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The Positive Illusory Bias and ADHD Symptoms: A New Measurement Approach

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The Positive Illusory Bias and ADHD Symptoms: A New Measurement Approach

by

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A dissertation submitted in partial fulfillment
of the requirements for the degree of
Doctor of Philosophy in School Psychology
Department of Psychological and Social Foundations
College of Education
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Abstract

The purpose of this study was to investigate perceptions of academic and social competence among adolescents with a continuum of inattentive and hyperactive/impulsive symptoms. Past literature suggests that children with Attention-Deficit/Hyperactivity Disorder (ADHD) display self-perceptions that are overly positive compared to external indicators of competence, a phenomenon that is referred to as the positive illusory bias (PIB; Owens, Goldfine, Evangelista, Hoza, & Kaiser, 2007). The PIB is well supported among children with ADHD, and recent research suggests that the PIB persists into adolescence. To date, research on the PIB has relied on difference scores (i.e., an indicator of competence is subtracted from student self-ratings); however, difference scores suffer from numerous methodological limitations (Edwards, 2002). The current study investigated the relationship between self and teacher ratings of academic and social competence and inattentive, hyperactive/impulsive, and overall ADHD symptoms among a diverse sample of 395 students and their teachers. Polynomial regression and response surface methods were used to account for self and teacher ratings separately and decrease reliance on differences scores. These methods have been recommended to answer complex questions related to agreement and disagreement between ratings. The results of this study suggest that some adolescents with ADHD symptoms demonstrate the PIB, while others perceive their impairments and rate themselves as having low competence aligned with teacher ratings. Accurate ratings of low competence were more common within the academic domain than the social domain for students with overall ADHD symptoms as well as specific inattentive

and hyperactive/impulsive symptoms. Results within the social domain indicate that all ADHD symptoms increased more sharply as the discrepancy between self and teacher ratings increased. Student overestimation of competence in both the academic and social domains was shown to be more predictive of high inattentive symptoms compared to hyperactive/impulsive symptoms. These findings suggest this new analysis approach allowed for a more nuanced understanding of the complex relationship between student and teacher competence ratings and ADHD symptoms. Gaining a better understanding of the PIB through this improved methodology has the potential to influence assessment and intervention practices among school psychologists, and to contribute to future research in this area. This study contributes to the literature by being the first to (1) examine the PIB in relation to a range of general and specific ADHD symptoms, (2) use polynomial regression/response surface methods to address limitations of difference scores, and (3) explore the PIB among a school-based sample of adolescents.

Chapter One: Introduction

Statement of the Problem

Symptoms of Attention-Deficit/Hyperactivity Disorder (ADHD) impact a significant number of school-age children (Bussing, Mason, Bell, Porter, & Garvan, 2010). ADHD is one of the most common mental health problems when children enter school (Carter, Wagmiller, Gray, McCarthy, Horwitz, & Briggs-Gowan, 2010). Students with ADHD are at risk for negative academic and social functioning (McConaughy, Volpe, Antshel, Gordon, & Eiraldi, 2011), with symptoms and impairments persisting into adolescence for the majority of children (Bussing et al., 2010). The particular impairments experienced tend to differ based on specific symptoms (i.e., hyperactive-impulsive [HI] and inattentive [IA]). Children with more IA symptoms tend to experience greater academic difficulty, while problems with peers are more common among students with high HI symptoms (Gaub & Carlson, 1997). The majority of research on these symptoms focuses on individuals with a diagnosis of ADHD, rather than examining IA and HI symptoms on a continuum. Barkley (2006) suggests that considering diagnosis only is problematic because this excludes children who experience ADHD symptoms and related impairments at a level that does not meet diagnostic criteria (Barkley, 2006). This is supported by research demonstrating that adolescents and young adults (age 14-21) with sub-threshold levels of ADHD symptoms experience similar or worse functional impairments and school outcomes compared to students with a diagnosis (Bussing et al., 2010). It is also particularly important to examine ADHD on a continuum because students with different

constellations of symptoms receive the same diagnostic label but experience different impairments (Barkley, 2006). Recent literature suggests that a bifactor model best describes ADHD symptoms and the heterogeneous outcomes associated with this disorder (Martel, von Eye, & Nigg, 2010a). This model accounts for general ADHD symptoms as well as the specific symptoms of HI and IA and promotes consideration of specific symptom profiles rather than just ADHD diagnosis (Martel et al., 2010a).

Given the association between ADHD symptoms and impairment, it may be expected that students with ADHD symptoms would have low self-concept; however, many studies show that these students may not perceive their deficits and overestimate competence in domains of significant impairment (e.g., Hoza, Gerdes, Hinshaw, Arnold, Pelham, Molina, et al., 2004). These overly positive self-perceptions are often referred to as the positive illusory bias (PIB), a phenomenon in which “children with ADHD unexpectedly provide extremely positive reports of their own competence in comparison to other criteria reflecting actual competence” (Owens, Goldfine, Evangelista, Hoza, & Kaiser, 2007, p. 335). This phenomenon has been demonstrated across multiple domains of functioning among students with a diagnosis of ADHD, with the majority of recent research focusing on the academic, social, and behavioral domains (McQuade, Hoza, Waschbusch, Murray-Close, & Owens, 2011a; McQuade, Tomb, Hoza, Waschbusch, Hurt, & Vaughn, 2011b; Swanson, Owens, & Hinshaw, 2012).

Current literature supporting the presence of the PIB in individuals with ADHD has been conducted primarily with elementary-age students. However, symptoms of ADHD have been shown to persist into adolescence and adulthood, with estimates that as many as 65% of children diagnosed with ADHD continue to meet diagnostic criteria during adolescence (Wolraich, Wibbelsman, Brown, Evans, Gotlieb, Knight et al., 2005). Additionally, academic and social

problems associated with ADHD may become more pronounced during adolescence due to the increasing academic demands and emphasis on peer acceptance associated with middle and high school (Wolraich et al., 2005). Two recent studies have explored the PIB longitudinally and provided insight about the persistence of the PIB into the adolescent years in the social, academic, and behavioral domains (Hoza, Murray-Close, Arnold, Hinshaw, Hechtman, & The MTA Cooperative Group, 2010; McQuade et al., 2011a). Hoza and colleagues (2010) showed that the PIB persisted in the social domain from childhood to adolescence (participants age 14-19 at the end of the six year study), while the PIB in the behavioral domain was shown to decrease during adolescence. McQuade and colleagues (2011a) investigated the relationship between the PIB and depressive symptoms over a three year period (among boys age 8-12 at the beginning of the study) and found that the PIB was present in the academic, social, and behavioral domains across all time points. However, the primary finding of this study was that lower self-perceptions predicted depressive symptoms over time, with a decrease in social self-perception being most related to higher rates of depressive symptomatology over time (McQuade et al., 2011a). Considering that (a) ADHD symptoms have been shown to persist into adolescence for the majority of children, (b) adolescence is marked with increased challenges in the academic and social domain, and (c) the PIB has been demonstrated among adolescents with a diagnosis of ADHD, research focused on the academic and social self-perceptions of adolescents with a range of ADHD symptoms is warranted.

The majority of studies on the PIB have compared the self-perceptions of children with ADHD diagnoses to control groups of children without ADHD. One study has investigated self-ratings and external indicators of competence within a sample of children with a range of ADHD symptoms (not only children with a diagnosis of ADHD), and considered the severity of ADHD

symptoms in relation to the PIB (Diamantopoulou, Henricsson, & Rydell, 2005). These authors found that children with higher levels of ADHD symptoms demonstrated greater positive illusions than those with low levels of ADHD symptoms. Teacher ratings and peer nominations indicated significant social difficulties among students with the highest level of ADHD symptoms, but self-ratings indicated that these children did not perceive or report their social impairments (Diamantopoulou et al., 2005). This study suggests that the degree of ADHD symptoms may be an important consideration when exploring the PIB. Examining a range of ADHD symptoms is particularly important when investigating the PIB among adolescents because adolescents with subthreshold levels of ADHD symptoms (i.e., those who did not meet diagnostic criteria but were identified as high-risk for ADHD and were rated by parents as having some ADHD symptoms) have been shown to demonstrate significant functional impairments in multiple domains (Bussing et al., 2010).

Only two published studies have directly investigated the relationship between the PIB and specific ADHD subtypes (i.e., IA, HI, and Combined), with differing conclusions. Owens and Hoza (2003) suggest that children with HI and Combined subtype of ADHD demonstrate the PIB, while children with IA symptoms were shown to have more accurate self-perceptions (Owens & Hoza, 2003). These authors also investigated symptom severity within the group meeting diagnostic criteria for ADHD and found that more severe HI symptoms were associated with larger discrepancies between self and teacher ratings. Conversely, Swanson and colleagues (2012) found no differences in the PIB between girls diagnosed with the IA and Combined subtypes. Taken together, it is clear that research on the PIB and specific ADHD symptoms is quite limited, with both of these investigations considering ADHD diagnosis rather than the full range of specific ADHD symptoms. The only study to date that explored the PIB within a

general middle school population (versus an ADHD and non-ADHD group in the majority of past research) found that students demonstrating the PIB in the academic domain had significantly higher levels of both HI and IA symptoms compared to students with realistic or overly negative self-perceptions (Fefer, 2011). Within the social domain students with the PIB were shown to exhibit significantly higher levels of IA symptoms, with no significant differences in HI symptoms found between groups (Fefer, 2011). The results of this study suggest the importance of further investigating the relationship between domain specific self-concept and specific ADHD symptoms. It is important to note that IA symptoms were most common within this sample (Fefer, 2011). Because ADHD symptoms change throughout development, with IA symptoms becoming more common during adolescence (Smith, Barkley, & Shapiro, 2007; Wolraich et al., 2005), it may be particularly important to consider a full range of specific ADHD symptoms when exploring the PIB among adolescent samples. The PIB has never before been investigated within a bifactor conceptualization with consideration of both general ADHD and specific HI and IA symptoms; this is an important next step to understand the complex relationship between the PIB and ADHD.

