Impairment and Internalizing Comorbidity in Adolescent ADHD: Gender Considerations, Risk Factors, and Response to Treatment

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Abstract

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The literature on attention-deficit/hyperactivity disorder (ADHD) has historically concentrated on externalizing symptoms in elementary-aged males. This paper investigates gender differences in ADHD-related impairment, relationships between ADHD and comorbid internalizing problems, and response to intervention for adolescents with ADHD. Participants are 325 ethnically diverse rising 6th and 9th graders randomized to a high intensity (412 hour) Summer Treatment Program for Adolescents (HI; n=109) vs. low intensity (24 hour) organizational skills intervention (LI; n=109) and an untreated comparison group (n=107). Multiple regression of baseline data was used to evaluate differences in patterns of impairment by gender and grade as well as the relationship between three common areas of ADHD-related impairment (social problems, academic impairment, and family conflict) and teen-reported depressive and anxious symptoms. Results showed few differences in parent- or teacher-reported impairment by gender

or grade. Notably, participants identifying as female were found to have fewer parent-reported academic problems (b=-0.09, p=0.017). Rising 9th graders were found to have higher levels of family conflict (b=0.18; p<0.001) than rising 6th graders. A disordinal interaction was found in for teen-reported depressive symptoms (b=1.43; p=0.006) and parent-reported anxiety symptoms (b=-1.37; p=0.012) with lower symptoms reported for females compared to non-females in the 6th grade cohort but higher levels than non-females in the 9th grade cohort. In terms of the interaction between baseline ADHD-related impairment and internalizing problems, higher levels of family conflict was found to predict depressive symptoms (b=1.36; p=0.032). The HI intervention was found to be associated with a decrease in anxiety symptoms compared to the LI intervention one year following intervention (d =0.28). Grade was found to moderate treatment effects of the LI intervention compared to the untreated group with a greater reduction in symptoms for rising ninth graders (d=-0.48) than rising 6th graders (d=-0.01).

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Chapter 1: Introduction

Attention-deficit/hyperactivity disorder (ADHD) is among the most pervasive and persistent childhood disorders (Barkley, 2015), impacting between one and three students in a classroom of 25 to 30 (DuPaul & Jimerson, 2014; Fabiano et al., 2013). ADHD-related impairment at school, home, work, and in peer relations (Fabiano & Pyle, 2019) frequently leads to significant and adverse outcomes in adulthood, particularly when untreated (Biederman et al., 2010; Hinshaw, et al., 2012). Over fifty years of extensive research have contributed to developing effective treatments for many children with ADHD, particularly elementary-aged boys (Hartung & Widiger, 2002). However, the historic underrepresentation of girls, comorbid internalizing disorders, and adolescents in ADHD literature has resulted in disproportionate access to effective interventions (Quinn, 2005).

Impact of ADHD in Schools

Close to 60% of special education students qualified under emotional disturbance (ED) and other health impairment (OHI) are diagnosed with ADHD (Schnoes, et al., 2006). Additionally, students with ADHD are at elevated risk for poor grades, course failure, enrollment in remedial classes, school drop-out, and teacher-rated behavioral problems (Kent et al., 2011; Kuriyan et al., 2013). In the elementary general education setting, ADHD is implicated in the majority of problematic behaviors (Harrison et al., 2012) and problems related to ADHD cost school districts a significant amount of time and resources (Robb et al., 2011). Furthermore, the U.S. Department of Education, Office of Civil Rights (2016) reports that over 10% of received complaints are related to discrimination against a youth with ADHD. These complaints are potentially caused by the current lack of sufficient structure and support in schools to consistently and effectively meet the needs of this significant population (Fabiano & Pyle, 2019).

As school-based mental health professionals, school psychologists are in a unique position to improve ADHD-related identification and intervention. This requires a deep understanding of the heterogeneity in ADHD presentation and related impairments, developmental trajectory for those with the disorder, and evidence-based interventions.

ADHD in the Literature

As a common childhood disorder, ADHD has been extensively studied for over fifty years (Barkley, 2015) and, as a result, school psychologists have access to an abundance of research describing overall symptomatology, impairment, course, and treatment. Despite a rich research history, which started in 1775 and includes more than 10,000 published articles (Barkley, 2015), several gaps in the literature inhibit the effective identification and treatment of all youth with ADHD.

First and foremost, the majority of research on ADHD, especially longitudinal studies, has been concentrated on elementary-age boys, leading to an overemphasis on the male presentation of the disorder and the under-recognition of girls with ADHD (Biederman et al., 2002; Waschbusch & King, 2006). Consequently, many girls with ADHD are unidentified (Nandeau et al., 2015) and gender-specific impairments are less targeted in intervention (Waite, 2007).

Similar to girls, adolescents with ADHD are underrepresented in the literature, particularly in regards to psychosocial interventions (Antshel, 2015; Chan et al., 2016; DuPaul & Evans, 2008). While researchers have developed a considerable number of evidence-based treatments for elementary-age youth with ADHD (Evans et al., 2014; Fabiano et al., 2009; Washington State Institute for Public Policy, 2018), many of these interventions are less effective in the adolescent population (Chan et al., 2016; Barkley et al., 1992). Considering evidence that

between 40 and 50% of ADHD symptoms persist into adulthood (Sibley et al., 2016a) and the well-documented risks associated with ADHD symptoms (Babinski et al., 2011b; Biederman et al., 2010a; Biederman et al., 2010b; Hinshaw et al., 2012), effective adolescent intervention could dramatically improve the prognosis of individuals with ADHD.

Comorbid ADHD and internalizing disorders (e.g. depression and anxiety) represent a third understudied area in ADHD research (Owens et al., 2015). The literature documents a concrete and substantive connection between comorbid externalizing disorders (such as oppositional defiant disorder and conduct disorder) and ADHD (Pliszka, 2015). In comparison, reported prevalence rates of co-occurring depression and anxiety for those with ADHD are more limited and inconsistent (Biederman et al., 2008; Roy et al., 2014; Roy et al., 2015; Vloet et al., 2010; Zhou et al., 2018). Additionally, few studies have evaluated risk factors that described the mechanism through which youth with ADHD develop depression or anxiety or how internalizing symptoms respond to intervention in youth with ADHD (Becker et al. 2013; Mrug et al., 2004; Ward et al., 2019).

The Current Study

The current study aims to address the gaps in the ADHD literature cited above. This study will examine areas of gender differences in impairment, pathways to internalizing comorbidity, as well as the efficacy of a summer treatment program for adolescents (STP-A; Pelham et al., 2015) in reducing internalizing symptoms and social problems. Finally, the implications of these results will be discussed regarding their impact on the field of school psychology specifically, and the study of ADHD broadly.

Chapter 2: Literature Review

Youth ADHD represents a heterogeneous, or internally diverse, population, with a range of impairments and needs (Faraone et al., 2015; Monuteaux, et al., 2010). ADHD symptoms interact with biological, developmental, and societal factors to create a pattern of impairment that is unique to each individual (Hartung et al., 2002; Maegden & Carlson, 2000; Molina et al., 2017). The current ADHD literature disproportionality describes specific characteristics, impairments, and interventions. Following a summary of ADHD, including presentation, and prevalence, this review will highlight aspects of diagnosis, impairment, comorbidity, and intervention that are often underrepresented in the literature. First, research on gender considerations in diagnosis and ADHD-related impairments will be reviewed. Second, the review will summarize the current understanding of internalizing comorbidity in ADHD and associated risk factors. Finally, the literature on adolescent ADHD interventions will be reviewed, in particular, the summer treatment programs for teens with ADHD (STP-A).

ADHD 101

ADHD is a common neurodevelopmental disorder that can cause significant impairment across multiple settings, including home, school, work, and in social situations (Barkley, 2015; Blachman & Hinshaw, 2002; Chronis-Tuscano et al., 2010). In addition to core symptoms of inattention and/or hyperactivity/impulsivity, emotion dysregulation and social problems are frequently observed associated features of the disorder (American Psychiatric Association [APA], 2013). Prior to the Diagnostic and Statistical Manual of Mental Disorder, 5th edition (DSM-5), individuals diagnosed with ADHD were required to manifest symptoms prior to age seven (APA, 1994). While the DSM-V increased the age of onset to 12 years of age (APA, 2013), ADHD remains commonly perceived as a childhood disorder, despite evidence of persistence of

symptoms into adulthood (Biederman et al., 1996a; Biederman et al., 2010a; Biederman et al., 2010b; Sibley et al., 2016a).

ADHD Presentation

The DSM-V defines ADHD by two core dimensions, inattention (IA) and hyperactivity/impulsivity (HI), each with nine possible symptoms (APA, 2013). The IA dimension pertains to difficulties with organization, sustained attention, lack of persistence in difficult tasks, and distractibility. The HI dimension includes hyperactive symptoms such as fidgeting, frequently leaving an assigned area, excessive or loud talking, as well as impulsive symptoms including blurting out answers, interrupting others, and difficulty waiting for one's turn (APA, 2013).

Individuals can be diagnosed with three distinct presentations of ADHD; the predominantly inattentive presentation (ADHD-I), the predominantly hyperactive/impulsive presentation (ADHD-HI), and the combined presentation (ADHD-C). Diagnosis of ADHD-I and ADHD-HI require a child to exhibit six or more symptoms from their respective dimensions while a diagnosis of ADHD-C requires six or more symptoms from both lists. Adolescents (17 and older) and adults are required to exhibit five, as opposed to six, symptoms to address developmental considerations (APA, 2013).

Gender Differences in Presentation. While girls are often considered as 2.2 times more likely to have ADHD-I than are boys, ADHD-C is the most common presentation for both genders (Biederman et al., 2004; Milich et al., 2001). Hartung and colleagues (2002) conducted a study of 127 children with ADHD (22 girls and 105 boys between the ages of three and seven). The study included a structured clinical interview using the Diagnostic Interview Schedule for Children (DISC; Shaffer et al., 2000) to confirm diagnoses and identify ADHD presentations, but

did not require impairment in two or more settings to diagnose ADHD. ADHD-C was the most frequently diagnosed presentation for both females (59%) and males (67%). More girls than boys were diagnosed with ADHD-I (23% vs. 9%) and more boys than girls had ADHD-HI (24% vs. 18%). This finding indicates that, while girls and boys differ on their risk for unidimensional presentations, both genders most frequently exhibit clinical levels of symptomatology in both dimensions, contradicting the common misconception that girls predominantly qualify for the inattentive presentation of the disorder (Owens et al., 2015).

Prevalence

In 2016, 9.4% of parents reported that their child had received an ADHD diagnosis at some point and that 89.4% of children with historical diagnoses of ADHD were reported to have ADHD currently (Danielson et al., 2018). This amounts to 5.4 million children or 8.4% of children in the United States between the ages of two and 17 (Danielson et al., 2018). Prevalence rates vary across studies and appear to be increasing over time (CDC, 2010). This is not surprising given the expansion of research on ADHD over the past 20 years, with the number of studies on ADHD doubling in 2013 alone (Barkley, 2015). On the other hand, some researchers attribute the rise in reported ADHD to an increase in diagnosis due to changes in DSM-V required age of onset (Faraone et al., 2015). The current literature lacks consensus on a specific prevalence rate for ADHD. The DSM-5 reports prevalence rates of 5% in children and 2.5% in adults (APA, 2013). Reported prevalence for all ages varies from 2.5% (Simon et al., 2009) to 8.4% (Danielson et al., 2018), depending on sampling procedures. Currently, the most accepted prevalence is 8.4%. In terms of childhood prevalence, national surveys estimate that (CDC, 2010) 9.5% of children had been diagnosed at one point, whereas Mikami & Hinshaw (2003) report rates between 3 and 7%. The discrepancy between the lowest and highest prevalence rates

reported above amounts to anywhere from 3.2 to 5.1 million children in the United States impacted by the disorder: a highly unspecific range considering the wealth of research on the topic.

Gender Ratios in Prevalence. Gender differences in prevalence rates represent another inconsistency in ADHD research (Faraone et al., 2015). The reported gender ratio of ADHD prevalence ranges from 3:1 (male to female) in community-based samples to 9:1 in clinic-based samples (Biederman et al., 2002; Gaub & Carlson, 1997; Gershon, 2002; Owens et al., 2015). The literature provides divergent evidence regarding the validity and theoretical conceptualization of the gender discrepancy (Arnett, 2015; Biederman et al., 2002; Leopold et al., 2019; Hartung et al., 2002; Owens et al., 2015). However, the historic male-orientation of ADHD research and subsequent under-representation of a females in the development of diagnostic criteria as well as gender differences in the presentation of ADHD are frequently cited as perpetuating gender bias in referrals (Bauermeister et al., 2007; Gershon, 2002; Nadeau et al., 2015). Gender differences in ADHD prevalence warrants further research (Leopold et al., 2019).

Gender Considerations in ADHD

The majority of ADHD research, especially longitudinal studies, has concentrated on elementary-age boys, leading to an overemphasis on the male manifestation of symptoms and the under-recognition of girls with ADHD (Biederman et al., 2010b; Waschbusch & King, 2006). For example, in a meta-analysis of 70 empirical ADHD studies in the *Journal of Abnormal Child Psychology* between the release of the DSM-III and DSM-IV, 49% of the studies included both genders with no studies containing all female participants. Of the 4,873 children in these 70 studies, 19% (n = 906) were girls and 81% were boys (n = 3,967; Hartung & Widiger, 1998).

Research on girls with ADHD lags behind the literature on males with the disorder (Gaub & Carlson, 1997; Gershon, 2002). However, over the last decade, there has been increasing research interest in gender differences in ADHD presentation, impairment, comorbidity, and prognosis (Bauermeister et al., 2007; Biederman et al., 2005; Biederman et al., 2010b; Hartung et al., 2002; Owens et al., 2015; Nandeau et al., 2015). Several longitudinal studies have now followed both boys and girls with ADHD through young adulthood and have integrated gender considerations into analysis of outcomes. Principal investigator (PI), Joseph Biederman, conducted parallel male and female studies PhD (Biederman et al., 1996b; Biederman et al., 2002) and evaluated gender differences in ADHD impairment and outcomes (Biederman et al., 2004; Biederman et al., 2005; Biederman et al., 2010a; Biederman et al., 2010b). Likewise, The Pittsburgh ADHD Longitudinal Study, Brooke Molina (PI), compares adult women with childhood ADHD to adult men with childhood ADHD (Babinski et al., 2011b) and to women with no childhood diagnosis of ADHD (Babinski et al., 2011a; Babinski et al., 2011b). The Berkley Girls with ADHD Longitudinal Study, (Stephen Hinshaw PhD (PI); Hinshaw, 2002; Hinshaw et al., 2006; Hinshaw et al., 2012; Owens & Hinshaw, 2016) compares girls with ADHD to neuro-typical peers.

While some studies report few differences between boys and girls with ADHD (Babinski et al., 2011b; Bauermeister et al., 2007; Biederman et al., 2002; Hartung et al., 2002), others describe differing patterns of impairment between genders (Gaub & Carlson, 1997; Gershon et al., 2002, Owens et al., 2015). Biederman and colleagues (2005) describe the influence of gender on the expression of ADHD as a limited but definite moderator, indicating that although objective and measurable gender differences in ADHD symptoms and impairment have been

inconsistent, there is substantial evidence that the experience of ADHD differs for females versus males. One significant gender difference is in ADHD referral and diagnosis.

Gender Considerations in Diagnosis

The field trials used to establish DSM-IV criteria for ADHD included predominantly male subjects, influencing the diagnostic criteria, and increasing the salience of symptoms more commonly observed in males, such as hyperactivity and impulsivity (Roberts et al., 2015). Females often do not meet diagnostic criteria, despite experiencing significant impairment, because they less frequently exhibit the overt externalizing ADHD (Murray et al., 2018) more typical in male ADHD. The normative sampling of Caucasian elementary-age boys in DSM-V field trials and subsequent diagnostic criteria has equated ADHD with hyperactivity, inhibiting the identification of girls with less visible presentations (Murray et al., 2018; Waite, 2007). As there is no consideration of gender differences in DSM-V diagnostic criteria, in order to receive a diagnosis, girls with ADHD are often required to exhibit more extreme symptomatology (Roberts et al., 2015; Waschbusch & King, 2006).

Implications of Gender Considerations in Symptom Profile on Diagnosis. Boys with ADHD often demonstrate more overt ADHD symptoms than girls (Kok et al., 2016; Monuteaux et al., 2010; Newcorn et al., 2001; Thorell & Rydell, 2008) and are more likely to have disruptive and/or hyperactive behaviors (Elkins et al., 2011; Hartung et al., 2002; Kok et al., 2016; Leopold et al., 2019; Stein & Shin, 2002). Contrastingly, girls often present with more inattentive or internalizing symptoms (Biederman et al., 2002; Hartung et al., 2002; Kok et al., 2016; Milich et al., 2001), leading to a higher referral rate in males than females (Kok et al., 2016) as both school (Gershon, 2002; Owens et al., 2015) and clinic referrals (Biederman et al., 2002) are often driven by the presence of overt and disruptive behavior. In fact, referral rates are much lower for

gender-typical girls than for girls with traits perceived as more masculine, due to increased likelihood of externalizing behaviors in the latter (Kok et a., 2016). A 1998 study by Arcia & Conners found that girls with hyperactive symptoms were, on average, referred 18 months earlier than boys with hyperactivity and 38 months earlier than girls without hyperactivity, highlighting the influence of both gender expectations and hyperactivity on referral.

The increased likelihood of predominantly inattentive symptoms in girls further impacts referral rates as inattentive symptoms tend towards a later onset (Stein & Shin, 2002) and share more overlap with other clinical disorders than do hyperactive/impulsive behaviors (Kofler et al., 2013; Lipszyc & Schachar, 2010). Therefore, inattentive symptoms are more difficult to distinguish from other conditions (Biederman et al., 2002; Spitzer et al., 1990) and girls are subsequently often misdiagnosed with a comorbid disorder indicated as their primary condition (Quinn, 2005). Specifically, coexisting anxiety and depression, often reported as more common in girls with ADHD than boys, tends to mask underlying ADHD (Meinzer, 2014; Waite, 2007).

ADHD symptoms in girls has been found to increase significantly between the ages of 11 and 13 (Murray et al., 2018) and they frequently exhibit less academic impairment in elementary school than do boys with ADHD (Bauermeister et al., 2007; Biederman et al., 2004). Girls also tend to demonstrate stronger coping skills than boys do and are often reported to effortfully minimize symptoms in order to meet teacher or parental expectations (Bauermeister et al., 2007; Faraone et al., 2015; Kok et al., 2016; Waite, 2007). As the rate of referral is highest for children in grades four and five (LeFever et al., 1999), a later onset of visible impairment in the school setting could inhibit referral of females with ADHD (Murray et al., 2018).

Implications of Gender Considerations in Symptom Severity on Diagnosis. Gender has been found to contribute mildly to variance in severity of inattentive (10% variance) and

hyperactive/impulsive symptoms (13%; Leopold et al., 2019). Gaub & Carlson (1997) conducted a meta-analysis on ADHD research finding, overall, few gender differences in ADHD symptoms and impairment. Furthermore, the authors report that identified gender differences largely disappeared in studies utilizing clinic-based samples. While the meta-analysis found few qualitative differences between boys and girls in expression of ADHD, sufficient quantitative differences suggest that, due to gender-specific behavioral expectations, reducing the symptomatic requirements of current ADHD criteria might promote more proportional diagnosis (Gaub & Carlson, 1997). Failing to identify gender-specific manifestations of a disorder could contribute to disproportionate diagnoses between the two sexes (Murray et al., 2018; Hartung & Widiger, 1998). Recent studies on ADHD in adulthood, which include a higher proportion of female participants due to increased self-referral, indicate that further research into gender differences is required to improve identification of ADHD in girls (Babinski et al., 2011b; Bagwell et al., 2006).

Similarly, Waschbush & King (2006) conducted a study of 1,491 elementary students to determine the number of children who demonstrated significant impairment due to ADHD but did not meet criteria according to the DSM-IV. Measures included teacher and parent ratings on the Assessment of Disruptive Symptoms (ADS-IV; Waschbusch, Sparkes, & Northern Partners in Action for Children & Youth, 2003), the Children's Impairment Rating Scale (CIRS; Pelham et al., 1996), as well as peer nominations. Girls with ADHD demonstrated lower symptoms of inattention (Teachers- $F(1, 1474) = 62.011$, $p < 0.001$; Mothers- $F(1, 793) = 25.08$, $p < 0.001$) and hyperactivity (Teachers- $F(1, 1477) = 58.01$, $p < 0.001$; Mothers- $F(1, 793) = 16.33$, $p < 0.001$) than boys. As a community-based sample, children were divided into groups (DSM and comparison) according to whether their ADHD symptoms, as reported by their mothers and

teachers, met DSM-IV criteria. Raters were asked to compare children to their same-sex peers while completing rating scales.

An additional group, the sex-specific group, was comprised of children who did not meet DSM-IV criteria, but who had parent- or teacher- reported inattention or hyperactive/impulsive, symptoms 1.5 standard deviations above the mean for their gender (Waschbusch & King, 2006). The researchers used 1.5 standard deviations as a cut off as it equates to 7% of the sample, which is close to the estimated prevalence rate of ADHD (8.4%; Danielson et al., 2018) well as the research and clinical practice frequently utilizes 1.5 standard deviations above the mean as the clinically significant cut off (Achenbach, 1991). The study found that boys were significantly more likely to be in the DSM group and that girls were significantly more likely to be in the sex-specific group. Furthermore, the sex-specific group was more similar to the DSM group than the comparison group in overall impairment and peer nominations. In teacher ratings, the sex-specific group had more overall impairment (Cohen's d = 0.44 to 0.45) with the exception of the combined sex-specific group (no significant difference) and fewer peer nominations (Cohen's d = 0.25 to 0.55) than the comparison group. The sex-specific group had lower overall impairment (Cohen's d = -1.06 to -1.07) compared to the DSM group, however, they did not differ in peer nominations. According to mother ratings, the sex-specific group had more overall impairment (Cohen's d = 0.92 to 1.66) and fewer peer nominations (Cohen's d = 0.46 to 0.75) compared to the comparison group. Those in the hyperactive/impulsive and combined sex-specific group significantly differed from the DSM group in overall impairment (Cohen's d =-0.56 to -1.39).

Interpreting Waschbusch & King's (2006) results, while boys might experience more severe ADHD-related impairment, they are also more likely to receive a diagnosis. Comparatively, girls might experience less overall impairment or symptoms than boys, however

those with impairment are less likely to qualify for a diagnosis of ADHD, according to the DSM-IV criteria. Furthermore, undiagnosed girls often experience impairment more similar to those with ADHD than to their typical peers. These findings are replicated in a 2007 study in Puerto Rico (Bauermeister et al., 2007) that reports the potential for a small percentage of girls with symptomatology consistent with ADHD but who fail to meet DSM-IV criteria for a diagnosis.

Summary of Gender Considerations in Diagnosis. The consequence of under-identifying girls with ADHD is that women who are diagnosed later in life are more likely to experience comorbidity, emotional dysregulation, and self-esteem challenges (Smyth et al., 2016). Further research on gender differences in ADHD-related impairment, including how these impairments interact with social expectations, would facilitate referral and diagnosis gender ratios more representational of prevalence in community-based samples. Continuing to work towards a deeper understanding of heterogeneity in ADHD will expand conceptualization of the disorder beyond the stereotypical elementary male manifestation (Murray et al., 2018). Additionally, evidence that girls develop more quickly and are more likely to experience inattentive symptoms which present later, promotes the inclusion of age as well as gender in future analyses of ADHD-related impairment.

Gender Considerations in ADHD-Related Impairment

While literature describing female ADHD-related impairment in adolescence and adulthood is limited, there is evidence that girls with childhood ADHD experience greater psychiatric symptomatology across multiple domains and more severe functional impairments than neurotypical girls (Babinski et al., 2011a, Babinski et al., 2011b; DuPaul et al., 2006 Hinshaw et al., 2012). The female pattern of impairment may differ slightly from their male counterparts (Babinksi et al., 2011a; Murray et al., 2018; Gaub & Carlson, 1997; Gershon, 2002;

Washbusch & King, 2006), potentially due to variations in baseline risks associated with gender. Furthermore, there is evidence that, although girls may appear less empirically impaired than boys, their experience of impairment may be more severe relative to societal gender norms (DuPaul et al., 2006).

Consequently, a comprehensive conceptualization of ADHD views impairment through a lens that layers biological and societal factors on top of reported or observed symptoms (Bauermeister et al., 2007; Nadeau et al., 2015). Tuckman (2009) reports that gender differences in ADHD impairment is more attributable to societal expectations than to ADHD symptom severity because gender often moderates the experience of living with ADHD. Therefore, both effective identification and treatment of ADHD incorporates the individual's biopsychosocial context (Bauermeister et al., 2007).

Meta-Analyses. The seminal meta-analysis gender differences in ADHD (Gaub & Carlson, 1997) compared females and males on 11 measures of ADHD symptoms and related impairments, including impulsivity, academic performance (global, math, reading and spelling), social functioning (global and peer-liking), fine motor skills, maternal and parental education, and parental depression. The analysis showed that girls were more frequently reported as cognitively impaired both overall (Cohen's d = -0.366; p = 0.002) and verbally (Cohen's d = -0.494; p = 0.002). Girls were reported as less hyperactive (Cohen's d = 0.16; $p < 0.001$), to have fewer instances of comorbid conduct disorder (Cohen's d = 0.14; p = 0.003), less externalizing behavior (Cohen's d = 0.17; p = 0.03), and to show less aggression towards peers (Cohen's d = 0.35; p = 0.007). Results depended on the sampling methods utilized by the study, with community-based samples suggesting girls were more attentive, less aggressive, and more liked by peers. In clinic-based samples, no significant gender differences were found with a trend

towards girls being more inattentive ($p > 0.05$). These findings indicate that, while overall the male and female expression of ADHD is similar, there are some gender specific patterns of impairment and that these patterns vary depending on the identification process. The authors recommend the use of gender-specific norms if impairment and symptoms differ by gender and population-based norms if the translation of symptom to impairment is comparable for boys and girls, leveraging the example of the societal stigmatization of hyperactivity in girls to promote the use of gender-specific norms for ADHD conceptualization.

In subsequent meta-analysis (Gershon, 2002), girls were found to have lower ratings of hyperactivity (d =0.29, $p < 0.05$), inattention (according to teacher- but not parent-ratings) (d = 0.23, $p < 0.05$), impulsivity (d = 0.22, $p < 0.05$), and other externalizing problems (teacher-rated) (d = 0.21, $p < 0.05$), but greater intellectual impairment (full scale IQ = d = -0.27, $p < 0.05$; verbal IQ = d = 0.37, $p < 0.05$) and more internalizing problems (d = -0.12, $p < 0.05$). The author found no significant gender differences in academic achievement, neuropsychological differences or social functioning.

Longitudinal Studies. Biederman and colleagues (2002; 2006; 2010a; 2010b) conducted parallel male and female studies, with 140 children with ADHD versus a comparison group of typically developing peers (male study, N = 120; female study, N =122). Diagnoses were confirmed using the Kiddie Schedule for Affective Disorders for School-Age Child-Epidemiologic Version (K-SADS-E; Orvaschel, 1994), which has a median kappa reliability based on 173 interviews of .86 for ADHD, .93 for multiple anxiety disorders, and .83 for major depressive disorder. The study found several gender differences in the manifestation of ADHD. Girls had a significantly later age of onset for the disorder (M = 3.50 years, SD = 2.50) than boys (M = 2.70 years, SD = 1.00; t = 3.00 (df =1), p = 0.003). ADHD presented a stronger risk factor

for substance abuse in boys than in girls, with ADHD increasing the risk of substance abuse 20 times more in girls than in boys. Girls had a significantly lower risk of experiencing another behavior disorder, but were more likely to have a panic disorder, separation disorder, anxiety, and depression. While girls with ADHD statistically had lower IQs than boys with ADHD, the difference was not clinically significant, and girls exhibited significantly higher reading scores and lower rates of LD. The authors found no evidence of gender differences in psychosocial functioning or familial factors but reported that girls with ADHD had fewer school problems and participated in more spare-time activities than their male counterparts.

The Berkeley Girls with ADHD Longitudinal Study (BGALS; Hinshaw, 2002; Hinshaw et al., 2006; Hinshaw et al., 2012; Owens & Hinshaw, 2016) compared girls with ADHD to girls without a diagnosis of ADHD. While the study included no males with ADHD, the authors compare female participants to comparable male studies. Results indicated no significant male vs. female differences in mother-reported inattention, but teachers rated girls as less inattentive (Cohen's $d = 0.68$; $p < 0.01$). Girls were rated as less hyperactive on both the teacher-completed Disruptive Behavior Disorders checklist (DBD; Pelham et al., 1992) and Conners Rating Scales (Cohen's $d = 0.76\text{-}0.85$; $p < 0.01$; Conners, 1997;). While girls with ADHD experienced more internalizing symptoms than control girls ($p < 0.01$), there was no difference between boys and girls with ADHD. No gender differences were found in social impairment measures (measured by peer preference and the Social Skills Rating System; SSRS; Gresham & Elliot, 1990) but both girls and boys were significantly more impaired than controls after controlling for IQ and psychopathology. No differences, according to gender, were found on behavioral measures or measures of global impairment.

The Pittsburgh ADHD Longitudinal Study (PALS) began initial recruitment of 364 children with ADHD and 240 demographically matched neurotypical peers in 1987 and is ongoing. Participants ranged from five to 16 years old at recruitment and ADHD youth participated in an 8-week summer treatment intervention (Molina et al., 2016).

Neuropsychological Impairment. There are several studies evaluating neuropsychological differences in males and females with ADHD (Balint et al., 2009; Monuteaux et al., 2010). Although studies have found subtle but meaningful sex difference in cognition, brain structure, and brain function for individuals with ADHD (Monuteaux et al., 2010), this review of the current literature found little evidence of gender differences in neuropsychological functioning.

One meta-analysis (Balint et al., 2009) included 25 studies, 1711 participants with ADHD, and 1731 controls. The studies reviewed included mostly adult participants with a slight underrepresentation of women. Measures evaluated in the analysis include: the Stroop Color-Word Test (Golden, 1975) to assess impulsivity, the Trail Making Test (Reitan, 1994) to assess attention, the Weschler Adult Intelligence Scale, Revised Edition (WAIS-R; Weschler, 1981), and the Continuous Performance Test (Conners, 1994; Conners et al., 2003). Balint and colleagues found that overall more studies reported men with ADHD to be more neurologically impaired than women with ADHD.

