, p = .289). Among the included covariates, only symptoms of ODD were significant (β = .16, SE = .03, p < .001); age (β = .23, SE = .15, p = .129), income (β = .02, SE = .03, p = .645), and stimulant medication use (β = -.24, SE = .19, p = .190) were unrelated. For teacher reported impairment, the model explained 49.2% of the total variance (R^2 = .49, F(8, 286) = 34.62, p < .001). ADHD symptoms (β = .31, SE = .04, p < .001) and surgency (β = -.03, SE = .01, p = .001) were significant, while EC (β = .02, SE = .01, p = .101) and NA were not (β = .00, SE = .01, p = .955). Among the included covariates, symptoms of ODD (β = .44, SE = .07, p < .001) and stimulant medication use (β = .98, SE = .38, p = .010) were significant, while gender (β = -.26, SE = .30, p = .393) and income (β = -.12, SE = .07, p = .166) were unrelated.

Table 3.1. *Bivariate Correlations*

Variable	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
1. ADHD symptoms	---										
2. Surgency	.532**	---									
3. Effortful Control	-.587**	-.346**	---								
4. Negative Affectivity	.195**	.328**	.018	---							
5. ODD symptoms	.587**	.450**	-.292**	.251**	---						
6. Age	.037	-.014	.023	-.015	.138*	---					
7. Sex	-.188**	-.192**	.255**	.235**	-.081	.043	---				
8. Household income	-.174**	-.238**	.135*	-.151**	-.223**	-.006	.009	---			
9. Stimulant medication	-.407**	-.241**	.334**	-.088	-.223**	-.076	.138*	.060	----		
10. Parent Impairment	.624**	.428**	-.465**	.261**	.535**	.119*	-.053	-.147**	-.317**	---	
11. Teacher Impairment	.615**	.272**	-.292**	.136*	.572**	-.016	-.118*	-.220**	-.140*	.370**	---

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

Table 3.2 *Regression Parameters for Analyses with ADHD and Surgency Predicting Impairment*

Parameter	*β*	*SE*	*F*	*df* (model)	R^2
Model 1: Surgency Predicting Parent reported Impairment			42.45**	6	.45
ODD symptoms	.23*	.04			
Age	.07	.08			
Household income	.00	.03			
Stimulant medication	-.07	.19			
ADHD symptoms	.41**	.02			
Surgency	.09	.00			
Model 2: Surgency Predicting Teacher reported Impairment			45.58**	6	.49
ODD symptoms	.34**	.07			
Sex	-.03	.29			
Household income	-.8	.07			
Stimulant medication	.13**	.38			
ADHD symptoms	.55**	.03			
Surgency	-.18**	.01			

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

Table 3.3. *Regression Parameters for Analyses with ADHD and EC Predicting Impairment*

Parameter	β	*SE*	*F*	*df* (model)	R^2
Model 3: EC Predicting Parent reported Impairment			44.63**	6	.46
ODD symptoms	.26**	.04			
Sex	.07	.08			
Household income	.00	.03			
Stimulant medication	-.06	.19			
ADHD symptoms	.35**	.02			
EC	-.17**	.01			
Model 4: EC Predicting Teacher reported Impairment			42.86**	6	.47
ODD symptoms	.30**	.07			
Sex	-.03	.29			
Household income	-.07	.07			
Stimulant medication	.13**	.38			
ADHD symptoms	.53**	.03			
EC	.09	.01			

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

Table 3.4. *Regression Parameters for Analyses with ADHD and NA Predicting Impairment*

Parameter	β	*SE*	*F*	*df* (model)	R^2
Model 5: NA Predicting Parent reported Impairment			43.55**	6	.45
ODD symptoms	.22*	.04			
Age	.07	.08			
Household income	.00	.03			
Stimulant medication	-.07	.19			
ADHD symptoms	.44**	.01			
NA	.11**	.00			
Model 6: NA Predicting Teacher reported Impairment			42.15**	6	.47
ODD symptoms	.32**	.07			
Sex	-.01	.30			
Household income	-.06	.07			
Stimulant medication	.14**	.38			
ADHD symptoms	.48**	.30			
NA	-.03	.01			

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

Table 3.5 *Regression Parameters for Moderation Analyses with ADHD and Surgency Predicting Impairment*

Parameter	*β*	*SE*	*F*	*df* (model)	R^2
Model 1: Surgency Predicting Parent reported Impairment			51.78**	7	.45
ODD symptoms	.22*	.04			
Age	.07	.08			
Household income	.00	.03			
Stimulant medication	-.07	.19			
ADHD symptoms	.42**	.02			
Surgency	.09	.00			
ADHD symptoms*Surgency	.05	.00			
Model 2: Surgency Predicting Teacher reported Impairment			40.81**	7	.50
ODD symptoms	.36**	.07			
Sex	-.03	.28			
Household income	-.07	.07			
Stimulant medication	.37*	.37			
ADHD symptoms	.52**	.03			
Surgency	-.16**	.01			
ADHD symptoms*Surgency	-.11*	.00			

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

Table 3.6. *Regression Parameters for Moderation Analyses with ADHD and EC Predicting Impairment*

Parameter	β	*SE*	*F*	*df* (model)	R^2
Model 3: EC Predicting Parent reported Impairment			38.27**	7	.46
ODD symptoms	.26**	.04			
Age	.07	.08			
Household income	.00	.03			
Stimulant medication	-.06	.19			
ADHD symptoms	.35**	.02			
EC	-.17**	.01			
ADHD symptoms*EC	.03	.00			
Model 4: EC Predicting Teacher reported Impairment			38.79**	7	.49
ODD symptoms	.31**	.07			
Sex	-.04	.29			
Household income	-.06	.07			
Stimulant medication	.12*	.38			
ADHD symptoms	.51**	.03			
EC	.08	.01			
ADHD symptoms*EC	.12**	.00			

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

Table 3.7. *Regression Parameters for Moderation Analyses with ADHD and NA Predicting Impairment*

Parameter	β	*SE*	*F*	*df* (model)	R^2
Model 5: NA Predicting Parent reported Impairment			37.55**	7	.46
ODD symptoms	.23**	.04			
Age	.07	.08			
Household income	.00	.03			
Stimulant medication	-.08	.19			
ADHD symptoms	.43**	.01			
NA	.12**	.00			
ADHD symptoms*NA	-.05	.00			
Model 6: NA Predicting Teacher reported Impairment			36.01**	7	.47
ODD symptoms	.32**	.07			
Sex	-.01	.31			
Household income	-.06	.07			
Stimulant medication	.14	.39			
ADHD symptoms	.48**	.03			
NA	-.03	.01			
ADHD symptoms*NA	.00	.00			

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

Table 3.8. *Simple Slopes Analyses with ADHD and Surgency Predicting Impairment*

Parameter	β	*SE*	*F*	*df* (model)	R^2
Model 7: Teacher reported Impairment at Low Surgency			40.81**	7	.50
ODD symptoms	.36**	.07			
Sex	-.03	.28			
Household income	-.07	.07			
Stimulant medication	.12*	.37			
ADHD symptoms	.64**	.04			
Low Surgency	-.16**	.01			
ADHD symptoms*Low Surgency	-.16*	.00			
Model 8: Teacher reported Impairment at High Surgency			40.81**	7	.50
ODD symptoms	.36**	.07			
Sex	-.03	.28			
Household income	-.07	.07			
Stimulant medication	.37*	.37			
ADHD symptoms	.41**	.04			
High Surgency	-.16**	.01			
ADHD symptoms*High Surgency	-.16*	.00			

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

Table 3.9. *Simple Slopes Analyses with ADHD and EC Predicting Impairment*

Parameter	β	*SE*	*F*	*df* (model)	R^2
Model 9: Teacher reported Impairment at Low EC			38.79**	7	.49
ODD symptoms	.31**	.07			
Sex	-.04	.29			
Household income	-.06	.07			
Stimulant medication	.12*	.38			
ADHD symptoms	.38**	.04			
Low EC	.08	.01			
ADHD symptoms*Low EC	.18**	.00			
Model 10: Teacher reported Impairment at High EC			38.79**	7	.49
ODD symptoms	.31**	.07			
Sex	-.04	.29			
Household income	-.06	.07			
Stimulant medication	.12*	.38			
ADHD symptoms	.64**	.04			
High EC	.08**	.01			
ADHD symptoms*High EC	.18**	.00			

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

Table 3.10. *Regression Parameters for Analyses with Surgency and EC Predicting Impairment*