Exploring the PIB among school-based samples has the potential to inform the practices of school psychologists. It is particularly important for school psychologists to further understand this phenomenon within the academic and social domains because these are often the target of assessment and intervention efforts for students with ADHD symptoms. It has been shown that the presence of the PIB may decrease the effectiveness of interventions (Mikami, Calhoun, & Abikoff, 2010). Children who do not perceive their difficulties may not fully engage in interventions, which often require student effort for improvement. Regarding assessment, although it is well documented that students with ADHD do not accurately report externalizing

behavior (Barkley, Fischer, Smallish, & Fletcher, 2002), the PIB suggests that these students also provide inaccurate reports of their abilities in multiple domains. A greater understanding of the PIB may impact how school psychologists use self-report data and provide insight into what symptom profiles are associated with inaccurate reports. Thus, more research on the PIB could provide insight into how school psychologists can best support students with ADHD.

Despite the clear need for school psychologists to understand the potential impact of the PIB on their assessment and intervention practices for students with ADHD symptoms, researchers have struggled to find a reliable method to investigate this complex phenomenon. Empirical research investigating the PIB among children with ADHD has evolved over the past decade. Methods used to measure the PIB in past literature include the absolute self-perception method, in which mean self-concept ratings of individuals with ADHD are compared to a control group or normative sample, and pre/post performance ratings to identify the presence of the PIB related to specific tasks or situations (Owens et al., 2007). The pre/post performance method involves children rating their performance on a task (either before or after completing the task) and comparing ratings to their actual performance and/or to children in a control group. Each of these methods has significant limitations and yield inconclusive results about the presence of the PIB. Currently, use of the criterion or discrepancy analysis is suggested to be best for research on the PIB (Owens et al., 2007). This method involves subtracting a criterion score (i.e., an external source of actual such as teacher ratings or standardized achievement test score) from a student's self-ratings of their domain specific competence. Difference scores/discrepancy analysis continue to be recommended and used most often in literature on the PIB despite extensive critiques of discrepancy scores as methodologically problematic (Edwards, 2001; Owens et al., 2007). It has been suggested that the use of difference scores may provide a

distorted view and limit understanding of complex relationships between variables because self and other ratings are combined into one score (Edwards, 2002). Methodology for exploring agreement and disagreement between self and other ratings has been proposed in the fields of business and industrial-organizational psychology (Shanock, Baran, Gentry, Pattison, & Heggstad, 2010). This methodology involves the use of polynomial regression in combination with response surface testing to investigate the independent and joint effects of self and other ratings on outcome variables of interest. Edwards (2002) advocates for the use of polynomial regression to answer complex research questions that have previously relied on difference scores. Extensions of this method to research on the PIB are needed as this would allow for an exploration of how agreement and disagreement (i.e., overestimation and underestimation) between self and others (e.g., teachers) ratings of competence may predict the level of ADHD symptoms (Shanock et al., 2010).

Purpose of the Current Study

The purpose of this study was to investigate perceptions of academic and social competence among high-school students with a broad range of ADHD symptoms (no symptoms to levels which would meet diagnostic criteria for ADHD). The relationship between self and teacher ratings of competence and general and specific (i.e., IA and HI) ADHD symptoms was investigated using polynomial regression and response surface method to directly investigate agreement and disagreement between self and teacher ratings. The goal was to advance theory about the PIB and inform future research and practice related to students with ADHD symptoms in adolescence. The following three research questions are addressed in the current study:

1. To what extent, if any, does agreement and disagreement between self and teacher ratings of competence (in the academic and social domains) predict the level of general ADHD

symptoms among high school students?

- a. Using the discrepancy method?
 - b. Using polynomial regression/response surface analysis?
2. To what extent, if any, does agreement and disagreement between self and teacher ratings of competence (in the academic and social domains) predict the level of HI symptoms among high school students?
- a. Using the discrepancy method?
 - b. Using polynomial regression/response surface analysis?
3. To what extent, if any, does agreement and disagreement between self and teacher ratings of competence (in the academic and social domains) predict the level of IA symptoms among high school students?
- a. Using the discrepancy method?
 - b. Using polynomial regression/response surface analysis?

Hypotheses

Based on literature reviewed in Chapter 2, it was hypothesized that overall ADHD symptoms would be predicted by disagreement represented in quadrant three of Figure 1 (i.e., the PIB). It was hypothesized that disagreement as represented in quadrant three of Figure 1 (i.e., the PIB) would also be most predictive of HI symptoms. This is consistent with findings from the only study to find differences between ADHD subtypes, which suggested that the PIB was most associated with HI symptoms (Owens & Hoza, 2003). Finally, it was hypothesized that agreement as represented by quadrant one of Figure 1 would be most predictive of IA symptoms. This is consistent with past literature suggesting that elementary-age students with IA were more likely to acknowledge their impairments and not demonstrate the PIB (Owens & Hoza, 2003). It

is important to note that these hypotheses were based on limited research, and little is known about the relationship between the PIB and specific ADHD symptoms. The current study provides insight into the relationship between the PIB and specific ADHD symptoms in both the academic and social domains.

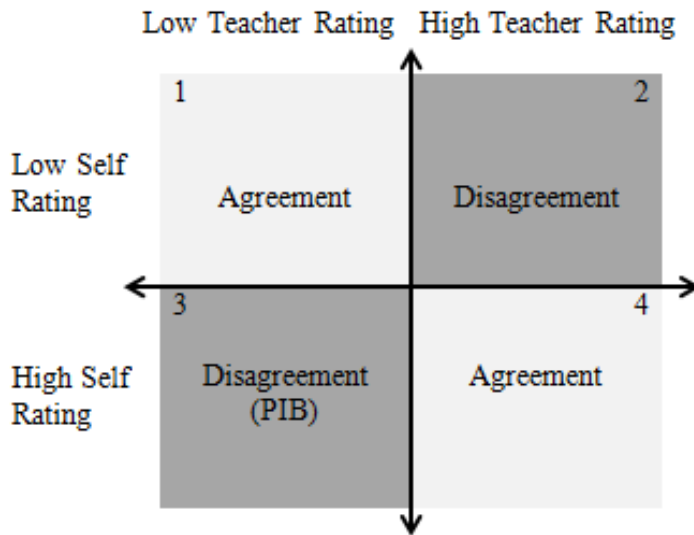


Figure 1. Matrix of possible combinations of Self and Teacher ratings to conceptualize the various ways that agreement and disagreement can occur (not categorical groups).

Definitions of Key Terms

Attention-deficit/Hyperactivity Disorder (ADHD). ADHD is defined by the core symptoms of inattention, hyperactivity, and impulsivity. A clinical diagnosis of ADHD requires that a child, adolescent, or adult exhibit six or more symptoms in either the area of inattention (IA) and/or hyperactivity-impulsivity (HI; American Psychiatric Association [APA], 2000). For a diagnosis, these symptoms must be present before age 7, maladaptive, inconsistent with the behavior of others at their age level, and be present for at least six months to receive a diagnosis. The current study explored specific ADHD symptoms on a continuum rather than as a diagnostic label, meaning that students displaying all levels of inattentive (IA) or hyperactive/impulsive (HI) symptoms were included in the sample (ranging from no symptoms present to levels of

symptoms warranting a diagnosis). ADHD is discussed as a diagnostic label and in relation to specific symptoms (i.e., IA and HI) within the current document.

Inattention. Inattentive (IA) symptoms are most often assessed by nine specific behaviors listed within the definition of ADHD in the DSM-IV and now in the DSM-5 (APA, 2000, 2013; Barkley, 2006). These include difficulty sustaining attention, making mistakes or not attending to details, having trouble listening when directly spoken to, not following through with instructions or failure to complete tasks, difficulty organizing, avoidance of tasks that require ongoing mental effort, losing things, being easily distracted, and being forgetful (APA, 2000).

Hyperactivity/Impulsivity. The behavioral dimension of hyperactivity-impulsivity is defined by nine symptoms listed within the description of ADHD in the DSM-IV and 5, six representing hyperactivity and three representing impulsivity. The symptoms of hyperactivity include fidgeting, leaving the seat or assigned area, running or climbing excessively or feelings or restlessness, difficulty playing quietly, acting as if “driven by a motor,” and excessive talking (APA, 2000; 2013). Symptoms of impulsivity include blurting out answers to questions, difficulty waiting for their turn, and interrupting in others’ conversations (APA, 2000).