Another (2002) neuropsychological study by Rucklidge and Tannock that evaluated 13-16-year-old adolescents including 35 adolescents with ADHD, 12 with a specific reading disability (RD), 24 with both ADHD and RD, and 37 typically developing teenagers. The study included an equal representation of males and females. The study found no gender differences in processing speed, behavioral inhibition, working memory, retrieval speed, or variability of

reaction times. Likewise, Uebel and colleagues (2010) found no neuropsychological gender differences in participants with ADHD.

Social Impairment. ADHD literature is divided on whether girls or boys with the disorder experience more social impairment with some reporting an absence of moderation by gender (Becker et al., 2013; Hinshaw et al., 2012) and others finding males to be more impaired (Hartung et al., 2002). A third group reports more peer rejection or social problems in girls with ADHD than in boys with ADHD (Mikami & Hinshaw, 2003; Smyth et al., 2016), particularly in adolescence (Noren et al., 2016). DeBoo & Prins (2007) found no gender differences overall when comorbidity is taken into account.

Becker et al. (2013) evaluated the relationship between gender, negative social preference and internalizing/externalizing problems in 180 children with ADHD-I, between the ages of seven and 11 (41% female, $n = 78$). ADHD diagnoses were confirmed using the ADHD module of the Child Symptoms Inventory (CSI-4; Gadow & Sprafkin, 2002), Impairment Rating Scale (IRS; Fabiano et al., 2006) and the K-SADS (Orvaschel, 1994). Diagnoses were verified with 100% agreement from an independent clinician. Social preference was assessed using teacher ratings of the proportion of peers that liked/accepted or disliked/rejected the child as well as with the Dishion Social Acceptance Scale (Dishion et al., 1991). Becker and colleagues found that boys and girls with ADHD did not differ on teachers' negative social preference scores.

A 2006 study assessed how the social interactions of girls with ADHD differed from girls of the same age ADHD ($N = 80$; $M = 10.8$ years) using a simulated social computer game (Ohan & Johnson, 2006). Research assistants told each participant that they would be playing a game with real girls her age living in the same city. The game was social in nature and required participants to make decisions about spreading rumors and excluding other (simulated) girls.

They also had the opportunity to message other (simulated) girls. Participant choices and messages were recorded and coded for frequency and intensity in three areas (aggression, prosocial, and social awkwardness).

Results found that girls with ADHD to be significantly more overtly and relationally aggressive ($F(2, 78) = 3.63$, $\eta^2 = 0.14$, $p < 0.03$) and less covert, indirect relational aggression ($F(2, 78) = 6.34$, $\eta^2 = 0.25$, $p <. 0003$) than control girls. Additionally, ADHD status predicted less frequent ($F(2, 78) = 0.50$, $\eta^2 = 0.16$, $p < 0.04$) prosocial interactions. Similarly, girls with ADHD exhibited more frequent ($F(2, 78) = 3.01$, $\eta^2 = 0.10$, $p <0.05$), and more intensely ($F(2, 78) = 4.32$, $\eta^2 = 0.19$, $p < 0.02$) socially awkward interactions than girls without ADHD. These findings indicate that girls with ADHD may interact with their social world in way that is gender atypical. Specifically, girls with ADHD engaged in less sophisticated relationship aggression and less rumor spreading, tending towards more overt and immature aggression. According to evidence that these forms of covert relational aggression is indicative of peer inclusion, (Zalecki & Hinshaw, 2004), even this outwardly benign difference in girls with ADHD might contribute to a lack of connection with peers. A 2016 study indicates that gender differences in social impairment may continue to increase in adolescence (Noren et al., 2016). Noren and colleagues found that 41.8% of girls with diagnosed ADHD and 36.4% of girls with subthreshold ADHD report peer problems in adolescences compared with 16.1% of girls with no ADHD symptoms and 36.9% of boys with ADHD (Noren et al., 2016).

Academic Impairment. Similar to other areas of impairment, extant literature reports discrepant findings regarding gender differences in academic impairment (Bauermeister et al., 2007; DuPaul & Prins, 2006). A 2007 community-based study of 1,886 children, ages 4 to 17, in Puerto Rico found little evidence of significant gender differences in the risks and sequela of

ADHD. However, authors report that boys with ADHD demonstrated higher impairment in school than did girls (Bauermeister et al., 2007). Boys showed more impairment on the Brief Impairment School Scale ($\beta = 1.40$, $p < 0.01$; BIS; Bird et al., 2005) and in overall impairment, ($\beta = 1.80$, $p < 0.01$). Boys had more speech and (Odds Ratio (OR) = 2.40, $p < 0.01$) sleep (OR = 1.40, $p < 0.05$) problems. Additionally, males were more likely to fail a grade (OR = 2.80, $p < 0.01$) and be suspended from school (OR = 3.20, $p < 0.01$) compared to girls. However, the rates of disruptive behaviors were similar for boys and girls with ADHD; therefore, it is possible that boys exhibit more annoying or distressing disruptive behaviors than do girls.

Similarly, a 2006 study of 133 males and 42 females with ADHD (DuPaul et al., 2006) found that boys and girls with ADHD did not vary significantly in academic functioning. Results showed no significant difference in academic achievement (measured by the Woodcock Johnson Tests of Achievement, Third Edition), classroom grades, or social skills (Social Skills Rating System- Teacher Form; SSRS-T; Gresham & Elliot, 1990). Interestingly, authors report significant gender differences on the BASC, teacher rating form (BASC-T; Reynolds & Kamphaus, 1992), Wilks' $\Lambda = 0.85$; $F(5,155) = 5.32$, $p < 0.001$), with girls experiencing more impairment in internalizing problems, externalizing problems, school problems, and on the Behavioral Index, with effect sizes ranging from .46 to .57. Conversely, girls were rated lower on the adaptive skills scale ($t_{(1,59)} = 4.28$, $p < 0.001$, Effect Size = 0.79). Observed behavioral data yielded no significant gender difference. Overall, the study found that both girls and boys with ADHD to be in the low average range in reading and math on both the Woodcock Johnson Tests of Achievement (Woodcock & Mather, 1989) and on report cards. While girls were found to exhibit stronger academic motivation and study skills, both genders were impaired relative to their neurotypical peers. The researchers concluded that although the genders displayed

divergent patterns of impairment, they faced similar risk for deficits in academic, emotional, and social functioning.

Gender Considerations in Adolescent and Young Adult Outcomes.

While the research consistently finds youth with ADHD, including females, are at increased risk of experiencing negative life outcomes in adulthood (Babinski et al., 2011b; Chronis-Tuscano et al., 2010; Hinshaw et al., 2002), some studies report no difference between the genders (Bussing et al, 2010). There is evidence that women with a childhood diagnosis of ADHD are more likely to self-report ADHD symptoms in adulthood than are men with a childhood diagnosis of ADHD (Millenet et al., 2018), indicating that ADHD may be more persistent for females than males. Additionally, there is some evidence that women with ADHD are more at risk for adverse life outcomes than men with ADHD when compared to the non-ADHD population (Chronis-Tuscano et al., 2010; Noren et al., 2016). Reports of outcomes of females with ADHD are limited by challenges in recruiting females with ADHD for longitudinal studies and the historical male-orientation of ADHD research (Biederman et al., 2010b; Nadeau et al., 2015; Owens et al., 2015). However, the Berkley Girls with ADHD Longitudinal Study (BGALS; Hinshaw, 2002; Hinshaw et al., 2006; Hinshaw et al., 2012) is one example of a longitudinal female-only study. Understanding the trajectory of ADHD symptoms and impairment in adolescence for girls is particularly critical given evidence that they experience an increase in symptomatology between the ages of 11-13, more so than do their male counter parts (Murray et al., 2018).

BGALS Study. Hinshaw et al. (2012) conducted a follow up of the BGALS (140 girls with ADHD and 88 comparison girls without ADHD, (6 – 12 years old at baseline) matched for age and ethnicity (Hinshaw et al., 2006). Within the ADHD group, 93 girls were diagnosed with

ADHD-C and 47 with ADHD-I. The researchers evaluated the girls at a 10-year follow up, when they were 17 to 24 years old, for ADHD symptoms, internalizing and externalizing symptoms, substance use, eating pathology, self-perception, functional impairment (global, academic, and service utilization), self-harm, and driving behavior. The researchers found that girls with ADHD experienced significantly greater impairment than comparisons girls ($F(64,132) = 2.27$, $p < 0.001$) and in each of the assessed areas, excluding eating disorders. Furthermore, authors report few differences between the ADHD-C and ADHD-I groups.

In regard to internalizing symptoms, Hinshaw and colleagues (2012) found that the ADHD groups had significantly higher anxiety than the comparison group (OR = ~ 4) using the Diagnostic Interview Schedule for Children, fourth edition, (DISC-IV; Shaffer et al., 2000) and higher (but not significantly, $p = 0.024$) rates of depression or dysthymia (OR~ 3). There were no differences in internalizing symptoms using the Beck Depression Inventory-II (BDI-II; Beck et al., 1985) or the Adult Self-Report (ASR; Achenbach & Rescorla, 2003). Girls with ADHD met criteria more frequently for oppositional defiant disorder or conduct disorder diagnoses, as measured with the Adult Behavior Checklist (40% compared to 5% in comparison girls; ABCL; Achenbach & Rescorla, 2003) and the ASR (medium effect size). The ADHD groups did not differ significantly from each other. The Substance Use Questionnaire (SUQ; Molina & Pelham, 2003) showed no significant differences between ADHD groups and comparison girls (Hinshaw et al., 2012). Nor did the Eating Disorders Inventory (EDI-2; Garner, 1991). The authors report that the study's previous adolescent follow-up found significant differences in eating pathology but that, between the adolescence and young adulthood follow-ups, the means increased for all groups with the comparison group experiencing the largest increase in eating pathology. In terms of self-perception (measured by the Self-Perception Profile for Adolescents; Harter, 1999), both

ADHD groups had significantly more negative perceptions of themselves (p =0.007) but did not differ between ADHD type.

The Columbia Impairment Scale (CIS; Bird, 1999) documented significant and large effects between ADHD groups and comparison girls in global impairment with no between-ADHD group differences. Girls with ADHD had significantly lower scores in math and reading (large effect sizes) on the Weschler Individual Achievement Test, Second Edition (WIAT-II; Wechsler, 2001) with no differences between ADHD groups. Girls with ADHD-C and ADHD-I were significantly more likely to receive school services (OR almost 7) compared to comparison girls and did not differ from each other. Self-harm, as measured by the Barkley Suicide Questionnaire and Self-Injury Questionnaire (Barkley, 2006; Claes et al., 2001), was significantly more likely in the ADHD groups with 22% of girls with ADHD-C reporting a suicide attempt compared to 8% of girls with ADHD-I and 6% of comparison girls. There was a significant difference in self-injury, described as sub-suicidal self-injury between both ADHD-C and comparison girls (OR = 4.4) as well as between girls with ADHD-C and ADHD-I (OR = 2.5). The study found no difference in reported driving behavior. Overall, Hinshaw and colleagues (2012) found that girls with ADHD maintain marked impairment in early adulthood and that there are few differences based on ADHD presentation. The only longitudinal female ADHD study BGALS, provides valuable information about developmental trajectory of girls/women with ADHD compared to girls/women without ADHD. However, the BGALS study is limited in its ability to compare those with female ADHD to those with male ADHD in regard to impairment or long-term outcomes. The Biederman parallel studies is the only known set of studies that can directly compare women/girls with ADHD both to other women/girls and to men/boys with ADHD.

Biederman Parallel Studies. Biederman and colleagues conducted an 11-year follow up of 96 women with ADHD and 91 comparison women (Biederman et al., 2010b), to evaluate developmental trajectories and young adult outcomes (Baseline age, *M* = 12 years; Follow up age, *M* = 22 years). Furthermore, these findings can be compared to the parallel male study, which is identical in design (*N* = 217, *M* = 22 years; Biederman et al., 2006). Using the Structured Clinical Interview for DSM-IV (SCID; First et al., 1997) and the Kiddie Schedule for Affective Disorders and Schizophrenia, Epidemiological Version (K-SADS-E; Orvaschel,1994), the study showed an association between ADHD and mood/anxiety problems, disruptive behaviors, and language problems. The authors report a hazard ratio of 7.2 for antisocial disorders, 6.8 for mood disorders, 2.1 for anxiety disorder, 3.5 for additive disorders, and 3.5 for eating disorders. All results with the exception of addictive disorders remained significant after controlling for baseline psychopathology and illustrate the additional risk of these outcomes for women with ADHD compared to the comparison women.

When viewed in conjunction with a parallel male study (Biederman et al., 2006), these results demonstrate that girls with ADHD are similarly impaired to their male counterparts with different patterns of impairment. Women were less likely to develop anti-social personality disorder (13% vs 6%) and more likely to experience depression (20% vs. 8%), agoraphobia (25% vs. 3%) and social phobia (20% vs. 4%). The authors indicate that these findings align largely with findings from the BGAL study. The Biederman parallel studies illustrate the potential outcomes for women with a history of childhood ADHD relative to other women and to men with ADHD, they are limited however, by a sample that is predominantly (93%) females. Furthermore, the study does not evaluate mechanisms through which women with ADHD

develop psychopathology in adulthood, meaning that while we know what could happen to girls with ADHD as they age, the study does not provide guidance towards preventative measures.

The Pittsburgh ADHD Longitudinal Study. Initiated as a one-time adolescent ADHD study in 1994, The Pittsburgh ADHD Longitudinal Study (PALS) has collected data on men and women with ADHD into their 40s (Molina et al., 2017). No evaluation of gender differences in symptoms or impairment during childhood gender was found during review of the literature. Subsequent studies utilizing adult follow up data compare women with childhood ADHD to both comparison women and to men with childhood ADHD (Babinski et al 2011a; Babinski 2011b). PALS studies are limited by the number of girls with ADHD included at baseline ($N = 36$) and published analyses focus on longitudinal outcomes, specifically, the relationship between ADHD and risky adult behaviors (Pedersen et al., 2016; Thompson et al., 2007), as opposed to childhood patterns of impairment.

Summary of Gender Considerations in ADHD

The gender disproportionality in ADHD literature is well documented (Babinsky et al., 2011b; Owens et al., 2015; Hartung et al., 2002; Hartung & Widiger, 1998; Waschbusch & King, 2006) and has resulted in a literature base that is both limited and inconsistent (Biederman et al., 2004; Gaub & Carlson, 1997; Gerson, 2002). A notably small number of studies directly compare females with ADHD to males with ADHD, particularly in long-term outcomes, making it difficult to identify exactly how ADHD impairment differs between genders. There is evidence of gender differences in the manifestation of symptoms that are often not captured in current research methods (Quinn, 2005). For example, a 2019 study suggests that girls with ADHD may report internal feelings of restlessness as opposed to externalized hyperactivity/impulsivity

(Murray et al., 2018). Furthermore, girls with ADHD are less likely to receive treatment than boys with ADHD (Danielson et al., 2018).

While it is clear that girls and boys with ADHD are objectively more similar than different (Babinski et al., 2011; Biederman et al., 2004; Biederman et al., 2010b; Gaub & Carlson, 1997; Leopold et al., 2019), further research is required to assess the interaction of ADHD symptoms and impairments with the biological, societal, and psychological factors that differ between genders (Babinsky et al., 2011a; Bauermeister et al., 2007). Given the lack of research describing gender differences, future studies with an adequate number of female participants could contribute to the literatures by describing gender differences in measured impairment. Continuing to build a foundational literature describing the gender-specific characteristics will facilitate more proportional diagnosis and improve the efficacy of ADHD treatment for girls.

Comorbidity in Youth with ADHD

Youth with ADHD are at significant risk for developing a comorbid psychiatric disorder (Bagwell et al., 2006; Biederman et al., 2005; Faraone et al., 2015; Pliska, 2015). In individuals with ADHD, the rates of comorbidity with another mental health disorder range from 67% to 84% (Biederman et al., 2008; Sobanski et al., 2008), with some studies reporting two or more comorbid psychological disorders in the majority of clinic-referred adults (Biederman et al., 2008; Pliszka, 2015). Additionally, these numbers drastically increase within child samples. For example, Bird, Gould, and Staghezza-Jaramillo (1994) found that 94.4% of children with ADHD had a comorbid mental health disorder. Comorbid disorders typically develop after the onset of ADHD symptoms (Owens et al., 2015; Pliszka, 2015), often catalyzed by ADHD-related impairment (Owens & Hinshaw, 2016; Roy et al., 2015). Co-occurring psychological disorders

common to individuals with ADHD include specific learning disorders, communication disorders, disruptive behavior disorders, and internalizing disorders such as depression and anxiety (Stein & Shin, 2008)

Comorbidity can increase the severity of ADHD symptoms (Roy et al., 2014) and augment the likelihood of the persistence of ADHD into adulthood (Biederman et al., 1996a; Owens et. al, 2015; Stein & Shin, 2002; Roy et al., 2014) Furthermore, comorbid psychiatric disorders can both moderate and mediate the relationship between ADHD symptoms and a range of adverse life outcomes including suicidal ideation, anti-social personality disorder, and peer rejection (Biederman et al., 2010; Chronis-Tuscano et al., 2010; Daviss, 2008; Owens & Hinshaw, 2016). Research examining comorbidity in youth with ADHD creates a deeper understanding of the heterogeneity of the disorder, contributes to the identification of risk factors and assists in predicting the trajectories of youth with ADHD (Bird et al., 1994, Pliszka, 2015).

Externalizing Comorbidity

Externalizing disorders, specifically oppositional defiant disorder (ODD) and conduct disorder (CD) are the most extensively researched ADHD comorbidities and are widely considered to be the most common, with prevalence rates ranging from 45% to 85% (Pliszka, 2015). Although generally considered less common in girls with ADHD than their males counterparts (Biederman et al., 2002; Gaub & Carlson, 1997; Gershon, 2002; Rasmussen & Levander, 2009), some studies report no significant gender difference in the prevalence of externalizing comorbidity. (Biederman et al., 2005; Gabel et al., 1996; Levy et al., 2004). Youth with ADHD and comorbid ODD or CD often receive the most negative prognosis and subsequently, a significant amount of research has gone into both understanding the implications of the diagnostic combination and designing interventions that target externalizing behaviors.

Examples of interventions targeting externalizing symptoms for youth with ADHD include Defiant Children (Barkley, 1997), Parent-Child Interaction Training (PCIT; Eyeberg & Robinson, 1982), and the Incredible Years (Webster-Stratton, 1992). While these interventions were developed more than 20 years ago, they continue to be among the most frequently utilized childhood ADHD interventions (Washington State Institution for Public Policy, 2018).

Internalizing Comorbidity

Compared to the extensive research on comorbid externalizing disorders, research pertaining to comorbid internalizing disorders (specifically depression and anxiety) and ADHD is limited in volume and inconsistent across studies (Babinski et al., 2011b; Bagwell et al., 2006; Jarrett et al., 2016; Meinzer et al., 2014; Owens et al., 2015). Studies show that rates and experience associated with internalizing comorbidity can vary depending on group characteristics (Bagwell et al., 2006; Meizner et al., 2016; Roy et al., 2014. The lack of consensus in the literature reflects both the prioritization of research on externalizing problems and the complexity of the ADHD-internalizing interaction (Meinzer et al., 2015; Pliszka, 2015).

ADHD and Depression. Risk of depression in individuals with ADHD is heterogeneous within the ADHD population and often reported as more significant than risk for the general population (Fischer et al., 2002; Meinzer et al., 2013; Meinzer et al., 2014; Hinshaw et al., 2012; Roy et al., 2014). A 2014 meta-analysis found that 88% of reviewed studies reported higher rates of depression in youth and adolescents with ADHD compared to peers without a diagnosis (Meinzer, 2014). Specifically, Costello et al. (2004) found that 25 to 50% of youth with ADHD also have depression compared to a range between 6 and 20% in the general population. Hazard ratios for developing comorbid depression with a diagnosis of ADHD range from 3.67%

(Yoshimasu et al., 2012) to 6.8% (Biederman et al., 2010a). A meta-analysis by Angold, Costello, Farmer, et al., 1999 found a 5.5 times greater risk of depression in the ADHD community compared to the general population. More recently, Roy et al. (2014) state that youth with ADHD have a 33% chance of developing depression. Other studies have found a diagnosis of ADHD is not significantly associated with increased risk of depression overall, but can be depending demographics such as gender (Bagwell et al., 2006) and age (Meizner et al., 2016).

Several longitudinal studies have documented the development rates of adolescent depressive symptoms in youth with childhood ADHD compared to youth without ADHD. Fisher et al. (2002) conducted a 13-year follow up study of 158 youth (90% male) with ADHD and 81 comparison youth, reporting that 26% of kids with ADHD met the criteria for major depressive disorder (MDD) at age 20-21 compared to 12% of controls. A 14-year longitudinal study of 125 children with ADHD (14.4% female) and 123 comparison children found a 4.32 hazard ratio for depression for youth with an ADHD diagnosis. Authors report recurrent depression in 18.4% of adolescents with ADHD (age 17-18) compared to 1.6% of controls (Chronis-Tuscano et al., 2010). Meinzer et al. (2016) found that a history of ADHD in childhood significantly predicted the development of depression in emerging adulthood (age 18). These findings exhibit a substantial literature base associating ADHD with depression, however, few studies have evaluated the relationship between ADHD and depression in girls, a population widely shown to be more susceptible to depression (CDC, 2010).

Gender Considerations in Comorbid ADHD and Depression. Several studies have documented a stronger correlation of ADHD and depression in girls compared to boys (Bagwell et al., 2006; Biederman et al., 2002; Biederman et al., 2008; Mrug et al., 2012; Noren et al., 2016). In the general population, girls are between 1.5 and 3 times more likely to develop

depression in adolescence than are boys (APA, 2013). Biederman et al. (2008) reports that female-specific biological and societal factors may moderate the interaction of ADHD symptoms and depression. These gender differences remain largely unknown due to the limited number of longitudinal studies with a significant portion of girls with ADHD (Owens & Hinshaw, 2006), and fewer comparing girls and boys with ADHD (Babinski et al., 2011a). One study of 140 girls (age 6-18 at baseline) with ADHD and 122 controls, found that at follow up, the ADHD group had 2.5 times higher rates of depressive disorder (MDD) after adjusting for psychiatric comorbidity (Biederman et al., 2008). The authors report MDD in 65% of girls with ADHD and in 21% of controls, a 5.1 hazard ratio before adjusting for psychiatric comorbidity. Another study reports evidence that young women with ADHD experience more depressive symptoms compared with non-ADHD women but found no significant difference when comparing women with ADHD to men with ADHD (Babinski et al., 2011b). However, the study notes that it was limited by sample size and recommends future investigation of gender differences in comorbid depression and ADHD.

The Effects of Comorbid Depression and ADHD. Depression has been shown to increase the severity and persistence of ADHD-related impairment (Chronis-Tuscano et al., 2010; Roy et al., 2014). Additionally, ADHD is correlated with earlier onset of depressive symptoms, particularly in females (Chronis-Tuscano et al., 2010; Daviss, 2008), longer and more severe depressive episodes, and increased recurrence rates (Daviss, 2008). Biederman et al. (2008) found that the mean age of onset for depression was 9.7 years (*SD* = 4.1) in females with ADHD compared to 12.6 years (*SD* = 2.6) in girls without ADHD. The study also found a diagnosis of ADHD associated with longer average duration of depression (Girls without ADHD, *M* =3.7 years, *SD* = 2.9; Girls with ADHD, *M*= 5.7 years *SD* = 3.6).

The combination of ADHD and depression also can lead to more negative life outcomes than a diagnosis of ADHD alone (Biederman et al., 1991; Chronis-Tuscano et al., 2010). Youth with ADHD and depression often face greater impairment in social functioning, higher levels of family conflict, more adverse life events (Blackman et al., 2005; Daviss, 2008), and are more likely to experience suicidality (Biederman et al., 2008; Chronis-Tuscano et al., 2010; Faraone et al., 2015). For example, Chronis-Tuscano et al. (2010) found that youth with ADHD were 200% more likely to make a suicide attempt between the ages of 9 and 18 compared to control youth.

Additional research evaluating comorbid depression and ADHD is warranted to verify inconsistent findings and address gaps in the literature. In particular, the lack of longitudinal studies comparing the developmental trajectories of girls and boys with ADHD in regard to depressive symptomatology impedes the development of effective preventive measures. Future directions include an evaluation of the mechanisms through which ADHD predicts depression and how this pathway is moderated by gender.

ADHD and Anxiety. Literature comparing the prevalence of anxiety within the ADHD population to the general population is limited (Bagwell et al., 2006; Falk et al., 2017). Anxiety disorders have been reported as the most prevalent mental health concern for youth with prevalence rates ranging from 5% to 25% (Beesdo et al., 2009; Tannock, 2000), because of this, further evaluation of the relationship between anxiety and ADHD could provide valuable information for clinicians, educators, and caregivers working with youth.

Studies have placed the frequency of anxiety in youth with ADHD between 25% to 48% (Jensen et al., 2001; Owens et al., 2015; Roy et al., 2014). Hazard ratios for youth with ADHD range from 2.1:1 to 3.3:1 (Biederman et al., 2010a; Chavira et al., 2004; Yoshimasu et al., 2012). Biederman's longitudinal study shows a higher rate of anxiety in adolescence for youth with

ADHD, reporting a 20% one-year prevalence rate of anxiety in male youth with ADHD compared to 12% in controls. Other research reports that an ADHD diagnosis does not increase the risk of developing anxiety (Manuzza et al., 1993,1998; Weiss & Hechtman, 1993) or that the risk of anxiety increases in early adolescence, but diminishes in early adulthood (Mrug et al., 2012).

Gender Considerations in Comorbid ADHD and Anxiety. The literature on girls with ADHD and anxiety shows even more inconsistency (Biederman et al., 2008; Roy et al., 2014). Roy et al. (2014) states that girls are more likely to develop anxiety overall, but that girls with ADHD are at no higher risk than neuro-typical girls. A study comparing a small sample of young adult women with ADHD ($N = 34$) and demographically matched peers with ADHD found that only a subset of women with ADHD were at elevated risk of anxiety problems (Babinsky et al., 2011b). In contrast, Biederman et al. (2008) found that girls with ADHD (ages 6 to 18 at baseline) had a 2.3 odds ratio in terms of developing multiple anxieties five years later compared to girls without ADHD. Further research utilizing large samples is required to better understand the influence of gender on the risk of comorbid anxiety with ADHD as the current literature does not find consensus on the relationship.

Effects of Comorbid Anxiety on Youth with ADHD. Extant literature on outcomes associated with comorbid ADHD and anxiety is concentrated primarily on the effect of anxiety on cognitive behavioral functioning in youth with ADHD (Falk et al., 2017; Jarrett et al., 2016; Schatz & Rostain, 2006). These studies evaluating implications of comorbid anxiety on ADHD-related impairments lack consensus (Sorrenson et al., 2011; Schatz & Rostain, 2006; Falk et al., 2017). For example, a study by Sorrenson et al., (2011) reports that youth with comorbid anxiety and ADHD show impaired inhibition in comparison to peers with just ADHD and compared to

neuro-typical peers. They did not find significant differences in working memory, emotional control, or shift. On the other hand, Schatz & Rostain (2006) report that anxiety may inhibit impulsivity. In respect to aggression and delinquency, a study of 377 children in four groups found youth with ADHD to be less aggressive than both peers with anxiety alone and peers with combined ADHD and anxiety (Falk et al., 2017) but did not differ significantly from the group consisting of children without diagnoses (Falk et al., 2017). These results indicate that anxiety might not moderate the relationship between youth and aggressive or delinquent behavior. Overall, there is not sufficient evidence to suggest comorbid anxiety increases or decreases behavioral symptoms in youth with ADHD.

Cognitively, youth with both anxiety and ADHD have been found to exhibit decreased cognitive efficiency (Schatz & Rostain, 2006), particularly in terms of working memory (Jarret et al., 2016; Pliszka, 1999). Results regarding response times are mixed with Pliszka (1999) reporting slower response times in youth with both anxiety and ADHD compared to youth with ADHD alone. In another study, Jarrett et al. (2016) reports no significant differences between the two groups.

Additional implications of comorbid anxiety and ADHD include an increased risk of sleep problems (Accardo et al., 2012; Hansen et al., 2011) and delayed referral for ADHD evaluation (Schatz & Rostain, 2006). Furthermore, Jarrett et al., (2016) found that two-thirds of youth in their study diagnosed with both ADHD and anxiety were less responsive to stimulant medications than youth with ADHD alone. Despite the limited literature, there is evidence to suggest that youth with ADHD are at increased risk for developing anxiety and that children with ADHD differ on critical assessments of cognitive functioning depending on whether or not they have a comorbid anxiety condition. Further research on the mechanisms influencing the

development of anxiety in youth with ADHD would illuminate commonalities between individuals with both disorders and inform potential interventions.

Risk Factors for Developing Comorbid Internalizing Problems and ADHD

Potential pathways to the development of internalizing problems in youth with ADHD are less frequently researched than the connection between ADHD and conduct problems (Johnston & Mash, 2001; Meinzer et al., 2015; Owens & Hinshaw, 2016). This is unsurprising considering evidence from longitudinal studies indicating that both young women and men with a history of childhood ADHD are at greater risk for negative externalizing outcomes, for example anti-social disorder, than internalizing ones (Biederman et al., 2010a; Biederman et al., 2010b; Meinzer et al., 2014; Owens & Hinshaw, 2016). However, several studies have examined individual predictors of internalizing disorders including; academic achievement, social problems, and familial conflict (Al-Yagon, 2016; Becker et al., 2013; Masten et al., 2005; Meinzer et al., 2015). Academic, social, and family problems are among the most frequently cited ADHD-related impairments (Meinzer et al., 2014; Steinberg & Drabick, 2015). Exploring the association between these impairments and internalizing problems could direct intervention and identify those most at risk for developing of depression and anxiety in youth with ADHD. This is particularly critical for adolescent girls, as they are reported to experience internalizing problems more frequently than boys both overall and within the ADHD population (Babinski et al., 2011b; Owens & Hinshaw, 2015).

Academic Risk Factors. Academic problems including poor grades, school discipline, grade failure, and smaller skill deficits such as note-taking, study skills, and organization are well-established in youth with ADHD (Fabiano & Pyle, 2019; Kent et al., 2011). Poor academic achievement has been associated with poorer job outcomes, lower life satisfaction, and substance

use (Barkley et al., 2008; Kuriyan et al., 2013; Owens & Hinshaw, 2016). The association of academic problems with globally adverse adult outcomes supports evaluating this ADHD-related impairment as a potential risk factor for internalizing symptoms in youth with ADHD.