Parameter	β	*SE*	*F*	*df* (model)	R^2
Model 11: Surgency alone Predicting Teacher reported Impairment					
			17.74**	1	.07
Surgency	.28**	.01			
Model 12: Surgency and ADHD Predicting Teacher reported Impairment					
			65.03**	2	.38
Surgency	-.13	.01			
ADHD	.68**	.03			
Model 13: EC alone Predicting Teacher reported Impairment					
			8.53**	1	.05
EC	-.23**	.02			
Model 14: EC and ADHD Predicting Teacher reported Impairment					
			54.09**	2	.42
EC	.24**	.02			
ADHD	.77**	.04			

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

Table 3.11. *Regression Parameters for Moderation Analyses with ADHD, Surgency, EC, and NA Predicting Impairment*

Parameter	β	*SE*	*F*	*df* (model)	R^2
Model 15: ADHD, Surgency, EC, NA Predicting Parent reported Impairment					
			35.61**	8	.48
ODD symptoms	.24**	.03			
Age	.07	.07			
Household income	.02	.03			
Stimulant medication	-.06	.19			
ADHD symptoms	.31**	.02			
Surgency	.06	.00			
EC	-.20**	.00			
NA	.11*	.00			
Model 16: ADHD, Surgency, EC, NA Predicting Teacher reported Impairment					
			34.62**	8	.49
ODD symptoms	.33**	.07			
Sex	-.04	.30			
Household income	-.08	.07			
Stimulant medication	.12	.38			
ADHD symptoms	.60**	.04			
Surgency	-.18**	.01			
EC	.09	.01			
NA	.00	.01			

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

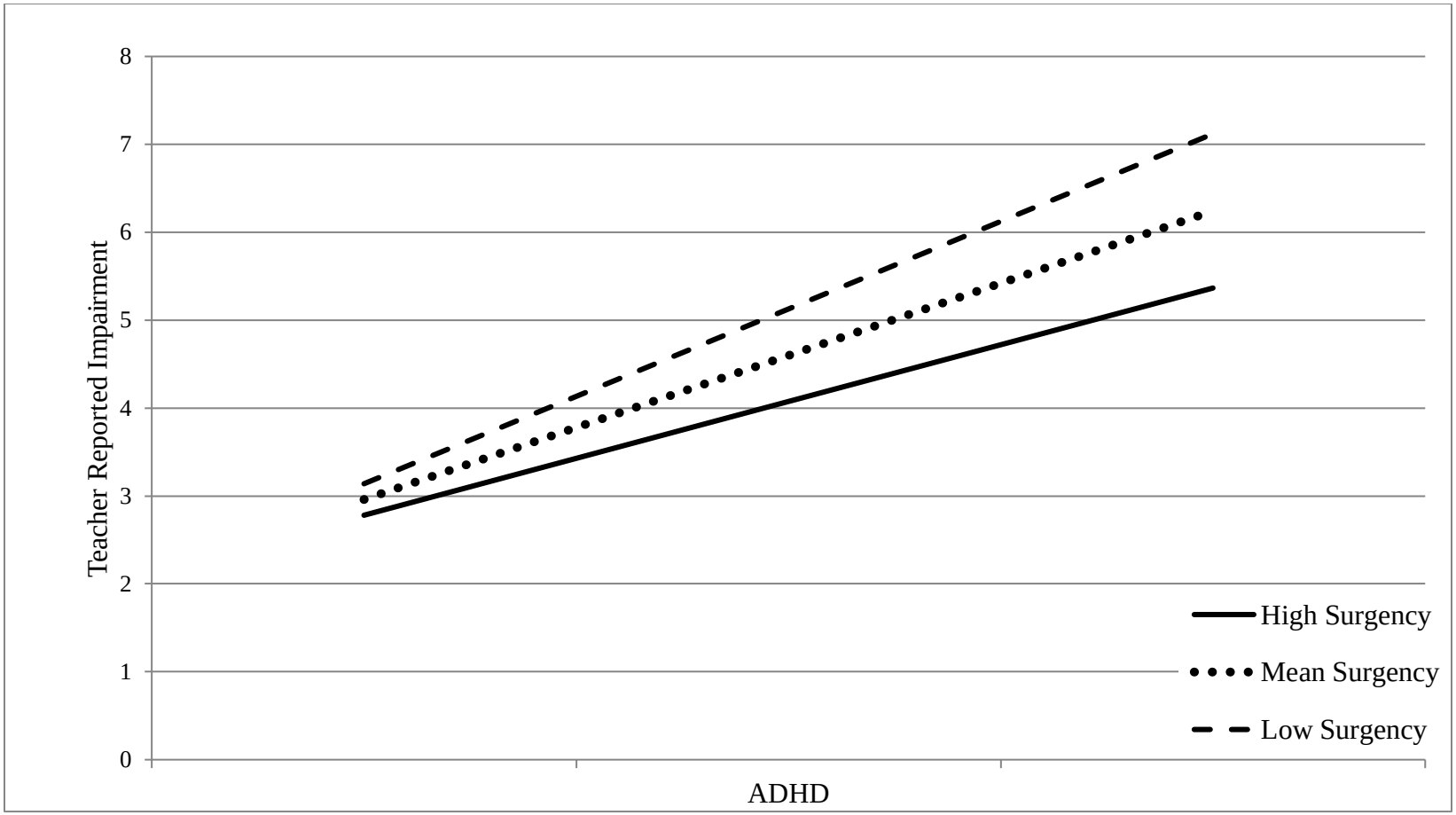

Figure 3.1. *Regression Depiction of Interaction between ADHD Symptoms and Surgency Predicting Teacher Reported Impairment*

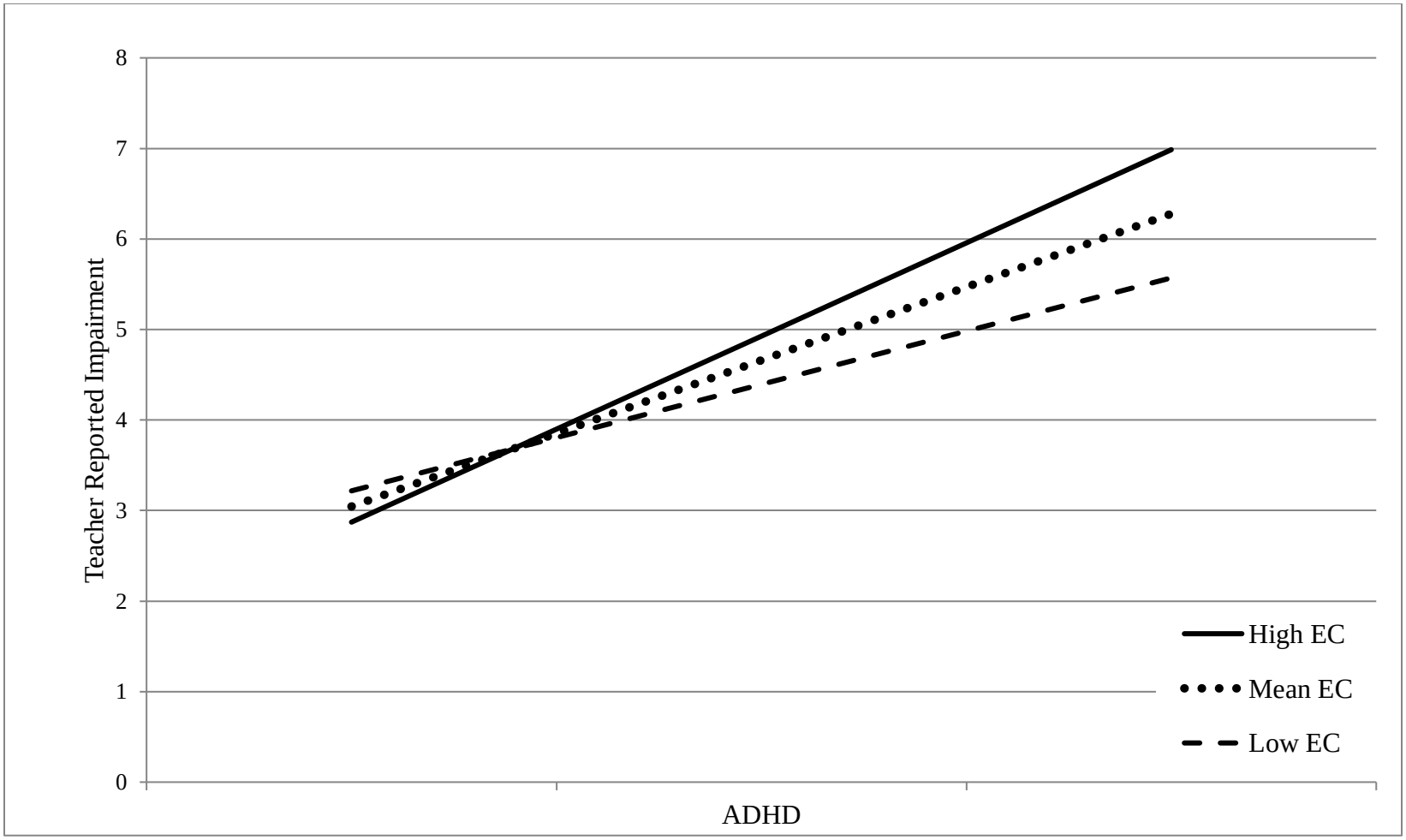

Figure 3.2. *Regression Depiction of Interaction between ADHD Symptoms and EC Predicting Teacher Reported Impairment*