Self-concept. Self-concept is a multidimensional and hierarchical construct that is used to refer to an individual’s self-evaluations of his or her competence in specific domains, such as the academic, social, or behavioral domains (Harter, 1999). While self-concept tends to be viewed as domain-specific, this multidimensional model also includes global self-concept, which represents individuals’ overall feelings toward themselves (Harter, 1999). This global evaluation of oneself is also referred to as self-esteem or self-worth in the literature; however, it has been suggested that self-esteem, global self-concept, and other more general terms are nearly

impossible to differentiate (Bracken, Bunch, Keith, & Keith, 2000). Furthermore, this broad levels of self-perceptions is suggested to be too complex and comprehensive to have a meaningful relationship with specific domains of functioning (e.g., academic or social; Valentine, Dubois, & Cooper, 2004). The term self-concept has been selected for the purpose of this study because it is commonly used to refer to self-evaluations of attributes in specific domains, such as the academic or social domains of interest in the current study (Harter, 1999). The multidimensional nature of this term, which includes global and domain specific self-concept (Bracken, 2009; Harter, 1999; Marsh, 1994), allows for a focus on domains that may be particularly salient for adolescents with ADHD.

Difference score. Also called a discrepancy score, this is when the score from one measure is subtracted from the score from another measure to create a distinct score representing the difference between the two indicators. This is currently the most common method used to investigate the PIB among children with ADHD, with the PIB represented as a discrepancy score between self-ratings and some external indicator of competence (e.g., standardized achievement test scores or teacher ratings) in which the self-rating exceeds the other indicator of competence (see quadrant 3 of Figure 1).

Positive Illusory Bias (PIB). This term refers to the overestimation of self-competence within a specific domain, either in comparison to another group or compared to a criterion that is meant to reflect one's actual abilities (Owens et al., 2007). While the majority of past research on the PIB considers teacher ratings of competence for the comparison, parent and camp counselor ratings of competence, performance on a standardized achievement test, or performance on a specific task have also been used as indicators of actual competence or abilities (Owens et al., 2007). Within the current study the PIB was considered present when student

ratings of competence were higher than teacher ratings of student competence (see quadrant 3 of Figure 1). Difference scores that were more than one half standard deviation above the mean were considered to be indicative of the presence of the PIB.

Accuracy of self-perceptions. Accuracy of self-perceptions refers to the extent to which two scores (i.e., self and teacher ratings of competence) are consistent or in agreement (see quadrant 1 and 4 of Figure 1). In line with past research, difference scores that were within one half standard deviation above or below the mean were considered as realistic or accurate ratings of competence (Fefer, 2011; Fleenor, 1996).

Underestimation of competence. This term refers to situations in which a student rates their competence lower than their teacher, indicating that they perceive themselves to be less competent than what the external rating (i.e., teacher rating) suggests. This can be thought of as the opposite of the PIB (see quadrant 2 of Figure 1). Difference scores more than one half standard deviation below the mean were considered to be indicative of underestimation of competence.

Polynomial regression. A form of multiple linear regression which is used to explore nonlinear phenomena (Edwards, 2002). Polynomial regression fits a nonlinear relationship between independent variables and corresponding values of the dependent variable (Edwards, 2002). This method has commonly been used with response surface methods in industrial/organizational psychology to answer questions related to agreement and disagreement between self and other ratings.

Response surface methods. This is a three-dimensional graphing procedure used for estimating and interpreting the results of polynomial regression analysis that visually depicts how predictor variables of interest relate to one outcome (Edwards, 2002). These graphs

correspond to polynomial regression equations and allow for investigations of how agreement and disagreement between two predictor variables relate to an outcome. This allows for formal interpretation of curvilinear and linear relationships between these three variables (Edwards, 2002).

Contributions to the Literature

To date, there are no previous studies investigating the relationship between the PIB and specific ADHD symptoms among high school students. It is important to better understand whether the self-perceptions of adolescents with ADHD symptoms are in line with the PIB identified in children and young adolescents with ADHD (e.g., Fefer, 2011; McQuade et al., 2011a), or if their self-perceptions become more realistic, differentiated across domains, and demonstrate an increasing trend during the high school years as has been shown to occur in adolescence among the general population (Harter, 2012). Recent research suggests that the PIB persists in the academic, social, and behavioral domains for adolescents with a diagnosis of ADHD (McQuade et al., 2011a; Hoza et al., 2010), but it remains unclear how this relates to specific ADHD symptoms. It is of particular importance to attend to specific ADHD symptoms on a continuum when investigating the PIB among adolescents because IA symptoms may become more prevalent during adolescence (Fefer, 2011; Wolraich et al., 2005) and some studies suggest that overall ADHD symptoms decrease during adolescence (Hoza et al., 2010). This is the first study to provide insight about the self-perceptions of adolescents with a broad range of ADHD symptoms. The PIB had also never before been investigated related to both general *and* specific ADHD symptoms (i.e., IA and HI); the current study adds to the small body of literature that has considered subtype or symptom severity in analyses (Diamantopoulou et al., 2005; Owens & Hoza, 2003; Swanson et al., 2012). Specifically, the current study investigated

symptoms of ADHD within a bifactor conceptualization, with consideration of general and specific ADHD symptoms. Investigating general ADHD symptoms allows for comparisons with the majority of past research on the PIB, and additional investigation of specific ADHD symptoms contributes to understanding if the PIB is differentially associated with IA or HI symptoms.

Additionally, the PIB had not yet been explored with methods which allowed for both self and other ratings to be accounted for separately without the reliance on difference scores. The current study used polynomial regression and response surface methods to explore the relationship between agreement and disagreement between student-ratings and teacher-ratings of academic and social competence, and how these ratings predict the presence of general and specific ADHD symptoms. Identifying improved methods to measure the PIB is a critical first step in answering many remaining empirical questions about the PIB and symptoms of ADHD.

Chapter Two: Review of the Literature

This chapter outlines the research base on self-concept in adolescents with symptoms of Attention-deficit/Hyperactivity Disorder (ADHD) through a discussion of three important elements: (1) an overview of current conceptualizations of ADHD and the symptoms and impairments associated with ADHD symptoms, (2) an introduction to theories of self-concept, and a description of findings related to self-concept among children and adolescents with ADHD, and (3) a discussion of methods used to investigate self-perceptions in past research, as well as a review of alternative methods that may more adequately allow for the comparison between self and other rating.

Attention-Deficit/Hyperactivity Disorder

ADHD is a common childhood disorder characterized by symptoms of inattention, hyperactivity, and impulsivity (American Psychological Society [APA], 2000), which lead to impairment in multiple domains of functioning. The following section outlines the prevalence of ADHD diagnosis and symptoms, various conceptualizations of ADHD, and the specific impairments associated with this disorder. Comorbid concerns and developmental considerations are also discussed.

Prevalence. Prevalence studies suggest that approximately 7-10% of school-age children in the United States meet diagnostic criteria for ADHD (Barbarese, Katusic, Colligan, Pankratz, Weaver, Weber, et al., 2002; Froehlich, Lanphear, Epstein, Barbarese, Katusic, & Kahn, 2007). When high levels of ADHD symptoms are considered, rather than full diagnostic criteria,

prevalence rates are significantly higher, with one study showing prevalence rates of 18.2% among preschool children, 15.9% for elementary age students, and 14.8% for students in middle and high school based on teacher ratings of DSM-IV symptoms (Nolan, Gadow, & Sprafkin, 2001). A recent study investigating ADHD symptoms among 164 middle school students found that 15% of the sample had diagnosable levels based solely on teacher report (6 or more symptoms) of inattentive symptoms and 5% had six or more HI symptoms (Fefer, 2011). Within this same middle school sample an additional 6% of students were shown to demonstrate sub threshold (4 or 5 symptoms endorsed by teacher) inattentive symptoms and an additional 4% had sub threshold hyperactive/impulsive symptoms (Fefer, 2011). ADHD is one of the most common mental health problems among children entering school and is therefore an important area for research (Carter et al., 2010).

The difference in prevalence rates for ADHD diagnosis versus the presence of symptoms is often overlooked. Barkley suggests that an ADHD diagnosis should be conceptualized as the extreme end of a continuum of behavior which is typical for children, and urges both practitioners and researchers to consider ADHD as a dimensional construct (Barkley, 2006). He suggests that diagnostic thresholds which attempt to categorize ADHD symptoms exclude children who experience ADHD symptoms and related impairments but do not meet diagnostic criteria (Barkley, 2006). This is supported by recent research demonstrating that adolescents and young adults (age 14-21) with sub-threshold levels of ADHD symptoms (i.e., exhibiting 4 or 5 HI or IA symptoms versus six or more symptoms required for diagnosis) experience similar or worse functional impairments and school outcomes compared to students with a diagnosis (Bussing et al., 2010). In further support of the importance of considering ADHD symptoms on a continuum, there is variability within groups of children diagnosed with ADHD with students

with different constellations of symptoms receiving the same diagnostic label but experiencing unique impairments (Barkley, 2006). One empirical study demonstrated that ADHD symptoms and impairment were not highly correlated in four large samples of children with ADHD, and symptoms only accounted for an average of 10% of the variance in impairment (Gordon, Antshel, Faraone, Barkley, Lewandoski, Hudziak et al., 2006). Barkley states that “disorder begins where impairment begins” (Barkley, 2006, p. 99) and argues that diagnostic cutoffs prevent impairment from guiding ADHD assessment and intervention. For these reasons, the level of ADHD symptoms will be the focus of the current study, rather than ADHD diagnosis. The following section presents various ways which ADHD has been explained in past research because these models inform how ADHD was defined within the current study.

Conceptualizations of ADHD.