Masten and colleagues (2005), conducted a 20-year-long study of 205 children (ages eight to 12 at baseline) to determine the relationship between externalizing symptoms, academic achievement, and internalizing symptoms. Results showed that academic achievement at year 10 significantly predicted internalizing problems at year 20 (β= -0.54, p = 0.004) although researchers hypothesize that social competence would likely account for more variance in internalizing problems than it would for academic achievement. The authors report no difference in model fit between genders.

Contrastingly, a more recent study assessing the relationship between impairment and depression in 342 adolescents (M = 13.09 years; SD = 1.62) found that fewer academic problems (Adolescent Academic Problems Checklist; [AAPC]; Sibley et al., 2014a) predicted higher depressive symptoms (b = - 0.12, sr^2 = 0.01, p < 0.05), as measured by the Withdrawn/Depressed subscale (YSR; Achenbach, 1991) controlling for ADHD symptom severity (Ward et al., 2019). Similarly, social problems (b = 0.01, sr^2 = 0.02, p < 0.01) and parent-teen conflict (b = 0.10, sr^2 = 0.03, p < 0.01) were also predictive of depressive symptoms on a smaller scale. Social problems were measured using Social Problems subscale t-scores on the Child and Behavior Checklist (CBCL; Achenbach, 1991). Parent-teen conflict was assessed via the youth report of the Conflict Behavior Questionnaire-20 (CBQ-20; Robin & Foster, 1989).

Interestingly, the contribution of parent-teen conflict to variance in depression was stronger for youth with low intention and low hyperactivity/impulsivity. Given evidence that females with ADHD tend to display less severe symptomatology in community-based samples

(Arnett et al., 2015; Gaub & Carlson, 1997), future studies would contribute to literature on both gender differences in ADHD and risk factors for the development of internalizing problems in youth with ADHD by evaluating how gender mediates the relationship between family conflict and depression. Overall, these results demonstrate a small but significant relationship between academic impairment and depressive symptoms above and beyond the direct relationship between ADHD symptoms and depression.

Academic problems appear to contribute, at least in part, to challenges in adulthood (Masten et al., 2005). Few studies have explicitly evaluated the role that school problems have on depression and anxiety for youth with ADHD. Those that have, combine depression and anxiety into an overall internalizing problems outcome (Masten et al., 2005; Owens & Hinshaw, 2016) and, apart from Masten et al., (2005), do not consider gender as a moderator.

Social Risk Factors. Social problems represent one potential mediator between ADHD and internalizing problems, particularly for girls (Becker et al., 2013; Ward et al., 2019). Social difficulties and peer problems are among the most common and persistent impairments in individuals with ADHD (Hoza, 2007; Hoza et al., 2005; McQuade & Hoza, 2015; Normand et al., 2010; Wehmeier et al., 2009). While the underlying nature and origin of peer difficulties are not completely understood, the core symptomatology of youth with ADHD, including hyperactivity, impulsivity, and disruption, tends to be aversive to peers (McQuade & Hoza, 2015) resulting in negative social reciprocation (Mikami & Hinshaw, 2003). The pattern is frequently repeated when the child moves to new groups or situations (Uekermann et al., 2010) resulting in children with ADHD frequently experiencing peer rejection and social isolation (Hoza, 2007; Maedgen & Carlson, 2000; McQuade & Hoza, 2015).

Social problems, including victimization and peer rejection, are implicated in a wide range of adverse adult outcomes including anxiety, depression, social withdrawal, suicidal ideation, school avoidance, and poor academic outcomes (McQuade & Hoza, 2015; Roy et al., 2015; Wiener & Mak, 2008). Peer rejection creates a cycle of missed opportunities to develop positive social competencies (Hoza, 2007) and, given that youth with ADHD often exhibit social deficits, jeopardizes their likelihood of future social success (deBoo & Prins, 2007, Mikami & Hinshaw, 2003). Subsequently, youth with ADHD frequently experience social isolation and loneliness, significant predictors of depression (Roy et al., 2015).

Several studies have evaluated the relationship between peer rejection and internalizing problems for youth with ADHD (Owens & Hinshaw, 2016; Mrug et al., 2012; Roy et al., 2015; Yip et al., 2013; Ward et al., 2019). Findings are inconclusive, but trend towards a positive association of social and internalizing problems. Additionally, there is some evidence of moderation by gender (Becker et al., 2013; Roy et al., 2015).

In one study, Ladd & Troop-Gordon (2003) found chronic friendlessness between grades one and four to predict internalizing ($\beta = 0.20$) problems in adolescence and was not found to differ by gender. Specifically, friendlessness was only found to be a significant predictor through its association with a child's self-beliefs, indicating that children had to both be aware of peer rejection and integrate social failure into their perception of themselves for friendlessness to impact their internalizing symptoms. This complicates generalizing the findings to youth with ADHD as who frequently demonstrate positive illusory bias (Hoza et al., 2010; Mikami et al., 2010) which leads them to overestimate their social skills. Additional limitations include a lack of self- or parent- reported internalizing symptoms (measured by the TRF- Internalizing

Problems scale, Achenbach, 1991), and the fact that the participants were young (M = 10.1 years) to be considered adolescents.

Another study (Yip et al., 2013) of 312 youth with ADHD between the ages of five and 17 found peer problems (Peer Problems scale, Strengths and Difficulties Questionnaire; Goodman, 1997) to be a significant mediator for internalizing problems (Internalizing Problems scale, Teacher Report Form; Achenbach, 1991). Controlling for attention problems (Attention Problems scale, Teacher Report Form; Achenbach, 1991), peer problems were associated with internalizing problems with an effect size of 1.33 and accounted for 68% of total effect of attention problems on internalizing problems. No differences were reported by gender. While demonstrating an association between peer problems and internalizing symptoms, this study is limited by the singular use of teacher-report measures. Given the wide age range, some participants would be in middle and high school and so teachers would have limited contact in which to observe both peer problems and internalizing symptoms. Utilizing parent and/or adolescent report measures would increase the accuracy of symptom measurement. Furthermore, the measures were completed simultaneously, which complicates interpreting peer problems as a mediator due to the inability to make causal inferences.

Roy et al. (2015) conducted a longitudinal study of 728 children (M = 19.1 years at final assessment) and found that, controlling for gender, peer dislike (β = 0.25, SE = 0.10, p = 0.001), but not victimization, predicted clinical depression. Peer dislike and victimization data was measured through peer nominations when participants were an average age of 13.6 years. Depression in early adulthood (M = 19.1 years) was measured using the World Health Organization Composite International Diagnostic Interview (CIDI; Kessler et al., 2004). The study results showed peer dislike and victimization as modest mediators, together accounted for

7% of the relationship between ADHD symptoms and depression. The results differed by gender with social problems mediating a total of 10% of effect of ADHD symptoms on depression for girls but making no significant contribution for boys. Interestingly, the study found that ADHD symptoms were most predictive of depression at age 13 and that by age 19, youth with ADHD were not at increased risk. The study indicates that while social problems are a risk factor for the development of depression in youth with ADHD, the effects could be minimal and contingent on the type of social problem and on the adolescent identifying as female. Furthermore, researchers hypothesize that positive illusory bias could have artificially limited the mediatory role of social problems in the development of depression, stating that participants may have overestimated their peer status and were less effected by receiving minimal nominations than expected. Future studies utilizing parent reports of social problems could more capture more of the variance in depression accounted for by social problems in youth with ADHD (Ward et al., 2019).

A study of 188 children between the ages of seven and 11 (M= 8.67), Becker et al. (2013) found gender to moderate the extent to which negative peer preference (as measured by the Dishion Acceptance Scale; Dishion, 1990) predicted internalizing problems in youth with ADHD. Internalizing problems were robustly measured through the collection of both depression and anxiety ratings from the participants, parents, and teachers. Children completed the Revised Children's Manifest Anxiety Scale (RSMAS; Reynolds & Richmond, 1992) as well as the Child Depression Inventory (CDI-2; Kovacs, 1992). Parents and teachers completed the Behavior Assessment System for Children (BASC; Reynolds & Kamphaus, 1992). In addition, parents reported on youth depression (CDI-2 Parent; Kovacs, 1992).

The study found that negative social preference did not have a main effect on either anxiety or depression (p's > 0.05) when controlling for gender. However, when entering gender

as a moderator, negative social preference did significantly predict child-reported anxiety (β = 0.23, p = 0.030) and depression (β = 0.27, p = 0.020) in girls, but not boys (anxiety, β = -0.15, p = 0.100; depression, β = -0.02, p = 0.800). Similar trends were found in parent and teacher reports of participants internalizing problems. The study also found associations between negative peer preference and externalizing behavior for both boys and girls, indicating that social rejection might be a more salient predictor of overall psychopathology in girls with ADHD (Becker et al., 2013).

The reviewed studies indicate that social factors, including negative social preference as well as teacher-, parent-, and child- reported social problems, may significantly contribute to internalizing problems in youth with ADHD. The results, however, are inconsistent, particularly in regard to gender as a moderator. Further studies exploring the role of peer rejection in the development of both anxiety and depression might be particularly salient for girls. Evidence shows that the conduct problems associated with ADHD might be more socially impairing for girls (Owens & Hinshaw, 2016) as they deviate more from societal gender expectations (Kok et al., 2016). Additionally, girls are both more likely to experience depression in adolescence than boys (APA, 2013) and found to be more sensitive to peer opinions than their male counterparts to peer opinions (Roy et al., 2015). It is possible that girls are less effected by positive illusory bias than are males, which is theorized to act as a protective factor against peer rejection for youth with ADHD (Hoza et al., 2010; Mikami et al., 2010). The reviewed studies demonstrate that social problems are likely implicated in the development of depression for youth with ADHD, but that additional research is required in light of inconsistent findings. In particular, future research should include gender as a moderator and assess social problems using multiple raters to explore the potential protective effects of positive illusory bias.

Familial Risk Factors. While evidence of increased stress and conflict for many families of children with ADHD is well-documented in the literature (Johnson & Mash, 2001; Martel, 2009; Steinberg & Drabick, 2015), they are not a universal associated feature of the disorder (Johnson & Mash, 2001). For example, a study of adolescent-parent interactions in youth with ADHD, youth with ADHD and co-morbid oppositional defiant disorder, and comparison youth, found that comorbid youth indicated a significantly more conflictual parent-child relationship than the comparison group while youth with ADHD alone did not differ significantly from either group (Barkley et al.,1992).

Furthermore, negative parenting behaviors and familial conflict have been shown to predict conduct problems in children (Johnston, 1996; Johnston & Mash, 2001). According to the parent emotion socialization model, increased stress level and more conflictual interactions impacts the stability and consistency of familial social processes and hinders a child's emotional development (Johnston; 1996, Steinberg & Drabick, 2015). Challenging child temperaments, such as negative emotionality and neuroticism, frequent in youth with ADHD (Martel, 2009; Nigg, 2006) increase the likelihood of invalidating parenting styles, Though the majority of research on the interaction of parenting and conduct problems is centered on early and elementary childhood, Barkley et al. (1994) report similar findings for adolescents.

Additionally, Meinzer et al., 2015 found that parental support uniquely contributes to depressive symptoms in 350 young adults with ADHD (72.3% female) above and beyond the variance of ADHD symptoms alone. Researchers operationalized support using the Perceptions of Parents Scale (POPS; Robbins, 1994) which surveyed participants perceptions of warmth, autonomy, and involvement for each parent. Specifically, one standard deviation increase in support was associated with a 0.16 standard deviation decrease in depressive symptoms for

mothers (p = 0.022) and 0.21 (p = 0.001) for fathers. The study conceptualized results via the parent emotion socialization model (Johnston, 1996).

Conversely, Al-Yagon (2016) conducted a study applying an attachment framework to socioemotional and behavioral adjustment in youth with learning disabilities (LD) and comorbid ADHD. The author theorized that the presence of a close relationship would protect youth from internalizing problems. The study included 91 adolescents between the ages of 15 and 17 years with comorbid LD and ADHD. The study found that neither maternal, nor paternal attachment predicted internalizing problems in youth with ADHD, but that a secure maternal attachment was significantly and negatively associated with internalizing problems for neuro-typical controls (β = -0.40). These results demonstrate that while positive familial relationship might be a protective factor against internalizing disorders for youth without ADHD, it might not for those with the disorder.

A major tenant of parent-behavioral training, a psychosocial intervention with well documented efficacy for elementary age youth with ADHD (Antshel, 2015), is increasing positive parent-child interactions (Webster-Stratton, 1992). Additional research evaluating how familial relations and conflict is related to the development of internalizing problems could help predict the effect that parent training might have on a child's later internalizing problems. Furthermore, as parenting-interventions are not considered as effective for adolescents (Antshel, 2015) researching the impact of the quality of a parent-child relationship could have on internalizing problems could inform the improvement of existing adolescent interventions.

Moderation of Internalizing Symptoms in a Related Study of Adolescents. Ward et al. (2019) evaluated the contribution of ADHD symptoms and impairment to variance in adolescent-reported depressive symptoms. Of note, the study sample of 342 adolescents with ADHD (Age;

M= 13.09, *SD* = 1.62) overlaps with the sample utilized in the current study. Some participants are included in both Ward et al. as well as the current study analysis, while other participants are unique to each study. ADHD symptoms included inattentive symptoms, hyperactive/impulsive symptoms, and symptoms associated with sluggish cognitive tempo (SCT). Impairment was categorized as social problems (Child Behavior Checklist [CBCL; Achenbach, 1991], Social Problems *t*-score), academic problems (Adolescent Academic Problems Checklist- parent-report; Sibley et al., 2014a), and family conflict (Conflict Behavior Questionnaire-20, youth report; Robin and Foster, 1989). Controlling for age and IQ, Ward and colleagues found all predictors to contribute to variance in depressive symptoms (p's < 0.05) with lower family conflict (sr^2 = 0.03), higher social problems (sr^2 = 0.02), and fewer hyperactive/impulsive symptoms (sr^2 = 0.02) associated with lower depressive symptoms. Results indicate that families of impairment, specifically family conflict and social problems contribute to internalizing problems above and beyond ADHD symptoms. Future investigation of ADHD-related impairment as risk factors in the development of internalizing problems could build on results by exploring moderation by gender and grade.

Risk Factors for Females with ADHD. Owens & Hinshaw (2016) evaluated pathways to negative adult outcomes for young women with ADHD. The authors theorized that two potential pathways were likely to predict negative adult outcomes, emotion dysregulation, and obstacles that interfere with critical adolescent experiences. The study tested the first pathway using a composite of internalizing measures including; parent and teacher Internalizing Problems *t*-scores (CBCL & TRF, Achenbach 1991), the total score from the Child Depression Inventory (CDI, Kovacs, 1992), and both youth- and parent-reported anxiety and depressive symptoms form the DISC-IV (Shaffer et al., 2000). In terms of the second predicted pathway, the authors

theorized that peer rejection and school problems were the most likely obstacles to critical adolescent experiences. They measured peer rejection using a social relationship interview that asked participants three questions related to peer rejection. In addition, they used a 12-item social relationship questionnaire to assess participants' relationship quality with peers and parents. Both measures were summed, standardized, and combined to create a peer-rejection composite. School failure and disciplinary problems were assessed using parent reported suspensions/expulsions, grade failures, school-setting, and drop-outs. Predictors data was collected five years from baseline, when the participants were between 11 and 18 (M = 14.3) years old.

Adult outcomes, determined using the two averaged Global Assessment of Functioning interviews (GAF; APA, 1994), were measured 10 years from baseline when young women were between 17 and 25 (M =19.6 years). During one four-hour parent assessment and one eight-hour participant assessment, clinicians collected information in 11 primary areas of functioning (ADHD symptoms, externalizing/delinquent behavior, internalizing disorders and symptoms, substance use, eating disorder symptoms, academic achievement, well-being, service utilization, self-harm, problematic driving, and global impairment) in addition to other personal information.

The study found that school failure and disciplinary problems in adolescence mediated the relationship between conduct problems and overall adult functioning, contributing 25% of the variance in GAF (F(8, 109) = 4.50, p = 0.005, R^2 change = 0.25). Neither adolescent social problems, nor internalizing problems predicted overall adult functioning. In terms of adult internalizing problems, together adolescent internalizing (indirect effect = 0.13, SE = 0.10) and social (indirect effect = 0.19, SE = 0.12) problems accounted for 26% of variance in adult internalizing problems (F(8, 109) = 7.34, p = 0.001, R^2 change = 0.26). The unique contribution

of social problems is not reported. School problems in adolescence were not found to be significant.

These results indicate that both academic and social problems can mediate the relationship between childhood conduct problems and negative adult outcomes in girls with ADHD, but they mediate different pathways. Academic problems in adolescence contributes to the development of reported adverse global functioning in adulthood while adolescent social problems are associated with adult internalizing problems. Findings promote the inclusion of both school and social problems (which in this study integrated family conflict) in evaluation of pathways to negative adult outcomes while suggesting that social problems may have more significance than school problems in predicting internalizing problems. One limitation of this study is that it fails to report the unique contributions of both adolescent internalizing and adolescent social problems to variance in adult internalizing problems. Therefore, it is unclear how well social problems in adolescence would predict adult internalizing problems, controlling for adolescent internalizing problems.

Summary of Risk Factors for Internalizing Comorbidity. Given the paucity of literature on pathways to internalizing comorbidity in youth with ADHD, further research on the topic is warranted. The literature that exists appears to highlight social problems (Al-Yagon, 2016; Owens & Hinshaw, 2016; Roy et al., 2015; Ward et al., 2019) as the most likely mediator between ADHD and internalizing comorbidities, though evidence of the association remains inconsistent (Becker et al., 2013). Additionally, the role of gender as a moderator of internalizing problem risk factors for youth with ADHD remain inconclusive and are largely absent from study designs. However, evidence that girls differ from boys in the relationship between ADHD and internalizing problems (Babinski et al., 2011b; Becker et al., 2013), as well as the

documented symptom severity by family conflict interaction in predicting depression (Ward et al., 2019) suggest that exploring gender as a moderator could advance the current understanding of pathways to internalizing problems for youth with ADHD. While this review found two studies that evaluated multiple potential mediators to negative adult outcomes for females with ADHD (Owens & Hinshaw, 2016; Ward et al., 2019), no studies examined how these trajectories might differ by gender of the participant when multiple risk factors are considered. Furthermore, few studies differentiate between anxiety and depression as internalizing outcomes. Considering gender and grade, further research could evaluate the contribution of academic, social, and familial factors to variance in adolescent depressive and anxious symptoms. Such research would identify critical areas and times for intervention that could disrupt the pathway from childhood ADHD to adolescent or adult internalizing problems.

Evidence-Based ADHD Interventions

Over fifty years of research have produced an extensive array of effective and evidence-based interventions for ADHD (Barkley, 2015; Faraone et al., 2015; Washington State Institute for Public Policy, 2018). This section will begin by briefly reviewing the current literature on evidence- and research-based ADHD interventions for children followed by a discussion of adolescent interventions. Finally, the design and evidence for a multicomponent adolescent intervention, the summer treatment program for adolescents (STP-A; Pelham et al., 2010) will be described.

Evidence-Based Interventions for Children

The symptoms and impairments of ADHD are frequently treated with stimulant medication and psychosocial intervention (Schoenfelder & Sasser, 2016). While stimulant medication is effective in around 80% of youth (Faraone et al., 2006), approximately 20-30% of

children do not benefit substantially from stimulants and many experience impacted sleep and appetite as a result of medication (Schoenfelder & Sasser, 2016). Despite a strong evidence that stimulants can mitigate core ADHD symptoms, they do not generally improve peer relationships, family conflict, or academic impairment (Antshel, 2015) and documentation of long-term benefits on functioning is lacking (Molina et al., 2009). Evidence from the longitudinal Multimodal Treatment Study of Children with ADHD (MTA) shows that stimulant medication is most effective when combined with psychosocial intervention (MTA Cooperative Group, 1999). Given that up to 90% of adolescents discontinue stimulant medication (Sibley et al., 2014c), this review will focus on summarizing evidence-based psychosocial interventions.

Antshel (2015) defines a psychosocial intervention as "any intervention that stresses psychological or social factors rather than biological variables" (p. 80). These interventions target impairments, the common motivation for parents seeking treatment, as opposed to symptoms (Angold et al., 1999). Psychosocial interventions for youth with ADHD tend to include behavioral therapy techniques and operant conditioning principles, the most common of which are parent-training interventions (Barkley, 2015).

Behavioral Parent-Training (BPT). BPT programs are based on a social learning model of disruptive child behavior and are typically comprised of weekly training sessions with parents, either group or individual format, that teach strategies in three broad areas: adapting environmental conditions to increase chance of positive behavior, restructuring tasks, and establishing consistent consequences for negative behaviors (Antshel, 2015). Specific strategies taught during parent session include; providing positive parental attention and praise, socio-emotional coaching, establishing rewards systems, providing clear and explicit expectations, ignoring minor misbehavior, and developing short and immediate consequences for negative

behavior (Webster-Stratton, 1992). Defiant Children (Barkley, 1997), Incredible Years (Webster-Stratton, 1992), and Parent-Child Interaction Therapy (Eyeberg & Robinson, 1992) represent several of the most commonly used BPTs.

Reviewing efficacy literature for children with disruptive behavior disorders, Washington State Institute for Public Policy recently increased the classification of BPTs from research-based to evidence-based (Washington State Institute for Public Policy, 2018). Two additional recent meta-analyses have shown parent training interventions to be effective for children with ADHD (Evans et al., 2014; Pelham & Fabiano, 2008). The efficacy of parent-training interventions for children with ADHD appears to be generalizable across communities based on a 2010 study which found that, although parenting styles differed based on the family's ethnicity, ethnicity did not moderate treatment effects (Jones et al., 2010). However, there are limitations to BPTs. First, although positive outcomes regarding a reduction in ADHD symptoms are documented, they do not normalize a child's functioning and have not been shown to generalize well to other settings, such as school (Antshel, 2015). Furthermore, parent-training has been documented as less effective for adolescents with ADHD (Barkley et al., 1992; Schoenfelder & Sasser, 2016).

School-Based Interventions. While effective school-based interventions for youth with ADHD exist, they are less studied than BPTs (Murray et al., 2017). Furthermore, the format of individualized education program documentation fails to support teachers in implementing effective, evidence-based interventions for youth with ADHD (Fabiano & Pyle, 2019; Spiel et al., 2014). A recent (2019) meta-analysis of school-based treatment for children with ADHD organizes effective treatments into the multitiered systems of support (MTSS) frequently used in schools (Fabiano & Pyle, 2019). Tier one interventions describe classroom management techniques that aim to promote compliance in all students. Those specifically designated as

effective for youth with ADHD include labeled praise, planned ignoring, as well as posting and regularly reviewing classroom rules (Pfiffner & DuPaul, 2015). Class-wide programs such as the evidence-based Good Behavior Game (Barrish et al., 1969) create motivation for positive classroom behavior. Fabiano & Pyle indicate that daily report cards (Volpe & Fabiano, 2013) and organizational skills straining (Gallagher et al., 2014; Langberg, 2011; Schultz & Evans, 2015) are effective targeted or tier two interventions for students with ADHD who do not adequately respond to tier one interventions. In the third level of support, the meta-analysis identifies time-outs (Fabiano et al., 2004) and a token economy (Kazdin, 1997; Pelham & Fabiano, 2008) as evidence-based strategies for students with ADHD.

Limitations for school-based interventions for ADHD include a lack of set procedures in schools which result in ineffective intervention and assessment (Fabiano & Pyle, 2019). Additionally, the literature recognizes that while involving parents in ADHD interventions promotes the persistence and generalization of behavioral, school-based interventions do not frequently or consistently collaborate with families (Owens, et al., 2008; Pelham, 2016; Pfiffner et al., 2013). In particular, a 2018 study found that parent engagement and a strong therapeutic alliance were important moderators in the efficacy of a school-based organization intervention for teens (Breaux et al., 2018). As the school-based interventions reviewed primarily target elementary-age children with ADHD, more research in evidence-based school implemented interventions for adolescents is warranted (Fabiano & Pyle, 2019).

Summer Treatment Programs. The final format of psychosocial ADHD interventions reviewed are summer treatment programs (STPs). The original STP, developed by Pelham and colleagues in 1980 at Florida State University (Pelham & Hoza, 1996) is an research-based intervention that integrates many of the components in the previously described treatments into

an intensive summer camp-like format. The five major components come from evidence-based strategies for treating children with ADHD include; parent behavioral training, applying behavior modification techniques to a classroom setting, academic skills training, social skills training (usually through sports), and a stimulant medication trial (although not all STPs include medication (Antshel, 2015). STPs are an intensive, child-directed behavioral intervention that target attention, social, and behavioral challenges (Pelham et al., 2005).

Most STPs range from six to eight weeks, grouping youth into bunks of approximately 12 kids who remain together for the summer. The program utilizes contingency management strategies throughout the day and provides families with a daily report card addressing behavior and progress towards goals (Antshel, 2015). There is moderate research support for the efficacy of the STP in younger children (Chronis et al., 2004; Evans et al., 2014; Fabiano et al., 2007; Pelham et al., 2005; Pelham et al., 2010) including longitudinal evidence from the Multimodal Treatment of Attention-Deficit/Hyperactivity Disorder Study (MTA Collaborative Group, 1999). A recent adaptation of the STP for adolescents, the summer treatment program for adolescents (STP-A; Pelham et al., 2015) has demonstrated strong initial efficacy (Sibley et al., 2011; Sibley et al., 2013b, Sibley et al., 2018b).

Evidence-Based Interventions for Adolescents with ADHD

Adolescence is a particularly difficult time for youth with ADHD, as core ADHD-related deficits interact with an increasingly complex web of responsibilities, larger consequences for failure, and a push towards independence (Robin, 2015; Smith et al., 2000). During teen years, adolescents with ADHD frequently overestimate their abilities, and underestimate challenges, resulting in poor decision-making including refusing supports and terminating ongoing treatment (Chan et al., 2016; Hoza et al., 2010). Between 40 and 50% of childhood ADHD symptoms

persisting into adulthood (Sibley, et al., 2016a) and studies have found significant adverse outcomes associated with undertreated symptoms, including lower educational attainment, legal problems, financial dependence, and substance abuse (Biederman et al., 2006; Kuriyan et al., 2013; Owens & Hinshaw, 2006). Evidence indicates that adolescents with ADHD demonstrate a significant need for effective intervention.

Despite the wide variety of evidence-based interventions for elementary-age youth (Barkley, 1997; Pelham & Fabiano, 2008; Pelham & Hoza, 1996; Webster-Stratton, 1992), studies have documented less efficacy in the adolescent population (Antshel, 2015; Smith, et al., 2000) and research adapting existing childhood interventions to teens is limited (Chan et al., 2016). Compared to over 175 studies on psychosocial ADHD treatments for children (Fabiano et al., 2009), one review found only15 adolescent interventions (Smith et al., 2000).

As the most pertinent concerns for adolescents with ADHD revolve around a lack of motivation in schoolwork, disorganization, forgetfulness, and time-management, (Sibley, 2019) the majority of adolescent interventions are centered on academic skills training (Chan et al., 2016; Sibley et al., 2014c). Adolescent ADHD interventions that address comorbid internalizing problems are rare (Chan et al., 2016; Sibley et al., 2014c), highlighting a concerning literature gap considering evidence that the development of depression and anxiety increase during adolescence (Biederman et al., 2010a; Hinshaw et al., 2012) and evidence that the academic problems targeted by most adolescent ADHD interventions are found to be less salient risk factors for internalizing symptoms than social problems (Masten et al., 2005; Owens & Hinshaw, 2002; Ward et al., 2019). The following section will review recent meta-analyses of adolescent ADHD interventions.

Meta-Analyses of Adolescent ADHD Interventions. Chan and colleagues (2016) reviewed 10 multicomponent psychosocial interventions for adolescents with ADHD (N = 916 participants) that integrated behavioral, cognitive behavioral, and training components. The majority of studies (n =8) were academic focused, combining organizational skills training with parent and teacher contingency management training. Two studies had a foundation in cognitive behavioral therapy (CBT), though one also included organizational skills. Authors report treatment effect on ADHD symptoms, functional impairment, academic and organizational outcomes, and comorbid emotional and behavioral symptoms.

Five studies measured the efficacy of variations of the Challenging Horizons Program (CHP; Evans et al., 2009). CHP is typically implemented as an after-school model with 150-minute sessions up to three times per week and teaches academic skills such as organization and note taking, as well as social skills through sports. In addition, parents attend monthly parent meetings and adolescents attend weekly meetings with school-based mental health professionals and teachers for additional academic skills training. Studies evaluating the CHP found inconsistent effects in terms of ADHD symptoms with some showing a reduction in inattentive symptoms but not hyperactive/impulsive symptoms, and others showing the opposite. Likewise, results were mixed in terms of both functional impairment and academic skills/organization. Only two studies reported treatment effects on comorbid emotional behavioral symptoms (Evans et al., 2016; Molina et al., 2008) with Molina and colleagues finding a significant improvement in parent-rated internalizing symptoms (Cohen's d = 0.55), but not for externalizing symptoms (Cohen's d = 0.19, $p < 0.05$). Other academic-oriented interventions reviewed include the Homework, Organization, Planning Skills (HOPS; Langberg et al., 2012), Supporting Teens' Autonomy Daily (STAND; Sibley, 2013), and Survey Question, Read, Write, Recite with

homework monitoring (SQR4; Meyer & Kelley, 2007) programs. Each of these programs will be discussed in further detail below.

HOPS is an extension of CHP and typically entails 16 20-minute sessions during the academic day focused on organization, time management, and planning as well as two one-hour family meetings with parent, child, and a school-based mental health profession to develop a home reinforcement schedule. Langberg and colleagues (Langberg et al., 2012) report that their 11-week iteration of HOPS resulted in improved inattentive symptoms (Cohen's $d = 0.52$, $p < 0.05$), parent-rated life impairment (Cohen's $d = 0.69$, $p < 0.001$), higher GPA (high C range for the treatment group compared to low C range for the control group), and improved parent-rated task planning (Cohen's $d = 1.05$, $p = 0.006$), organization (Cohen's $d = 0.88$, $p < 0.001$), and homework completion (Cohen's $d = 0.85$, $p = 0.001$). Results found no improvement in teacher-rated planning and the study did not measure change in comorbid emotional and behavioral symptoms (Langberg et al., 2012).