CHAPTER 4

DISCUSSION

The present study addressed two main research questions – do symptoms of ADHD and temperament dimensions [surgency, effortful control (EC), and negative affectivity (NA)] predict impairment in middle childhood, and, does temperament moderate the relation between ADHD and impairment? It was hypothesized that higher levels of ADHD, surgency, and NA, and lower levels of EC would be associated with higher levels of both parent and teacher-reported impairment. We further hypothesized that temperament would moderate the ADHD/impairment relation such that this association would be stronger at higher levels of surgency and NA and at lower levels of EC. This study sought to fill a gap in the literature regarding the relations among temperament, ADHD, and impairment. While substantial research has examined how temperament and ADHD are independently related to both impairment (e.g., Hoza et al., 2005; Martel et al., 2014) and each other (Bates et al., 2014), only one study to date (De Pauw & Mervielde, 2011) has examined all three variables together. The present study builds on that foundation by assessing temperament as a moderator of the ADHD/impairment relation in a sample of participants ages eight to 10 using both parent and teacher report. We also offer unique contributions to the literature by examining ADHD continuously rather than categorically, over sampling for participants with ADHD symptoms, capturing a relatively diverse sample with regard to race/ethnicity and

household income, and by incorporating both parent and teacher reported ADHD symptoms and impairment ratings.

The study hypotheses were partially supported. Higher levels of ADHD symptoms were associated with higher levels of both parent and teacher reported impairment across all analyses. This finding adds to the already robust literature that links ADHD in childhood to a host of problems. Childhood ADHD has been connected to issues such as social rejection (e.g., having fewer friends, being less well liked by peers; Bunford et al., 2015; Hoza et al., 2015), more negative interactions with parents and increased family conflict (Johnston & Mash, 2001), emotion regulation difficulties (Barkley, 2006) and academic problems (Hinshaw, 1992). The present study's findings support the relation between ADHD and a range of problems both at home and school, as we assessed participants' relationships with peers, siblings, parents, the family unit, and teachers, as well as their self-esteem, and academic performance and impact on the classroom setting.

Also in support of our hypotheses, EC and NA were associated with parent-reported impairment in the expected directions. However, surgency was not significantly predictive of parent-reported impairment. The findings on EC and NA add support to the well-established literature on temperament and impairment, while the lack of effects for surgency suggests the need for additional consideration of how this dimension functions with regard to parents' perceptions of problems for their children.

In the present study, EC included scales that measure constructs such as attention, inhibitory control, the ability to enjoy low stimulation activities, and the ability to notice smaller details in stimuli. It is unsurprising then that lower levels of EC were associated

with greater impairment. Research has demonstrated links between EC and factors such as emotion regulation, executive attention, social rejection, mood symptoms, and parenting factors that include involvement and communication (Ato, Galián, & Fernández-Vilar, 2014, 2015; Kieras, Tobin, Graziano, & Rothbart, 2005; Kotelnikova, Mackrell, Jordan, & Hayden, 2015; Simonds, Kieras, Rueda, & Rothbart, 2007), and our measure of parent-reported impairment includes items that capture many of these factors.

Findings also showed a positive relation between NA and impairment for parent-report. NA, which encompasses traits such as anger, discomfort, fear, sadness, and low soothability, has also been connected with internalizing problems, avoidance of new or stressful situations, negative interactions with parents and parental distress, peer rejection, and problems with siblings (Carson & Parke, 1996; Crawford, Schrock, & Woodruff-Borden, 2011; Dill, Vernberg, Fonagy, Twemlow, & Gamm, 2004; Eisenberg, Fabes, & Murphy, 1996; Kramer, 2010).

Contrary to our hypotheses, surgency was not significantly associated with parent reported impairment. These findings are in line with results from De Pauw and Mervielde's (2011) results regarding the lack of a significant relation between surgency and impairment. Surgency includes activity level, enjoyment of highly stimulating activities, impulsivity, and low shyness and is related to the concepts of extraversion and positive emotionality (Rothbart, Ahadi, & Hershey, 1994). The insignificant relation between surgency and impairment may be the result of a number of factors. First, as the home environment tends to be more unstructured than most school environments, the potentially problematic aspects of surgency (e.g., impulsivity) may not be as relevant to expectations and demands in the home, and therefore may not be viewed as problematic

by parents in the same way they might be by teachers. Further, given that parents and caregivers utilize a variety of parenting styles, ranging from fairly permissive to fairly strict, some parents may view the outgoing, active aspects of surgency as positive, while others may view them as negative; this view of surgency as having both positive and negative qualities has also been echoed in the literature (Gunnar, Sebanc, Tout, Donzella, & van Dulmen, 2003). Gunnar and colleagues (2003) also note some interaction effects between surgency and EC with regard to outcomes. The present study did not include dimensions of temperament together in any of the models, a potential future direction for additional work in this area.

As described above, temperament was not a significant moderator in any of the analyses examining the relation between ADHD symptoms and parent reported impairment. These results suggest that, in the current sample, parents view ADHD as more salient than temperament with regard to impairment. It is possible that parents view aspects temperament as simply part of their child's nature rather than as traits that may lead to problems in relationships or school performance. In contrast, parents may be more likely to associated ADHD with problem behaviors regardless of other factors, including temperamental traits.

For teacher reported impairment, analyses revealed a significant relation between impairment and surgency, although this relation was not in the expected (i.e., positive) direction. Further, results showed that surgency was a significant moderator of the ADHD/impairment relation. ADHD and impairment were positively related across levels of surgency, but this relation was stronger at low levels of surgency compared to higher levels. These findings are inconsistent with our hypothesis that that the positive

ADHD/temperament relation would be stronger at higher levels of surgency. While analyses revealed that EC was not significantly related to impairment, there was a significant relation between ADHD and impairment, which was moderated by EC. Simple slopes analyses revealed that, at both high and low levels of EC, ADHD was positively associated with impairment, and that this relation was stronger when EC was high. These findings are inconsistent with our hypothesis that the ADHD/impairment relation would be stronger at lower levels of EC. NA was not significantly related to teacher reported impairment and moderation analyses were also non significant.

As described above regarding results from the parent analyses, surgency encompasses aspects of temperament that may be viewed more positively (e.g., approach, positive emotionality) and aspects that may be viewed more negatively (e.g., impulsivity). The more negative and potentially problematic aspects of surgency, such as impulsivity, are somewhat aligned with symptoms of ADHD. Therefore, our finding that ADHD is more strongly associated with impairment at lower levels of surgency may be the result of a lack of the positive aspects of surgency (e.g., prosocial behaviors) that could offset the more negative aspects that are shared with ADHD. Behaviors such engagement in the classroom and higher social engagement may be more common in those with higher levels of surgency, and these behaviors could reduce the negative impact of aspects of surgency such as impulsivity that are shared with ADHD and are commonly associated with problems in functioning and relationships. In sum, these more positive aspects of surgency may function as a buffer against impairment. This finding makes a strong case for additional, more detailed research into the overlap between ADHD and surgency, as well as ADHD and temperament dimensions more broadly,

especially given the somewhat mixed findings on surgency within the literature (e.g., De Pauw & Mervielde, 2011; Gunnar et al., 2003).