Diagnosis. Based on the Diagnostic and Statistical Manual, Fourth Edition, Text Revision (DSM-IV-TR; APA, 2000) a diagnosis of ADHD requires that an individual exhibit 6 or more symptoms of either inattention (IA) or hyperactivity-impulsivity (HI), and that some of the symptoms be present before age 7. Within the new DSM-5 (APA, 2013) this age of onset criteria was changed to 12, and individuals 17 and older are only required to present 5 symptoms to meet diagnostic criteria. Examples of IA symptoms include difficulty following instructions, sustaining attention, being forgetful, or easily distractible. Examples of HI symptoms include problems with waiting one’s turn, talking excessively, interrupting, and fidgeting. Hyperactivity and impulsivity are grouped together due to past research suggesting that they are a single behavioral dimension (DuPaul, Anastopoulos, Power, Reid, Ikeda, & McGoey, 1998), which some researchers have labeled as disinhibition (Barkley, 2006). To receive a diagnosis of ADHD these symptoms must be maladaptive, inconsistent with the behavior of others at their

developmental level, and be present for at least six months (APA, 2000). Within the DSM-IV, an individual could be diagnosed as one of three ADHD subtypes depending on the specific symptoms present. These included: 1) ADHD predominantly inattentive type (IA; presenting 6 or more symptoms of inattention and less than 6 symptoms of hyperactivity-impulsivity), 2) ADHD predominantly hyperactive-impulsive type (HI; 6 or more symptoms of hyperactivity-impulsivity and less than 6 symptoms of inattention), and 3) ADHD combined type (C; 6 or more symptoms in both areas; APA, 2000). Although this definition is widely accepted, there continues to be controversy related to how ADHD is best described. Some suggest that having subtypes is problematic because small changes in symptoms can lead to individuals meeting criteria for another diagnostic subtype (Lahey, Pelham, Loney, Lee, & Willcutt, 2005). Some authors argue that a subtype consisting of individuals who only demonstrate IA symptoms without any HI symptoms is needed because of the unique characteristics associated with this group (Carr, Henderson, & Nigg, 2010). Within the new DSM-5 subtypes have been replaced with presentation specifiers that align with the DSM-IV subtypes described previously (APA, 2013). Additionally, the criteria for adolescents and adults age 17 and older has been decreased to 5 symptoms rather than the 6 symptoms required for diagnosis in younger individuals (APA, 2013).

Debate related to the criteria for an ADHD diagnosis has a longstanding history; and the definition of this disorder has undergone considerable change with each version of the DSM. The first appearance of ADHD was in the DSM-II which only included a single sentence about hyperactivity/hyperkinesis (APA, 1968). The DSM-III introduced Attention Deficit Disorder with and without hyperactivity, which emphasized all three core symptoms separately with inattention and impulsivity as core symptoms (APA, 1980). The DSM-III-Revised included only

a single dimension of ADHD (APA, 1987). Most recently the DSM-IV introduced the three distinct ADHD subtypes which are based on two factors: hyperactivity-impulsivity and inattention (APA, 1994, 2000; Barkley, 2006). The DSM-IV was the first to require impairment across multiple settings as a requirement for diagnosis (APA, 1994; Barkley, 2006). The newest version, the DSM-5 that was recently released in May of 2013, continues to emphasize the presence of symptoms across setting and also includes the new ADHD specifier of Inattentive presentation (restrictive) for individuals who have high levels of IA symptoms (more than six) but have less than two HI symptoms (APA, 2013). This is different than the previous IA subtype which simply required more than six IA symptoms and less than six HI symptoms. The DSM-5 also emphasizes that ADHD is not only a childhood disorder; the requirement for age of onset was changed from 7 years old to 12 years old, and examples of symptoms relevant for adolescents and adults were added (APA, 2013). As is evidenced by the changes across each version of the DSM, there has been controversy about how to best describe ADHD and the associated symptoms.

Factor structure of ADHD. Factor analytical studies have been conducted to provide empirical support for how to best describe ADHD and explain the heterogeneous presentations of the disorder. Conceptualizations include a one-factor model (ADHD), a correlated two-factor model of inattention and hyperactivity-impulsivity; a second-order model with inattention and hyperactivity-impulsivity encompassed under a second-order ADHD factor; a three-factor model with inattention, hyperactivity, and impulsivity; and most recently a bifactor model. The correlated two-dimensional model of ADHD has received the most support in the literature to date (e.g., Achenach & Rescorla, 2001; Burns, Boe, Walsh, Sommeers-Flanagan, & Teegarden, 2001; Collett, Crowley, Gimpel, & Greenon, 2000) and influenced the conceptualization of

ADHD subtypes for diagnosis in the DSM-IV. Inattentive and hyperactive-impulsive symptoms have been linked to unique impairment and behavioral outcomes across multiple domains (Gaub & Carlson, 1997). Thus it is considered important to distinguish between these two symptom clusters when considering etiology and/or treatment (APA, 2000; Barkley, 2006). A correlated three-factor model of ADHD has also been supported through several studies using confirmatory factor analysis and investigating inattention, hyperactivity, and impulsivity separately (Gomez, Harvey, Quick, Scharer, & Harris, 1999; Pillow, Pelham, Hoza, Molina, & Stultz, 1998). A unique three-factor model including inattention, hyperactivity, and sluggish cognitive tempo has also been supported in recent literature using parent and teacher ratings (Bauermeister, Barkley, Bauermeister, Martinez, & McBurnett, 2011). Neither of these three-factor models is widely adopted in the literature. Other authors argue that a one factor model may better explain ADHD because the symptoms often co-occur (such as in the Combined subtype) and symptoms of ADHD are shown to be highly correlated (Conners, 2008; Conners, Sitarenios, Parker, & Epstein, 1998; Erhart, Dopfner, Ravens-Siebere, & the BELLA study group, 2008). However, the unidimensional model of ADHD is not as well supported as the two-factor model (Burns et al., 2001; Martel et al., 2010a). The correlated two-factor and second-order two-factor models align with the DSM-5 ADHD diagnosis in that inattentive and hyperactive-impulsive symptoms are considered separately under the broader category of ADHD (APA, 2013).

Although the correlated two-factor model of ADHD is well supported, alternative conceptualizations using bifactor models are currently being proposed to better account for the heterogeneity which characterizes ADHD (Dumenci, McConaughy, Achenbach, 2004; Martel et al., 2010a; Martel, Roberts, Gremillion, von Eye, & Nigg, 2010b; Toplak, Pitch, Flora, Iwenofu, Ghelani, Jain, & Tannock, 2009). Bifactor models have been proposed to account for complex

dimensional health and mental health constructs in general (Reise, Morizot, & Hays, 2007), and have been shown to best account for general and specific dimensions of ADHD (Dumenci et al., 2004, Martel et al., 2010a, 2010b, 2011; Toplak et al., 2009; Toplak, Sorge, Flora, Chen, Banaschewski, Buitelaar et al., 2012). Martel and colleagues (2010a) suggest that “this model is more compatible than any other model with the current subtype structure in DSM-IV...” (p. 906-907). Of note, this model is also aligned with the most recent model of ADHD provided in DSM-5 (APA, 2013). This model of ADHD symptoms has gained research support across a variety of samples (Dumenci et al., 2004; Martel et al., 2010a, 2010b, 2011; Toplak et al., 2009, 2012). This model is compared to models of intelligence, with a general ‘g’ factor as the overall ADHD factor and the specific ‘s’ factors of verbal and nonverbal intelligence being equivalent to IA and HI symptoms in a bifactor model (Toplak et al., 2009). These models allow for each observed variable to simultaneously load onto a g factor and the s factors (conceptualized at the same level), with s factors contributing independent variance and covariance beyond what is explained by the g factor (Toplak et al., 2009).

Investigations of a bifactor model. Dumenci and colleagues (2004) shared empirical support for a bifactor model of ADHD symptoms utilizing the 26 Attention Problems items from the Teacher Report Form (TRF; Achenbach & Rescorla, 2001) to compare a one-factor, two-factor, and three-factor model (i.e., bifactor model). The bifactor model, with a general ADHD factor and specific factors of inattention and hyperactivity-impulsivity, provided the best fit across multiple fit indices within a confirmatory factor analyses across gender and age groups (6-11 years and 12-18 years) in large clinical ($N = 2,702$) and general population ($N = 2,635$) samples (Dumenci et al., 2004). This study demonstrated that ADHD should not be considered a unidimensional construct, but that a model with a latent general ADHD factor accounting for

the correlation between IA and HI symptoms provides the best fit to explain ADHD symptoms (Dumenci et al., 2004). The authors suggest that this conceptualization of ADHD will help to identify students who experience impairment related to sub threshold levels of both IA and HI symptoms.

The bifactor model has also shown to best account for ADHD symptoms among a clinical sample of 201 adolescents age 13-18 (Toplak et al., 2009). This study used confirmatory factor analysis and compared a correlated two-factor model (IA and HI) a correlated three-factor model (IA, H, and I), a bifactor two-factor model (general ADHD, IA, and HI), and a bifactor three-factor model (general ADHD, IA, H, and I). The authors purport that a bifactor model which accounts for a general ADHD factor underlying all DSM-IV symptoms, as well as the specific inattentive and hyperactive symptom clusters, will best describe both commonalities shared by individuals with this diagnosis and the heterogeneity that is also seen with ADHD. Analyses indicated that the bifactor two-factor model had the best fit with parent and adolescent reports of DSM-IV symptoms assessed via diagnostic interview. These findings were replicated and the bifactor model was also the best-fitting model with parent and teacher ratings on a scale measuring 18 positively phrased DSM-IV ADHD symptoms. Overall, this study found that the eighteen DSM-IV symptoms of ADHD loaded strongly on a general ADHD factor, along with two dimensional symptom factors, across parent, teacher, and adolescent self-reports (Toplak et al., 2009). This suggests that the bifactor model can be broadly applied to conceptualize ADHD and is not tied to ratings from a specific method or informant.