STAND (Sibley, 2013) is a parent-teen collaborative intervention originally of 10 sessions that includes motivational enhancement, directly teaches organization, time management, and planning skills to youth, teaches parents to support adolescent academic, organizational, and behavioral skills, and facilitates a parent-adolescent behavioral contract. Aiming to relieve intervention demands on school staff (Sibley, 2013), STAND is a blended, engagement-oriented intervention that targets executive functioning and motivation deficits in teens with ADHD (Sibley, 2019) through a parent-teen partnership. Parents and adolescents attend ten 60-minute weekly family sessions that progress through three phases, an engagement phase, a skill phase, and a planning phase (Sibley et al., 2013; Sibley et al., 2016b; Sibley, 2019). Future iterations refined the STAND program weekly family sessions, parents are

coached to develop a system of school-home collaboration with teachers and school staff. In the pilot study of STAND, authors report improved parent- (but not teacher) -reported inattentive and hyperactive/impulsive symptoms (Cohen's *d* range = 1.20 to 1.42, *p*'s < 0.05). While adolescent-rated parent-child conflict improved (Cohen's *d* = 0.65, *p* < 0.05), the treatment group did not significantly differ from the control group in parent-rated conflict. Similar to HOPS, the treatment group improved on parent-rated (but not teacher-rated) academic problems (Cohen's *d* = 1.30 *p* < 0.05), planner usage (Cohen's *d* = 5.15 *p* < 0.05), and GPA (Cohen's *d* = 0.25, *p* < 0.05). In terms of emotional and behavioral symptoms, Chan and colleagues report improved parent-rated ODD symptoms (Cohen's *d* = 0.65, *p* < 0.05) but do not document findings in terms of internalizing problems. More recent controlled clinical trials of STAND found meaningful changes in teen and parent behaviors. For teens, this included improved organizational skills, time management, planning, ADHD symptom severity, homework behavior, GPA, and a stronger parent-teen relationship. Parents in the study noted reduced stress (Sibley et al., 2016b, Sibley, 2019)

The SQR4 study compared a nine-week self-monitoring homework and academic skills intervention to parent monitoring and control group (Meyer & Kelley, 2007). In the self-monitoring group, students are trained in the Survey, Question, Read, Write, Recite (SQR4 Hayden & McLaughlin, 1987) study strategy and homework completion skills. SQR4 consists of scanning text headings, generating questions, reading for answers to their questions, rewording the text to answer questions, and comparing their answers to the text. Parents are encouraged to reward self-monitoring but not to complete monitoring measures for the teens. In the parent monitoring group, both teens and parents are instructed in the same strategy and asked to complete monitoring checklists together. The study did not measure change in ADHD symptoms,

impairment, or emotional and behavioral symptoms. Results showed that both the SQR4 group and parent mentoring group improved in the percentage of homework turned in (90% to 92%) compared to controls (60%, $p < 0.001$).

Of the two CBT-based studies, one implemented 12 weeks of manualized group CBT (Vidal et al., 2015) and the other compared nine weeks of Plan My Life (PML; Boyer et al., 2015), a combination of CBT, skills training, and motivational interviewing, with a solution-focused treatment (SFT), which included CBT and motivational interviewing without skills training. Both saw improvement in ADHD symptoms (manualized CBT, Cohen's *d* range = - 7.5 to – 8.4, *p*'s < 0.001; PML & SFT, $\eta p^2 = 0.24$, $p < 0.001$, no between group differences), and impairment. In the Boyer et al. study, both groups of CBT (PML and SFT) saw improved academic and organizational outcomes, but this outcome was not measured in the study by Vidal and colleagues. In terms of comorbid emotional and behavioral symptoms, results from the manualized CBT (Vidal et al., 2015) study indicated no change in anxious or depressive symptoms while both groups in the Boyer and colleagues (2015) study experienced a positive change in depression, anxiety, ODD, and CD symptoms (ηp^2 range = 0.09 to 0.14, $p < 0.001$) with no significant between-group differences.

Overall, Chan and colleagues (2016) note the limited number of high-quality studies evaluating psychosocial treatments for youth with ADHD and the interventions reviewed predominantly target academic skills. Therefore, while the exhibited medium to large improvements in functional impairment and academic outcomes (Chan et al., 2016) indicate adolescent interventions for ADHD can be effective, more research is required to consider them evidence-based. Furthermore, only one study reported a reduction in internalizing symptoms (Boyer et al., 2015), two reported no significant change in internalizing symptoms (Molina et al.,

2008; Vidal et al., 2015), and the remaining seven studies either did not measure or did not report outcomes in internalizing symptoms. As these psychosocial interventions show evidence of positive symptomatic, functional, and academic effects, research into how adolescent ADHD interventions influence internalizing symptoms is warranted.

In another systematic review, Sibley and colleagues (2014) review 15 years of literature on ADHD interventions for adolescents. The authors found 22 new studies on behavioral therapy interventions. Additionally, the results of 17 pharmacological studies and three cognitive enhancement training studies are discussed in the review, however, this is outside of the defined scope of the current study.

Of the reviewed psychosocial studies, the results of eight controlled trials and one open trial are reported. All studies were methodologically sound including multi-informant measures (63.8%) and reported on multiple outcomes (90.9%). The review included studies implemented as after school programs (n =2), intensive summer programs (n =1), in school (n =2), and in outpatient clinics (n = 4). Of the reviewed interventions, 50.0% integrated aspects of home school collaboration and 81.8% included parent-teen collaboration. These characteristics have both theoretical (Owens et al., 2008; Pelham, 2016; Pfiffner et al., 2013) and empirical support (Evans et al., 2011; Sibley et al., 2013) and are integrated in the summer treatment program for adolescents (STP-A; Pelham et al., 2015)

Improving teen functioning in academics (68.2%, median effect size = 0.41) and reducing family conflict (22.7% of studies, medium to large effect size results) were primary areas of focus. Notably, effects for academic outcomes ranged from no significant effects for teacher-rated outcomes, to very small effects on GPA, to robust effects on parent-report and directly observed outcomes. While positive changes in functional, externalizing, and academic outcomes

are widely reported in the review, similarly to the Chan et al. (2016) review, internalizing problems were neither a primary target nor widely reported outcome of adolescent ADHD interventions. Only one psychosocial study reported improved internalizing problems, (Molina et al., 2008) and this study was described in the previous literature review. Despite evidence that behavioral therapy interventions can be effectively delivered in schools in the presence of adequate resources (Langberg et al., 2012), this review identified the burden of allocating these resources during the school year as an obstacle to intervention. This burden is addressed by interventions that move services to the summer months (e.g. STP-A).

The Summer Treatment Program for Adolescents

An adolescent adaptation of the nationally recognized and evidence-based Summer Treatment Program (STP; Pelham et al., 1997), the Summer Treatment Program for Adolescents with ADHD (STP-A; Pelham, et al., 2015) integrates developmental considerations into a theoretical framework with strong empirical evidence of efficacy for children with ADHD (Chronis et al., 2004; Fabiano et al., 2007; Pelham et al., 2010; Pelham et al., 2005). In particular, STP-A includes a program that explicitly teaches academic and organizational skills relevant to middle and high school in a secondary school-like structure to promote generalizability to youth's lives after the program. Additionally, STP-A addresses particular adolescent socio-emotional, independence, and vocational needs through programmatic modules such as health, daily jobs, social-problem solving, and business meetings, promoting adaptive development in these areas (Sibley et al., 2011). For a detailed description, see treatment manual (Pelham et al., 2015).

Evidence for STP-A. As a recently developed intervention, STP-A currently has a limited evidentiary base. However, results from multiple evaluative studies (Babinsky et al.,

2013; Derefinko et al., 2014; Sibley et al., 2011; Sibley et al., 2012b; Sibley et al., 2013b; Sibley et al., 2018b) suggest that STP-A effectively adapts the research-based STP (Pelham et al., 1997) to meet the developmental needs of adolescents. Specifically, results indicate efficacy in the improvement of ADHD symptoms, academic and organizational outcomes, and parent-child relations.

Preliminary Findings. A 2011 pilot study (Sibley et al., 2011) evaluated STP-A treatment effects for 19 adolescents between the ages of 11 and 16 (M = 14.06 years, SD = 1.73). This iteration of STP-A was clinic-based and offered through a university research center in the northeastern United States. Results showed that adolescents, with the exception of one rater, improved overall (82.4% to 94.7%) as measured by an adolescent Improvement Rating Scale (IRS; Pelham et al., 2000). The IRS asked respondents (parents, adolescents, two STP-A teachers, and counselors) to use a seven-point likert scale (0= no problem, 1= much worse … 7 = much improved) to rate participants in the areas of conduct problems, adult-direct defiance, social functioning, inattention/disorganization, mood/well-being, and academic skills. Across all but one rater (science/health teacher) ratings converged around somewhat improved (likert scale = 5). Overall, these preliminary results indicate that STP-A has the potential to benefit adolescents in a wide range of domains, including mood/well-being. This study is limited in several areas. First, the sample size is small (n = 19), includes only six female adolescents with ADHD and no comparison youth, compromising generalizability to the general population. Second, while the primary outcome measure (IRS; Pelham, 2000) evaluates improvement in a range of outcomes using multiple raters, it lacks the complexity to describe specific treatment effects. Furthermore, reviewing the literature found few instances of the IRS as an outcome measure in ADHD research, complicating a comparison of results to other studies. Including

outcome measures more widely used in ADHD studies (e.g. CBCL/TRF/YSR; Achenbach, 1991and IRS; Pelham et al., 2004) would enable comparison of STP-A to other adolescent ADHD interventions. Furthermore, increasing the scope and sensitivity of outcome measures (e. g. AAPC; Sibley et al., 2014a and CBQ-20; Robin & Foster, 1989) would permit a more comprehensive and nuanced analysis of treatment effects. Regardless, this pilot study reports promising results and the more recent iteration of STP-A (Sibley et al., 2018b) addresses many of the mentioned limitations in study design.

Randomized Control Trial of STP-A. In a second iteration of STP-A, Sibley et al. (2018b) build on preliminary evidence from the 2011 pilot study utilizing a larger sample size (*N* = 325) and more generalizable and sensitive outcome measures. The study assessed ADHD symptoms, academic functioning, and familial conflict in adolescents (rising 6th and 9th graders) receiving the complete version of STP-A (high intensity; HI), a less intensive intervention using STP-A components (low intensity; LI), and no treatment. Intervention was implemented largely by the school district from which participants were recruited in collaboration with university researchers who provided training, support, and consultation.

Treatment Conditions. The HI group received the comprehensive STP-A (Pelham et al., 2010) described previously and evaluated in the 2011 pilot study. Intervention for the LI group consisted of a manualized eight-week organization skills group 1.5 hours per week (Sibley, 2013) led in the evenings at the STP-A school by school-based mental health professionals and school personnel. The classes used didactic instruction, hands-on activities, discussions, and directed exercises at home to facilitate the development of organizational habits and establish supportive structures at home. LI treatment also included the manualized parent-training sessions (1.5

hours/week for eight weeks) and school-year consultation components of STP-A. The untreated group received no intervention from study staff.

Results. Authors assessed ADHD symptoms using the Disruptive Behavior Disorder Rating Scale (DBD parent and teacher versions; Pelham et al., 1992), organizational problems (Adolescent Academic Problems Checklist [AAPC]; Sibley, et al., 2014a), grade point average (GPA; district-reported), bookbag organization (observed), homework recording (observed), disciplinary incidents (district-reported), and parent-teen conflict (Conflict Behavior Questionnaire [CBQ-2] teen and parent versions; Robin & Foster, 1989), at baseline, at the end of the summer, and throughout the following school year ending with a final assessment in in the summer (EOY).

EOY group comparisons show that for ADHD symptom severity, ninth graders in the HI group improved significantly more in parent-rated inattention ($d = 0.40$; $p = 0.01$) and hyperactivity/impulsivity ($d = 0.46$, $p = 0.01$) than ninth graders in the LI group. Additionally, 9th grade HI adolescents exhibited a significant reduction in parent-reported hyperactivity/impulsivity symptoms ($d = 0.60$, $p = 0.01$), but increased teacher-rated inattention ($d = -0.26$, $p = 0.02$) compared to the untreated group. No significant between-group differences in ADHD symptom change were found for 6th graders, nor was there a difference between LI and untreated adolescents on any ADHD symptom measure (p's > 0.05)

In regard to improvement in academics and organization, the only significant group differences were between the HI and untreated groups in parent-rated organization problems ($d = 0.54$; $p = 0.02$) and in 9th grade GPA ($d = 0.47$; $p = 0.04$). They were not found to improve in teacher rated organization problems, book-bag organization, or homework recording (p's > 0.10)

compared to adolescents receiving no treatment. Furthermore, the HI group did not significantly differ from the LI group on any academic or organizational measure (p's > 0.10).

In behavioral and family indices, the HI group was found to have significantly less parent-reported family conflict (b = 0.10, d = 0.39, p < 0.01). Additionally, parents of teens in the HI group report significantly more use of contingency management than parents of youth in both the LI group (b = 0.25, d = 0.43, p = 0.04) and the untreated group (b = 0.33, d = 0.43, p < 0.01). This is a surprising result given that parents with adolescents in the LI and HI groups received the same parent-training and school year consultation components of the STP-A. A possible interpretation is that for parents in the HI group, reinforcement of positive daily report cards during STP-A established contingency management structures that persisted through the following school year.

Discussion. Compared to a less intensive summer intervention and untreated control group, comprehensive STP-A was found to have moderate yet inconsistent efficacy in improving adolescent ADHD symptoms, academic functioning, and parent-teen relationship quality. In terms of general trends, the reduction of parent-rated ADHD symptoms appears to be one of the strongest treatment effects and STP-A was associated with more improvement in rising 9th graders than in rising 6th graders.

The few differences between teens receiving the low intensity and high intensity treatment, as well as the lack of significant differences between low intensity and control groups indicate that the benefits of STP-A components may be incremental. While adolescents receiving comprehensive STP-A exhibited improvement in some measures of symptom severity, organization, GPA, and parent conflict, these results were not consistent between raters or grades. Furthermore, at the end of the school year following intervention, the HI group differed

from the LI group only in parent-rated symptoms of inattention and hyperactivity/impulsivity. Additionally, these results were only true for students who were entering 9th grade.

Limitations. This study is limited in several ways. In an effort to avoid inflating type II error, the authors do not control for type I error. Secondly, parents and teens were not blind to treatment conditions and expectations of treatment benefits might have impacted ratings. In terms of generalizability, although both recruitment and intervention were conducted in one school district, participants represent an ethnically and socioeconomically diverse sample (see Table 1).

Of particular note, this evaluation of STP-A is limited by the scope of reported outcomes. One of the stated goals of STPs are to promote youth self-esteem through facilitating positive social, behavioral, and functional growth (Pelham et al., 2004). While participants in the HI condition received social skill intervention and vocational instruction, the potential benefits of these components are not represented in the reported outcome measures. Evaluating how change in social problems and internalizing symptoms differs depending on the intensity of treatment would deepen the current understanding of STP-A treatment effects and inform future socio-emotional interventions, which are limited in extant literature on adolescent ADHD interventions (Chan et al., 2016; Sibley et al., 2014c).

Future Directions. Given the strong evidence of social impairment in youth with ADHD (Andrade, 2012; Wiener & Mak, 2009; Ohan & Johnston, 2007) including deficits in areas such as violating rules (Mrug et al., 2007; Wehmeier et al., 2009) and difficulty with waiting for his/her turn (McQuade & Hoza, 2015), the sports format of the social skills component of STP-A could have a beneficial effect on adolescents' social functioning. Similarly, STP-A provides the opportunity to form social connections over the 360 hours of intervention and organized social

activities which could address the frequent lack of reciprocal friendships (Blachman & Hinshaw, 2002; Mikami & Hinshaw, 2003) experienced by youth with ADHD. The tendency of youth with ADHD to overestimate their social functioning (Fefer et al., 2015; Mikami et al., 2010) and demonstrate deficits in social cognition (Uekermann et al., 2010). Indicates that they could benefit from behavioral feedback components of STP-A. The theoretical connection of treatment components to these various areas of social deficit typical in ADHD suggest that STP-A might be associated with a reduction in reported social problems. The relevance of evaluating social effects of ADHD interventions is highlighted by studies finding social problems in youth with ADHD to be resistant to treatment (deBoo & Prins, 2007; Hoza, 2007; McQuade & Hoza, 2007).

Furthermore, STP-A components have the potential to improve depressive and anxious symptoms in youth both through addressing social deficits and through developing self-efficacy in adolescents. Studies have found that social problems are predictive of internalizing problems in youth with ADHD (Becker et al., 2013; Owens & Hinshaw, 2016; Ward et al., 2019), therefore the STP-A components that target social deficits could indirectly reduce depressive and anxious symptoms. Adolescents with ADHD have been shown to have lower self-esteem and self-efficacy than teens without ADHD (Sibley, 2019). Instructing STP-A program staff to prioritize the recognition of positive behaviors could contribute to the development of positive self-esteem. Given evidence showing low self-esteem in early adolescence (M = 12.98 years) to be predictive of depression three years later (Zhou et al., 2018) STP-A could reduce depressive and anxious symptoms through building self-esteem. Similarly, low self-efficacy has been hypothesized to contribute to depression through the perceived and lived experience of failing to meet expectations and the anticipation of future failures (Gordon et al., 2012). The vocational, academic, and skills training components of STP-A could increase self-efficacy by facilitating

the development of competencies, strategies, and leadership characteristics that could empower teens to navigate the increasingly complex responsibilities of adolescence (Sibley et al., 2011) more effectively.

Connecting STP-A components to theory and evidence in the literature, has documented mechanisms through which STP-A could improve adolescent social problems and depressive/anxious symptoms. An evaluation of adolescent outcomes in these areas for the three treatment conditions would contribute to the current literature in three ways. First, assessing STP-A as a potential effective treatment for adolescent social skills and for teens at-risk of developing depression and anxiety could increase the limited number of adolescent ADHD interventions targeting internalizing symptoms. Second, between-group differences in treatment effects would provide information on the components of STP-A that might be effectively target social and/or depressive and anxious symptoms. For example, if there is little difference in a change in reported social problems or internalizing symptoms between the LI and HI groups, but a significant difference between the LI and no treatment groups, the components that are shared between HI and LI conditions might be considered the most beneficial. Third, including gender in analysis will expand the current literature documenting gender differences in response to ADHD interventions (Babinski et al., 2013; Mikami et al., 2013).

The Proposed Study

In summarizing the current literature on three underrepresented domains of ADHD research: gender considerations, internalizing comorbidity, and adolescent interventions (Hartung & Wilcutt, 2002; Owens et al., 2015; Chan et al., 2016), this review has identified areas in each domain warranting further study. In regard to gender considerations, the historic overemphasis of the male presentation of ADHD (Waschbush & King, 2006) and small number of studies

evaluating gender differences (Gaub & Carlson, 1997; Gershon, 2002; Owens & Hinshaw, 2016; Babinski et al., 2011b) has resulted in a limited and inconsistent description of gender differences in impairment, outcomes, and treatment response (Babinski et al., 2013; Biederman et al., 2010b; Nandeau et al., 2015). These limitations are reflected in disproportionate referral rates (Hartung & Wilcutt, 2002; Waschbusch & King, 2006) and the absence of ADHD interventions targeting female-specific needs. Furthermore, studies demonstrate evidence that girls with ADHD experience different patterns of impairment (Gaub & Carlson, 1997; Babinski et al., 2011b), risk factors for developing internalizing comorbidity (Becker et al., 2013; Bagwell et al., 2006), and response to intervention (Babinski et al., 2013). Reviewed literature advocates for the consideration of gender in analyses of impairment, developmental trajectories, and response to intervention.

Although comorbid internalizing disorders are less extensively studied in ADHD research than are co-occurring externalizing disorders (Bagwell et al., 2006; Ward et al., 2019) significant evidence documents elevated prevalence rates of depression and anxiety in the ADHD populations (Fischer et al., 2002; Roy et al., 2014) as well as the increased risk of adverse life outcomes resulting from the interaction of ADHD and comorbid internalizing problems (Chronis-Tuscano et al., 2010; Daviss, 2008). Few studies have investigated pathways through which childhood ADHD develops into depression and anxiety or identified risk factors that predict internalizing problems in adolescents with ADHD (Owens & Hinshaw, 2016; Ward et al., 2019). However, those that have, identify social problems, academic problems, and family conflict as potential mediators in the development of internalizing problems for youth with ADHD (Al-Yagon, 2016; Becker et al., 2013; Owens & Hinshaw, 2016; Ward et al., 2019). Extant ADHD literature is often limited in that it frequently evaluates the relationship of one (as

opposed to multiple) ADHD-related impairment with the development of anxiety and/or depression (Becker et al., 2013; Roy et al., 2015; Yip et al., 2013), omits gender as a potential moderator (Owens & Hinshaw, 2016; Ward et al., 2019), and/or combines depression and anxiety into one internalizing outcome (Masten et al., 2015; Owens & Hinshaw, 2016). All studies reviewed exhibit at least one of these limitations, indicating a need for ADHD research that investigates pathways in the development of anxiety and depression, considering gender, multiple domains of impairment, as well as the interaction between gender and impairment as potential risk factors.

In comparison to the substantial inventory of evidence-based interventions for ADHD (*N* = 175; Fabiano et al., 2009), there are significantly fewer adolescent interventions (Chan et al., 2016; Sibley et al., 2014c; Smith et al., 2000). The literature on adolescent ADHD interventions is additionally limited by a lack of reported internalizing outcomes (Chan et al., 2016). The increased prevalence in adolescent depression and anxiety for youth with ADHD (Hinshaw et al., 2012; Owens & Hinshaw, 2016), documentation of ADHD symptom persistence into adulthood (Sibley et al., 2016a), and frequent discontinuation of childhood ADHD treatment in teenagers (Chan et al., 2016; Sibley et al., 2014c) in spite of increasing demands (Antshel, 2015) demonstrates a significant need for studies evaluating the efficacy of ADHD interventions in the promotion of positive adolescent adjustment. Early evaluations of an adaptation of the widely-researched childhood summer treatment program (Pelham & Hoza, 1996; Chronis et al., 2004; Evans et al., 2004), the summer treatment program for adolescents (STP-A; Pelham et al., 2015) demonstrates significant promise in treating not only academic organizational impairments in adolescents with ADHD (Sibley et al., 2011, Sibley et al., 2018b), but also social and internalizing problems. As prior evaluations of STP-A do not include gender as a moderator and

are limited in both the scope and specificity of reported outcome measures, a study that describes STP-A treatment effects by gender on social problems, depression, and anxiety outcomes would contribute to the current literature on adolescent ADHD interventions.

The current study proposes to perform a secondary analysis on baseline, post-intervention, and one-year follow up data from the STP-A evaluation study by Sibley and colleagues (2018b). This data set contains a large (N = 325) sample of diverse adolescents (for demographics see Table 1) with a substantial number of girls (n = 84) with ADHD. The study aims to evaluate gender differences in ADHD-related impairment, risk factors and moderators of the development of internalizing problems in adolescents with ADHD, and treatment effects of STP-A on social problems, depression and anxiety for both rising 6th and 9th graders with ADHD. Research questions and hypotheses are described below.

Research Question #1

To what extent do patterns of impairment in adolescents with ADHD differ by gender and grade level?

Research Question #1: Hypothesis. Current literature examining gender differences in ADHD-related impairment have typically found that girls exhibit similar levels of overall impairment (Biederman et al., 2005; Gershon, 2002; Leopold et al., 2019), particularly in clinic-referred samples (Gaub & Carlson, 1997). Recent studies report that female ADHD is manifested in different patterns of impairment, partially due to the interaction of core ADHD symptoms with societal factors (Bauermeister et al., 2007; Biederman et al., 2010; Kok et al., 2016). Specifically, recent evidence predominantly shows females in community-based samples to be rated as less impaired overall (Arnett et al., 2015). It is therefore hypothesized that neither gender nor grade will predict global, academic, or interpersonal impairment. Adolescents entering 9th grade

identifying as female and with ADHD are predicted to demonstrate higher levels of internalizing problems compared to female participants entering 6th grade and all participants not identifying as female (Babinsky et al., 2011a; Babinsky et al., 2011b; Biederman et al., 2008).

Research Question #2

Research Question #2a. What is the relationship between common domains of ADHD impairment (school problems, social problems, and family conflict) and internalizing comorbidity in adolescents with ADHD?

Research Question #2a: Hypothesis. The current literature provides theoretical (Johnston & Mash, 2001; Steinberg & Drabick, 2015) and empirical evidence (Al-Yagon, 2016; Masten et al., 2005; Owens & Hinshaw, 2016; Ward et al., 2019) that social problems, academic impairment, and familial conflict are risk factors for the development of depression and anxiety in youth with ADHD. However, studies most frequently report social problems as a mediator between ADHD symptoms and internalizing problems (Becker et al., 2013; Owens & Hinshaw, 2016; Roy et al., 2015; Ward et al., 2019; Yip et al., 312). Therefore, it is hypothesized that social problems will be the most significant predictor of both depression and anxiety in adolescents with ADHD.

Research Question #2b. To what extent is the relationship between impairment and internalizing comorbidity moderated by gender and grade level?

Research Question #2b: Hypothesis. The relationship between impairment and internalizing symptoms is predicted to be stronger for females than males and for rising 9th grade participants compared to rising 6th grade students. This is hypothesized for two reasons. First, research that finds ADHD impairment to become more evident for females during adolescence as the complexity of school becomes makes it harder to compensate for executive functioning

challenges (Waite, 2007) and is reflected in the later identification of girls with ADHD (Waschbush & King, 2006). Secondly, some researchers believe that while ADHD symptoms or impairment may not differ significantly or quantifiable by gender, the differing characteristics of social relationships and societal expectations for girls compared to boys necessitates the consideration of biology when interpreting impairment (Biederman et al., 1996; Biederman et al., 2008). Given that social interactions become more salient and complex during adolescence, particularly for girls (Daneel, 2019), this study anticipates the translation of impairment to internalizing problems to be more strongly associated with girls and to likewise increase with age. Therfore, a significant gender by grade by impairment interaction is hypothesized with social problems predicting anxiety and depression most strongly for girls in grade nine. No significant moderation by gender or grade is hypothesized between academic problems or family conflict and outcome measures.

Research Question # 3

Research Question #3a. What is the impact of STP-A treatment conditions on adolescent social problems, depressive symptoms, and anxiety?

Research Question #3a: Hypothesis. Strong theoretical evidence suggests the potential of STP-A components to positively impact adolescent social (Blachman & Hinshaw, 2002; Mikami & Hinshaw, 2003; Mrug et al., 2007; Wehmeier et al., 2009) and internalizing (Becker et al., 2013; Gordon et al., 2012; Zhou et al., 2018) problems. Furthermore, a 2011 study of the found that adolescents reported mood/well-being (5.06 on a 7-point likert scale ranging from 1= very much worse, 4= unchanged, and 7 indicating very much improved) and social functioning (5.12) as the most significant improvements related to participating in STP-A. Likewise parents reported mood/wellbeing as the most significant improvement (5.25). Mood/well-being

encompassed self-esteem, happiness, dealing with anger/frustration, accepting disappointment, and self-awareness (Sibley et al., 2011 It is hypothesized that the main effect of High Intensity (HI) group will indicate greater improvement in social problems and anxiety than the Low Intensity (LI) group or the untreated group, but that differences in depression will not prove to be significant. No significant difference in outcome is hypothesized between the LI and untreated group in social problems or depression but that the LI group is predicted to improve significantly more in anxiety compared to the untreated group.

Research Question #3b. To what extent are treatment effects moderated by gender or grade level?

Research Question #3b: Hypothesis. Due to the developmental differences between rising 6th and rising 9th graders and the increased task load of high school (Langberg et al., 2008; Sibley, 2019), a significant group by grade by time interaction is hypothesized for outcomes. This hypothesis is supported by significant grade by time interactions were found comparing the HI vs. LI conditions in the original paper written on this iteration of STP-A, specifically in terms of inattention severity (b = -0.143, p = 0.01), hyperactivity/impulsivity severity ((b = -0.115, p = 0.01). Similarly, treatment effects on inattention (b = -0.108, p = 0.01) and grade point average (b = 0.122, p = 0.04) were also found when comparing the HI vs. untreated groups (Sibley et al., 2018b). Given the lack of gender-specificity in the intervention, no gender by group by time interactions are anticipated.

Chapter 3: Methods

The present study analyzed data collected by Sibley et al. (2018b) during an evaluation of the efficacy of both high and low intensity conditions of the Summer Treatment Program-Adolescent (STP-A; Pelham et al., 2015) in improving youth organizational and academic outcomes. This dataset is appropriate for the current study for two reasons. First, the STP-A study demonstrates a strong theoretical foundation and research design, integrating intervention elements found to be effective for adolescents with ADHD (e.g. Chan et al., 2016; Sibley et al., 2011; Sibley et al., 2011; Sibley et al., 2013a; Sibley et al., 2013b; Sibley et al., 2018b). Second, the research design implemented robust diagnostic procedures for participant selection (Stein & Shin, 2008), included participants (adolescent and female ADHD populations) and empirically validated measures (see measures section) aligned with current research questions.

Study Context

Setting

STP-A was conducted in partnership with the fourth largest school district in the United States which has over 350,000 students (Census.gov, 2019) The district, located in Florida, is the second most ethnically diverse district in the United States and encompasses urban, suburban, and rural neighborhoods. According to the district, students were born in 160 different countries, 56 different languages are spoken in student homes, and 70.2% of the student population receives free or reduced-priced lunch (Miami-Dade County Public Schools, 2015). Data was collected between April 2012 and July 2016. Intervention took place during the summers of 2012, 2013, and 2014. A fourth cohort of comparison youth were assessed between 2015 and 2016.

Participants

The total participant pool amounted to 325 students with ADHD entering sixth grade (*n* = 168) and ninth grade (*n* = 157) with 218 participants randomly assigned into the two treatment conditions and grouped by grade and a third untreated group evaluated in the fourth year of the study. The groups were compared to ensure successful randomization and were found to have no significant difference on demographic or clinical variables ($p > 0.25$). Demographic information is provided in Table 1.

High Intensity Condition. The high intensity (HI) treatment group (*n* =109), received the full, manualized STP-A intervention which included 360 hours of direct student intervention conducted by district personnel during the summer, 12 hours of parent training, daily staff-parent communication, and consultation during the school year as needed. Details of both the high and low intensity STP-A is provided previously in this proposal and a complete description of the intervention is available in the treatment manual (Pelham et al., 2010).

Low Intensity Condition. The low intensity (LI) treatment group (*n* = 109) received a 12-hour adolescent organizational skills intervention (Supporting Teens Autonomy Daily, STAND; Sibley, 2013), 12 hours of parent training, and consultation throughout the following school year as needed.

Untreated Condition. Comparison youth (Untreated; *n* = 107) were recruited via the same process used for participants in treatment groups in the fourth year of the study. Comparison youth received no STP-A intervention or consultation. The untreated group was not found to significantly differ from treatment groups with the exception of use of medication at baseline and the frequency of medication initiation in the year following the baseline summer.