Findings also revealed a moderating effect of EC on the relation between ADHD and teacher reported impairment, although the main effect of EC was insignificant. Again, ADHD was positively associated with impairment across levels of EC, but this relation was stronger at higher levels of EC. This finding is at odds with the robust literature that links low EC to impairment. For example, research has also demonstrated positive associations between EC and academic performance (Blair & Razza, 2007), as well as links between low EC and externalizing problems (Eisenberg et al., 2005). Given the wealth of literature documenting the negative association between EC and both ADHD and impairment, as well as the negative correlations between EC and ADHD and EC and impairment in our study. Further, the results of our post hoc analyses revealed a negative relation between EC and impairment when ADHD symptoms were not included in the model; the direction of this relation was reversed when controlling for ADHD symptoms. Given our findings, which are inconsistent with a large body of literature, as well as the results of our post hoc analyses, the finding that ADHD is more associated with impairment when EC is high likely represents a statistical anomaly.

Finally, results did not indicate a significant relation between NA and teacher reported impairment, nor did they demonstrate a moderating effect of NA on the ADHD/impairment relation. NA is associated with internalizing problems such as anxiety, with some researchers suggesting that NA represents a "broad-band construct" that is related to these concerns (King, Ollendick, & Gullone, 1991; Wolfe et al., 1987). Research suggests that teachers may be less attentive to internalizing problems compared

to parents (Becker, McBurnett, Hinshaw, & Pfiffner, 2013; Cai, Kaiser, & Hancock, 2004; Youngstrom, Loeber, & Stouthamer-Loeber, 2000). Therefore, if teachers are less attuned to internalizing tendencies, they may be less likely to view them as being related to impairment in the classroom and might, instead, believe classroom problems to be the result of other factors.

Taken together, results from the present study add support to the existing literature on the relations among ADHD, temperament, and impairment. Our findings add support to the literature on the relations between ADHD and impairment (e.g., Flory, Molina, Pelham, Gnagy, & Smith, 2006), as well as the literature on temperament and impairment (e.g., Cicirelli, 2012), particularly the role of EC. Findings are not strongly suggestive of a moderating role for temperament in the ADHD/impairment relation, but provide an opportunity for further consideration of how temperament may function with regard to these variables. Our results also suggest the need for additional reflection and research into how surgency and NA may be related to impairment across settings and reporters, given that the significance of the relation between these temperament dimensions and impairment differed as a function of setting. Finally, results highlight the existence of variation across settings and reporters and underscore the need for multiple reporters and a focus on how behavior and impairment may differ as a function of setting.

Strengths and Limitations

The present study has multiple strengths that add to the literature on the relation between ADHD, temperament, and impairment in middle childhood. First, the study design utilized multiple reporters, as data on both ADHD symptoms and impairment were collected from both a parent/caregiver and participants' teachers. The use of a multi

informant approach allows for the collection of data that provide more nuanced information about the presentation of symptoms and impairment across settings. With regard to ADHD in particular, a multi informant method shows greater accuracy in correctly identifying ADHD than other methods (e.g., De Los Reyes et al., 2015). Using a multi informant approach with regard to impairment is also useful, as children's problems may manifest differently as a function of setting, for a variety of reasons, including their interpersonal relationships with others, the individual characteristics and approaches of authority figures, and the demands and expectations placed on them in various settings. Collecting data from multiple informants who interact with participants in both the home and school environment provides a more well-rounded picture of participants' functioning.

This emphasis on impairment rather than symptoms alone is another strength of the current study. While ADHD symptoms are an integral part of the present study's aims, there is significant variability in the type and severity of symptoms those with ADHD experience (Sjöwall & Thorell, 2014). Therefore, understanding both symptoms and their associated impairment is essential, as the presence of symptoms alone does not necessarily indicate the presence of problems or a need for treatment.

As a result of a number of well-planned recruitment strategies, the present study includes data from a relatively diverse sample of participants. The racial/ethnic makeup of the sample was split fairly evenly between participants whose parents identified them as being either White (42.7%) or African-American (43.3%). With regard to income, slightly more than half the parents in the study reported a household income of less than $50,000, with most indicating that their household income was between $25,000 and

$49,999. Overall, a sample with greater demographic diversity allows for greater generalizability of study findings, rather than limiting the representativeness of the sample compared other populations.

While diversity on some demographic variables is a desirable quality, another strength of this study is its focus on a relatively narrow age and school grade range. All participants ranged from age 8 to 10 and 98% of parents reported that their child was currently (or, for those participating in the summer, most recently) enrolled in 2nd through 5th grade. Most other studies of ADHD, temperament, and/or impairment include a more heterogeneous sample with regard to age and grade. For example, De Pauw and Mervielde's (2011) sample included participants ages 6 through 14, which may encompass individuals at both the beginning of elementary school through those in early high school. Studies whose participants span a fairly wide age range are not uncommon in this literature (e.g., de Nijs et al., 2004; DuPaul, Reid, Anastopoulos, & Power, 2014; Sjöwall & Thorell, 2014). Given the developmental nature of ADHD, as well as the differences in classroom structure between most American elementary schools versus middle and high schools, it stands that the nature of symptoms and impairment children experience may be quite different for those in early elementary school versus those in high school; the range of development across this span of childhood is also worth noting. Further, elementary school aged children typically spend a significant amount of time with one teacher, whereas older children often rotate between multiple teachers throughout the course of the day. This consistent contact with one teacher in elementary school likely results in teachers gaining a better and more comprehensive understanding

of children's behavior, strengths, and areas for growth, which may allow for more accurate reporting on measures of symptoms and functioning.

The present study also has a number of limitations. Participants in the study were from a fairly narrow age range (8-10 year olds), which can limit our ability to generalize findings to other groups, including adolescents. However, as described above, the study's narrow range can also be viewed as an asset, as children older than 10 years old are likely to be in a different type of school setting (i.e., middle versus elementary school) where behavioral and academic expectations are likely to be significantly different, which may, in turn, impact their functioning and problems.

Parent report of impairment was fairly low *(M*=1.65, *sd*=1.59). The parent version of the IRS can be scored in several ways, including by calculating the mean for all scores or by obtaining a count of items scored above 3 (Fabiano et al., 2006). The mean scores for each of the parent reported IRS items were all below 3 (range = 1.38 – 2.11). In comparison, teachers reported higher levels of impairment overall *(M*=4.43, *sd*=3.18), and each item's mean score across all participants was above 3 (range = 3.68 – 5.94). However, despite the relatively low and level of impairment reported by parents, analyses were able to detect meaningful relationships between parent reported impairment and most of the variables of interest.

Another limitation within this study relates to the use of parent reported temperament alone, compared to the inclusion of teacher report and/or behavioral observations. It is possible that parent and teacher views on participants' temperament may vary, and that behavioral observations may yield additional or different data regarding temperament. Still, there is strong agreement throughout the literature that

temperament is "constitutionally based", and although it is subject to change over time through the course of development and in response to experience, it is not believed to change significantly as a function of setting. Further, behavioral observations from a laboratory setting "… may be influenced by the artificial context in which behavior is assessed" (Chronis-Tuscano et al., 2009, p. 933), and the collection of behavioral observation from natural settings such as school or the home environment would require a tremendous amount of time and resources from both the research team and participants. Therefore, although temperament data were only collected using parent report, we believe they offer an accurate representation of participants' relatively enduring temperamental traits.

Analyses revealed that data missing from each of the predictor and outcome variables with the exception of temperament were missing completely at random (MCAR). Given that there is no test to determine if data are missing at random (MAR; Greenland, & Finkle, 1995), it is possible that the missingness of the temperament data may be related to some other study variable, which would bias our findings. However, given that there was very little missing data for the TMCQ (less than 3%), issues related to missing data are not of significant concern in the present study.

Finally, the present study's cross sectional nature does not allow us to determine the direction of the relations among ADHD, temperament, and impairment, and does not allow for causal inference. However, the temperament literature has established that temperament develops in the earliest stages of life (e.g., Thomas, Chess, & Birch, 1970), and any meaningful information regarding ADHD symptoms and/or impairment would be collected at a later point, once children begin to develop more autonomy. Additionally,

given that only one other study to date has examined the relations among all three variables (De Pauw & Mervielde, 2011), the present study serves help establish the general foundation of research in this area, which can then be used by future researchers to inform more complex designs, including longitudinal studies of their relations over time. Overall, although the present study has several limitations, it also has numerous strengths and adds to the literature on ADHD, temperament, and impairment by examining the relations among these variables in a large, diverse sample of children, utilizing data from multiple reporters.

Implications

The present study has implications for both research and practice related to negative outcomes associated with both ADHD and temperament. Findings demonstrated that teachers rated participants as having higher levels of impairment compared to parents, which supports the continued emphasis (in both research and clinical practice) on utilizing multiple reporters for issues concerning ADHD. In the present study, the constructs of surgency and EC both encompass some traits that are also considered hallmark features of ADHD, whereas NA does not. Given that the ADHD/impairment relation was moderated by surgency and EC but not surgency for teacher, additional research should continue to utilize novel approaches to determining how the overlap between ADHD symptoms and certain aspects of temperament may be relevant.