Martel and colleagues published two studies in 2010 demonstrating the utility of a bifactor model among 548 children age 6 through 18. One study examined the bifactor model to describe disruptive behavior disorders broadly and included both Oppositional Defiance Disorder

(ODD) and ADHD within the bifactor model (Martel et al., 2010b). Using confirmatory factor analysis, this study compared a one-factor model of disruptive behavior symptoms, a two-factor model with ADHD and ODD symptoms, a three-factor model with inattention, hyperactivity-impulsivity, and ODD symptoms, in addition to a more complex second-order disruptive behavior model with ADHD and ODD symptoms loading on a higher order disruptive behavior factor (Martel et al., 2010b). Lastly, a bifactor model was tested which includes a general disruptive behavior factor in addition to separate ADHD and ODD (Martel et al., 2010b). The bifactor model, with the overarching disruptive behavior category in addition to separate but correlated factors of ODD and ADHD accounting for unique individual variance, was shown to provide the best fit for both parent and teacher ratings of DSM-IV symptoms (Martel et al., 2010b). This research suggests the complexity of disruptive behavior disorders in childhood, with ODD and ADHD as only partially independent diagnostic categories. This provides insight into the heterogeneity of children with disruptive behavior, and the presence of a general disruptive behavior factor helps to explain high comorbidity between ODD and ADHD (Martel et al., 2010b).

Martel and colleagues (2010a) also examined a bifactor model specific to ADHD symptoms in this same community-based sample of 548 children age 6 through 18. Using confirmatory factor analysis the bifactor, one-, two-, and three-factor models, and a second-order factor model (with inattentive and hyperactive-impulsive as separate symptom factors which together define a higher order ADHD factor) were tested. The bifactor model, with all ADHD symptoms loading onto a general ADHD factor and specific inattentive and hyperactive-impulsive symptom factors, demonstrated the best fit with data from mother and teacher reports of DSM-IV symptoms. Findings from this study suggest that the latent structure of ADHD

includes both a general ADHD and specific factors for inattentive and hyperactive-impulsive symptoms. This model was demonstrated to fit across different age, gender, and diagnosis status with only minor differences detected in loadings (Martel et al., 2010a).

This sample of students was also utilized within another study by Martel and colleagues conducted to provide external validation of the bifactor model (Martel, Roberts, Gremillion, von Eye, & Nigg, 2011). The authors investigated associations between ADHD symptoms and cognitive control, child behavior problems, and personality traits using continuous symptom ratings of general ADHD and specific inattention and hyperactive-impulsive symptoms (i.e., latent factor scores from the bifactor model), and also created three subtype categories based on these latent factor scores (which were similar to the DSM-IV). The authors conclude that the bifactor model is more useful than a DSM-IV subtype conceptualization in describing heterogeneity among children with ADHD in relation to behavior problems, cognitive control, and personality/temperament. This study suggests that exploring relationships between symptoms and impairments through a bifactor model may have important implications for planning interventions to meet the individual needs of students with ADHD (Martel et al., 2011).

A recent study investigating the bifactor model has provided support for this model across a large age range (age 5-17) and with samples from multiple cultures and nationalities (Toplak et al., 2012). A sample of 1,373 children and adolescents with ADHD and 1,772 unselected siblings was recruited from seven European countries and Israel. Models of data from parent clinical interviews and parent and teacher ratings scales were compared for those with ADHD and their siblings, and either the two or three-factor bifactor model provided the best fit to ADHD symptoms across all participants, methods, and informants. The authors suggest that a two-factor bifactor model should be favored over a three-factor bifactor model as two-

factors are more parsimonious (Toplak et al., 2012). Overall, this study confirms the utility of a bifactor model of ADHD in describing a general construct of ADHD in addition to the specific characteristics of inattention and hyperactivity-impulsivity across multiple ages and nationalities, and in individuals with and without a diagnosis of ADHD.

Another recent study comparing various factor structures of ADHD symptoms demonstrates support for a bifactor model within a school-based sample of children ages 6-9 (Normand, Flora, Toplak, & Tannock, 2012). This study is unique in that both confirmatory and exploratory factor analysis procedures were used to support the bifactor model with two (IA and HI) and three (IA, H, and I) specific factors using teacher and parent ratings across both genders. Additionally, this longitudinal study is the first to use parent and teacher ratings to support the generalizability of the bifactor model over time (two time points separated by 12 months; Normand et al., 2012).

Taken together, these studies suggest that a bifactor model best represents ADHD and the heterogeneous presentation and outcomes associated with this disorder. This conceptualization of ADHD also aligns with a dimensional perspective of ADHD because levels of general and specific ADHD symptoms are considered rather than classifying individuals by diagnostic subtype (Barkley, 2006). A bifactor model is unique in that it suggests that all ADHD symptoms share common variance, captured within the general ADHD factor, but that inattention and hyperactivity-impulsivity also capture unique variance that is separate from the general ADHD factor. The support that has been garnered for this model through recent research corresponds with the heterogeneity within the diagnostic category of ADHD that is well known, as well as the distinct differences across the two distinct behavioral dimensions (Martel et al., 2011). The

following section will outline findings related to differences in impairment and outcomes across the two dimensions of this disorder.

Inattention. The Inattention dimension of ADHD is most often assessed by nine specific behaviors listed within the DSM-IV and DSM-5 (APA, 2000, 2013; Barkley, 2006). These include difficulty sustaining attention, making mistakes or not attending to details, having trouble listening when directly spoken to, not following through with instructions or failure to complete tasks, difficulty organizing, avoidance of tasks that require ongoing mental effort, losing things, being easily distracted, and being forgetful (APA, 2000). An investigation of the presence of ADHD diagnoses in a sample of 3,082 children age 8-15 suggests that this subtype is most common, with an overall prevalence rate of 4.4% for IA compared to 2.2% for HI and C (Froehlich et al., 2007). Interestingly, IA has been found to be most common among adolescents with ADHD, as other symptoms may change or become less visible as students reach adolescence; some children who meet criteria for the C subtype shift to the IA subtype as they approach adolescence (Lahey, 2001; Wolraich et al., 2005).

Students with the IA subtype have been shown to experience significant impairments across multiple domains. A study comparing a school-based sample of 221 children with ADHD (123 IA, 47 HI, and 51 C) and 221 control children in kindergarten through fifth grade indicated that impairment was rated as present among 76% of the IA group in the academic domain, 59% in the social domain, and 58% within the behavioral domain. Only 11% of students identified as IA subtype did not demonstrate any impairment (Gaub & Carlson, 1997). The specifics of these impairments are outlined in the following section.

As indicated by Gaub and Carlson (1997), academic impairments have been shown to be most associated with the IA subtype of ADHD (Short, Fairchild, Findling, & Manos, 2007). The

IA subtype was shown to have the highest percentage of comorbid learning disabilities, and the IA and C groups were shown to experience more learning related impairments than the HI group (Gaub & Carlson, 1997). Children diagnosed with ADHD IA subtype (age 4-15) were shown to experience the greatest difficulty in the academic areas of reading and math compared to other students with ADHD (Short et al., 2007).

Socially, children with the IA subtype are characterized as appearing withdrawn, sluggish, and passive (McBurnett, Pfiffner, & Frick, 2001; Milich, Balentine, & Lynam, 2001). Wheeler Maedgen and Carlson (2000) suggest that children with the IA subtype rate themselves lower on social knowledge than children with the combined subtype and are viewed by teachers and parents as exhibiting social passivity. Children in the IA group were nominated by peers as being shy and are observed to be socially withdrawn during playgroups (Hodgens, Cole, & Boldizar, 2000). Within a bifactor model of ADHD symptoms, the specific IA factor was shown to be associated with high reactive control and agreeableness, and low extraversion (Martel et al., 2011). Lack of assertiveness has been identified as a primary factor contributing to social impairments among children (age 7-12) with a diagnosis of ADHD IA subtype, and it is suggested that this may be an important target for intervention with these students (Solanto, Pope-Boyd, Tryon, & Stepak, 2009).

Interestingly, students within the IA group have been shown to display higher levels of appropriate behavior and lower levels of externalizing symptoms (Gaub & Carlson, 1997). It has been suggested that the IA subtype exhibits more behavioral assets than children diagnosed with the HI or C subtypes of ADHD (Short et al., 2007). These assets include having more positive attitudes about school (despite having more academic difficulty) and being rated as more emotionally adaptive than children with HI or C subtypes of ADHD (Short et al., 2007).

Children with IA symptoms were shown to experience much less difficulty with emotional regulation compared to children with the combined subtype (Wheeler Maedgen & Carlson, 2000).