Recruitment and Eligibility

Participants were recruited during the spring of their fifth-or eighth-grade year. School staff, including teachers, counselors, special education staff, and administration made referrals based on a provided study description and nomination form. Following nomination, parents were contacted by trained research assistants who obtained consent and conducted a brief phone screening in parents' preferred language, verifying the presence of both *DSM-IV-TR* ADHD symptoms and evidence of impairment.

Prospective participants exhibiting at least four symptoms from the Inattention (IN) and/or Hyperactivity/Impulsivity (HI; APA, 2000) criteria as well as clinically significant academic problems based on teacher nominations and phone screening, were invited to an evaluation. The clinical significance requirement was satisfied if the student was rated a minimum of 3 out of a possible 6 in academic problems on the Impairment Rating Scale (IRS; Fabiano et al., 2006).

Study eligibility was then determined through a clinical review by two doctoral psychologists who confirmed a diagnosis of ADHD through a combination of parent- and teacher-ratings of symptoms (Disruptive Behavior Disorder Rating Scale; DBD; Pelham et al., 1992) and impairment (IRS; Fabiano et al., 2016) as well as a structured parent interview (Computerized-Diagnostic Interview Schedule for Children; DISC; Shaffer, Fisher, Lucas, et al., 2000). The interview established that the symptom, age of onset, multiple settings of impairment, criteria for ADHD diagnosis were met, and ruled out comorbid disorders as the primary cause of symptoms. Participants were considered eligible if they satisfied all DSM-IV-TR diagnostic criteria. A third clinician was consulted in the event of disagreement between the two evaluators.

Of the 736 adolescents referred, 35 parents either could not be reached or declined to participate and 205 youth were ruled out during either the phone screening or secondary evaluation. While 325 youth were deemed eligible to participate, intervention space required 167 students to be excluded. Total retention for the study was 99.4%. Parents and participants ($100) as well as teachers ($20) were compensated for their completion of assessments and rating measures. Both the Florida International University institutional review board and the participating school district approved all study procedures.

Intervention Design

The school district personnel delivered STP-A components and provided participants with transportation to the district school where intervention occurred. Psychosocial aspects of the intervention were led by a student services staff member (e.g. special education teacher, reading intervention specialist) while academic interventions were conducted by teachers and teachers' aides. These groups were supported by three college interns. School personnel involved in the intervention were ethnically representative of the district population A university-based clinical psychologist supervised two district employed mental health specialists, a school psychologist, and a school counselor who provided the parent-training portion of the intervention as well as trained school staff involved. The ten-week staff training included discussions, lessons, tests, and practice such as role-playing. Staff members were given a treatment manual, required to obtain a score of 80% on an assessment of procedural knowledge and given weekly reliability assessments to promote treatment fidelity.

Organizational Skills Training (for the LI group). Adolescents assigned to the low intensity intervention attended a manualized 8-week organizational skills group (Sibley et al., 2014c). The group was held at the STP-A school in the evening once per week for 1.5 hours at

the same time as parents attended their training (see next) sessions. School-based mental health specialists and local school district staff provided didactic instruction and facilitated discussion exercises in organizational skills. In addition, teens were given exercises to practice skills at home between sessions, for example, negotiating a homework plan for the upcoming school year. At the end of sessions, teens met briefly with parents to outline a plan for skills practice.

Parent-Training (for the HI and LI groups). A manualized parent-training program for adolescents with ADHD (Pelham et al., 2015), was implemented by school mental health specialists, in 1.5-hour weekly sessions during the 8 weeks of summer intervention. Format of the training sessions alternated between small-group (four to six parents) and full-group (ten to 15 parents) and included didactic instruction and discussion of how to integrate parenting concepts into their family's culture and structure. Topics included monitoring academic achievement, setting daily routines, applying behavioral concepts to homework, and creating a parent-teen contract that utilizes privileges to reinforce daily responsibilities. Parents were also encouraged to use skills learned in their sessions to support teen skill practice during the week and following school year. Bilingual staff facilitated parent-training in both English and Spanish.

School-Year Consultation (for the HI and LI groups). School mental health specialists consulted with school staff throughout the following school year utilizing a manualized treatment based on research-based adolescent ADHD interventions (Evans et al., 2007; Langberg et al., 2012). This consultation included a preliminary meeting where a school staff member was appointed to provide organizational skill interventions upon student request. Furthermore, consultants contacted the appointed school staff member monthly to obtain information regarding school performance and provide consultation if significant impairment was reported, however these services were not frequently utilized (Sibley et al., 2016b).

Summer Treatment Program-Adolescent (for the HI group). The STP-A, which was the intervention for the HI group, consisted of eight, 45-hour weeks of STP-A (Pelham et al., 2010) from 8:00 a.m. to 5:00 p.m. Monday through Friday, mimicking the typical structure of a school week. The daily schedule was divided into 30- to 50-minute modules including core academic modules (health, science, creative writing, and history), academic support modules (organizational skills and study hall), vocational modules (job training), and social skills (sport skills). These modules, behavior feedback system, and daily parent-staff communication are discussed earlier in this proposal. For a complete description see the intervention manual (Pelham et al., 2015).

The health block utilized the LifeSkills© Training Program (Botvin, 1979), an evidence-based program centered on the prevention of delinquency, substance use, and violence. History class prioritized the development of note-taking and study skills. The science block targeted study skills, collaborative work through daily labs, and quiz-taking. Study skills taught in both science and history were evidence-based (Deshler et al., 1984). Participants were provided with goals and daily feedback in each module. Creative writing emphasized the writing process, story analysis, and provided youth with feedback on their writing. During study hall, counselors monitored youth during an unstructured work period where participants practiced time-management skills and were provided rewards for on-task behavior. Organizational Skills Training (OST; Evans et al., 2009) consisted of individual coaching on time management, organization, and management. Social skills were taught through Sports Skill Drills (Pelham et al., 1997), a module utilized in the youth STP programs. This period reinforced sportsmanship, leadership, and problem solving. Vocational modules developed planning skills, responsibility, teamwork, and money management skills through a Future Business Leaders of America (FBLA)

style program (Geddes, 1986) and daily job period. Teens applied to jobs that were tailored to his or her needs, led meetings, raised funds for an end of summer trip, and interacted with supervisors. They received feedback as well as monetary compensation based on performance ratings.

Additionally, those in the HI treatment group received daily staff-parent communication in the form of a daily report card. During orientation, school mental health specialists conducted a one-hour parent session, developing a home-based contingency management to reward youth for meeting daily goals during STP-A which they proposed to their adolescent. Daily communication of performance included verbal feedback and guidance on access to home rewards to parents by lead counselors, as well as a written summary of progress towards goals. Verbal communication was provided in either Spanish or English, based on parent preference. For a more detailed description of programmatic elements, see Sibley et al., 2011.

Measures

Attendance and Fidelity

Adolescent attendance was recorded daily. Attendance and dosage for each group are reported in Table 2. Parent-training and organizational sessions were audiotaped for fidelity by a trained research assistant; 20% of meetings and attendance was recorded. Trained observers randomly attended 20% of STP-A modules, monitoring fidelity for reliability and STP-A implementation utilizing standardized checklists (Sibley, et al., 2011) by trained research assistants. Average score on fidelity checklists was 95% for STP-A, 96.5% for parent-training, and 90.5% for adolescent organizational skills training (Sibley et al., 2018b).

Global Impairment

Global ADHD-related impairment was measured using the parent- and teacher-reports of the Impairment Rating Scale (IRS; Fabiano et al., 2006). The IRS assessed youth's functioning across seven broad areas: peer relationships, sibling relationships, parental relationship, school, self-esteem, family functioning, and perceived severity. This measure captures aspects of impairment across all other families of impairment reported in this analysis and is therefore considered a global measure of impairment. Raters indicate impairment by marking an X along a continuum. A metrical score from 1-6 was then generated from their response. For analysis, parent and teacher IRS ratings are reported as the mean of their seven responses. The IRS has strong documentation of concurrent, predictive, convergent, and discriminant validity (Evans et al., 2011; Fabiano et al., 2006) and has been demonstrated to accurately indicate impairment in adolescents with ADHD across settings and informants (Becker et al., 2013; Evans et al., 2013; Sibley et al., 2011; Sibley et al., 2012a; Ward et al., 2019).

Grade Point Average

The school district provided report cards following each academic quarter. Grades in academic classes were converted to a 5-point scale (i.e., 4.0 = A to 0.0 = F) and averaged to produce a grade point average (GPA) for each participant. Grades were not weighted by class difficulty level. GPA provides a contextual and objective measure of school performance that directly impacts a student's academic opportunities and outcomes. In this study, GPA provides information regarding how a student's behavioral patterns interact with their academic achievement. Given that girls with ADHD have been shown to demonstrate stronger academic coping strategies than boys with ADHD (Bauermeister et al., 2007). GPA can provide insight into how this gender difference translates to school performance. Furthermore, GPA is visible and

relevant to students, parents, and teachers, making it a measure with the potential to influence participants' internalizing symptoms (Sibley et al., 2018b).

School Problems

Teen academic school problems were assessed using the Adolescent Academic Problems Checklist (AAPC; Sibley et al., 2014a). The AAPC contains 25 academic problems frequently associated with ADHD including completion of schoolwork, organization, and school behavior. Both parents and teachers rated participants on a 4-point scale from 0 (*not at all*) to 3 (*very much*) for each behavior. Academic problems are described by the mean item rating for each parents and teachers. In a sample of 346 adolescents with ADHD, the AAPC was found to have an internal reliability rating of $\alpha = 0.92$ (Sibley et al., 2014b). The internal reliability for the AAPC in the current sample is also $\alpha = 0.92$.

Family Conflict

The quality of the parent-teen relationship was assessed via the Conflict Behavior Questionnaire-20 (CBQ-20; Robin & Foster, 1989), a 20-item scale adapted from the complete 73-item CBQ. The CBQ-20 is shorter to complete and contains the CBQ items that differentiate families based on distress. It has a 0.96 correlation with the CBQ (Robin & Foster, 1989). Parents and teens both rated statements regarding their relationship on a 5-point scale with 1 indicating strong agreement to 5 indicating strong disagreement. The mean item score for both teens and parents represented the construct of family conflict in the current study. Internal reliability for this sample ranged from $\alpha = 0.91$ to 0.94.

Social Problems

The Child Behavior Checklist- Ages 6-18 (CBCL; Achenbach, 1991a) and the Youth Self Report, Ages 11-18 (YSR; Achenbach & Rescorla, 2003) were used to evaluate social problems

in teens. Both the CBCL and the YSR are well-validated broad-band measures of internalizing and externalizing symptoms used widely in both clinical practice and research (Buckholdt et al., 2014; Crystal et al., 2001; Mikami et al., 2011). Adolescents and parents rated items (112 and 113, respectively) on a 3-point scale (0= *not true*, 1= *somewhat or sometimes true,* 2= v*ery true or very often true)* reflecting behaviors that occurred over the past six months. *T*-scores (*M* = 50, *SD* = 10) were then calculated for subscales with higher scores reflecting more severe symptomatology.

Both the YSR and CBCL produce T-Scores in eight empirically-based syndrome subscales and six DSM-oriented scales. All CBCL and YSR scales have excellent internal consistency, test-retest reliability and validity (Achenbach & Rescorla, 2003). In addition, these scales are widely used in adolescent ADHD populations (Hinshaw, et al., 2002; Hinshaw et al.,2006, Ward et al., 2019). In particular, the Social Problems subscale has been used in prior ADHD research evaluating adolescent response to multicomponent treatment (Vanzin et al., 2018) and is shown to have strong validity in assessing social problems in youth with ADHD. (Karustis et al., 2000; Mikami et al., 2003; Ward et al., 2019).

Depressive Symptoms

The YSR and CBCL Withdrawn/Depressed subscale *t*-scores were used to assess symptoms associated with depression. Though the Affective Problems composite was considered as a measure, the Withdrawn/Depressed subscale is more widely used in ADHD literature to indicate depression (Crystal et al., 2001; Ward et al., 2019). A 2014 study found a significant but mild correlation between the Depressed/Withdrawn subscale and a diagnosis of depression, $r = 0.36$, $p < 0.01$in a sample of psychiatric inpatient adolescents (Gomez et al., 2014). The Depressed/Withdrawn subscale is created by summing the total responses (0 to 2) for each of the

YSR items related to depressive thoughts, feelings, and behaviors and generating a *t*-score based on a normative sample.

Anxiety Symptoms

The study conceptualized adolescent anxiety symptoms using the YSR and CBCL Anxiety Problems *t*-scores (DSM-oriented subscale) which assesses symptoms of generalized anxiety, separation anxiety disorder, and specific phobias. While the YSR Anxious/Depressed subscale was considered as the measure of anxiety, the DSM-oriented subscale has been shown to have strong psychometric properties and is correlated with DSM criteria for anxiety (Nakamura et al., 2009). Furthermore, the Anxious/Depressed subscale encompasses multiple internalizing disorders (Read et al., 2015).

Statistical Analyses

Original data collection included the calculation of *t*-scores as well as the examination for missing data, outliers, confirmation of normality in the distribution of all dependent variables. Data analysis included of a series of multilinear regression using standard and sequential predictor entry as well as linear mixed models (LMMs) conducted on SPSS version 25 statistical software. A priori comparisons of zero-order correlations were run to evaluate predictors for multicollinearity and determine statistical families to control for type one error. Pearson's bivariate correlations among all metrical variables utilized across all three analyses are shown in Table 3. There were no significant multicollinearity concerns.

Question #1: Patterns of ADHD Impairment by Gender and Grade

Multiple regression with sequential predictor entry examined the contribution of gender and grade to various ADHD-related impairments, as well as the incremental variance contributed by the interaction of gender and grade. This analytic design mirrors that of Arcia & Conners,

1998. Data was collected at baseline and each outcome variable is analyzed separately with *N's* for each analysis reported. Participants with missing data were not included in analysis.

Question #1: Predictors: Gender and grade were effect-coded (girls = 1, boys = -1; rising 9th grade = 1, rising 6th grade = - 1) to facilitate interpretation effects direction and interaction terms. The decision to use grade as opposed to age in representing developmental differences in participants was based on the limited age range of the sample (11-14). If treated as a metrical variable- age, developmental differences could hold less predictive power as small increases in age are less salient to outcomes and interactions than is a categorical distinction between adolescents entering sixth and ninth grade due to environmental contexts and teen adolescent accumulation of experience. This decision mirrors analysis in the original study which assesses how STP-A facilitates transition to both middle school and high school (Sibley et al., 2018b).

Question #1: Outcomes: Outcome variables, determined through review of literature comparing impairment in boys and girls with ADHD (Gaub & Carlson, 1997; Gershon, 2002), include domains of impairment with inconsistent evidence or domains that are directly aligned with the internalizing focus of this study. Furthermore, families of impairment evaluated in this study mirror those used in the related study by Ward et al. (2019). In order to control for type one error inflation due to multicollinearity amongst outcome variables, zero order correlations and conceptual relationships of variables were used to form families of impairment. *P*-values required for statistical significance were adjusted based on the number of outcome variables in each family of impairment via the Dunn-Sidak procedure. Outcomes were combined into four families of impairment; global impairment, (global impairment, parent and teacher; adjusted p = 0.025), academic impairment (GPA; academic problems (AAPC), parent-reports and teacher-

reports; adjusted $p = 0.017$), interpersonal impairment (Family conflict (CBQ-20), adolescent- and parent-reports, social problems, adolescent-reports (YSR) and parent-reports (CBCL); adjusted $p = 0.013$), and internalizing symptoms (depressive symptoms and anxiety symptoms), adolescent-reports (YSR) and parent-reports (CBCL). For all correlations between outcome variables, $r^2 < 0.49$, $p < 0.01$.

Multiple linear regression analysis contained two blocks of predictors. Block one included gender and grade to evaluate the main effects. Block two assessed the incremental variance contributed by the interaction of gender and grade to the outcome variables. The following model was replicated for each outcome variable:

$$\text{Predicted } Y_{impairment} = \beta_0 + [\beta_1 (\text{gender}) + \beta_2(\text{grade})] + [\beta_3 (\text{gender*grade})]$$

Question #2: Predictors of Internalizing Problems for Youth with ADHD

The second analysis examined two connected but unique research questions. First, multiple linear regression with standard predictor entry sought to model the unique contributions of three frequently-reported domains of ADHD-related impairment; social problems, family conflict and school problems, controlling for gender and grade. A second step of analysis, using multiple linear regression with sequential predictor entry evaluated gender and grade moderations for impairments with significant main effects in the previous analysis. No significant multicollinearity was found between among predictor variables $r^2 < 0.12$. Outcome variables for this analysis were depressive symptoms (YSR; Depressed/Withdrawn *t*-score), and anxiety symptoms (YSR; Anxiety Problems *t*-score). Given the aim of this analysis, to evaluate

the relationship between impairment and internalizing problems, predictor variables of impairment were determined to provide the greatest sensitivity to impairment and avoid missed impairment. Based on research that finds adolescents to be the most reliable reporters of internalizing problems (Ladd & Troop-Gordon, 2003), adolescent *t*-scores on the YSR were used as both depression (depressed/withdrawn subscale) and anxiety outcomes (anxiety problems subscale).

Question #2a*:* Predictor variables for part a were academic problems (AAPC, parent-report), family conflict (CBQ-20, parent-report), social problems (CBCL, social problems, parent-report), with gender and grade as covariates. Gender and grade are effect-coded (female = 1, non-female = -1; Rising 9th grade = 1, rising 6th grade = -1). All predictor variables were centered on the sample mean.

Predictor were chosen to maximize the likelihood of capturing impairment and to align with current research. Specifically, social and academic impairment measures align with Ward et al. (2019) which evaluated the interaction of impairment, ADHD symptoms, and items related to Sluggish Cognitive Tempo in an overlapping sample of adolescents with ADHD. The predictor representing family conflict was measured via the mean parent-rating on the CBQ-20 as studies have indicated that parent-ratings reflect greater severity than teen-ratings of the same familial interactions (De Los Reyes et al., 2012). Utilizing the parent-report as opposed to the teen-report is considered to reflect stronger sensitivity to potential impairment. Furthermore, using all parent-report measures as predictors reduces the likelihood that difference in predictor effects were related to variance in rater, given the trend toward correlation of intra-rater measures in zero order correlations. The following model for part one was repeated for each of the two outcomes, depressive symptoms and anxious symptoms.

Predicted $Y_{internalizing} = \beta_0 + \beta_1(\text{gender}) + \beta_2(\text{grade}) + \beta_3(\text{social problems}) + \beta_4(\text{school problems}) + \beta_5(\text{family conflict})$

Question #2b: Secondary Analysis. Secondary analysis examined the moderation of significant main effects of impairment on internalizing comorbidity by gender and grade using multiple linear regression with sequential predictor entry in three blocks. Block one repeated question 2a analysis, describing the main effect of the impairment on internalizing problems, controlling for gender and grade. Block two introduced two-way interactions of impairment by gender and impairment by grade. The final model examined the unique contribution of a three-way interaction (impairment by gender by grade). These interaction terms assessed how the predictive value of the significant impairments change depending on the developmental level and identified gender of the adolescent. The full model for each impairment predictor found to be significant in question one a analyses was repeated for all outcomes that predictor significantly contributed to is as follows:

$$\text{Predicted } Y_{internalizing} = \beta_0 + [\beta_1(\text{impairment}) + \beta_2(\text{gender}) + \beta_3(\text{grade})] + [\beta_4(\text{impairment*gender}) + \beta_5(\text{impairment*grade})] + [\beta_6(\text{impairment*gender*grade})]$$

Question #3: Treatment Effect on Internalizing Symptoms and Social Problems

In question three, separate linear mixed method with random effects analyses examined the treatment effects of STP-A on depression symptoms, anxiety symptoms, and social problems

using an intend-to-treat design. Due to the longitudinal nature of the study, missing data at post-intervention and follow-up time points were assumed to be missing at random and related to other variables in the model and to their values at previous time points (Schafer & Graham, 2002). By including all participants with at least one observation, LMMs maximized the power of analysis, treating missing data as random (West et al., 2006). Primary treatment effects (group by time interactions for each outcome) were modelled in question 3a analysis for each outcome. Secondary effects, moderation by gender and grade, were evaluated in question three b, for outcomes with significant primary treatment effects.

Medication (Yes = 1, no = 0), gender (Female = 1, non-female = 0), and grade (Rising 9th grade = 1, Rising 6th grade = 0) were dummy-coded as fixed effects during primary effect modelling. Medication was included as a covariate only in question three analysis as the first two analyses did not compare between treatment groups. The untreated group was found to differ significantly in medication use at baseline as well as the initiation of medication throughout the following school year compared to both HI and LI groups. Group effects were described in two dummy-coded variables with the LI group as the statistical reference group (HI: yes = 1, no = 0; NOTX: 1 = yes, 0 = no). A second set of LMMs were run with the untreated group as the statistical reference to compare HI and untreated groups. Time at POST (end of intervention) and EOY (end of following school year) were coded as months as the precise time of assessment was unique for each participant at each time point. The interaction of time*group represents treatment effects (primary effects) and the three-way interaction of time*group*gender/grade represent moderation effects (secondary effects). Outcome measures were teen-reported depressive symptoms (YSR Depressed/Withdrawn *t*-score) and anxious symptoms (YSR, Anxiety Problems *t*-score) as well as parent-reported social problems (CBCL, Social Problems *t*-score).

Question #3a: Primary Effects. In initial LMMs the primary outcome was the Group X Time effects for HI versus LI groups (β_{12}) and LI versus untreated groups (β_{13}). This was repeated with the untreated participants as the reference group, in which case Group X Time (β_{12}) represents differing treatment effects between the HI and untreated group. The final model for primary effects was repeated twice for each outcome, with LI and untreated groups alternating as reference groups and is reported below.

$$Y_{ij} = \pi_{0i} + \pi_{1i}\,(time) + e_{ij}$$

$$\pi_{oi} = \beta_{00} + \beta_{01}(medication) + \beta_{04}(HI) + \beta_{05}(untreated) + r_{0i}$$

$$\pi_{1i} = \beta_{10} + + \beta_{11}(HI) + \beta_{02}(untreated) + \beta_{12}(time*HI) + \beta_{13}(time*untreated) + r_{1j}$$

Question #3b: Secondary Effects. The second analysis of question three illustrated moderation of significant treatment effects by gender and grade respectively. Moderation of treatment effects between HI and LI groups were represented by the HI X moderator terms (β_{14}). Treatment effects in the LI group compared to the untreated group were illustrated by the untreated by LI moderator (β_{15}). A second set of LMMs were conducted with untreated as the reference group in which case the comparison of moderation of treatment effects for HI versus untreated groups is represented by the HI*moderator term (β_{14}). The following final model of secondary effects, moderation by both gender and grade (represented as moderator), were repeated for each outcome with significant primary treatment effects for each moderator (gender and grade).

$$Y_{ij} = \pi_{0i} + \pi_{1i}\,(time) + e_{ij}$$

$$\pi_{oi} = \beta_{00} + \beta_{01}(medication) + \beta_{02}(HI) + \beta_{03}(untreated) + \beta_{04}(moderator)$$
$$+ \beta_{05}(HI*moderator) + \beta_{06}(untreated*moderator) + r_{0i}$$

$$\pi_{1i} = \beta_{10} + \beta_{11}(HI) + \beta_{12}(untreated) + \beta_{13}(moderator)$$
$$+ \beta_{14}(HI*moderator) + \beta_{15}(untreated*moderator) + r_{1i}$$

Chapter 4. Results

Results for Question #1: Gender and Grade Differences in Patterns of ADHD-Impairment

Multiple linear regression with sequential predictor entry was used to predict patterns of ADHD-related impairment by gender, grade, and the interaction of gender and age. Mean impairment for each outcome variable, as well as the incremental variance contributed by the main effects of gender and grade, as well as the interaction of grade and gender are reported in Table 3-6. The results for each family of outcome variables is reported below.

Global Impairment

For global impairment, two independent outcomes were evaluated and therefore an adjusted p value of 0.025 was calculated using the Dunn-Sidak procedure. Results showed no significant variance in the omnibus F test of parent- or teacher-reports of teen global impairment based on teen gender, grade, or the interaction of gender and grade. The first model showed that neither main effects of gender nor grade accounted for a significant variance in parent or teacher reported global impairment (Parent: $R^2 = 0.00$, $F(2, 320) = 0.02$, $p > 0.050$, $R^2_{adjusted} = -0.01$; Teacher: $R^2 = 0.02$, $F(2, 305) = 2.95$, $p > 0.050$, $R^2_{adjusted} = 0.01$). Controlling for gender and grade, the interaction between gender and grade likewise made no significant contribution to variance in parent or teacher reported global impairment (Parent: $R^2_{change} = 0.00$, $F_{change}(1, 319) = 1.57$, $p > 0.050$ [$R^2_{total} = 0.01$, $R^2_{adjusted} = 0.00$]; Teacher: $R^2_{change} = 0.00$, $F_{change}(1, 304) = 1.36$, $p > 0.050$ [$R^2_{total} = 0.02$, $R^2_{adjusted} = 0.14$]. Results from the final block, controlling for all other variables, showed that average parent reported global impairment was 3.03 out of 6.00 (SE = 0.10) and that average teacher reported global impairment was 3.28 out of 6.00 (SE = 0.08). See Table 4.

Academic Impairment

Three academic outcomes; GPA, AAPC-Parent, and AAPC-Teacher, were evaluated for their variance by gender, grade, and the interaction of gender and grade. According to the Dunn-Sidak procedure, an adjusted *p* value of 0.017 was used to account for family-wise type I error inflation. Models, reported in Table 5, showed patterns in GPA and parent-rated academic problems (AAPC-Parent) related to predictors, but not for teacher-rated academic problems (AAPC-Teacher).

GPA. Results showed that the main effects of gender and grade account for a significant variance in teen GPA, $R^2 = 0.03$, $F(2, 311) = 5.36$, $p = 0.005$, $R^2_{\text{adjusted}} = 0.03$. Grade level (Rising 9th vs. Rising 6th) made a unique and negative contribution to GPA, $b = -0.12$, $SE = 0.05$, $t(308) = -2.95$, $p = 0.003$, $sr^2 = 0.03$, indicating that teens entering 9th grade were predicted to have a GPA 0.24 points lower than teens entering 6th grade. The main effect of gender did not make a unique contribution to GPA, $b = 0.07$, $SE = 0.05$, $t(308) = 1.47$ ($p > 0.050$).

The final model, with all three predictors, was found to make a unique contribution to variance in GPA, $R^2_{change} = 0.01$, $F_{change}(1, 307) = 4.68$, $p = 0.002$ ($R^2_{total} = 0.05$, $R^2_{adjusted} = 0.04$). Holding all other variables constant, the average GPA for adolescents in the sample was 2.24 (out of 4.00). While gender and grade did not continue to contribute to variance in GPA in the final model (Gender: $b = 0.07$, $SE = 0.05$, $t(307) = 1.53$, $p > 0.050$; Grade: $b = -0.07$, $SE = 0.05$, $t(307) = -1.57$, $p > 0.050$), the interaction of grade and gender did make a significant and positive contribution, $b = 0.10$, $SE = 0.05$, $t(307) = 2.16$, $p = 0.031$, $sr^2 = 0.01$. However, after adjusting *p* to account for familywise type 1 error inflation, the interaction was no longer significant.

Academic Problems. Main effects of gender and grade accounted for significant variance in parent-rated teen academic problems, $R^2 = 0.04$ ($R^2_{\text{adjusted}} = 0.03$), $F(2, 321) = 6.09$, *p*

= 0.003. Grade was found to be a significant predictor of parent-reported academic problems (b = 0.09, SE = 0.04, $t(321) = 2.59$, $p = 0.010$, $sr^2 = 0.03$) with teens in 9th grade reported to have more academic impairment. However, the individual contribution of gender, b = - 0.09 SE = 0.04), $t(321) = -2.31$, $p = 0.022$, $sr^2 = 0.02$, was not found to be significant after adjusting the familywise error rate.

Results from the final model of parent-rated academic problems, which included the interaction of gender and grade in addition to main effects, was likewise found to make a unique contribution to the outcome variable, $R^2_{change} = 0.01$, $F_{change}(1, 320) = 3.72$, $p = 0.001$ (R^2_{total} = 0.05, $R^2_{adjusted} = 0.04$). Holding all other variables constant, the average mean of parent-rated academic problems was 1.49 out of 3.00 (SE = 0.04). In the final model, with all predictors entered, only gender had a unique effect on parent-rated academic problem (b = -0.09, SE = 0.04, $t(320) = -2.40$, $p = 0.017$, $sr^2 = 0.01$) indicating that, in this sample, female teens were associated with less parent-rated academic impairment. Grade (b = 0.05, SE = 0.04, $t(320) = 1.35$, $p >$ 0.050) and the interaction of grade and gender (b = -0.07, SE = 0.04, $t(320) = -1.93$, $p > 0.050$) were not found to contribute uniquely to difference in parent-rated academic problems above and beyond the main effects.

No significant relationship was found in either model of teacher-reported academic problems in the first model, including the main effects of gender and grade, $R^2 = 0.02$, $F(2, 318)$ = 2.77, $p > 0.050$, $R^2_{\text{adjusted}} = 0.01$. Likewise, the final model, which included the interaction of gender and grade in addition to the main effects of gender and grade generated $R^2_{change} = 0.00$, $F_{change}(1, 317) = 0.024$, $p > 0.050$ ($R^2_{total} = 0.02$, $R^2_{adjusted} = 0.01$) and therefore was not found to be significant. The average teacher-rated adolescent academic problem mean was 1.59 out of 3.00 (SE = 0.04).

Interpersonal Impairment

Analysis of teen interpersonal impairment evaluated the effects of gender, grade, and their interaction on four outcomes; teen- and parent-ratings of family conflict and teen- and parent-ratings of adolescent social problems. *P* value was adjusted to 0.013 using the Dunn-Sidak procedure to account for potential familywise inflation of type I error. Modelling showed a unique contribution of predictors for teen-rated family conflict and not for parent-rated family conflict or social problems. Both teen- and parent-reported outcomes are described below and presented in Table 6.