These overlapping dimensions may be an area for specific focus with regard to behavioral treatments that include parents and teachers, and results may also inform how approaches may differ at home versus in the classroom depending on an individual's presentation and how his/her problems manifest in different settings. Further, our finding

that the relation between ADHD and teacher reported impairment was stronger when surgency was lower offers addition evidence for the importance of assessing facets that may be related to surgency in the academic setting, such as classroom engagement and prosocial behavior. Given that ADHD is associated with social impairment (e.g., Hoza et al., 2005), children who are higher in ADHD symptoms and lower in surgency may be at an even higher risk for social difficulties that may cause problems in the school setting. This may be an area of particular interest for intervention, as treatment both within the classroom setting and at home with parents could focus on these children's social functioning and comfort with being engaged with their peers and teachers at school.

As described in the previous sections, the present study adds to the significant literature on ADHD, temperament, and impairment, while contributing uniquely to the less well studied intersection of all three facets. Future studies may incorporate a number of this study's design elements, including measuring ADHD continuously, using of multiple reporters, oversampling for participants with ADHD, recruiting a demographically diverse sample, and focusing on a cohesive age range in consideration of factors such as developmental level and/or school setting. Our results also strongly suggest a need for additional work that examines how temperament, ADHD, and impairment are interrelated, particularly given the mixed findings on the impact of surgency and NA, in addition to surgency and EC's roles as moderators in some analyses but not others. Moving forward, researchers may also improve upon the current design in a number of ways, including by collecting longitudinal data and analyzing the overlap between ADHD and temperament in more depth. Despite these potential areas for growth, the present study represents an important early step in looking at the

interrelations between ADHD, temperament, and impairment and provides useful information in both the research and practice realms regarding how we may best approach ADHD and its associated issues when working with children.

REFERENCES

Agnew-Blais, J. C., Polanczyk, G., Danese, A., Wertz, J., Moffitt, T. E., & Arseneault, L. (2016). Persistence, remission and emergence of ADHD in young adulthood: results from a longitudinal, prospective population-based cohort. *JAMA Psychiatry, 73,* 713-720.

Ahadi, S. A., Rothbart, M. K., & Ye, R. (1993). Children's temperament in the US and China: Similarities and differences. *European Journal of Personality, 7,* 359-378.

Ato, E., Galián, M. D., & Fernández-Vilar, M. A. (2014). Gender as predictor of social rejection: the mediating/moderating role of effortful control and parenting. *Anales de Psicología/Annals of Psychology, 30,* 1069-1078.

Ato, E., Galián, M. D., & Fernández-Vilar, M. A. (2015). The moderating role of children's effortful control in the relation between marital adjustment and parenting. *Journal of Child and Family Studies, 24,* 3341-3349.

American Psychiatric Association. (1980). Diagnostic and Statistical Manual of Mental Disorders (3rd ed.). Washington, DC: Author

American Psychiatric Association. (2000). *Diagnostic and Statistical Manual of Mental Disorders* (4th ed., text rev.). Washington, DC: Author.

American Psychiatric Association. (2013). *Diagnostic and Statistical Manual of Mental Disorders* (5th ed.). Washington, DC: Author.

Anderson, J., Williams, S., McGee, R., & Silva, P. (1989). Cognitive and social correlates of DSM-III disorders in preadolescent children. *Journal of the American Academy of Child & Adolescent Psychiatry, 28,* 842-846.

Barbaresi, W. J., Weaver, A. L., Voigt, R. G., Killian, J. M., & Katusic, S. K. (2018). Comparing methods to determine persistence of childhood ADHD into adulthood: a prospective, population-based study. *Journal of Attention Disorders, 22,* 571-580.

Barkley, R. A., & Murphy K. (2006) Attention deficit hyperactivity disorder: a clinical workbook, 3rd edn. Guilford Press, New York.

Barkley, R. A., Fischer, M., Smallish, L., & Fletcher, K. (2002). The persistence of attention-deficit/hyperactivity disorder into young adulthood as a function of reporting source and definition of disorder. *Journal of Abnormal Psychology, 111*, 279 –289.

Bartholomew, K., & Horowitz, L. M. (1991). Attachment styles among young adults: a test of a four-category model. *Journal of Personality and Social Psychology, 61*, 226-244.

Bates, J. E., Schermerhorn, A. C., & Petersen, I. T. (2014). Temperament concepts in developmental psychopathology. In M. Lewis & K. D. Randolph (Eds.), *Handbook of developmental psychopathology* (pp. 311-329). Springer, Boston, MA.

Beauchaine, T. (2001). Vagal tone, development, and Gray's motivational theory: Toward an integrated model of autonomic nervous system functioning in psychopathology. *Development and Psychopathology, 13*, 183-214.

Becker, S. P., McBurnett, K., Hinshaw, S. P., & Pfiffner, L. J. (2013). Negative social preference in relation to internalizing symptoms among children with ADHD predominantly inattentive type: Girls fare worse than boys. *Journal of Clinical Child & Adolescent Psychology, 42*, 784-795.

Berdan, L. E., Keane, S. P., & Calkins, S. D. (2008). Temperament and externalizing behavior: Social preference and perceived acceptance as protective factors. *Developmental Psychology*, *44*, 957-968.

Biederman, J., Mick, E., & Faraone, S. V. (2000). Age-dependent decline of symptoms of attention deficit hyperactivity disorder: impact of remission definition and symptom type. *American Journal of Psychiatry, 157*, 816-818.

Blair, C., & Razza, R. P. (2007). Relating effortful control, executive function, and false belief understanding to emerging math and literacy ability in kindergarten. *Child Development*, *78*, 647-663

Bunford, N., Evans, S.W., Becker, S. P., & Langberg, J. (2015). Attention-deficit/hyperactivity disorder and social skills in youth: A moderated mediation model of emotion dysregulation and depression. *Journal of Abnormal Child Psychology, 43*, 283–296.

Buss, A. H., & Plomin, R. (1984). *Temperament: Early developing personality traits.* Hillsdale: Erlbaum.

Cai, X., Kaiser, A. P., & Hancock, T. B. (2004). Parent and Teacher Agreement on Child Behavior Checklist Items in a Sample of Preschoolers From Low-Income and

Predominantly African American Families. *Journal of Clinical Child & Adolescent Psychology*, *33*, 303-312

Carson, J. L., & Parke, R. D. (1996). Reciprocal Negative Affect in Parent- Child Interactions and Children's Peer Competency. *Child Development*, *67*, 2217-2226.

Cheema, J. R. (2014).Some General Guidelines for Choosing Missing Data Handling Methods in Educational Research. *Journal of Modern Applied Statistical Methods*, *13*, 53-75.

Chhabildas, N., Pennington, B. F., & Willcutt, E. G. (2001). A comparison of the neuropsychological profiles of the DSM-IV subtypes of ADHD. *Journal of Abnormal Child Psychology*, *29*, 529-540.

Chronis-Tuscano, A., Degnan, K. A., Pine, D. S., Perez-Edgar, K., Henderson, H. A., Diaz, Y., ... & Fox, N. A. (2009). Stable early maternal report of behavioral inhibition predicts lifetime social anxiety disorder in adolescence. *Journal of the American Academy of Child & Adolescent Psychiatry*, *48*, 928-935.

Cicchetti, D., & Cohen, D. J. (Eds.). (2006). *Developmental psychopathology, Volume 3: risk, disorder, and adaptation* (Vol. 3). John Wiley & Sons.

Cicirelli, V. (2013). *Sibling Relationships Across the Life Span*. New York, New York: Springer Science & Business Media.

Clark, L. A. (2005). Temperament as a unifying basis for personality and psychopathology. *Journal of Abnormal Psychology, 114*, 505-521.

Clark, L. A., Watson. D., & Mineka. S. (1994). Temperament, personality, and the mood and anxiety disorders. *Journal of Abnormal Psychology, 103,* 103-116.

Crawford, N. A., Schrock, M., & Woodruff-Borden, J. (2011). Child internalizing symptoms: contributions of child temperament, maternal negative affect, and family functioning. *Child Psychiatry & Human Development*, *42*, 53-64.

Danielson, M. L., Bitsko, R. H., Ghandour, R. M., Holbrook, J. R., Kogan, M. D., & Blumberg, S. J. (2018). Prevalence of parent-reported ADHD diagnosis and associated treatment among US children and adolescents, 2016. *Journal of Clinical Child & Adolescent Psychology*, *47*, 199-212.