Some students with the IA subtype are suggested to demonstrate sluggish cognitive tempo (SCT; Milich et al., 2001). SCT is described as an aspect of inattention which includes being sluggish, passive, confused, or lethargic (Barkley, 2006). It has been suggested that there is heterogeneity within the current IA subtype because some individuals display SCT and others do not (Carlson & Mann, 2002). School-age children with IA symptoms and SCT were rated by teachers as daydreaming or getting lost in their thoughts and as slow moving or lethargic, whereas those with IA symptoms without SCT were not (Carlson & Mann, 2002). Additionally, the students who were rated as having SCT exhibited more internalizing problems including anxiety and depression, were socially withdrawn, and demonstrated fewer externalizing symptoms (Carlson & Mann, 2002). The differences between these two groups may be due to the fact that individuals diagnosed as ADHD IA subtype based on the DSM-IV conceptualization can still demonstrate up to five symptoms of HI (Milich et al., 2001). Using a bifactor model to examine associations between outcomes and symptoms, Martel and colleagues (2011) suggest that individuals with symptoms loading on the specific IA factor demonstrated slower cognitive performance responses than those with other bifactor subtypes. This suggests that SCT may be an important feature of IA (Martel et al., 2011). While there is not currently consensus in the literature about whether SCT items are necessary to identify a “pure inattentive group” (Milich et al., 2001, p. 470), individuals with the predominantly IA symptoms are known to demonstrate impairments that are different than their counterparts with higher levels of HI symptoms (Lahey et al., 2001). The inclusion of an inattentive presentation (restrictive) subtype in the recently

released DSM-5 is a result of the accumulation of literature suggesting that individuals displaying only IA symptoms (not displaying significant HI symptoms) are unique compared to other subtypes (APA, 2012).

Hyperactivity-Impulsivity. The behavioral dimension of hyperactivity-impulsivity is defined by nine symptoms listed within the DSM-IV and DSM-5, six representing hyperactivity and three representing impulsivity. The symptoms of hyperactivity include fidgeting, leaving the seat or assigned area, running or climbing excessively or feelings of restlessness, difficulty playing quietly, acting as if “driven by a motor,” and excessive talking (APA, 2000; APA, 2013). Symptoms of impulsivity include blurting out answers to questions, difficulty waiting for their turn, and interrupting in others’ conversations (APA, 2000). In a large-scale study on prevalence, Foehlich and colleagues (2007) suggest that the HI subtype occurs in 2.2% of children age 8-15. The combination of the H and I symptoms into one HI dimension, as seen in the DSM, is the result of factor-analytical studies indicating that these symptoms make-up a single behavioral dimension (DuPaul, Anastopoulos, Power, Reid, Ikeda, & McGoey, 1998). This combination is particularly important in older students, because difficulties with hyperactivity at a young age are suggested to be reflected through poor impulse control or self-monitoring skills in adolescence (Smith et al., 2007). Hyperactivity is directly related to difficulties with impulsivity and is often considered to be a failure to regulate activity levels which results in higher rates of motor activity (Berlin & Bohlin, 2002). Impulsivity, also referred to as disinhibition, has been thought of as an underlying factor that contributes to the other core symptoms of ADHD and this symptom is considered the best marker to distinguish students with ADHD from students without the disorder (Barkley, 2006). A comparison of impairments associated with this ADHD subtype suggested that 80% of the HI group were rated

as exhibiting behavioral impairments, 53% as exhibiting social impairments, and 23% with academic impairments. Only 4% of students in the HI group were rated as not experiencing impairments in any domain (Gaub & Carlson, 1997). The specifics of the impairments experienced by this group are outlined below.

As indicated by the percentages provided above, behavioral impairments tend to be most common among students with high levels of HI symptoms (Gaub & Carlson, 1997). The HI and C subtypes experience more externalizing problems, such as aggressive behavior, low frustration tolerance, defiance, and disruption compared to the IA subtype the non-ADHD controls (Gaub & Carlson, 1997, Short et al., 2007). Students with the HI subtype were also shown to receive higher ratings of working hard at school, and were shown to demonstrate less internalizing symptoms (Gaub & Carlson, 1997). However, Short and colleagues (2007) suggest that the HI and C subtypes experience more internalizing behavior, as well as greater social difficulty than those with IA symptoms. Barkley (2006) suggests that a combination of impulsivity and aggression can cause these students to experience conflict with peers and be viewed as self-centered and demanding. Hodgens and colleagues (2000) used peer nominations across classroom and play group settings and found that the HI/Combined subtype was most likely to be nominated for arguing with peers or starting fights.

Martel and colleagues (2011) suggest that both specific HI and the general ADHD symptoms within a bifactor model were associated with anxiety/depression, social difficulty, rule-breaking, and aggression. Regarding dimensions of personality, HI and general ADHD (when measured continuously) were associated with low agreeableness and high extraversion. When symptoms were used for categorical grouping, the general ADHD and the general ADHD

+ specific hyperactive impulsive groups exhibited cognitive profiles with impairments in response inhibition, set-shifting, and variable responding.

Combined symptoms. Individuals with the combined subtype of ADHD, defined as the presence of six or more symptoms of inattention and hyperactivity/impulsivity, have been shown to behave similarly to those with the HI subtype and exhibit comparable impairments (Barkley, 2003). Research on ADHD prevalence suggests that approximately 2.2% of children meet diagnostic criteria for this subtype (Froehlich et al., 2007). Ninety percent of students in the C subtype group have been shown to experience behavioral impairment, 82% experience academic impairment, and 82% demonstrated social impairments (Gaub & Carlson, 1997). As suggested in the previous discussion, the combined subtype has often been considered along with HI symptoms in past research and some of the findings reported above included the C subtype in analyses of students with HI. A study investigating differences in psychopathology, cognitive control, and personality traits using the bifactor model suggests that the general ADHD and specific HI factor are similarly associated with many of these constructs, and thus provides support for combining the HI and C subtypes when investigating outcomes and associations in the literature (Martel et al., 2011). This finding also suggests that students diagnosed as having either the HI or C subtype may benefit from similar interventions. However, some studies have examined the C subtype separately. Gaub and Carlson (1997) suggest that the C subtype received the highest ratings of: peer dislike, social problems, anxiety/depression, attention problems, and total problem behavior compared to the other two groups. A study using peer nominations found that the combined group was rated as more aggressive and more likely to fight or argue (Hodgens et al., 2000). Solanto and colleagues (2009) suggest that the combined

type experiences high rates of impulsiveness and self-control which directly contribute to their social difficulties.

This discussion demonstrates that the impairments experienced by students with ADHD symptoms vary based on the specific symptoms present. Overall, students with high levels of IA symptoms are suggested to have the greatest academic impairments, while HI and C symptoms are more associated with behavioral impairments (Gaub & Carlson, 1997; Short et al., 2007). Social impairments are common across all symptoms, but the behaviors contributing to social difficulties are shown to differ based on subtype (Solanto et al., 2009).

Comorbidity. Many different forms of internalizing and externalizing symptoms have been mentioned in the previous section, and many students with ADHD exhibit clinical levels of other psychological disorders. The ADHD-C subtype has the highest levels of comorbidity among all three ADHD subtypes (Barkley, 2003). Comorbidity is found with both internalizing and externalizing disorders and comorbid conditions are prevalent across all age groups. In a clinical sample of preschool (ages 4-6) and school-age (ages 7-9) children diagnosed with ADHD, the prevalence rate for comorbid disruptive behavior disorders was 64% among preschool and 60% among school-age children (Wilens, Biederman, Brown, Tanguay, Monuteaux, Blake et al., 2002). Disruptive behavior disorders, including Conduct Disorder (CD) and Oppositional Defiant Disorder (ODD), are one of the most common comorbidities among these young students with ADHD (Wilens et al., 2002). Similar findings have been found with adolescents, with reviews suggesting that between 25 and 55% of adolescents with ADHD have comorbid ODD and CD (Barkley, 2006).

Mood disorders, which include dysthymia, major depression, and bipolar disorder, were found to be comorbid with ADHD among 47% of preschoolers and 50% of school age children

(Wilens et al., 2002). Only 25% of preschool students and 20% of school age students were shown to exhibit ADHD without any comorbid conditions (Wilens et al., 2002). Depression has also been identified as occurring at high rates within individuals with ADHD; 25-30% of children with ADHD display depressive symptoms (Barkley, 2006; Biederman, Mick, & Faraone, 1998). There is not currently consensus about which ADHD subtype is most associated with internalizing symptoms. Two studies have found the greatest internalizing symptoms among the C group (Gaub & Carlson, 1997; Short et al., 2007), while others suggest that children with the IA subtype have the highest rates of depression and social withdrawal (Carlson & Mann, 2000; Milich et al., 2001). It is suggested that the prevalence of comorbid internalizing disorders increases with age, with more depressive symptoms in adolescents compared to samples of younger children with ADHD (Wolraich et al., 2005). One study including students with ADHD between 9 and 16 years old found that 48% of their sample exhibited comorbid depression (Bird, Gould, & Staghezza, 1993). Depression was the most common comorbidity in this age group, beyond the levels of comorbid ODD/CD (36%) and comorbid anxiety disorder (36%) found within this sample (Bird et al., 1993).

In a Swedish school based population sample 87% of children with ADHD had one comorbid condition, and 67% had two comorbid diagnoses (Kadesjo & Gillberg, 2001). This study included a measure of reading/writing related learning disorders and suggested that 40% of students with ADHD also exhibited a learning disorder (Kadesjo & Gillberg, 2001). Other research has suggested that learning disabilities are common among students with ADHD, with approximately half of special education students with ADHD qualifying as having a learning disability (Schnoes, Reid, Wagner, & Marder, 2006). Findings from research with the Swedish school-based sample also suggested that although comorbidity was most common in the group

with ADHD, comorbid diagnoses are also more common among students with sub-threshold ADHD symptoms compared to students without ADHD (Kadesjo & Gillberg, 2001).