Family Conflict. Results show that the main effects of grade and gender account for a significant variance in teen-reported family conflict, $R^2 = 0.07$, $F(2, 321) = 11.60$, $p < 0.001$, $R^2_{\text{adjusted}} = 0.06$. Grade made a significant and positive contribution to teen-ratings of family conflict, $b = 0.18$, $SE = 0.04$, $t(321) = 4.56$, $p < 0.001$, $sr^2 = 0.06$, indicating that older adolescents were more likely to endorse family conflict. Gender was not significantly associated with differences in teen-rated family conflict, $b = 0.07$, $SE = 0.05$), $t(321) = 1.61$, $p > 0.050$. The final model, which included the interaction of grade and gender, significantly accounted for additional variance in adolescent reporting of familial conflict, $R^2_{change} = 0.00$, $F_{change}(1, 320) = 0.00$ $p < 0.001$ ($R^2_{total} = 0.07$, $R^2_{adjusted} = 0.06$). The average teen mean rating on family conflict items was 2.26 out of 3.00 ($SE = 0.05$), Holding all other variables constant. Specifically, grade continued to uniquely predict teen-reported family conflict ($b = 0.18$, $SE = 0.05$), $t(320) = 3.98$ $p < 0.001$, $sr^2 = 0.05$, with rising 9th grade teens reporting more family conflict. Neither gender ($b = 0.07$, $SE = 0.05$), $t(320) = 1.61$ $p > 0.050$) nor the interaction of grade and gender ($b = 0.00$, $SE = 0.05$), $t(320) = 0.01$ $p > 0.050$) significantly contributed to outcome variance.

Modelling of parent-reported family conflict found no significant relationship with respect to gender or grade, $R^2 = 0.02$, $F(2, 322) = 2.78$, $p > 0.050$, $R^2_{\text{adjusted}} = 0.01$. Likewise, no additional variance was accounted for by the addition of the interaction of gender and grade term, $R^2_{change} = 0.00$, $F_{change}(1, 321) = 0.25$, $p > 0.050$ ($R^2_{total} = 0.02$, $R^2_{adjusted} = 0.01$). Controlling for gender and grade, the average mean parent-rating of family conflict was 2.64 ($SE = 0.05$).

Social Problems. Teens reported an average social problems *t*-score of 58.88 in this sample ($SE = 0.54$) after controlling for gender and grade. Neither the main effects model ($R^2 = 0.01$, $F(2, 321) = 1.94$, $p > 0.050$, $R^2_{\text{adjusted}} = 0.01$), nor the final model (including the interaction term), $R^2_{change} = 0.00$, $F_{change}(1, 320) = 1.18$, $p > 0.05$ ($R^2_{total} = 0.02$, $R^2_{adjusted} = 0.00$), found gender or grade to account for a significant variance in teen-rated social problems. Holding all other variables constant, parents endorsed items generating an average *t*-score of 61.01 ($SE = 0.60$) on the CBCL Social Problems subscale. Like in teen-reported social problems, neither the main effects of gender and grade ($R^2 = 0.00$, $F(2, 322) = 0.44$ $p > 0.05$, $R^2_{\text{adjusted}} = 0.00$) nor the final model, $R^2_{change} = 0.00$, $F_{change}(1, 321) = 0.001$, $p > 0.050$ ($R^2_{total} = 0.00$, $R^2_{adjusted} = -0.01$), contributed significantly to difference in parent *t*-scores. In this sample, gender and grade are not associated with variance in social problems *t*-scores.

Internalizing Symptoms

The internalizing comorbidity family included both parent- and teen-ratings of adolescent depressive and anxious symptoms. Using the Dunn-Sidak procedure, the *p* value required for significance was adjusted to 0.013 to account for the four analyses in this family. Results showed evidence of variable moderation of internalizing comorbidity by grade and gender. See Table 7.

Depressive Symptoms. The main effects of grade and gender were not found to contribute significantly to variance in teen-reported depressive symptoms $R^2 = 0.01$, $F(2, 321) = 1.63$, $p > 0.050$, $R^2_{\text{adjusted}} = 0.00$. However, results show the final model with all predictors (grade, gender, and grade by gender) to account for a significant variance in teen-reported depressive symptoms, $R^2_{change} = 0.02$, $F_{change}(1, 320) = 7.71$, $p = 0.012$ ($R^2_{total} = 0.03$, $R^2_{adjusted} = 0.02$). Specifically, while gender ($b = -0.97$, $SE = 0.52$, $t(320) = 1.88$ $p > 0.050$) and grade ($b = 0.49$, $SE = 0.52$, $t(320) = 0.96$ $p > 0.050$) were not uniquely predictive of adolescent ratings of depressive symptoms, the gender by grade interaction term showed additional variance in teen-reported depressive symptoms ($b = 1.43$, $SE = 0.52$), $t(320) = 2.77$, $p = 0.006$, $sr^2 = 0.01$. As illustrated in Figure 1, the interaction was disordinal, showing that the direction of the effect of gender on teen-reported depressive symptoms changed depending on the grade level of the participant. The ratings of female identifying as rising 6th graders generated an average *t*-score 3.85 points lower than their same-age non-female identifying peers, reflecting a less significant experience of symptoms associated with depression. However, for teens entering 9th grade, on average, female participants' ratings generated a Depressed/Withdrawn *t*-score 1.87 points higher than the non-female group.

Modelling of parent *t*-scores on the Depressed/Withdrawn subscale of the CBCL found no significant main effects of gender and grade ($R^2 = 0.01$, $F(2, 322) = 1.62$, $p > 0.050$, $R^2_{\text{adjusted}} = 0.00$). Furthermore, adding the interaction of grade and gender to the model did not account for additional variance in parent-ratings of teen depressive symptoms, $R^2_{change} = 0.00$, $F_{change}(1, 321) = 0.43$, $p > 0.05$ ($R^2_{total} = 0.01$, $R^2_{adjusted} = 0.00$). Holding gender and grade constant, parent-ratings generated an average *t*-score of 59.89 ($SE = 59.89$).

Anxiety Symptoms. Results found the main effects of gender and grade to account for significant variance in anxiety problem *t*-scores generated from teen-ratings, $R^2 = 0.03$, $F(2, 321) = 4.82$ $p = 0.009$, $R^2_{\text{adjusted}} = 0.02$. The main effects (Gender: $b = -0.95$, $SE = 0.45$, $t(321) = -2.098$, $p = 0.037$, $sr^2 = 0.00$; Grade: $b = -0.92$, $SE = 0.40$, $t(321) = -2.31$, $p = 0.021$, $sr^2 = 0.00$) were predictive of teen-reported anxiety symptoms, however, after correcting for familywise type I error inflation, both predictors failed to meet statistical significance. Likewise, the final model, which included the interaction of gender and grade in addition to the main terms was not found to be significant after adjusting *p*-value criteria, $R^2_{change} = 0.00$ $F_{change}(1, 320) = 0.54$, $p = 0.018$ ($R^2_{total} = 0.03$, $R^2_{adjusted} = 0.02$). In the final model, holding all else constant, teens-ratings generated an average *t*-score of 56.31 on the Anxiety Problems subscale.

In terms of parent-reported adolescent anxiety symptoms, neither the main effects model ($R^2 = 0.00$, $F(2, 322) = 0.03$ $p = > 0.050$, $R^2_{\text{adjusted}} = -0.01$) nor the final model with all predictors entered ($R^2_{change} = 0.02$ $F_{change}(1, 321) = 6.45$, $p > 0.050$ ($R^2_{total} = 0.02$, $R^2_{adjusted} = 0.01$) were found to contribute to *t*-score variance. The final model shows that, holding grade and gender constant, parent-ratings generated an average *t*-score of 58.61. While grade and gender do not independently contribute to variance in parent-reported adolescent anxiety problem, results show a significant disordinal grade by gender interaction ($b = -1.37$, $SE = 0.54$, $t(321) = -2.54$, $p = 0.012$, $sr^2 = 0.02$) indicating that parent-ratings of teen anxiety problems changed depending on gender and grade level. Average parent *t*-scores for in rising 6th grade females were 3.09 points lower than for non-female adolescents. For adolescents entering 9th grade, however, parent *t*-scores were 2.37 points higher for females than non-females.

Results for Question #2: Variance in Internalizing Comorbidity by Impairment

For the second research question, analysis was completed via two regression analyses. First, multiple linear regression with simple predictor entry assessed variance in teen-reported depressive and anxiety symptoms attributed to social impairment, academic problems, and family conflict, holding grade and gender constant. Second, multiple linear regression with sequential predictor entry evaluated moderation effects of gender, grade and gender by grade for impairments found to be significant in the first regression. Main effects of ADHD-related impairment, grade, and gender in the first regression are reported in Table 8. Results from the second regression for significant main effects in the previous regression are reported in Table 9.

Results for Question #2a: Main Effects of Impairment on Internalizing Symptoms

The set of predictors (gender, grade, social impairment, academic impairment, and family conflict) accounted for a significant amount of variance in teen-reported depressive symptoms, $R^2 = 0.04$, $F(5, 317) = 2.48$ $p = 0.032$, $R^2_{adjusted} = 0.02$. The model estimates of intercepts showed that, controlling for grade and gender, teens with average parent-reported social, school, and family problems were predicted to endorse depressive symptoms generating a *t*-score of 58.39 ($SE = 0.46$). Only family conflict, $b = 1.36$, $SE = 0.63$, $t(317) = 2.16$, $p = 0.032$, $sr^2 = 0.01$, was found to have a unique effect on teen-rated depressive symptoms. Gender ($b = 0.78$, $SE = 0.52$, $t(317) = 1.48$, $p > 0.050$), grade ($b = -0.30$, $SE = 0.46$, $t(317) = -0.64$, $p > 0.050$), social impairment ($b = 0.08$, $SE = 0.05$, $t(317) = 1.55$, $p > 0.050$), and academic impairment ($b = -0.79$, $SE = 0.87$, $t(317) = -0.90$, $p > 0.050$) were not uniquely predictive of depressive symptoms. Specifically, there was an estimated mean increase of 1.36 points in adolescent *t*-scores for each standard deviation (from sample mean) increase in parent-rated family conflict, holding all other variables constant.

In terms of anxiety problems, the set of predictors (gender, grade, social impairment, academic impairment, and family conflict) accounted for significant variance in adolescent *t*-scores, $R^2 = 0.04$, $F(5, 317) = 2.54$, $p = 0.028$, $R^2_{\text{adjusted}} = 0.02$. Holding all variables constant, the model predicted teen *t*-scores of 56.29 ($SE = 0.46$). Only gender ($b = -0.95$, $SE = 0.46$, $t(317) = -2.07$, $p = 0.040$, $sr^2 = 0.01$) and grade ($b = -0.98$, $SE = 0.40$, $t(317) = -2.43$, $p = 0.016$, $sr^2 = 0.02$) were found to uniquely contribute to differences in teen-reported anxiety problems. Controlling for grade and gender, none of the main effects significantly predicted anxiety problems (social impairment, $b = 0.05$, $SE = 0.05$, $t(317) = 1.07$, $p > 0.050$; academic impairment, $b = 0.29$, $SE = 0.76$, $t(317) = 0.38$, $p > 0.050$; family conflict, $b = -0.34$, $SE = 0.55$, $t(317) = 0.62$, $p > 0.050$).

Results for Question #2b Moderation of Family Conflict and Depressive Symptoms

Results from part 2a found family conflict to be the only significant main effect and only in predicting depressive symptoms. The second analytic step therefore includes a single multiple regression with sequential predictor entry. The first model, with family conflict, grade, and gender as predictors contributed significantly to differences in teen-reported depressive symptoms, $R^2 = 0.03$, $F(3, 320) = 3.26$, $p = 0.022$, $R^2_{\text{adjusted}} = 0.02$. Likewise, the second model, which included two-way interaction terms significantly accounted for incremental variance above and beyond main effects, $R^2_{change} = 0.03$ $F_{change}(3, 317) = 2.86$, $p = 0.006$ ($R^2_{total} = 0.06$, $R^2_{adjusted} = 0.04$). Addition of the three-way interaction between family conflict, gender, and grade in the final model was similarly found to significantly contribute to variance in depressive symptoms above and beyond main effects and two-way interactions, $R^2_{change} = 0.01$ $F_{change}(1, 316) = 2.67$ $p = 0.004$ ($R^2_{total} = 0.06$, $R^2_{adjusted} = 0.04$).

In the final model, with all predictors entered, the mean predicted teen-reported depressive symptom *t*-score with average family conflict, irrespective of grade and gender was

estimated to be 58.47. Parent-rated family conflict ceased to be significant in the final model, b = 1.29 (SE = 0.66), $t(316) = 1.96$, $p = 0.040$, $sr^2 = 0.01$. As in the first and second models, gender (b = 0.87, SE = 0.51, $t(316) = 1.69$, $p > 0.050$) and grade (b = 0.349, SE = 0.51, $t(316) = 0.68$, $p > 0.050$) were not uniquely predictive of teen-reported depressive symptoms.

Only the gender by grade interaction was found to have a significant relationship with depressive symptoms, b = 1.50 (SE = 0.51), $t(316) = 2.92$, $p = 0.004$, $sr^2 = 0.02$, as illustrated in Figure 1. The relationship was disordinal indicating that the direction of gender's effect on depressive symptoms differed by grade level given average ratings of family conflict. Female adolescents entering 6th grade ratings of depressive symptoms generated a t-score 1.27 points higher than non-female-identifying teens. For rising 9th graders, the average t-score for female participants was 4.73 points higher than their non-female peers. Family conflict by gender (b = - 0.44 (SE = 0.66), $t(316) = - 0.67$, $p > 0.050$) and family conflict by grade (b = 0.37 (SE = 0.66), $t(316) = 0.57$, $p > 0.050$) were not found to uniquely contribute to variance in depressive symptoms. Similarly, the three-way interaction of family conflict by gender by grade, was not found to be significantly related to differences in depressive symptoms (b = 1.08 (SE = 0.66), $t(316) = 1.63$, $p > 0.050$).

Results for Question #3 Treatment Effects of STP-A

Results show treatment effects on teen-reported depressive symptoms, anxiety symptoms, and parent-reported social problems. Primary and secondary effects are described by outcome below and reported in Table 10. Marginal means and treatment effects are reported in Table 11.

Depressive Symptoms

Results show significant primary treatment effects with the high intensity treatment contributed to a decrease in teen-reported depressive symptoms. Specifically, comparisons of HI

and LI groups (b = - 0.17, t = -2.15, p = 0.032, d = 0.24) as well as HI and untreated groups (b = - 0.14, t = -1.97, p = 0.049, d = 0.17) were found to be significant. No significant primary treatment effects were found comparing untreated and LI groups (b = - 0.05, t = -2.15 p > 0.050). In terms of secondary effects, gender and grade were not found to moderate treatment effects. Gender moderation results are as follows; HI versus LI (b = - 0.16, t = -0.92 p > 0.050), untreated versus LI (b = 0.12, t = 0.73 p > 0.050), HI versus untreated (b = -0.28, t = -1.65 p > 0.050). Similarly, grade was not found to significantly moderate treatment effects on depressive symptoms for the HI versus LI group (b = 0.17, t = 1.08, p > 0.050), the untreated group versus LI (b = -0.10, t = -0.675, p > 0.050), or HI versus untreated group (b = 0.22, t = 1.61, p > 0.050).

Anxiety Symptoms

LMMs showed significant primary effects by one group on teen-reported anxiety. Specifically, comparison of HI and LI groups (b = - 0.17, t = -2.37, p = 0.018, d = 0.28), but not LI and untreated groups (b = - 0.13, t = -1.82, p > 0.050) or HI and untreated groups (b = - 0.08, t = -1.14, p > 0.050) were found to be significant. For secondary effects, gender was not found to moderate treatment effects for any of the groups (HI v LI-, b = - 0.21, t = -1.29, p > 0.050; untreated v LI, b = - 0.05, t = -0.33, p > 0.050; HI v untreated, b = - 0.12, t = -0.78, p > 0.050). Contrastingly, grade was found to significantly moderate treatment effects when comparing the untreated and LI groups, b = - 0.27, t = -1.97, p < 0.050. LI treatment demonstrated stronger treatment effects compared to the untreated group in reducing in anxiety problems for rising ninth graders (d = -0.48; untreated vs.LI) than for rising 6th graders (d = -0.01; untreated vs. LI).

Social Problems

Significant primary treatment effects were found for both the HI versus LI comparison (b = -0.25, t = -2.59, p = 0.010, d = 0.31) and HI versus untreated groups (b = - 0.33, t = -3.70, p < 0.001, d = 0.42). Treatment effects for the untreated versus LI groups did not contribute significantly to change in parent-reported social problems between baseline and the end of the following school year (b = - 0.07, t = -0.76, p > 0.050). In terms of secondary effects, neither gender nor grade were found to significantly moderate group effects (p's > 0.050).

Chapter 5: Discussion

The purpose of the current study was to investigate patterns of impairment, risk factors for internalizing comorbidity, and response to treatment in rising 6th and rising 9th grade adolescents with ADHD. Analyses were conducted in three stages. The first phase examined gender and grade-level differences in patterns of ADHD impairment. In stage two, the association of academic impairment, social problems, and family conflict with depressive and anxiety symptoms was analyze examined. Phase three evaluated the treatment effects of a summer treatment program for adolescents on depressive symptoms, anxiety symptoms, and social problems. Follow up analysis of stage two and three evaluations assessed moderation of main effects by gender and grade. Results, implications, and limitations are addressed separately for each stage followed by a discussion of overarching study limitations, future directions and conclusions.

Stage One: Patterns of Impairment by Gender and Grade

Focus of the findings from the first phase was to describe the extent to which patterns of ADHD-related impairment in this sample of young adolescents differ depending on gender and grade level. It was hypothesized that participants would exhibit limited variation in global, academic, and interpersonal impairment. Internalizing symptoms were predicted to vary by both gender and grade with the female and rising 9th grade groups endorsing the highest internalizing symptoms. Stage one findings illustrate that, overall, young adolescent females and males experience similar levels of impairment with the exception of academic problems which were more prominent for boys. Results largely support past research describing few gender differences in impairment within community samples of youth with ADHD. Additionally, gender by grade interactions in GPA and adolescent-reported depression symptoms highlight young adolescence

as a critical time period for youth with ADHD where the trajectory of impairment may begin to diverge by gender. Results from each family of impairment are addressed, followed by a summative discussion of broad themes, limitations implications for practitioners, and future directions

Patterns of Global Impairment by Gender and Grade

Average parent and teacher global impairment ratings, holding gender and grade constant indicated moderate overall impairment. As hypothesized neither gender nor grade were found to contribute to differences in either parent- or teacher-reported global impairment ($p > 0.05$ for F-tests). Findings indicating that young female adolescents with ADHD in this sample do not significantly differ from their male peers in overall impairment are commensurate with past research in youth with ADHD (Biederman et al., 2002; Biederman et al., 2005; Gaub & Carlson, 1997) and adults with ADHD (Biederman et al., 2003).

Contrastingly, Bauermeister et al. (2007) found girls to have less parent reported overall impairment on a similar measure of global functioning (Brief Impairment Scale [BIS]; Bird et al., 2005). However, analysis of individual subscales of the BIS indicates that girls and boys differed in one out of three areas of impairment: school. The measure of global impairment in the current study encompasses seven areas of functioning. Therefore, individual areas of impairment are weighted less strongly in the current study than in the Bauermeister et al. study and may explain the discrepancy in findings.

Parents and teachers reported similar global impairment in rising 6th grade participants (Parents; $M = 3.02$, $SD = 1.62$; Teachers; $M = 3.47$, $SD = 1.14$) as they did for participants entering 9th grade (Parents; $M = 3.01$, $SD = 1.59$; Teachers; $M = 3.20$, $SD = 1.44$). This is consistent with a recent study which found minimal change in overall impairment ($d = 0.13$, $p <$

0.050) between fourth grade and ninth grade youth with ADHD (Leopold et al., 2019). Given evidence of differences in specific measures of impairment by grade and studies reporting an increase in ADHD symptoms in middle school (Langberg et al., 2008), the measure of global impairment (mean IRS item score) may be have been too broad to capture developmental differences. Given that this study evaluated different groups of participants in each grade level rather than compare impairment in the same youth over time. It is possible that impairment may change throughout middle school for individual youth or that the type of student willing to participate in the program the summer before 9th grade may differ from those willing to participate the summer before 6th grade.

Patterns of Academic Impairment by Gender and Grade

Results partially support the hypothesis that adolescent academic impairment would not differ by gender. No gender differences were found in GPA or teacher-ratings of academic problems. On the other hand, parents reported fewer academic problems in female adolescents than in males. Overall, gender differences in academic outcomes of the current study are consistent with extant literature in documenting minimal gender differences in academic performance (Biederman et al., 2003; Gaub & Carlson, 1997; Owens et al., 2015) as well as some evidence of stronger academic motivation and behaviors in females with ADHD (Bauermeister et al., 2006; Biederman et al., 2002; DuPaul et al., 2006; Owens et al., 2015). Few ADHD studies have evaluated gender differences in GPA, which is likely related to the underrepresentation of adolescents in ADHD research and limited relevance of GPA in elementary populations. However, findings support and extend results from an evaluation of elementary age children with ADHD (*M* age = 8.5 years) which found no gender differences in report card grades in either reading or math (DuPaul et al., 2006) to an adolescent population.

Notably, while parents reported fewer academic problems in females (*M* = 1.40, *SD* = 0.62) compared to males (*M* = 1.57, *SD* = 0.59), there were no significant gender differences in teacher-ratings academic problems (for females, *M* = 1.51, *SD* = 0.56; for males; *M* = 1.66, *SD* = 1.67). This finding is interesting given reports of gender-bias in school referrals (Gershon et al., 2002; Owens et al., 2015) and previous research reporting higher teacher-rated impairment compared to parents (Biederman et al., 2005). The lack of gender differences in teacher-rated academic problems could be explained by recruitment procedures or the measure of academic problems utilized in the current study. In terms of recruitment procedures, the same teachers who referred students for the study based on impairment completed the rating-measures. Teachers had already recognized impairment to refer participants and so gender-bias in perceived academic impairment may be lower in the current study than in clinic-referred studies. Alternative, the current measure of school problems, the Adolescent Academic Problems Checklist (AAPC; Sibley et al., 2014a), includes items more related to academic performance such as organization, note-taking, and homework completion, as opposed to externalizing or disruptive behaviors. This explanation is consistent with literature implicating disruptive behaviors as a significant contributor to gender discrepancies in school-based referrals (Arcia & Conners; 1998; Kok et al., 2016; Owens et al., 2015).

While both parents and teachers reported higher academic problems in males (parents, *M* =1.58, *SD* = 0.59; teachers, *M* = 1.67, *SD* = .054) than in females (parents, *M* =1.40, *SD* = 0.62; teachers, *M* = 1.51, *SD* = 0.57), gender was only a significant moderator in parent ratings. This may indicate that gender specific problematic academic behavior are more visible at home (*M* = 11., *SD* = 1.14 than in school or that parents are more attuned to problematic behaviors in males than females. This could be related to the structure of school compared with the home

environment or higher impairment in academic-related tasks completed at home. Discrepancies between parent and teacher reports of school problems could be an indication of the interaction of gender-specific biopsychosocial considerations and ADHD. There is evidence that while girls may experience greater cognitive deficits (Gaub & Carlson, 1997; Gershon, 2002) they may also demonstrate stronger motivation and compensatory strategies to compensate for deficiencies (Bauermeister et al., 2007; DuPaul et al., 2006; Faraone et al., 2015). These compensatory strategies, which could include organization, time management, effort, and studying, may be more visible to parents. However, elevated ratings of problematic academic behaviors for females indicate that any compensatory strategies utilized by girls in this study are not sufficient to compensate for impairment.

It was hypothesized that adolescent academic impairment would not differ by grade. Results provided mixed support of this hypothesis. Parents and teachers report similar levels of academic problems for each grade. In contrast, older adolescents were found to have lower GPAs than younger participants in the first block of analysis. However, grade level differences in GPA were no longer significant when considering the disordinal interaction of gender and grade. Specifically, in spring of 5th grade, females with ADHD had a GPA 0.06 points lower than males, but 0.34 points higher in the spring of 8th grade.

These results show that males with ADHD may struggle more than females to meet the increasing demands of middle school (Langberg et al., 2008; Sibley et al., 2013). GPA is an ecologically-valid outcome measure considered to be associated with academic behaviors like those represented in this study by parent and teacher-ratings of academic problems. Parents endorsement of fewer academic problems for females may indicate that relative strengths in academic behaviors such as organization, work completion, and study skills may explain GPA

was higher for rising 9th grade girls compared to 6th grade girls. Additionally, deficiencies in compensatory or adaptive academic behaviors may explain the lower GPA observed in rising 9th grade males compared to rising 6th grade males. Gender differences in academic behaviors may explain how girls with ADHD transition from performing similarly to males in GPA at the end of elementary school to outperforming them by the end of middle school.

Interpersonal Impairment by Gender and Grade

Adolescents were not hypothesized to differ by gender or grade on measures of interpersonal impairment which included both family conflict and social problems. This hypothesis was largely supported by results showing no significant gender differences in teen or parent reports of family conflict and social problems. Adolescent and parent ratings of social problems as well as parent reported family conflict were consistent across both grade levels. On the other hand, rising 9th graders endorsed significantly more family conflict than those entering 6th grade. Furthermore, adolescent and parent ratings of family conflict ($r^2 = 0.10$, $p < 0.01$) and social problems ($r^2 = 0.04$, $p < 0.01$) were found to be mildly, yet significantly correlated.

Family Conflict. Findings support past ADHD research reporting elevated conflict in parent-teen relationships (Garcia et al., 2019) with no significant gender differences (Biederman et al., 2005). In the current study, adolescents endorsed an average of 2.2 ($SD = 0.74$) out of 5.0 on items related to the quality of the parent-teen relationship with 1 indicating no conflict and 5 indicating high levels of conflict. Average parent-ratings as 2.6 ($SD = 0.81$) out of 5.0. A recent study of conflict between parents and adolescents with ADHD found that conflict between parents and adolescents exceeded the clinical threshold, occurring at least 50% of days (Garcia et al., 2019) which may reflect more significant conflict than the current study. However,

differences in measures (perceived quality vs. frequency) complicate comparisons and both studies support elevated family conflict.

Interestingly, this study found higher family conflict reported for participants finishing middle school compared to participants entering middle school. Current findings may be related developmental differences in 14-year-olds compared to 11-year-olds or the increasing demands throughout middle school (Langberg et al., 2008) as homework problems have been identified as the most significant point of conflict between parents and teens with ADHD (Garcia et al., 2019). Given evidence in this study suggesting a more significant decline in GPA during middle school and higher parent-reported academic problems in males compared to females, the absence of a gender by grade interaction is notable and warrants further research. Another possible

The fact that teens in the older group, but not their parents, reported more conflict than the younger group is notable given that relationships are reciprocal. One explanation might be that adolescents entering 9th grade seek autonomy (Inguglia et al., 2015; Oudekerk et al., 2015) and separation from parents (Friedman, 2014) during identity development. Additionally, parental expectations of teens, including chores and self-management increase during middle school (Sibley, 2019). Adolescents may increasingly resent parental involvement as the demands of school and home increase. Alternatively, adolescents entering 9th grade may be more aware of conflict at home than those entering 6th grade due to a reduction in self-perception bias related to cognitive development (Hoza et al., 2010).

Social Problems. As hypothesized, social problems did not differ depending on gender or grade. Both adolescents (average *t*-score = 58.92, *SD* = 8.22) and parents (average *t*-score = 60.75 *SD* = 9.47) indicate that participants in this sample may experience mild elevation in social problems as scores between 50 to 60 are considered to be in the average range and scores

between 60 and 70 are considered at-risk (Achenbach 2003). Findings support the relevance of self-perception bias (Mikami et al., 2010; Hoza et al., 2010) within this sample as adolescents reported fewer social problems than did parents). Parent and adolescent ratings of social problems demonstrated mild, yet significant correlation ($r^2 = 0.04$, $p < 0.01$).

A 2018 study using the Strengths and Difficulties Questionnaire to compare youth with ADHD to non-ADHD youth, found similar parent-reported peer problems *t*-scores in adolescents with ADHD ($M = 58.1$) compared to ($M = 49.9$) in comparison youth (Ragnarsdottir et al., 2018). The authors interpreted the ADHD group as experiencing elevated levels of social problems. Although the current study did not include neurotypical youth, the Ragnarsdottir et al. interpretation suggests current findings supports the strong documentation of social impairment in youth with ADHD (Hoza, 2007; McQuade & Hoza, 2015; Wiener & Mak, 2008).

However, it is surprising that higher elevation in social problems were not found in the current sample. One possible explanation could be that the Social Problems subscale does not adequately measure the social difficulties experienced by youth with ADHD. For example, peer victimization (McQuade et al., 2017; Wiener & Mak, 2009) and social status (McQuade & Hoza, 2015; Mikami & Hinshaw et al., 2003; Maedgen & Carlson, 2000), which have been documented as strongly associated with a diagnosis of ADHD, were not explicitly measured. Furthermore, this study did not include observational measures of social functioning which could reduce the appearance of social problems in the current study given that youth with ADHD tend to experience more social impairment in live situations rather than cold situations due to association of emotional dysregulation and peer rejection in youth with ADHD (Andrade et al., 2012; Maedgen & Carlson, 2000; Mikami et al. 2007). The literature on social problems defines cold situations as those in which youth are asked about social knowledge and live situations as

the application of social skills in the context of an interaction (Andrade et al., 2012; McQuade & Hoza 2015; Mikami et al., 2007).

Current findings which indicate that girls and boys with ADHD may experience similarly elevated problems with peers is supported by literature reporting no gender differences in social or peer problems in youth with ADHD (Becker et al., 2013; DeBoo & Prins, 2007; Gaub & Carlson, 1997; Hartung et al., 2002; Wiener & Mack, 2009). However, research into gender differences in social impairment for youth with ADHD is limited and largely focused on children (Ragnarsdottir et al., 2018) and there is evidence that females with ADHD may experience more peer rejection and impairment related to social hierarchies (Blachman & Hinshaw, 2002; Mikami & Hinshaw, 2003; Ohan & Johnson, 2007). Studies which have found more evidence of social problems in girls tend to utilize observations and peer nominations as opposed to rating scales which may capture more nuance social factors affecting girls more significantly than boys.

The absence of grade level differences in the current study supports research that social impairment persists for youth with ADHD as socially inappropriate ADHD-related behaviors and a positive bias towards functioning are barriers to adjusting and approving behavior to succeed social (McQuade & Hoza, 2015; Wehmeier et al., 2009). Results reflecting no gender by grade interaction may be explained by the small developmental window between grade level groups (3 years). Some evidence suggests that more gender effects may emerge later in adolescence as a result of differences societal expectations by gender (Smyth et al., 2000; Tuckman, 2009).