De Los Reyes, A., Augenstein, T. M., Wang, M., Thomas, S. A., Drabick, D. A., Burgers, D. E., & Rabinowitz, J. (2015). The validity of the multi-informant approach to assessing child and adolescent mental health. *Psychological Bulletin, 141*, 858-900.

de Nijs, P. F., Ferdinand, R. F., de Bruin, E. I., Dekker, M. C., van Duijn, C. M., & Verhulst, D. C. (2004). Attention-deficit/hyperactivity disorder (ADHD): parents' judgment about school, teachers' judgment about home. *European Child & Adolescent Psychiatry*, *13*, 315-320.

De Pauw, S. S., & Mervielde, I. (2010). Temperament, personality and developmental psychopathology: A review based on the conceptual dimensions underlying childhood traits. *Child Psychiatry & Human Development*, *41*, 313-329.

De Pauw, S. S., & Mervielde, I. (2011). The role of temperament and personality in problem behaviors of children with ADHD. *Journal of Abnormal Child Psychology*, *39*, 277-291.

Deault, L. C. (2010). A systematic review of parenting in relation to the development of comorbidities and functional impairments in children with attention-deficit/hyperactivity disorder (ADHD). *Child Psychiatry & Human Development*, *41*, 168-192.

Dill, E. J., Vernberg, E. M., Fonagy, P., Twemlow, S. W., & Gamm, B. K. (2004). Negative affect in victimized children: The roles of social withdrawal, peer rejection, and attitudes toward bullying. *Journal of Abnormal Child Psychology*, *32*, 159-173.

DuPaul, G. J., Reid, R., Anastopoulos, A. D., & Power, T. J. (2014). Assessing ADHD symptomatic behaviors and functional impairment in school settings: Impact of student and teacher characteristics. *School Psychology Quarterly*, *29*, 409-421.

Durbin, J., & Watson, G. S. (1950). Testing for serial correlation in least squares regression: I. *Biometrika*, *37*(, 409-428.

Dvorsky, M. R., & Langberg, J. M. (2014). Predicting impairment in college students with ADHD: the role of executive functions. *Journal of Attention Disorders*, 1087054714548037.

Einziger, T., Levi, L., Zilberman-Hayun, Y., Auerbach, J. G., Atzaba-Poria, N., Arbelle, S., & Berger, A. (2018). Predicting ADHD symptoms in adolescence from early childhood temperament traits. *Journal of Abnormal Child Psychology*, *46*, 265-276.

Eisenberg, N., Fabes, R.A., Guthrie, I.K., Murphy, B.C., Maszk, P., Holmgren, R., & Suh, K. (1996). The relations of regulation and emotionality to problem behavior in elementary school children. *Development and Psychopathology, 8*, 141–162.

Eisenberg, N., Fabes, R. A., & Murphy, B. C. (1996). Parents' reactions to children's negative emotions: Relations to children's social competence and comforting behavior. *Child Development, 67,* 2227-2247.

Eisenberg, N., Sadovsky, A., Spinrad, T.L., Fabes, R.A., Losoya, S.H., Valiente, C., … Shepard, S.A. (2005). The relations of problem behavior status to children's negative emotionality, effortful control, and impulsivity: Concurrent relations and prediction of change. *Developmental Psychology, 41,* 193–211.

Eisenberg, N., Zhou, Q., Spinrad, T. L., Valiente, C., Fabes, R. A., & Liew, J. (2005). Relations among positive parenting, children's effortful control, and externalizing problems: A three-wave longitudinal study. *Child Development, 76,* 1055-1071.

Evans, D. E., & Rothbart, M. K. (2007). Development of a model for adult temperament. *Journal of Research in Personality, 41,* 868-888.

Fabiano, G. A., Pelham, Jr, W. E., Waschbusch, D. A., Gnagy, E. M., Lahey, B. B., Chronis, A. M., ... & Burrows-MacLean, L. (2006). A practical measure of impairment: Psychometric properties of the impairment rating scale in samples of children with attention deficit hyperactivity disorder and two school-based samples. *Journal of Clinical Child and Adolescent Psychology, 35,* 369-385.

Faraone, S. V., Sergeant, J., Gillberg, C., & Biederman, J. (2003). The worldwide prevalence of ADHD: is it an American condition?. *World Psychiatry, 2,* 104-113.

Faul, F., Erdfelder, E., Buchner, A., & Lang, A.-G. (2009). Statistical power analyses using G*Power 3.1: Tests for correlation and regression analyses. *Behavior Research Methods, 41,* 1149-1160.

Fiske, D. W. (1966). On the coordination of personality concepts and their measurement. *Human Development, 9,* 74-83.

Flory, K., Malone, P. S., & Lamis, D. A. (2011). Childhood ADHD symptoms and risk for cigarette smoking during adolescence: School adjustment as a potential mediator. *Psychology of Addictive Behaviors, 25,* 320-329.

Flory, K., Milich, R., Lynam, D. R., Leukefeld, C., & Clayton, R. (2003). Relation between childhood disruptive behavior disorders and substance use and dependence symptoms in young adulthood: Individuals with symptoms of attention-deficit/hyperactivity disorder are uniquely at risk. *Psychology of Addictive Behaviors, 17,* 151-158.

Frick, P. J., & Morris, A. S. (2004). Temperament and developmental pathways to conduct problems. *Journal of Clinical Child and Adolescent Psychology, 33,* 54-68.

Frick, P. J., Kamphaus, R. W., Lahey, B. B., Loeber, R., Christ, M. A. G., Hart, E. L., & Tannenbaum, L. E. (1991). Academic underachievement and the disruptive behavior disorders. *Journal of Consulting and Clinical Psychology, 59*, 289-294.

Gagne, J. R. (2013). Personality and Temperament. In eLS, (Ed.).doi: 10.1002/9780470015902.a0005244.pub2

Gelman, A., Hill, J., & Yajima, M. (2012). Why we (usually) don't have to worry about multiple comparisons. *Journal of Research on Educational Effectiveness, 5*, 189-211.

Goldfeld, S. M., & Quandt, R. E. (1965). Some tests for homoscedasticity. *Journal of the American Statistical Association, 60,* 539-547.

Goldsmith, H. H., Lemery, K. S., Buss, K. A., & Campos, J. J. (1999). Genetic analyses of focal aspects of infant temperament. *Developmental Psychology, 35*, 972-985.

Goldsmith, H.H., Lemery, K.S., & Essex, M.J. (2004). Roles for temperament in the liability to psychopathology in childhood. In L. DiLalla (Ed.), *Behavior genetic principles – Development, personality, and psychopathology* (pp. 19–39). Washington, DC: APA Press.

Goldsmith, H. H., Buss, A. H., Plomin, R., Rothbart, M. K., Thomas, A., Chess, S., ... & McCall, R. B. (1987). Roundtable: What is temperament? Four approaches. *Child Development, 58*, 505-529.

Graham, J. W. (2009). Missing data analysis: Making it work in the real world. *Annual Review of Psychology, 60*, 549-576.

Gray, J. A. (1991). The neuropsychology of temperament. In J. Strelau & A. Angleitner (Eds.), *Explorations in temperament: International perspectives on theory and measurement. Perspectives on individual differences* (pp. 105–128). New York, NY: Plenum.

Greene, R. W., Biederman, J., Faraone, S. V., Monuteaux, M. C., Mick, E., DuPre, E. P., ... & Goring, J. C. (2001). Social impairment in girls with ADHD: patterns, gender comparisons, and correlates. *Journal of the American Academy of Child & Adolescent Psychiatry, 40*, 704-710.

Greenland, S., & Finkle, W. D. (1995). A critical look at methods for handling missing covariates in epidemiologic regression analyses. *American Journal of Epidemiology, 142*, 1255-1264.

Gunnar, M. R., Sebanc, A. M., Tout, K., Donzella, B., & van Dulmen, M. M. (2003). Peer rejection, temperament, and cortisol activity in preschoolers. *Developmental Psychobiology, 43*, 346-368.

Harris, P. A., Taylor, R., Thielke, R., Payne, J., Gonzalez, N., & Conde, J. G. (2009). Research electronic data capture (REDCap)—a metadata-driven methodology and workflow process for providing translational research informatics support. *Journal of Biomedical Informatics, 42*, 377-381.

Hill, J. C., & Schoener, E. P. (1996). Age-dependent decline of attention deficit hyperactivity disorder. *The American Journal of Psychiatry, 153*, 1143-1146.