Academic impairments. Underachievement is a common problem for children and adolescents with ADHD, particularly for those with IA symptoms as outlined above. However, some studies investigating impairment have considered overall ADHD symptoms without consideration of subtype. Therefore, the current section will outline research on the academic impairments experienced by students with symptoms of ADHD or a diagnosis. Eighty percent of children diagnosed with ADHD are two grades or more below grade level by the time they are eleven years old (Cantwell & Baker, 1992). It is estimated that thirty to forty-five percent of children with ADHD have received special education services related to their academic impairments by the time they reach adolescence (Barkley, 2006). Adolescents with ADHD are three times more likely to have been retained at one grade level and 10-35% of students with ADHD fail to graduate from high school (Barkley, 2003). Interestingly, Bussing and colleagues (2010) suggest that adolescents with sub-threshold levels of DSM-IV ADHD symptoms are at an increased risk for negative educational outcomes, and at a greater risk for grade retention and failure to graduate than their diagnosed peers. The authors suggest that this may be related to lack of school-based services available for students without a diagnosis of ADHD.

Under-productivity tends to be the most common inhibiting school-based impairment among school-age children with ADHD symptoms (Barkley, 2003). Children and adolescents with ADHD symptoms tend to have difficulties with behavioral aspects of academic performance such as motivation, task persistence, or productivity, which compound their academic underachievement (Barkley, 2003). Students with higher levels of ADHD symptoms have been shown to experience the lowest school performance among a sample of children with

ADHD age 9-14 (Barry, Lyman, & Klinger, 2002). This finding held true even when deficits in executive functioning were statistically controlled (Barry et al., 2002).

A meta-analysis of 72 studies published between 1990 and 2006 demonstrated that students with ADHD had lower achievement than non-ADHD controls across studies using achievement tests, rating scales, GPA, retention, and special education status as indicators of academic achievement (Frazier, Youngstrom, Glutting, & Watkins, 2007). Achievement tests showed the most impairment among children with ADHD, particularly in reading and math (Frazier et al., 2007). Another recent study investigated impairments across the academic and social domain in children age 6 to 11 with and without ADHD, and another group of children referred to a clinic but without ADHD (McConaughy et al., 2011). The ADHD group scored significantly lower than children in the referred non-ADHD and control groups on parent and teacher ratings of academic functioning, and lower than control children on standardized achievement tests (McConaughy et al., 2011).

Other academic difficulties experienced by adolescents with ADHD include the tendency to procrastinate, be disorganized, become distracted easily, have difficulty with completing projects, and receive poor grades (Wolraich et al., 2005). These problems are more pronounced on tasks that require sustained effort and attention and are not of high interest (Barkley, 2006). The increased academic demands, more independence and responsibility for work completion, switching between a variety of teachers and subjects, and increased volume of homework associated with middle school and high school can present significant challenges for adolescents with ADHD (Wolraich et al., 2005). Students with ADHD tend to experience a decline in grades throughout each school year during middle school, with grades at the beginning of the year being

higher than the end of the year as the demands become more intense (Shultz, Evans, & Serpell, 2009).

Overall, the link between ADHD symptoms and academic impairment is well supported across age groups, students with and without an ADHD diagnosis, and across ADHD subtypes (Loe & Feldman, 2007). Higher levels of ADHD symptoms are linked to greater impairment in the academic domain (Barry et al., 2002). Impairments tend to increase with age as the demands of school increase from elementary to secondary school (Wolraich et al., 2005). Although interventions have been demonstrated to improve academic productivity among children and adolescents with ADHD, little is known about how to improve the overall academic performance and educational outcomes (Loe & Feldman, 2007). Trout and colleagues came to a similar conclusion after reviewing research on non-medication interventions for academic difficulty among students with ADHD, suggesting that much more systematic research on academic interventions is needed in order to know how to best address the impairment experienced by students with ADHD (Trout, Lienemann, Reid, & Epstein, 2007).

Social impairments. Children and adolescents with ADHD symptoms have been shown to demonstrate significant social impairments, although the specific social difficulties experienced vary by subtype as suggested previously (Hodgens et al., 2000; Solanto et al., 2009; Wheeler et al., 2000). In general, poor social skills are likely to contribute to the social difficulties of children with ADHD, with shyness and withdrawal being the primary concern for those with IA subtype, and aggression more common among the HI and C subtypes (Barkley, 2003, Hodgens et al., 2000). The current discussion will focus on findings related to social impairments among students with ADHD symptoms in general, as many studies have not considered subtype. Common social impairments include intruding into conversations; being

aggressive, intense, or emotional; and speaking in an excessive and disorganized manner (Barkley, 2003).

A study investigating the relationship between self-control, ADHD, bullying, and bully victimization in a large sample of middle school students found that low self-control was correlated with higher rates of bullying; however, middle school youth with ADHD were shown to be victims of bullying whether or not difficulties with self-control were present (Unnever & Cornell, 2003). ADHD status was more highly correlated with being victimized by bullies than height, weight, age, or relative strength (Unnever & Cornell, 2003). Children with ADHD may not understand the nuances of social interaction, such as the concept of reciprocity or skills for initiating or exiting a conversation (Barkley, 2003). These negative social behaviors may lead students with ADHD to be rejected, avoided, or bullied by their peers. While other students are joining extracurricular activities and engaging in social events, children and adolescents with ADHD are often treated differently or rejected from these activities (Barkley, 2006).

It has also been shown that these social impairments may not be unique to children with an ADHD diagnosis (McConaughy et al., 2011). In comparing three groups of children (age 6-11), one group with ADHD diagnoses, another referred for learning/behavioral problems that do have ADHD diagnoses, and a control group, both the ADHD and the referred clinical groups scored significantly lower than controls on multiple indicators of social behavior. However, the ADHD group scored lowest on numerous measures of social functioning including involvement in social organizations, close friends, relationships with friends, siblings, and parents; social skills ratings from parents and teachers, and teacher ratings of adaptive functioning (McConaughy et al., 2011).

Rejection from activities is suggested to become particularly problematic during adolescence, as peers become more important to adolescents' overall sense of self (Brown, 2004; Harter, 1999). A recently published longitudinal study supports this claim that social difficulties are problematic in adolescence. Mrug and colleagues measured close friendships and peer rejection in a group of children with ADHD and found that social difficulties are predictive of poor outcomes over time (Mrug, Molina, Hoza, Gerdes, Hinshaw, Hechtman, & Arnold, 2012). Specifically, peer rejection predicted anxiety, delinquency, and substance use six years after baseline, and predicted general impairment six and eight years after baseline (mean age 14.9 and 16.8 respectively; Mrug et al., 2012). Interestingly, findings suggest that reciprocal friendship was not predictive of outcomes and did not protect against the negative effect of peer rejection (Mrug et al., 2012). Peer interactions are highly valued during the developmental period of adolescence (Brown, 2004; La Greca & Harrison, 2005). It is suggested that problems with peers have the potential to become most pronounced during adolescence for students with and without ADHD because of the increasing importance of peer acceptance during this time, increased desire for autonomy, as well as changes to the social environment (Brown, 2004; Hoza, 2007; La Greca & Harrison, 2005).

Developmental considerations. Recent research has concluded that 65% of childhood diagnoses of ADHD continue into adolescence (Wolraich et al., 2005), with ranges from 43-80% of children with ADHD having symptoms which persist into adolescence (Smith et al., 2007). Despite these statistics, many believe that ADHD is a disorder of childhood that is likely to be outgrown (Barkley, 2003). It has been suggested that this notion may have stemmed from the fact that the symptoms of ADHD change as children become adolescents, with hyperactive symptoms being less prevalent and less visible (Wolraich et al., 2005). The DSM-IV-TR ADHD

symptom list has also been widely criticized for lack of developmental sensitivity and is suggested to have impacted common beliefs regarding the persistence of ADHD into adolescence and adulthood (Barkley, 2006). The most recent version of the DSM (DSM-5; APA, 2013) requires only 5 or more symptoms for individualized age 17 or older, and raised the age of onset criteria from 7 to 12 (APA, 2012). It has also been suggested that lower prevalence rates in adolescent and adult samples could be due to the reliance on self-report data in older age groups (Barkley et al., 2002). Barkley and colleagues (2002) showed that prevalence rates in young adults were significantly higher when parent report was used as the primary data source.

Inattentive symptoms have been shown to become more common during adolescence (Fefer, 2011; Short et al., 2007; Wolraich et al., 2005), and the IA subtype seems to be most consistent across the lifespan (Barkley, 2006). It has been suggested that hyperactive symptoms are just an early manifestation of problems with impulsivity and disinhibition, which would explain why hyperactive behaviors decrease with age (Smith et al., 2007). Although the levels of motor activity may decrease with age, difficulty with inhibiting responses will likely manifest as a deficit in self-monitoring and regulation during adolescence (Barkley, 2006). Barkley and Fischer (2010) suggest that emotional impulsivity may be a key determinant of whether ADHD persists into adulthood for children with high levels of hyperactivity/impulsivity. Emotional impulsiveness was demonstrated to contribute to impairment and negative outcomes in adulthood beyond ADHD symptoms (Barkley & Fischer, 2010).