Internalizing Problems by Gender and Grade

The hypothesis that female adolescents entering 9th grade would exhibit more depressive and anxiety symptoms compared to males in any grade and females entering 6th grade was not supported by the main effects. After controlling for type I error rate, adolescents were not found

to differ by gender or grade in any measure of internalizing problems. However, a significant and disordinal gender by grade interaction in teen-reported depressive symptoms indicates that independent effects of gender and grade may be suppressed. While males in the 6th grade group reported more depressive symptoms in 6th grade, in the 9th grade group, females endorsed more depressive symptoms. Therefore, predictions regarding depressive symptoms, but not anxiety symptoms were upheld.

Similar to social problems, holding grade and gender constant, teens reported an average *t*-score of 58.01 (*SD* = 8.23) for depressive symptoms and 56.78 (*SD* = 7.22) for anxiety symptoms. These scores are in the high end of the average range (Achenbach, 2003). Parent *t*-scores (depressive symptoms = 59.89, *SD* = 10.23; anxiety symptoms = 58.61, *SD* = 8.53) reflect comparable perceptions of adolescent internalizing problems. Given the substantial evidence that youth with ADHD are at elevated risk for depression (Babinski et al., 2011a; Biederman et al., 1996; Hinshaw et al., 2012; Meizner et al., 2014), the severity of depression and anxiety symptoms found in this study is lower than anticipated. As participants in this study are between 11 and 14, onset of significant internalizing comorbidity may begin later in adolescence. This is supported by stronger evidence of co-occurring internalizing problems in older adolescents and adults (Chronis-Tuscano et al., 2010; Meinzer et al., 2016). Furthermore, there is evidence that comorbid depression is overestimated in clinic-referred samples of youth with ADHD (Meinzer et al, 2014). As a more community-based design, this study may reflect reports of internalizing problems in non-referred samples of youth with ADHD (Bussing et al., 2010; Meinzer et al., 2013). Alternatively, given evidence of modest correlation between the withdrawn/depressed subscale and a diagnosis of depression (Gomez et al., 2014), the measurement error may underestimate depressive symptoms in this population.

Findings from this study which indicate that females entering 6th grade experience fewer depressive symptoms than males in the same grade but that for rising 9th graders, depressive symptoms were higher for females ($sr^2 = 0.01$, $p = 0.006$). This disordinal interaction (Figure 1.) may have suppressed main effects of grade and gender. Results also suggest that, for young adolescent girls with ADHD, middle school represent a critical time period where depression worsens as where depressive symptoms in their male peers remains constant. Girls have been shown as between 1.5 and 3 times as likely to develop depression in adolescence than are boys (APA, 2013). Current results may reflect the gender difference in the general population as opposed to those specifically with ADHD. Given that no non-ADHD peers were included in the study, it remains unclear whether ADHD contributes to greater increase in depressive symptoms in females compared to males. On the other hand, the moderation of gender's association with depression by grade found in this study may support extant literature citing increased severity of depressive problems in adolescent and young adult females with ADHD (Biederman et al., 2002; Babinski et al., 2011b; Hinshaw et al., 2002) and indicate the window in which they begin to differ from males with ADHD.

In the current study, average adolescent ($M = 56.78$, $SD = 7.22$) and parent ($M = 58.70$, $SD = 8.53$) Anxiety Problems *t*-scores were slightly lower than those for depression but were similarly on the high end of the average range. Notably, female adolescents reported slightly lower anxiety symptoms than males ($sr^2 = 0.01$, $p < 0.05$). Findings show that according to both reporters, anxiety symptoms did not vary by gender or grade. These results align with research documenting an elevated risk for the ADHD population as a whole (Biederman et al., 2010; Roy et al., 2014; Yoshimasu et al., 2012) but minimal gender differences (Biederman et al., 2008). Results are in contrast to reports that while females with ADHD experience more anxiety than

males with ADHD, they do not differ significantly from females without ADHD (Roy et al., 2014). As this study did not contain adolescents without a diagnosis of ADHD, current findings cannot confirm that ADHD is a risk factor for anxiety. Interestingly, there was no significant correlation between parent and adolescent reports of anxiety, supporting the current clinical standard of evaluating internalizing problems through adolescent and not parent reports (Jarrett et al., 2016).

Implications for Diagnosis, Treatment, and Research

Similarities in Impairment Contrast Gender Disproportionality in Diagnosis. Studies have shown that gender differences in patterns of impairment vary between community-referred and clinic-referred samples (Biederman et al., 2002; Gaub & Carlson, 1997). The currently study, conducted in a school district is closer to community-based than clinic-based, given that participants were representative of the community and referred from over 100 schools. By evaluating all students perceived to demonstrate impairment, the gender-ratio in the current sample is comparable to community rates of ADHD (~3:1, males to females) The gender disproportionality in referrals for ADHD evaluations reflected in the reported 9:1 (male to female; Gershon et al., 2002; Owens et al., 2015) ratio in clinic-based studies and the overall absence of significant gender differences in this study with a community gender ratio, highlights the importance of reducing barriers to identifying ADHD in both adolescents and girls.

Interpretation of current results in light of evidence that many adolescents (Sibley et al., 2012a) and girls (Waschbush & King, 2006) with subthreshold ADHD symptoms demonstrate significant impairment, supports a referral process with a foundation in impairment as opposed to symptoms (Sibley et al., 2012a). Given that educators are frequent sources of referrals and have been shown to demonstrate gender bias in referrals (Waschbush & King, 2006), schools represent

a critical avenue to address disproportionality. Providing educators with guidelines to assess impairment warranting evaluation may reduce barriers to diagnosis for those outside of the elementary-age male symptom profile. Results advocate for gender-specific interventions during middle school targeting academic behaviors in boys and precursors to depression in girls. Both males and females may benefit from interventions facilitating a positive parent-teen relationship during middle school given findings of higher adolescent-reported family conflict across both genders.

Middle School Indicated as a Critical Period in Impairment Trajectory. Adolescence is a particularly difficult time for youth with ADHD given the interaction of ADHD-related impairment and increasing environmental demands. (Brahmbhatt et al., 2016; Robin, 2015; Smith et al., 2000). Additionally, the transition to both middle school (Langberg et al., 2008) and high school is associated with increased ADHD symptoms and impairment (Shaffhuser et al., 2016). While it is commonly believed that ADHD frequently desists in adolescence (Sibley et al., 2012a), results from this study support past research demonstrating that ADHD-related impairment persists into adolescence (Biederman et al., 1996b; Leopold et al., 2019; Lin & Gau, 2019; Molina et al., 2009; Sibley et al., 2012a) and may increase in some areas (Murray et al., 2019).

There is evidence from several longitudinal studies that impairment related to a childhood diagnosis of ADHD is associated with increasingly significant adverse functional outcomes in adolescence and adulthood (Babinsky et al., 2011a; Biederman et al., 2010; Chronis-Tuscano et al., 2010; Hechtman; Pedersen et al., 2014; Thompson et al., 2016). This study highlights middle school as a critical period where intervention may interrupt worsening impairment. Furthermore, results indicate that the developmental trajectories of impairment in females and males with

ADHD may begin to diverge during early adolescence. Current findings identify several areas for intervention during middle school and suggest adolescents may benefit from gender-specific targets or approaches to intervention.

Increase in Adolescent Perceptions of Family Conflict and Gender Considerations. This study finds that parent-teen relationships may become more conflictual during early adolescence, from the adolescent perspective. Little is currently known about the development of parent-teen conflict in early adolescence but there is evidence that homework and daily routines are specific triggers (Garcia et al., 2019). Both males and females may benefit from interventions facilitating a positive parent-teen relationship during middle school given findings of higher adolescent-reported family conflict across both genders. However, findings of declining GPA and more parent-reported academic problems in boys relative to girls indicates that interventions targeting academic impairment may have an added benefit of facilitating a positive parent-teen relationship for males. There is less evidence of academic impairment or declining performance was found for girls whose GPA increased relative to boys during middle school. This suggests that girls may benefit from different targets for interventions addressing conflict in parent-teen relationships and that further research into mechanisms for conflict between parents and young adolescent females with ADHD is warranted.

Emerging Gender Differences in Patterns of Impairment in Middle School. Results indicate that gender differences in patterns of impairment may change throughout middle school. As rising 6th grade students, male and females demonstrate similar GPAs and self-reported depressive symptoms but that by the spring of 8th grade, females report significantly more depressive symptoms while GPAs drop in males with ADHD. Given few identified gender differences in childhood impairment and limited research on female adolescents with ADHD,

these results indicate that the developmentally trajectory of ADHD may begin to differ in early adolescence for males and females (Noelen-Hoeksema, 2001). The current study has identified specific gender-specific targets for middle school intervention that may mitigate adverse outcomes later in adolescence and adulthood.

Academic Behavior Interventions Recommended for Males with ADHD. There is evidence that boys with ADHD have more problems with behavior in school (Bauermeister et al., 2007) and are at risk for future adverse school outcomes including requiring extra help, receiving special education (Biederman et al., 2003). Results show that at the end of elementary school, the female group had a lower GPA than the male group yet by the end of middle school, they were outperforming their male peers. This highlights middle school as a potential turning point where adolescent males with ADHD may begin a trajectory towards more significant adverse school outcomes. Middle school appears to be a critical time for academic intervention, specifically for males with ADHD. Furthermore, both parent and teacher reports indicate that academic behaviors are particularly challenging for males with ADHD. Failure to acquire positive academic behaviors such as organization, study skills, and homework completion may be a significant risk factor for males with ADHD and contribute to future problems in school.

Middle School Girls May Benefit from Interventions Targeting Depressive Precursors. In the younger group, girls reported slightly fewer depressive symptoms than boys. However, older female adolescents reported more depressive symptoms than same-age males. Results from this study and evidence of the increased risk of depression in adult women with ADHD both in comparison to men with ADHD (Chronis-Tuscano et al., 2010; Hinshaw et al., 2012) and women without ADHD (Babinski et al., 2011a) indicate that middle school represent the time period where risk for depression escalates for females with ADHD. This supports previous research

reporting girls to experience a sharper decline in self-esteem during early adolescence (Shaffhuser et al., 2016). Results from this study suggest preventive measures be taken for girls with ADHD in middle school to address increasing depression as well as highlights the importance of research into risk factors for the development of depression in this population. Furthermore, the disordinal interaction of gender and grade on depressive symptoms suggest that gender may be a critical factor in the development of comorbid depression for those with ADHD. Past research reporting consistent levels of depressive symptoms in youth (under age 9) and young adolescents (older than age 9) with ADHD (Ostrander et al., 2006) may have failed to find significant variance in depressive symptoms by omitting gender from analysis.

Stage Two: ADHD-Related Impairment and Internalizing Symptoms

Findings from the second stage focus on the relationship of three common areas of ADHD-related impairment (family conflict, academic impairment, and social problems) with internalizing symptoms as well as moderation by gender and grade for significant main effects. Results do not support the hypothesis that social problems would be most associated with internalizing problems and that the association would be strongest for rising 9th grade females. In fact, findings indicate that only family conflict was associated with depressive symptoms and that no family of impairment shared a significant relationship to anxiety symptoms.

Family Conflict Moderately Associated with Depressive Symptoms

Higher parent reported family conflict was found to be significantly associated with higher adolescent reported depressive symptoms ($sr^2 = 0.01$, $p = 0.032$). Furthermore, while the relationship between family conflict and depressive symptoms was not moderated by gender or grade, results show a significant gender by grade interaction for depressive symptoms. This is not surprising given this interaction was previously found in the first stage of analysis.

Results offer some support to research indicating that a conflictual parent-teen relationship may be a risk factor for the development of depression (Humphreys et al., 2013, Meinzer et al., 2015; Ward et al., 2019). A conflictual relationship with parents is theorized to mediate the relationship between externalizing problems and internalizing problems through a cycle where difficult childhood behaviors illicit invalidating parental responses. These responses then beget additionally problematic behavior which are then internalized by adolescence (Biederman et al., 2006; Johnston & Mash, 2001; Steinberg & Drabick, 2015). However, family conflict was no longer significantly associated with depressive symptoms after accounting the effects of gender and grade. Females entering 9th grade report more depressive symptoms than same-grade males and rising 6th graders regardless of parent-ratings of the parent-teen relationship as previously discussed.

A limited relationship between family conflict and depressive symptoms also has been documented (Biederman et al., 1998), indicating that more research is warranted in this area. Given some evidence that a conflictual parent-teen relationship contributes to the development of depression in adolescents with ADHD as well as current findings that rising 9th graders endorse more family conflict than those entering 6th grade, interventions focused on preventing the deterioration of the parent-teen relationship in early adolescence may also mitigate the development of depressive symptoms. Females adolescents with ADHD may particularly benefit from intervention targeting family conflict given current findings of a steeper incline of depressive symptoms for girls as well as research that conflictual parent-teen relationships are more predictive of depression for females with ADHD than males with ADHD (Humphreys et al., 2013).

Academic Problems not Associated with Depressive Symptoms

As hypothesized, academic problems were not found to be associated with adolescent-reported depressive symptoms ($p > 0.050$). Results support those from a related study using a sample which overlaps with the current sample which found more parent-reported academic problems to predict fewer depressive problems (Ward et al., 2019). Interpreting results from both studies in light of positive illusory bias (Hoza et al., 2010), adolescents may not be aware of problems in their school-related behavior or internalize consequences. Furthermore, there is evidence in longitudinal studies that academic problems are predictive of depressive symptoms in late-adolescence or early adulthood. In one study, academic attainment in late-adolescence was found to mediate the relationship between childhood ADHD symptoms and late-adolescent depressive symptoms (Powell et al., 2019). Another study found that academic competence mediated the relationship between childhood externalizing problems and adult internalizing problems (Masten et al., 2005). Discrepant findings in the current and Ward et al. study compared to the above studies may be explained by differences in the measurement of academic problems and in study design.

While the measure of academic problems in both the current study and Ward et al. describes adolescent behaviors associated with academic success, the contrasting studies utilized measures of academic ability or attainment. The later measurement of academic problems may be more salient in adolescents' self-image. Academic attainment is a functional outcome that may have more direct consequences for young adults than do parents' perception of their organization, study skills, and other academic behaviors. Given that youth with ADHD have difficulty anticipating long-term consequences of behavior (Barkely, 2015), they may be less likely to connect problematic academic behaviors in adolescence with quality of life in

adulthood. Academic competence, on the other hand, may be interpreted as a fundamental deficiency of ability as opposed to academic behaviors which may be interpreted as choices or affected by positive illusory bias (Hoza et al., 2010). Additionally, academic competence may be related to overall ability and have more global consequences that translate to an increase in depressive symptoms.

The longitudinal design of both Powell et al. and Masten et al. permits a more causational interpretation of the relationship between academic problems and depressive symptoms. Documenting academic problems throughout development and measuring depressive symptoms in late adolescence and early adulthood provides the opportunity to see long term impact of academic problems on depressive symptoms. The current study, which measures academic problems and depressive symptoms at the same time point is limited to describing one point in adolescents lives as opposed to their long-term development. Adolescents may not find academic problems to be salient in their self-perception because they have not experienced functional consequences.

No Significant Relationship Between Social Problems and Depressive Symptoms

The hypothesis that social problems would be associated with depressive symptoms was not supported by results ($p > 0.050$). This finding was unexpected given a significant relationship between the same measures of social problems and depressive symptom in an overlapping sample (Ward et al., 2019). Discrepancy in findings between the current and related study may be related to the portion of the sample that differed or predictors included in modelling. The current study included gender and grade in analysis of ADHD-related impairment's effect on depressive symptoms while Ward et al. included ADHD symptoms and sluggish cognitive tempo

variables in addition to impairment. In the current study, gender and grade may have accounted for more variance in depressive symptoms, suppressing the contribution of social problems.

Previous research documents a connection between social problems in childhood or early adolescence and depressive symptoms in later adolescence or adulthood (Bagwell et al., 2006; Humphreys et al., 2013; Mikami & Hinshaw, 2006; Powell et al., 2019). While, in the current study, co-occurring social problems were not reflected in depressive symptoms, there is evidence that the consequences of social deficits such as peer rejection and victimization may accumulate over time translating into social isolation and loneliness, precursors to depression, particularly in girls with ADHD (Mrug et al., 2007; Roy et al., 2015). Limited associations found in the current study support an accumulative model to describe the relationship between social problems and depressive symptoms where depressive symptoms develop following a pattern of negative social experiences. Furthermore, positive illusory bias has been shown to inflate self-perception of social functioning in youth with ADHD and may be protective against depressive symptoms in the short-term (Hoza et al., 2010; Mikami et al., 2010; Mrug et al., 2012). However, there is evidence that inflated self-perception of social and behavioral functioning decreases throughout adolescence and that this decrease is associated with increased depressive symptoms (Hoza et al., 2010).

Results from the current study indicate that immediate effects of social impairment on depressive symptoms may not be apparent in adolescents with ADHD. The absence of an immediate effect of social problems on depressive symptoms in conjunction with the strong documentation of negative consequences later in adolescence, warrants a proactive approach to addressing social problems. Increasing awareness of peer relationship problems, facilitating

positive peer interactions, and addressing victimization before depressive symptoms are present may mitigate the development of internalizing problems later in adolescence.

ADHD-Related Impairment Was Not Associated with Anxiety Symptoms

Analysis found that family conflict and academic impairment were not associated with anxiety symptoms ($p > 0.050$), supporting the hypothesis. However, the hypothesis of a relationship between social problems and anxiety symptoms was not upheld by results finding no association ($p > 0.050$). Interesting, holding impairment constant, both gender ($sr^2 = 0.01$, $p = 0.040$) and grade ($sr^2 = 0.02$, $p = 0.016$) were found to be uniquely related to anxiety problems with females and rising 9th graders reporting less anxiety than males or rising 6th graders.

The absence of a significant relationship between any family of ADHD-related impairment and anxiety symptoms is notable and may be related to the study design in assessing both predictors and outcomes simultaneously. Though research into risk factors for anxiety in adolescents is limited, studies that have reported peer problems as predictive of anxiety over time (Bagwell et al., 2016; Biederman et al., 2006). These studies evaluated peer problems and potential risk factors and then assessed anxiety problems later in adolescence. Such designs would capture the accumulative effects of ADHD-related impairment on anxiety symptoms. The current study indicates that while, over time peer problems may contribute to anxiety symptoms, they may not immediately translate to adolescent reports of anxiety. Similar to the discussion of social problems and depressive symptoms, lack of significant findings for association between impairment and anxiety outcome are consistent with theories of positive illusory bias and suggest that reactively intervening to elevated anxiety levels may be too late to address underlying impairment that may contribute to the elevation. Results may also indicate that social problems

for youth with ADHD may decrease in adolescence compared to childhood as teens have access to a wider group of peers and can exercise more choice in who they befriend.

Results reflecting lower anxiety symptoms in females compared to males when holding impairment constant may indicate that young adolescence may be a particularly challenging time for males with ADHD while females may struggle more in later adolescence. Past research comparing men and women with ADHD support this theory, reporting more (Biederman et al., 2003) or similar (Babinski et al., 2011b) anxiety symptoms in women with ADHD than men. Furthermore, finding stronger endorsements of anxiety in rising 6th graders is surprising given that comorbid anxiety has been reported to increase throughout adolescence (Bagwell et al., 2006; Fischer et al., 2002; Mannuzza et al., 1998). Given that the grade variable in the current study describes unique sets of rising 6th and rising 9th graders rather than evaluating the same group of adolescents at two time points, it is possible that the group entering 6th grade reported higher anxiety due to group differences.

Implications for Treatment

Lack of Concurrent Associations Supports Accumulative Model and Prevention. Given the widely reported elevated risk for depression and anxiety in older adolescents with ADHD and evidence that social problems, family conflict, and academic impairment mediate the relationship between ADHD-symptoms in childhood and internalizing problems in older adolescents and young adults with ADHD, the current study indicates that the effect of impairment on internalizing problems may be cumulative. In an accumulative model, additive consequences of deficits related to ADHD interact with adolescent's environment creating a pattern of negative experiences such social isolation, victimization, lower academic attainment, and a loss of familial support (Hoza et al., 2010; Masten et al., 2005; Mrug et al., 2012). The accumulation of

these negative experiences may then become risk factors for internalizing problems. Furthermore, current results indicate that this relationship might not be obvious in middle school, suggesting that school psychologists, clinicians, educators, and caregivers of adolescents with ADHD take a proactive and preventative approach to intervention as opposed to waiting for internalizing problems to emerge. On the other hand, the lack of association between impairment and internalizing problems found in this study may indicate that a lack of cognitive control in adolescents with ADHD may in fact be protective towards internalizing problems as adolescents with ADHD may not engage in self-reflection or rumination to the same extent as neurotypical peers suffering from internalizing problems.

Intervention in Parent-Teen Conflict May Protect Against Depressive Symptoms. Identifying family conflict as the only impairment significantly associated with depressive symptoms reported at the same time suggests a conflictual parent-teen relationship may translate more immediately to adolescent depressive symptoms than social problems or academic impairment. Positive illusory bias, which is shown to decrease throughout adolescence, may delay the impact of social problems and academic impairment, but not family conflict on internalizing problems until later in adolescence or adulthood. Alternatively, adolescents may experience more immediate consequences from a conflictual parent-teen relationship that are reflected in concurrent endorsements of depressive symptoms while the effects of social problems and academic impairment are experienced later. In either case, interventions mitigating family conflict in early adolescence may have the added benefit of reducing depressive symptoms.

Summary of Association Between ADHD-Related Impairments and Internalizing Problems

Overall, stage two found that family conflict is moderately associated with increased adolescent reported depression but that the relationship ceased to be significant after accounting for the interaction of gender and grade. While simultaneous measures of academic impairment and social problems were not associated with depressive symptoms, previous studies suggest depressive symptoms as a latent response to accumulated consequences of impairment. No association was found between ADHD-related impairments and concurrent internalizing symptoms. Interpreting results in the context of previous research on ADHD and comorbid depression and anxiety indicates several implications for conceptualizing the relationship between ADHD-impairments and internalizing problems. Given that ADHD is predictive of major depressive disorder after controlling for impairment in school, academic, and social settings (Meinzer et al., 2013), proactive intervention and further research into the developmental trajectory of ADHD-related impairment and depression is recommended. School psychologists and clinicians working with young adolescents with ADHD are uniquely suited to intervene early.

Stage Three: STP-A Treatment Effects on Internalizing Symptoms and Social Problems

Findings from stage three focus on treatment effects of the Summer Treatment Program for Adolescents (STP-A) on depressive symptoms, anxiety symptoms, and social problems. As hypothesized, comparison of anxiety symptoms and social problems reported at the end of the following school year with baseline symptoms found that the high intensity intervention (HI) led to be significantly more effective than either the LI intervention (anxiety symptoms, d = - 0.27; social problems d = -0.31) or untreated condition (anxiety symptoms d = -0.07; social problems d = - 0.42. Contrary to predictions, the HI intervention led to a more significant decrease in

depressive symptoms from baseline to the end of the following school year than both the LI (d = -0.24) and untreated group (d = - 0.17). In regard to the hypothesis that the LI treatment would be associated with a more significant decrease anxiety problems compared to the untreated group, no significant treatment effects were found when comparing the LI intervention and untreated condition on any outcome (p's > 0.05). In stage 3b, however, grade moderated treatment effects when comparing the LI and HI group (p = 0.05). Specifically, the LI intervention was associated with a more significant decrease in anxiety symptoms for rising 9th graders (d = -0.48) than rising 6th graders (d = -0.01) compared to the untreated group. Treatment effects were not moderated by gender as hypothesized due to the lack of gender-specific intervention components.

STP-A Shows Promise in Targeting Internalizing and Social Problems

Current findings suggest that the HI version of the STP-A may have a small effect on adolescent internalizing symptoms and social problems one year after intervention. Effect sizes in the current study are comparable to those found in an evaluation of STP-A effects on academic behaviors, GPA, and family conflict (Sibley et al., 2018b) in the same sample. Results support STP-A as a promising intervention to address a wide range of common impairments in adolescents with ADHD. Findings of no significant LI treatment effects compared to the untreated group indicates that that components unique to the HI intervention may be the mechanisms through which STP-A mitigates internalizing symptoms and social problems. The absence of significant overall LI treatment effects is consistent with the previous evaluation of STP-A on this sample (Sibley et al., 2018b) and indicates that the LI treatment may not have significant secondary effects on internalizing problems or social problems.

The HI version of STP-A includes several components that may serve as mechanisms of change for adolescent internalizing and social problems. First, the positive reinforcement model of behavior management implemented during treatment, including parental rewards for positive daily report cards and social reinforcement from staff, may mitigate decreasing self-esteem. Adolescents with ADHD have been found to experience a decline in self-esteem and self-concept as they enter high school (Shaffhuser et al., 2016). Experiencing success under clear expectations and receiving daily praise both in the program and at home may be protective against a decline in self-esteem throughout the next school year.

Second, given the strong documentation of social impairment and peer rejection in youth with ADHD (Mrug et al., 2007; Weheimeier et al., 2009; Wiener & Mak, 2009), the 360 hours of intervention and scaffolded social activities may provide adolescents opportunities to practice social skills and build reciprocal friendships. Furthermore, in-situ social coaching is considered more effective than cold instruction of social skills for the ADHD population as adolescents with ADHD demonstrate social knowledge but are impaired in their ability to use this knowledge in context (deBoo & Prins, 2007). Specifically, social problems in adolescents with ADHD are often related to socially inappropriate behaviors such as rule violation (Mrug et al., 2007) and deficits in social processing (Andrade et al., 2012). The program structure and contextualized support of STP-A represents a unique opportunity to develop social skills and build friendships. Reciprocal friendships are considered a critical factor in developing positive peer relationships (Weihmeier et al., 2009) and may be protective against the development of depression (Danneel et al., 2019) Therefore, experiences of positive social interactions throughout STP-A may also contribute to treatment effects on depressive and anxiety symptoms in addition to social problems.

Third, observed treatment effects on depressive and anxiety symptoms may be also related to improved self-efficacy as a result of skills training in academic, occupational, and organizational skills throughout STP-A. There is evidence that low self-efficacy contributes to depression through a cycle where youth fail to meet expectations, increasingly perceive themselves to fail, and anticipate future failures (Gordon et al., 2012). Not only does STP-A provide clear expectations that reduce the chance of failure, it also provides adolescents with tools they can use throughout the next school year to compensate for ADHD-related deficiencies.

LI Treatment Effects

Despite the lack of overall LI treatment effects, a significant grade by LI treatment interaction in anxiety problems suggests that an 8-week organizational skills group and weekly parent training may reduce anxiety symptoms in adolescents entering 9th grade but not for rising 6th graders. Notably, earlier phases of the current study found higher endorsements of family conflict in rising 9th graders and mild evidence of a relationship between family conflict and depressive symptoms. There is evidence that research homework and daily routine, both targets in the LI intervention, are particular triggers for family conflict in adolescents with ADHD between the ages of 11 and 14 (Garcia et al., 2019).

Previous studies evaluations of a collaborative parent and teen organizational intervention (Supporting Teen's Autonomy Daily [STAND]; Sibley, 2013) report some evidence of a reduction of teen-reported conflict with parents (Sibley et al., 2013a; Sibley et al., 2014a). Additionally, although researchers found neither significant LI treatment effects of moderation by grade on family conflict, in the current sample (Sibley et al., 2018b), a previous evaluation of STP-A found that home-conflict decreased between 75 and 85% from baseline to post-treatment. Therefore, for older middle school students LI treatment components may be particularly

effective in reducing parent-teen conflict and have secondary effects on internalizing symptoms. Further evaluation of the LI intervention model of 8 weeks of parent and teen organizational training (Sibley, 2013) and school year consultation (Sibley et al., 2016b) are warranted, specifically for adolescents entering 9th grade.

Implications of STP-A Treatment Effects and Cost

Treatment effects of STP-A on depressive symptoms, anxiety symptoms, and social problems are significant given the limited number of adolescent ADHD interventions found to be effective in reducing internalizing problems (Chan et al., 2016) and reports that social problems in youth with ADHD are often resistant to treatment (deBoo & Prins; Hoza, 2007). The current study adds internalizing symptoms and social problems to existing empirical support (Sibley et al., 2011; Sibley et al., 2012b; Sibley et al., 2018b) suggesting STP-A may be effective in mitigating a wide range ADHD-related impairment. Additionally, as a middle school intervention addressing multiple domains of impairment, STP-A may be uniquely beneficial for given the heterogeneity and evolution of ADHD impairment in early adolescence (Langberg et al., 2008). The broad scope of STP-A components may interrupt the development of adverse outcomes in later adolescence and childhood by proactively addressing risk factors that may be missed by more narrow interventions.

On the other hand, STP-A is intensive in time, components, and price compared to the LI treatment. The significant difference in treatment effects between the two interventions may be largely explained by the dose of treatment received (see Table 2). The cost of STP-A ($4,373 per participant) compared to the LI treatment ($97 per participant) is likewise significant and may present a barrier to future implementation. Future research on which STP-A components demonstrate the most efficacy in reducing internalizing and social problems may allow for an

adapted version that is more cost-effective. This is particularly critical for schools which are both fertile avenues for intervention and limited in resources.

Limitations

This study possesses numerous limitations. Overall, generalization of results to the larger population of adolescents with ADHD, should consider the age and demographics of the sample. Participants in the study range from 11 to 14, which represents a young sample of adolescents. Additionally, the high prevalence of Hispanic and African American students in the sample reflects populations less frequently included in ADHD research. Other limitations are specific to a particular stage of the study.

Specific Stage One Limitations

Several limitations are specifically relevant to the evaluation of patterns of impairment in the current study. First, correction for type I error rate may be conservative, given the minimal correlation between outcomes in the same family. This could mask gender or grade differences which may have otherwise been significant. Second, this study lacks ecologically-relevant, observational, or narrow-band measures that be more sensitive to gender and grade differences. With the exception of GPA, mean item scores and *t*-scores were used to reflect parent-, teacher-, and self-perception of broad areas of functioning. Therefore, stage one analysis may not capture the nuance of impairment manifestation or the interaction of specific behaviors with the adolescent's biopsychosocial world. Lastly, analysis did not include comparison youth without ADHD. This prevents the opportunity to investigate gender differences in the magnitude of impairment relative to same gender neurotypical peers. While this study reports difference in impairment between females and males with ADHD, it may fail to capture the implications of impairment for each gender.