Hinshaw, S. P. (1992). Externalizing behavior problems and academic underachievement in childhood and adolescence: causal relationships and underlying mechanisms. *Psychological Bulletin, 111,* 127-155.

Hoza, B., Mrug, S., Gerdes, A. C., Hinshaw, S. P., Bukowski, W. M., Gold, J. A., ... & Arnold, L. E. (2005). What aspects of peer relationships are impaired in children with attention-deficit/hyperactivity disorder?. *Journal of Consulting and Clinical Psychology, 73*, 411-423.

IBM Corp. Released 2017. IBM SPSS Statistics for Windows, Version 25.0. Armonk, NY: IBM Corp.

Jensen, P. S., Hoagwood, K. E., Roper, M., Arnold, L. E., Odbert, C., Crowe, M., ... & Newcorn, J. (2004). The services for children and adolescents–parent interview: Development and performance characteristics. *Journal of the American Academy of Child & Adolescent Psychiatry, 43*, 1334-1344.

Johnston, C., & Mash, E. J. (2001). Families of children with attention-deficit/ hyperactivity disorder: review and recommendations for future research. *Clinical Child and Family Psychology Review, 4*, 183-207.

Karalunas, S. L., Fair, D., Musser, E. D., Aykes, K., Iyer, S. P., & Nigg, J. T. (2014). Subtyping attention-deficit/hyperactivity disorder using temperament dimensions: toward biologically based nosologic criteria. *JAMA Psychiatry, 71*, 1015-1024.

Kessler, R. C., Adler, L., Barkley, R., Biederman, J., Conners, C. K., Demler, O., ... & Spencer, T. (2006). The prevalence and correlates of adult ADHD in the United States: results from the National Comorbidity Survey Replication. *American Journal of Psychiatry, 163*, 716-723.

Kieras, J. E., Tobin, R. M., Graziano, W. G., & Rothbart, M. K. (2005). You can't always get what you want: Effortful control and children's responses to undesirable gifts. *Psychological Science, 16*, 391–396.

King, N. J., Ollendick, T. H., & Gullone, E. (1991). Negative affectivity in children and adolescents: Relations between anxiety and depression. *Clinical Psychology Review, 11*, 441-459.

Kolko, D. J., & Pardini, D. A. (2010). ODD dimensions, ADHD, and callous–unemotional traits as predictors of treatment response in children with disruptive behavior disorders. *Journal of Abnormal Psychology, 119*, 713-725.

Kotelnikova, Y., Mackrell, S. V., Jordan, P. L., & Hayden, E. P. (2015). Longitudinal associations between reactive and regulatory temperament traits and depressive symptoms in middle childhood. *Journal of Clinical Child & Adolescent Psychology, 44*, 775-786.

Kramer, L. (2010). The essential ingredients of successful sibling relationships: An emerging framework for advancing theory and practice. *Child Development Perspectives, 4*, 80-86.

Lahey, B. B., Pelham, W. E., Loney, J., Lee, S. S., & Willcutt, E. (2005). Instability of the DSM-IV subtypes of ADHD from preschool through elementary school. *Archives of General Psychiatry, 62*, 896-902.

Lahey, B. B., & Willcutt, E. G. (2010). Predictive validity of a continuous alternative to nominal subtypes of attention-deficit/hyperactivity disorder for DSM–V. *Journal of Clinical Child & Adolescent Psychology, 39*, 761-775.

Lasky-Su, J., Faraone, S. V., Lange, C., Tsuang, M. T., Doyle, A. E., Smoller, J. W., ... & Biederman, J. (2007). A study of how socioeconomic status moderates the relationship between SNPs encompassing BDNF and ADHD symptom counts in ADHD families. *Behavior Genetics, 37*, 487-497.

Lee, C. A., Milich, R., Lorch, E. P., Flory, K., Owens, J. S., Lamont, A. E., & Evans, S. W. (2017). Forming first impressions of children: The role of attention-deficit/hyperactivity disorder symptoms and emotion dysregulation. *Journal of Child Psychology and Psychiatry,* Advanced online publication.

Lemery, K. S., Essex, M. J., & Smider, N. A. (2002). Revealing the relation between temperament and behavior problem symptoms by eliminating measurement confounding: Expert ratings and factor analyses. *Child Development, 73*, 867-882.

Lengua, L. J., & Kovacs, E. A. (2005). Bidirectional associations between temperament and parenting and the prediction of adjustment problems in middle childhood. *Journal of Applied Developmental Psychology, 26*, 21-38.

Mansfield, E. R., & Helms, B. P. (1982). Detecting multicollinearity. *The American Statistician, 36*(, 158-160.

Martel, M. M. (2009). Research review: a new perspective on attention-deficit/hyperactivity disorder: emotion dysregulation and trait models. *Journal of Child Psychology and Psychiatry, 50*, 1042-1051.

Martel, M. M., Gremillion, M. L., Roberts, B. A., Zastrow, B. L., & Tackett, J. L. (2014). Longitudinal prediction of the one-year course of preschool ADHD symptoms: Implications for models of temperament–ADHD associations. *Personality and Individual Differences, 64*, 58-61.

Martel, M. M., & Nigg, J. T. (2006). Child ADHD and personality/temperament traits of reactive and effortful control, resiliency, and emotionality. *Journal of Child Psychology and Psychiatry, 47*, 1175-1183.

Massetti, G. M., Pelham, W. E., Chacko, A., Walker, K. S., Arnold, F., Keenan, J.… & Burrows-MacLean, L. (2003). *Situational variability of ADHD, ODD, and CD: Psychometric properties of the DBD interview and rating scale*. Poster presented at the Association for Advancement of Behavior Therapy Conference, Boston, MA.

McBurnett, K., Pfiffner, L. J., & Frick, P. J. (2001). Symptom properties as a function of ADHD type: An argument for continued study of sluggish cognitive tempo. *Journal of Abnormal Child Psychology, 29*, 207-213.

McGee, R., & Share, D. L. (1988). Attention deficit disorder-hyperactivity and academic failure: Which comes first and what should be treated? *Journal of the American Academy of Child & Adolescent Psychiatry, 27,* 318-325.

Mikami, A. Y., & Pfiffner, L. J. (2008). Sibling relationships among children with ADHD. *Journal of Attention Disorders*, *11*, 482-492.

Miller, M., & Hinshaw, S. P. (2010). Does childhood executive function predict adolescent functional outcomes in girls with ADHD?. *Journal of Abnormal Child Psychology, 38*, 315-326.

Miller, M., Nevado-Montenegro, A. J., & Hinshaw, S. P. (2012). Childhood executive function continues to predict outcomes in young adult females with and without childhood-diagnosed ADHD. *Journal of Abnormal Child Psychology, 40*, 657-668.

Moffitt, T. E., Houts, R., Asherson, P., Belsky, D. W., Corcoran, D. L., Hammerle, M., ... & Poulton, R. (2015). Is adult ADHD a childhood-onset neurodevelopmental disorder? Evidence from a four-decade longitudinal cohort study. *American Journal of Psychiatry*, *172*, 967-977.

Muris, P., & Ollendick, T. H. (2005). The role of temperament in the etiology of child psychopathology. *Clinical Child and Family Psychology Review, 8*, 271-289.

Nigg, J. T. (2006). Temperament and developmental psychopathology. *Journal of Child Psychology and Psychiatry*, *47*, 395-422.

Nigg, J. T., & Goldsmith, H. H. (1998). Developmental psychopathology, personality, and temperament: reflections on recent behavioral genetics research. *Human Biology, 70,* 387-412.

Nigg, J. T. & Goldsmith, H. H. (2006). Personality and Temperament. In eLS, (Ed.). doi:10.1038/npg.els.0005244

Nigg, J. T., Goldsmith, H. H., & Sachek, J. (2004). Temperament and attention deficit hyperactivity disorder: the development of a multiple pathway model. *Journal of Clinical Child and Adolescent Psychology, 33,* 42–53.

Nigg, J. T., Willcutt, E. G., Doyle, A. E., & Sonuga-Barke, E. J. (2005). Causal heterogeneity in attention-deficit/hyperactivity disorder: do we need neuropsychologically impaired subtypes?. *Biological Psychiatry, 57,* 1224-1230.

Nystrom, B., & Bengtsson, H. (2017). A psychometric evaluation of the Temperament in Middle Childhood Questionnaire (TMCQ) in a Swedish sample. *Scandinavian Journal of Psychology, 58,* 477-484.