Specific Stage Two Limitations

In stage two, this study is limited in the ability to evaluate impairment as risk factors in the development of internalizing problems given that ratings of impairment and internalizing problems were collected at the same time point. The evaluation of concurrent measures and inability to rule out co-existing factors prevent causal interpretations of relationships. Significant relationships between impairment and internalizing problems are considered associations, without claiming to describe the direction of association. Furthermore, this study is limited as a secondary data analysis. While measures of impairment are validated and widely used in adolescent ADHD research (Buckholdt et al., 2014; Karustis et al., 2000; Sibley et al., 2014a), measures may lack sensitivity to specific factors connecting impairment and internalizing problems. The current study analyzed parent-report measures from the original study to maximize sensitivity to impairment in each domain consistent with previous studies (De Los Reyes et al., 2012; Ward et al., 2019). However, these measures may not capture the experiences related to each domain of impairment that contribution to internalizing problems. Specifically, in the social domain may be better represented by a live measure of social information processing (Andrade et al., 2012; Mikami et al., 2007) or peer nomination (Mrug et al., 2012). The measure of depression utilized in the current study has been found to have a moderate correlation with a diagnosis of depression and may have limited findings.

Specific Stage Three Limitations

Several study limitations are specific to stage three, with evaluated treatment effects and included multiple time points. First, it was not possible to blind adolescents and parents to treatment condition which may have influenced perception of treatment efficacy. Additionally, the untreated group is identified and randomized after intervention to contextualize treatment

effects. Therefore, comparison of HI and LI groups with the untreated group should be viewed as secondary effects. Furthermore, the untreated group differed from treatment groups in medication, which was included in models as a covariate. Lastly, analysis does not account for experiences, unrelated to treatment, accumulated throughout the school year, which may contribute to change in internalizing symptoms or social problems.

Future Directions

This study was conducted through secondary data analysis and aimed to further the literature in understudied areas related to ADHD; gender differences in adolescent impairment, risk factors for internalizing comorbidity, and internalizing treatment effects in adolescent interventions. The results of this study suggest specific topics and methodological considerations for future studies as well as clinical implications for school psychologists. Additionally, the current evaluation of the STP-A program contributes to the past evidence of efficacy and provides direction for future studies and intervention development for schools.

Future Directions in Patterns of Impairment

Findings and limitations of stage inform future directions in ADHD-related impairment research by investigating gender differences in adolescents at the beginning and end of middle school. Results from this study support past descriptions of similar impairment in females and males when using broad, report measures of impairment. These measures may lack sensitivity to subtle gender differences in manifestation of impairment within the adolescent's environmental context. While overall, genders may present as more similar than different, there is evidence that the interaction of ADHD impairment and environmental factors may differ by gender, particularly in social functioning. Future evaluations utilizing ecological-based and narrow-band measures when comparing gender differences are required to fully understand the manifestation,

implications, and needs or females with ADHD. School psychologists are recommended to utilize narrow band measures to increase sensitivity to depressive and anxious symptoms during middle school.

This study finds middle school to be a critical area in the development of ADHD-related impairment and represent the time when females and males begin different trajectories. In particular, at the end of middle school, adolescents report a more conflictual parent-teen relationship than those entering middle school. Research into the mechanism for this change and in preventive measures is warranted. Furthermore, this study supports evaluating gender differences in response to interventions during middle school, specifically those targeting academic problems precursors to depression. Given that early adolescence is a critical window for youth with ADHD, school psychologists and educators in middle school could prevent worsening of symptoms and the development of comorbidity by attending to warning signs that ADHD-related impairment is evolving or having new consequences for adolescents.

The current study was limited to describing differences between females and males with ADHD. Previous large-scale studies of ADHD impairment have used a similar design, exhibit gender disproportionality in sampling, or compare same-gender groups of adolescents with and without ADHD. In order to understand the gender differences in the impact of ADHD on functioning and outcomes, longitudinal studies are recommended to include large samples of both genders of ADHD and non-ADHD youth. Evaluation of gender differences in the magnitude of ADHD-related impairment relative to non-ADHD peers would further the emerging research on female-specific manifestations of ADHD.

Future Directions in Risk Factors for Internalizing Comorbidity

The current findings and previous research have not conclusively identified risk factors for the development of internalizing symptoms in adolescents with ADHD. The limitations and minimal findings of this study suggest that longitudinal studies are required to evaluate the developmental trajectory of impairment and internalizing comorbidity. An accumulative model where the consequences and experiences related to impairment overtime present risk factors could provide a framework for future research. Furthermore, results suggest further investigation into family conflict as a risk factor is warranted and that the use of narrow-band measures of internalizing symptoms may reveal more information about the relationship between impairment and internalizing problems. School psychologists are recommended to utilize narrow band measures in evaluations and to inform intervention.

Future Directions in Adolescent Interventions

Finally, results from this study find that the STP-A may have secondary benefits above and beyond the academic, organizational, and behavioral targets of the intervention. Further evaluation into secondary effects could build empirical support for STP-A and inform referrals for the intervention. This is particularly critical for school psychologists and educators as primary references for ADHD evaluation and treatment. Additionally, given that the full STP-A was found to be effective in reducing internalizing and social problems, while the organizational skills training/parent-training/consultation, future research would benefit from investigating which components of the STP-A contribute to reduced internalizing and social problems. This would provide the opportunity to increase the currently limited access in adolescent ADHD treatments targeting internalizing problems while reducing the cost of the program. As STP-A

was conducted through a school district, school psychologists and educators can adapt components of the intervention to meet the needs of their population.

Conclusion

This study sought to evaluate gender and grade level differences in ADHD-related impairment, associations between impairment and internalizing comorbidity, and treatment effects of the Summer Treatment Program for Adolescent on internalizing symptoms and social problems. Overall, young adolescent females and males with ADHD may demonstrate similar patterns of impairment and response to STP-A. However, middle school was identified as a critical time period where patterns of impairment may change, with emerging gender difference. Evidence of a mild association between family conflict and depressive symptoms as well as more conflict in the parent-teen relationship by adolescents entering high school suggest family conflict as a target for early adolescent interventions. The high intensity version of STP-A shows promise in mitigating depressive symptoms, anxious symptoms, and social problems in young adolescents. Furthermore, the low intensity version, parent-teen organizational skills training, may be more effective in reducing anxiety symptoms in rising 9th graders than youth entering 6th grade.

The risk for adverse outcomes, including comorbid internalizing problems associated with a diagnosis ADHD are clear and school psychologists have to a unique opportunity to address worsening impairment. However, further research into nuanced gender differences in the developmental trajectory of ADHD-impairment during adolescence is warranted to identify risk factors for later internalizing problems as well as targets for intervention. Middle school is found to be a critical time in the evolution of ADHD-related impairment and the study highlights the importance that school psychologists attend to subtle changes in manifestation during this time to

mitigate the development of more severe consequence by the end of high school. Specifically, gender specific interventions in early adolescence may interrupt the escalation of impairment and prevent the development of depression and anxiety, improving the prognosis for the 3.2 – 5.1 million American youth diagnosed with ADHD.

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Appendix A: Tables

Table 1.
Baseline Characteristics of the Sample

	Treatment Group		
	High Intensity	Low Intensity	Untreated
Number of Participants (N)	109	109	107
Grade (%)			
Rising 6th Grader	51.4	51.4	52.3
Raising 9th Grader	48.6	48.6	47.7
IQ M (SD)	95.3 (12.3)	94.6 (12.3)	93.2 (9.7)
*Stimulant Medication (%)**	45.9	45.9	32.7
% Female	23.9	28.4	25.2
Ethnicity (%)			
Hispanic Any Race	70.1	76.1	72.0
Black/African American	17.8	15.6	18.7
Other	12.1	8.3	9.3
Parent Education (%)			
High School or Less	21.3	22.1	21.5
Some College	31.5	37.5	30.8
Bachelor's Degree	30.5	26.9	27.1
Graduate Degree	16.7	13.5	20.6
Parent Language (%)			
English Speaking	83.2	73.8	81.7
Non-English Speaking	16.8	26.2	18.3
Class Placement (%)			
Special Education	16.0	21.4	14.0
Regular Education	75.0	70.0	78.5
Advanced/Gifted	8.3	8.6	7.5

*Significant differences ($p < 0.05$) between reference group and both randomized groups.

Table 2.

Intervention Attendance and Utilization by Group

	Rising Sixth Grade				Rising Ninth Grade			
	HI		LI		HI		LI	
Summer								
Teen Intervention Attended (%)*	79.7	(20.4)	44.1	(38.8)	79.3	(29.2)	45.9	(36.4)
Teen Intervention Hours Received*	279.7	(71.6)	5.3	(4.66)	278.3	(102.5)	5.5	(4.37)
Parent Intervention Attended (%)	51.6	(31.6)	44.1	(38.8)	55.2	(33.6)	45.9	(36.4)
Parent Intervention Hours Received	6.2	(3.79)	5.3	(4.66)	6.6	(4.03)	5.5	(4.37)
School-Year Follow-Up								
Parent Intervention Hours Received*	1.6	(1.95)	0.6	(0.96)	1.3	(1.79)	0.8	(1.34)
School Consultation Hours Received	0.2	(0.30)	0.2	(0.40)	0.3	(0.42)	0.3	(0.36)

Note: HI = high intensity; LI = low intensity.

*Statistically significant effect ($p < 0.05$).

Table 3.

Correlation Table for Outcome and Predictor Variables

Variables	*M*	*(SE)*	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
1. GPA	2.21	(0.70)	--												
2. Global Impairment (P)	3.02	(1.61)	.05	--											
3. Global Impairment (T)	3.35	(1.30)	-.15 *	.05	--										
4. Academic Problems (P)	1.53	(0.60)	-.14 *	.57 **	.04	--									
5. Academic Problems (T)	1.63	(0.55)	-.44 **	-.02 **	.58 **	.16 **	--								
6. Family Conflict (A)	2.22	(0.74)	.02	.26 **	.00	.16 **	-.03	--							
7. Family Conflict (P)	2.64	(0.81)	-.01	.55 **	.09	.42 **	.06	.32 **	--						
8. Social Problems (A)	58.92	(8.60)	.02	.25 **	.14 **	.08	.04	.24 **	.11	--					
9. Social Problems (P)	60.75	(9.71)	.07	.45 **	.17	.34 **	.02	.14 *	.32 **	.19	--				
10. Depression Symptoms (A)	58.78	(8.23)	.02	.17	.04	.02	-.09	.25 **	.14 *	.60 **	.12 *	--			
11. Depression Symptoms (P)	56.78	(10.23)	.01	.37	.04	.34 **	-.02	.18 **	.36 **	.08	.58 **	.19 **	--		
12. Anxiety Symptoms (A)	56.78	(7.22)	-.02	.13 *	.12 *	.06	.01	.15 **	.05	.70 **	.08	.49 **	.04	--	
13. Anxiety Symptoms (P)	58.70	(8.53)	-.03	.31	.08	.28 **	.04	.08	.30 **	.05	.63 **	.06	.57 **	.09	--

Note. $N = 308 - 325$. P = parent-report, T = teacher-report, A = adolescent-report, GPA = grade point average, global impairment = mean item score on Impairment Rating Scale (IRS), academic problems = mean item score on the Adolescent Academic Problems Checklist (AAPC), family conflict = mean item score on the Conflict Behavior Questionnaire-20 (CBQ-20), social problems = Youth Self-Report (YSR) and Child Behavior Checklist (CBCL) social problems *t*- score, depression symptoms = YSR/CBCL depressed/withdrawn *t*-score, anxiety problems = YSR/CBCL anxiety problem *t*-score.

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

Table 4.
Global Impairment by Gender and Grade

	Block 1								Block 2							
	$R^2\Delta$	R^2_{total}	R^2_{adj}	F	df	p	b	sr^2	$R^2\Delta$	R^2_{total}	R^2_{adj}	$F\Delta$	df	p	b	sr^2
Global Impairment (P)	0.00	0.00	-0.01	0.02	2,320	0.979			0.01	0.01	0.00	1.57	1,319	0.658		
Intercept							**3.03** ***								**3.03** ***	
Gender							0.02	0.00							0.02	0.00
Grade							-0.01	0.00							-0.07	0.00
Gender x Grade															-0.13	0.00
Global Impairment (T)	0.02	0.02	0.01	2.95	2,305	0.054			0.00	0.02	0.01	1.36	1,304	0.066		
Intercept							**3.28** ***								**3.28** ***	
Gender							-0.13	0.01							-0.12	0.01
Grade							-0.14	0.01							-0.09	0.00
Gender x Grade															-0.10	0.00

Note. Parent (P) $N = 323$, teacher (T) $N = 308$. P = parent, T = teacher; global impairment = IRS mean item score; gender is effect-coded with 1 = female, -1 = not female; grade is effect-coded with 1 = rising 9th grade, -1 = rising 6th grade.

Statistically significant effects (adjusted $p < 0.025$) are indicated in bold, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table 5.
Academic Impairment by Gender and Grade

	Block 1								Block 2							
	$R^2\Delta$	R^2_{total}	R^2_{adj}	F	df	p	b	sr^2	$R^2\Delta$	R^2_{total}	R^2_{adj}	$F\Delta$	df	p	b	sr^2
Grade Point Average (GPA)	0.03 **	0.03 **	0.03	5.36	2,308	0.005			0.01 **	0.05 **	0.04	4.68	1,319	0.002		
Intercept							**2.24** ***								**2.24** ***	
Gender							0.07	0.01							0.07	0.01
Grade							**-0.12** **	0.03							-0.07	0.01
Gender x Grade															0.10 *	0.01
Academic Problems (P)	0.04 **	0.04 **	0.03	6.10	2,321	0.003			0.01 **	0.05 **	0.04	3.72	1,320	0.001		
Intercept							**1.49** ***								**1.49** ***	
Gender							-0.09 *	0.02							**-0.09** *	0.02
Grade							**0.09** **	0.02							0.05	0.01
Gender x Grade															-0.07	0.01
Academic Problems (T)	0.02	0.02	0.01	2.77	2,318	0.064			0.00	0.02	0.01	0.02	1,317	0.138		
Intercept							**1.59** ***								**1.59** ***	
Gender							-0.08 *	0.02							-0.08 *	0.02
Grade							-0.01	0.00							-0.01	0.00
Gender x Grade																0.00

Note. GPA $N = 11$; parent (P) $N = 324$, teacher (T) $N = 321$. Academic problems = AAPC mean item score; gender is effect-coded with 1 = female, -1 = not female; grade is effect-coded with 1 = rising 9th grade, -1 = rising 6th grade.

Statistically significant effects (adjusted $p < 0.017$) are indicated in bold, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table 6.
Interpersonal Impairment by Gender and Grade

	Block 1								Block 2							
	$R^2\Delta$	R^2_{total}	R^2_{adj}	F	df	p	b	sr^2	$R^2\Delta$	R^2_{total}	R^2_{adj}	$F\Delta$	df	p	b	sr^2
Family Conflict (A)	0.07 ***	0.07 ***	0.06	####	2,321	<0.001			0.00 ***	0.07 ***	0.06	0.00	1,320	<0.001		
Intercept							**2.26** ***								**2.26** ***	
Gender							0.07	0.01							0.07	0.01
Grade							**0.18** ***	0.06							0.18 ***	0.05
Gender x Grade															0.00	0.00
Family Conflict (P)	0.02	0.02	0.01	2.77	2,322	0.064			0.00	0.02	0.01	0.25	1,321	0.125		
Intercept							**2.64** ***								**2.64** ***	
Gender							0.01	0.00							0.01	0.00
Grade							0.11 *	0.02							0.09	0.01
Gender x Grade															-0.03	0.00
Social Problems (A)	0.01	0.01	0.01	1.94	2,321	0.145			0.00	0.02	0.01	1.18	1,320	0.170		
Intercept							**58.88** ***								**58.89** ***	
Gender							-0.03	0.00							0.00	0.00
Grade							-0.94 *	0.01							-0.66	0.00
Gender x Grade															0.59	0.00
Social Problems (P)	0.00	0.00	0.00	0.44	2,322	0.644			0.00	0.00	-0.01	0.00	1,321	0.830		
Intercept							**61.01** ***								**61.01** ***	
Gender							0.53	0.00							0.53	0.00
Grade							0.17	0.00							0.18	0.00
Gender x Grade															0.02	0.00

Note. Adolescent measures (A) $N = 324$, parent measures (P) $N = 325$; family conflict = CBQ-20 mean item score; social problems = YSR/CBCL social problems t-score; gender is effect-coded with 1 = female, -1 = not female; grade is effect-coded with 1 = rising 9th grade, -1 = rising 6th grade.

Statistically significant effects (adjusted $p < 0.013$) are indicated in bold, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table 7.
Internalizing Symptoms by Gender and Grade

	Block 1								Block 2							
	$R^2\Delta$	R^2_{total}	R^2_{adj}	F	df	p	b	sr^2	$R^2\Delta$	R^2_{total}	R^2_{adj}	$F\Delta$	df	p	b	sr^2
Depressive Symtpoms (A)	0.01	0.01	0.00	1.63	2,321	0.198			0.02 **	0.03 **	0.02	7.71	1,320	0.012		
Intercept							**58.43** ***								**58.48** ***	
Gender							0.91	0.01							0.97	0.00
Grade							-0.20	0.00							0.49	0.00
Gender x Grade															**1.43** **	0.02
Depressive Symptoms (P)	0.01	0.01	0.00	1.62	2,322	0.199			0.00	0.01	0.00	0.43	1,321	0.301		
Intercept							**59.90** ***								**59.89** ***	
Gender							-0.45	0.00							-0.47	0.00
Grade							0.94	0.01							0.73	0.00
Gender x Grade															-0.43	0.00
Anxiety Symptoms (A)	0.03 **	0.03 **	0.02	4.82	2,321	0.009			0.00 *	0.03 *	0.02	0.54	1,320	0.018		
Intercept							**56.30** ***								**56.31** ***	
Gender							-0.95 *	0.01							-0.94 *	0.01
Grade							-0.92 *	0.02							-0.76	0.01
Gender x Grade															0.33	0.00
Anxiety Symptoms (P)	0.00	0.00	-0.01	0.03	2,322	0.970			0.02	0.02	0.01	6.45	1,321	0.091		
Intercept							**58.64** ***								**58.61** ***	
Gender							-0.12	0.00							-0.18	0.00
Grade							-0.05	0.00							-0.71	0.01
Gender x Grade															**-1.37** **	0.02

Note. Adolescent measures (A) $N = 324$, parent measures (P) $N = 325$; depressive symptoms = YSR/CBCL depressed/withdrawn t-score; anxiety problems = YSR/CBCL anxiety problems t-score; gender is effect-coded with 1 = female, -1 = not female; grade is effect-coded with 1 = rising 9th grade, -1 = rising 6th grade. Statistically significant effects (adjusted $p < 0.013$) are indicated in bold, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table 8.

Internalizing Symptoms by ADHD-Related Impairment, Gender, and Grade

	Model Fit				*Coefficients*					
	R^2_{total}	$R^2_{adjusted}$	$F(5,317)$	p	b	(SE)		$t(317)$	p	sr^2
Depressive Symptoms *	0.04	0.02	2.48	0.032						
Intercept					58.39	(1.52)	***	112.64	< 0.001	
Gender					0.78	(0.52)		1.48	0.140	0.01
Grade					-0.30	(0.46)		-0.64	0.522	0.00
Social Impairment					0.08	(0.05)		1.55	0.122	0.01
Academic Impairment					-0.79	(0.87)		-0.90	0.367	0.00
Family Conflict					1.36	(0.63)	*	2.16	0.032	0.01
*Anxiety Symptoms**	0.04	0.02	2.54	0.028						
Intercept					56.29	(0.46)	***	123.73	<0.001	
Gender					-0.95	(0.46)	*	-2.07	0.040	0.01
Grade					-0.98	(0.40)	*	-2.43	0.016	0.02
Social Impairment					0.05	(0.05)		1.07	0.285	0.00
Academic Impairment					0.29	(0.76)		0.38	0.702	0.00
Family Conflict					0.34	(0.55)		0.62	0.538	0.00

Note. $N = 323$. Depressive symptoms (YSR depressed/withdrawn *t*-score), anxiety symptoms (YSR anxiety problems *t*-score), social impairment (CBCL social problems *t*-score), academic impairment (AAPC, parent-report mean item score), family conflict (CBQ-20, parent-report, mean item score); for gender, female = 1, non-female = -1, for grade, rising 9th grade = 1, rising 6th grade = -1.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table 8.

Internalizing Symptoms by ADHD-Related Impairment, Gender, and Grade

	Model Fit				*Coefficients*				
	R^2_{total}	$R^2_{adjusted}$	$F(5,317)$	p	b	(SE)	$t(317)$	p	sr^2
Depressive Symptoms *	0.04	0.02	2.48	0.032					

Intercept					58.39	(1.52)	***	112.64	< 0.000	
Gender					0.78	(0.52)		1.48	0.140	0.01
Grade					-0.30	(0.46)		-0.64	0.522	0.00
Social Impairment					0.08	(0.05)		1.55	0.122	0.01
Academic Impairment					-0.79	(0.87)		-0.90	0.367	0.00
Family Conflict					1.36	(0.63)	*	2.16	0.032	0.01
*Anxiety Symptoms**	0.04	0.02	2.54	0.028						
Intercept					56.29	(0.46)	***	123.73	<0.001	
Gender					-0.95	(0.46)	*	-2.07	0.040	0.01
Grade					-0.98	(0.40)	*	-2.43	0.016	0.02
Social Impairment					0.05	(0.05)		1.07	0.285	0.00
Academic Impairment					0.29	(0.76)		0.38	0.702	0.00
Family Conflict					0.34	(0.55)		0.62	0.538	0.00

Note. $N = 323$. Depressive symptoms (YSR depressed/withdrawn *t*-score), anxiety symptoms (YSR anxiety problems *t*-score), social impairment (CBCL social problems *t*-score), academic impairment (AAPC, parent-report mean item score), family conflict (CBQ-20, parent-report, mean item score); for gender, female = 1, non-female = -1, for grade, rising 9th grade = 1, rising 6th grade = -1.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table 9.
Teen-Rated Depressive Symptoms by Family Conflict, Gender, and Grade

	Block 1							Block 2							Block 3						
	R^2_{change}	R^2_{total}	R^2_{adj}	F	p	b	sr^2	R^2_{change}	R^2_{total}	R^2_{adj}	$F\Delta$	p	b	sr^2	R^2_{change}	R^2_{total}	R^2_{adj}	$F\Delta$	p	b	sr^2
Model Fit	0.03 *	0.03 *	0.02	3.26	0.022			0.03 **	0.06 **	0.04	2.86	0.006			0.06 **	0.06 **	0.04	2.67	0.004		
Coefficients																					
Intercept						58.43 ***							58.50 ***							58.47 ***	
Family Conflict						1.43 *	0.02						1.33 *	0.01						1.29	0.01
Gender						0.89	0.01						0.95	0.01						0.87	0.01
Grade						-0.35	0.00						0.36	0.00						0.35	0.00
Family Conflict x Gender													-0.33	0.00						-0.44	0.00
Family Conflict x Grade													-0.19	0.00						0.38	0.00
Gender x Grade													1.50 **	0.03						1.50 **	0.03
Family Conflict x Gender x Grade																				1.08	0.01

Note. $N = 324$. Block 1 F test $df = 3, 320$ Block 2 F-change test $df = 3, 317$ Block 3 F-change test $df = 1, 316$. Depressive symptoms (YSR depressed/withdrawn t-score), anxiety symptoms (YSR anxiety problems t-score), social impairment (CBCL social problems t-score), academic impairment (AAPC, parent-report), family conflict (CBQ-20, parent-report); gender and grade are effect-coded with female = 1, non-female = -1, and rising 9th grade = 1, rising 6th grade = -1.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table 10.
Primary Group x Time and Secondary Group x Female x Time and Group x Grade x Time Effects in Linear Mixed Models

	HI:LI		*HI:LI*		*HI:LI*		*Untreated:LI*		*Untreated:LI*		*Untreated:LI*		*HI:Untreated*		*HI:Untreated*		*HI:Untreated*	
	Group x Time		*Group x Gender x Time*		*Group x Grade x Time*		*Group x Time*		*Group x Gender x Time*		*Group x Grade x Time*		*Group x Time*		*Group x Gender x Time*		*Group x Grade x Time*	
	b	p	b	p	b	p	b	p	b	p	b	p	b	p	b	p	b	p
Depressive Symptoms*	**-0.17**	0.032	-0.16	0.358	0.17	0.282	-0.05	0.543	0.12	0.733	-1.10	0.500	**-0.14**	0.049	-0.28	0.099	0.23	0.109
Anxiety Symptoms*	**-0.17**	0.018	-0.21	0.198	0.02	0.876	-0.05	0.543	-0.05	0.738	**-0.27**	0.050	-0.08	0.254	-0.12	0.435	0.19	0.151
Social Problems***	**-0.25**	0.010	-0.09	0.687	-0.01	0.946	0.07	0.448	0.09	0.697	0.00	0.991	**-0.33**	0.000	-0.16	0.465	-0.01	0.939

Note: N HI = high intensity; LI = low intensity; depressive symptoms = YSR depressed/withdrawn t-score; anxiety symptoms = YSR anxiety problems t-score; social problems = CBCL social problems t-score; gender and grade are dummy-coded with female = 1, non-female = 0; grade, rising 9th grade = 1, rising 6th grade = 0.

Statistically significant effects ($p < 0.05$) are indicated in bold; *$p \leq 0.05$, **$p \leq 0.01$, **$p < 0.001$

Table 11.
Estimated Marginal Means, Standard Deviations, and Treatment Effect Sizes

Measure	*High Intensity*						*Low Intensity*						*Untreated*						*Treatment Effects*		
	BL		*POST*		*EOY*		*BL*		*POST*		*EOY*		*BL*		*POST*		*EOY*		*BL-EOY* d		
	M	*(SD)*	*M*	*(SD)*	*M*	*(SD)*	*M*	*(SD)*	*M*	*(SD)*	*M*	*(SD)*	*M*	*(SD)*	*M*	*(SD)*	*M*	*(SD)*	*HI:LI*	*LI:Untreated*	*HI:Untreated*
Depressive Symptoms	57.45	(8.33)	56.63	(6.30)	55.01	(6.11)	57.24	(8.06)	57.09	(8.27)	56.78	(9.07)	59.14	(8.26)	58.81	(8.27)	58.15	(8.67)	**0.24**	-0.07	**0.17**
Anxiety Symptoms (6th)	52.82	(7.46)	51.62	(6.51)	49.23	(5.51)	57.65	(7.64)	57.17	(7.09)	56.21	(9.23)	58.56	(7.14)	58.06	(7.49)	57.04	(7.26)	0.28	**-0.01**	0.28
Anxiety Symptoms (9th)	55.72	(6.95)	55.01	(6.51)	53.59	(5.61)	53.69	(6.60)	53.60	(7.09)	53.43	(6.13)	57.33	(7.27)	56.13	(7.49)	53.74	(5.96)	0.28	**-0.48**	-0.20
Social Problems	61.17	(10.12)	59.57	(9.40)	56.39	(10.75)	60.57	(9.36)	59.99	(9.17)	58.39	(10.28)	57.98	(8.36)	57.68	(8.18)	57.20	(8.06)	**0.31**	0.10	**0.42**

Note. Means are marginal estimates after controlling for medication as a covariate. Means are displayed separately by grade when Group x Grade x Time interactions were present. HI = high intensity; LI = low intensity; depressive symptoms = YSR depressed/withdrawn *t*-score; anxiety symptoms = YSR anxiety problems *t*-score; social problems = CBCL social problems *t*-score. BL = baseline; POST = postsummer, EOY = end of year.

*Bold = significant group differences at assessment.

Appendix B: Figures

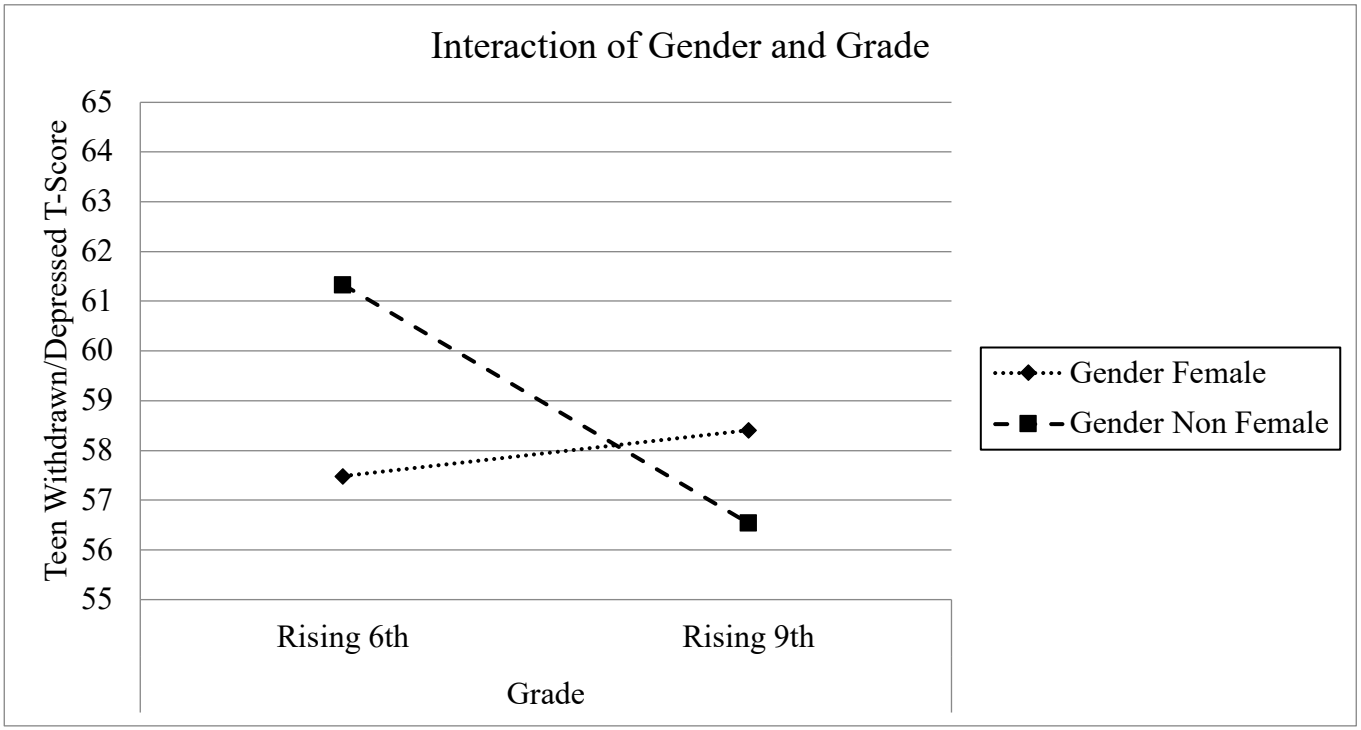

Figure 1. Interaction of gender and grade predicting depressive symptoms.
Note. Depressive symptoms = YSR depressed/withdrawn *t*-scores.