Overbey, G. A., Snell, W. E., & Callis, K. E. (2011). Subclinical ADHD, stress, and coping in romantic relationships of university students. *Journal of Attention Disorders, 15,* 67-78.

Papageorgiou, V., Kalyva, E., Dafoulis, V., & Vostanis, P. (2008). Differences in parents' and teachers' ratings of ADHD symptoms and other mental health problems. *The European Journal of Psychiatry, 22,* 200-210.

Pelham, W.E., Gnagy, E.M., Greenslade, K.E., & Milich, R. (1992). Teacher ratings of DSM-III-R symptoms for the disruptive behavior disorders. *Journal of the American Academy of Child and Adolescent Psychiatry, 31,* 210–218.

Power, T. J., Andrews, T. J., Eiraldi, R. B., Doherty, B. J., Ikeda, M. J., DuPaul, G. J., & Landau, S. (1998). Evaluating attention deficit hyperactivity disorder using multiple informants: The incremental utility of combining teacher with parent reports. *Psychological Assessment, 10,* 250-260.

Pressman, L. J., Loo, S. K., Carpenter, E. M., Asarnow, J. R., Lynn, D., McCracken, J. T., ... & Smalley, S. L. (2006). Relationship of family environment and parental psychiatric diagnosis to impairment in ADHD. *Journal of the American Academy of Child & Adolescent Psychiatry, 45,* 346-354.

Pritchard, A. E., Nigro, C. A., Jacobson, L. A., & Mahone, E. M. (2012). The role of neuropsychological assessment in the functional outcomes of children with ADHD. *Neuropsychology Review, 22,* 54-68.

Putnam, S. P., Ellis, L. K., & Rothbart, M. K. (2001). The structure of temperament from infancy through adolescence. In A. Eliasz & A. Angleitner (Eds.), *Advances and proceedings in research on temperament* (pp. 165–182). Germany: Pabst Scientist.

Rinsky, J. R., & Hinshaw, S. P. (2011). Linkages between childhood executive functioning and adolescent social functioning and psychopathology in girls with ADHD. *Child Neuropsychology, 17*, 368-390.

Robinson, J. L., Kagan, J., Reznick, J. S., & Corley, R. (1992). The heritability of inhibited and uninhibited behavior: A twin study. *Developmental Psychology, 28*, 1030-137.

Rothbart, M. K. (1981). Measurement of temperament in infancy. *Child Development, 52*, 569-578.

Rothbart, M. K., Ahadi, S. A., & Hershey, K. L. (1994). Temperament and social behavior in childhood. *Merrill-Palmer Quarterly, 40*, 21-39.

Rothbart, M.K., & Derryberry, D. (1981). Development of individual differences in temperament. In M.E. Lamb & A. Brown (Eds.), *Advances in Developmental Psychology* (Vol. 1, pp. 37-86). Hillsdale, NJ: Erlbaum

Rothbart, M. K., Derryberry, D., & Hershey, K. (2000). Stability of temperament in childhood: Laboratory infant assessment to parent report at seven years. In V. J. Molfese & D. L. Molfese (Eds.), *Temperament and Personality Development Across the Life Span* (pp. 85-119). Hillsdale, NJ: Erlbaum

Rothbart, M.K., Posner, M.I., & Hershey, K. (2006). Temperament, attention, and developmental psychopathology. In D. Cicchetti & D. Cohen (Eds.), *Developmental psychopathology: Vol. 2. Developmental Neuroscience* (2nd ed., pp. 465-501). New York: Wiley.

Royston, J. P. (1982). An extension of Shapiro and Wilk's W test for normality to large samples. *Applied Statistics,31,* 115–124.

Rusalov, V. M. (1989). Object-related and communicative aspects of human temperament: a new questionnaire of the structure of temperament. *Personality and Individual Differences, 10*, 817-827.

Rusalov, V.M. & Trofimova, I.N. (2007). *Structure of Temperament and Its Measurement.* Toronto, Canada: Psychological Services Press.

Russell, A. E., Ford, T., Williams, R., & Russell, G. (2016). The association between socioeconomic disadvantage and attention deficit/hyperactivity disorder (ADHD): a systematic review. *Child Psychiatry & Human Development, 47,* 440-458.

Saudino, K. J. (2005). Behavioral genetics and child temperament. *Journal of Developmental and Behavioral Pediatrics, 26*, 214-223.

SAS Institute. (2013). The SAS system for Windows. Release 9.4. SAS Inst., Cary, NC.

Schafer, J. L., & Graham, J. W. (2002). Missing data: our view of the state of the art. *Psychological Methods, 7*, 147-177.

Sibley, M. H., Swanson, J. M., Arnold, L. E., Hechtman, L. T., Owens, E. B., Stehli, A., ... & Jensen, P. S. (2017). Defining ADHD symptom persistence in adulthood: optimizing sensitivity and specificity. *Journal of Child Psychology and Psychiatry, 58*, 655-662.

Simonds, J. (2006). *The role of reward sensitivity and response: Execution in childhood extraversion.* Unpublished doctoral dissertation, University of Oregon.

Simonds, J., Kieras, J. E., Rueda, M. R., & Rothbart, M. K. (2007). Effortful control, executive attention, and emotional regulation in 7–10-year-old children. *Cognitive Development, 22*, 474-488.

Sjöwall, D., & Thorell, L. B. (2014). Functional impairments in attention deficit hyperactivity disorder: the mediating role of neuropsychological functioning. *Developmental Neuropsychology, 39*, 187-204.

Strelau, J. (1987). The concept of temperament in personality research. *European Journal of Personality, 1*, 107-117.

Strelau, J. (1991). Renaissance in research on temperament: Where to? In J. Strelau & A. Angleitner (Eds.), *Explorations in temperament: International perspectives on theory and measurement* (pp. 337–358). New York: Plenum.

Swanson, J. M., McBurnett, K., Christian, D. L., & Wigal, T. (1995). Stimulant medications and the treatment of children with ADHD. In *Advances in clinical child psychology* (pp. 265-322). Springer, Boston, MA.

Thomas, A., Chess, S., & Birch, H. G. (1970). The origin of personality. *Scientific American, 223*, 102-109.

Thomas, A., Chess, S., Birch, H. G., Hertzig, M. E., & Korn, S. (1963). *Behavioral individuality in early childhood.* New York: New York University Press.

Tripp, G., Schaughency, E. A., & Clarke, B. (2006). Parent and teacher rating scales in the evaluation of attention-deficit hyperactivity disorder: contribution to diagnosis and differential diagnosis in clinically referred children. *Journal of Developmental & Behavioral Pediatrics, 27*, 209-218.

Wåhlstedt, C., Thorell, L. B., & Bohlin, G. (2009). Heterogeneity in ADHD: Neuropsychological pathways, comorbidity and symptom domains. *Journal of Abnormal Child Psychology, 37,* 551-564.

Watson, D., & Clark, L. A. (1992). On traits and temperament: General and specific factors of emotional experience and their relation to the five-factor model. *Journal of Personality, 60,* 441-476.

Wechsler, D. (2011). Wechsler Abbreviated Scale of Intelligence–Second Edition Manual. Bloomington, MN: Pearson.

Weller, E.B., Weller, R.A., Fristad, M.A., & Rooney, M.T. (1999). Children's interview for psychiatric syndromes- parent version (P-ChIPS). Washington, DC: American Psychiatric Press.

White, J. D. (1999). Personality, temperament and ADHD: a review of the literature. *Personality and Individual Differences, 27,* 589-598.

Wilens, T. E., Biederman, J., & Spencer, T. J. (2002). Attention deficit/hyperactivity disorder across the lifespan. *Annual Review of Medicine, 53,* 113-131.

Willcutt, E. G., Nigg, J. T., Pennington, B. F., Solanto, M. V., Rohde, L. A., Tannock, R., ... & Lahey, B. B. (2012). Validity of DSM-IV attention deficit/hyperactivity disorder symptom dimensions and subtypes. *Journal of Abnormal Psychology, 121,* 991-1010.

Wolfe, V. V., Finch, A. J., Saylor, C. F., Blount, R. L., Pallmeyer, T. P., & Carek, D. J. (1987). Negative affectivity in children: A multitrait-multimethod investigation. *Journal of Consulting and Clinical Psychology, 55,* 245-250.

Youngstrom, E., Loeber, R., & Stouthamer-Loeber, M. (2000). Patterns and correlates of agreement between parent, teacher, and male adolescent ratings of externalizing and internalizing problems. *Journal of Consulting and Clinical Psychology, 68,* 1038-1050.