Short and colleagues (2007) compared younger children (age 4-6), older children (age 7-9), and young adolescents (age 10-15) who were newly diagnosed with ADHD based on symptoms, behavioral problems, and behavioral assets. Results indicated that symptoms of hyperactivity were significantly more common in young children compared to the other two

groups, while inattentive symptoms were most common among young adolescents (Short et al., 2007). Adolescents were also shown to exhibit the highest levels of overall externalizing problems. Interestingly, in contrast with the author's hypothesis that the life experience of older children would lead to greater behavioral assets, the oldest age group was shown to have the least behavioral assets. The specific behavioral assets measured include social networking (i.e., negative peer relationships and aggression towards peers), school attitude, emotional adaptability, and self-esteem. This study underscores the importance of early identification for those with ADHD to prevent behavior problems and promote the development of behavioral assets in this population (Short et al., 2007).

In addition, many of the academic and social impairments described previously may become more problematic for adolescents. Symptoms of ADHD may exacerbate the challenges associated with this developmental period and therefore it is important to understand more about ADHD and associated impairments in this age group. Barkley (2006) and Short and colleagues (2007) assert that impairments associated with ADHD impact self-acceptance, personal satisfaction, and other individual assets during later developmental phases (i.e., adolescence). It has also been well documented that adolescence is when feedback from others and from the environment is highly valued, and when an individual's sense of self becomes more fully developed (Harter, 1999). This suggests that low self-esteem could be a concern for adolescents with ADHD. For this reason, it is particularly important to understand the way that adolescents with symptoms of ADHD view themselves within the academic and social domains, as these are areas where they experience significant difficulties. The following will include a discussion of past research related to the self-concept in general, and then present findings related to the self-perceptions of children with ADHD.

Self-Concept

Although the focus of the current study is on the self-perceptions of students with symptoms of ADHD, a discussion of past literature related to self-concept in general will help to contextualize findings related to children and adolescents with ADHD. The following section will include an overview of theories proposed to explain self-concept, research on the development of domain specific self-concept in adolescence, and a discussion of past findings related to self-concept among children with ADHD.

Early research focused on a unidimensional model of self-concept that represents individuals' overall feelings toward themselves (referred to as self-esteem or self-worth; e.g., Coopersmith, 1967). Unidimensional models focus on a person's overall sense of worth as a person or their feelings averaged across multiple domains (Harter, 1999). In response to the development and use of self-concept measurement tools that viewed self-concept as a single score, Shavelson, Hubner, and Stanton (1976) provided a multidimensional model of self-concept. The authors of this seminal work posited that self-concept is a domain specific construct that is influenced by the environment. The dissemination of this model led to widespread agreement among psychological researchers about the importance of investigating self-concept within specific domains of functioning (Bracken, 2009). A multidimensional view of self-concept accounts for inherent differences across domains and allows individuals to judge their adequacy differently across contexts. Current theories suggest that self-concept is best summarized using a profile of scores across different domains rather than as a single aggregate score (Bracken, 2009; Harter, 1999; Marsh & Hattie, 1996). Multidimensional theories of self-concept are also hierarchical because they include global self-concept (often referred to as general self-esteem) as a separate dimension that focuses on a person's general contentment with

themselves (Harter, 1999; Manning, Bear, & Minke, 2006). Global self-concept is often viewed as encompassing self-evaluations from multiple domains and is therefore viewed as the broadest level of self-concept within these hierarchical models (Bracken & Howell, 1991; Harter, 1999).

Theories of self-concept. Three dominant theories have emerged to explain self-concept since the work of Shavelson and colleagues (Bracken, 1991, 2009; Harter, 1999; Marsh, 1988, 1990). These hierarchical multidimensional models share many similarities, but each is unique in some way. The model proposed by Marsh is the most aligned with the multidimensional perspective originally proposed by Shavelson and colleagues (1976). This model views self-concept as having “general self” (Marsh’s term for global self-concept) at the top of the hierarchy, with a broad intermediate level including academic and nonacademic self-concepts (Marsh & Hattie, 1996). Self-concept is viewed as highly differentiated across domains with academic and non-academic self-concept further broken down into physical abilities and peer relations (nonacademic domain), and verbal and math (academic domain). This model is developmental in nature because it accounts for changes as children age (Marsh, 1990). Children as young as kindergarten are suggested to be able to evaluate competence across academic and nonacademic domains, with older children being able to further distinguish between more specific domains such as math and verbal abilities (Marsh, Debus, & Bornholt, 2005). Marsh’s research suggests that domain-specific self-concept is more informative than global self-concept because performance in specific subject areas is highly correlated with self-concept in that subject area, but not with global self-concept (Marsh, 1992).

Bracken’s model is oriented around behavioral principles and emphasizes learning, reactions from others, and achievement/failure experiences as central to the development of self-concept (Bracken, 2009). This hierarchical model emphasizes global self-concept as the primary

level of self-concept, which encompasses a portion of six distinct yet correlated secondary domains (Bracken, 2009; Bracken & Howell, 1991). These six context-dependent domains include academic, affect, competence, family, physical, and social self-concept. Support for these six factors, as well as a single global self-concept factor, has been demonstrated through exploratory factor analysis (Bracken, Bunch, Keith, & Keith, 2000). The factor structure of 29 subscales from five pre-established multidimensional self-concept scales was examined in a sample of 221 students in fifth through eighth grade, and this hierarchical multidimensional model emerged as the best fit (Bracken et al., 2000). This model deemphasizes the developmental nature of self-concept and all six proposed domains are viewed as relevant for children and adolescents (Bracken et al., 2000; Crain & Bracken, 1994). Crain and Bracken (1994) suggest that their multidimensional model is useful to understand self-concept among students in grades five through twelve. Although the specific self-concept domains of importance stay the same throughout development, it is suggested that self-concept becomes more fixed within these domains with age, and that greater differences are seen between these domains in older children and adolescents (Bracken, 2009).

Harter's model focuses on cognitive and social factors as contributing to self-concept formation and emphasizes the importance of developmental considerations. The self is viewed as a cognitive construction, and self-concept development aligns with the individual's stage of cognitive development (Harter, 2006). Harter (1999) views several factors as central for shaping self-concept, including prior experiences of success and failure, and consideration of the perceived opinions of or feedback received from significant others (such as parents, teachers, or caregivers). Unlike other theorists who view global self-concept (also referred to as self-esteem or self-worth) as correlated with all of the specific domains of self-concept (Bracken, 2009),

Harter believes that it is important to ask about self-worth directly in order to obtain an evaluation of the individual's feelings of overall worth as a person. Global self-worth, the first tier of this hierarchical model, is examined as a construct that is separate from domain specific self-evaluations. This allows for relationships to be examined between overall evaluations of worth and perceptions in different domains. The second tier of Harter's hierarchy consists of the specific domains of self-concept that vary depending on developmental level. Harter views these domains as distinct and uncorrelated with other specific domains or with global self-worth (Harter, 1999). For children (approximately age 5-11), Harter examines five domains which include scholastic competence, social acceptance, athletic competence, physical appearance, and behavioral conduct, in addition to global self-worth. For adolescents (approximately age 12-18), Harter adds three additional domains based on contexts and concerns that become more salient beginning in early adolescence; these include job competence, close friendship, and romantic appeal (Harter, 1988). The domains that students acknowledge at different ages have been supported through exploratory factor analysis suggesting different factor structures across different age groups (Harter, 1985, 1999). Self-concept during adolescence has been found to be more differentiated across domains compared to self-concept during childhood (Harter, Bresnick, Bouchey, & Whiteshell, 1997). It is purported that self-concept becomes less dependent on the evaluations of others as individuals get older (Harter, 1999). In addition, Harter suggests individual differences in the developmental trends of self-concept (Harter, 2006). The self-concept of some individuals decreases during late childhood/early adolescence, and then gradually increases through adolescence and adulthood, while for others self-concept remains stable over time despite increased differentiation across domains (Harter & Pike, 1984).

Comparison of models. The similarities between the three models presented are quite evident. Each model considers self-concept to be a hierarchical and multidimensional construct with a global evaluation at the apex of the hierarchy. Additionally, each model emphasizes that the domains of self-concept become further differentiated as children age. Further, there is general agreement regarding the domains that should be included, with academic, social, and physical evaluations represented in each model.

Despite the similarities, each model has unique contributions. Marsh's model contains an intermediate level of self-concept (focused on academic and non-academic self-concept) that is not included in other models. Additionally, Marsh has demonstrated that academic self-concept can be further differentiated into core subject areas (verbal and math; Marsh et al., 1988), while other theorists consider all academic subject areas to be encompassed within their scholastic competence or academic domains (Bracken, 1992; Harter, 1999). Although there is support for a model which differentiates self-concept into math and verbal domains, there is uncertainty about where other academic areas are accounted for within Marsh's model (Marsh, 1990) and measures of overall academic performance are more commonly used in the literature (Harter, 1988). An additional area of disagreement across these theories is whether domains of self-concept are correlated; Bracken (2009) views domains as correlated, while other theorists view domains as being correlated only at low levels (Harter, 1985; Marsh & Hattie, 1996). Developmental considerations are also acknowledged to different extents across the three models.

The current study adopted components of each of these models while focusing on academic and social self-concept specifically. These key domains are supported by each of the three dominant theories presented (Bracken, 2009; Harter, 1999; Marsh, 2008). Academic and social self-concept were viewed within a multidimensional, hierarchical, and developmental

model of self-concept (Harter, 1988). The social acceptance, close friendships, and scholastic competence domains, as measured by the Self-Perception Profile for Adolescents (Harter, 1988), were examined in this study as these domains are related to the primary challenges frequently experienced by adolescents with ADHD. Additionally, these domains are linked to important outcomes such as academic achievement and the development of adequate social skills (Bracken, 2009; Trautwein et al., 2006), which have particular relevance to the school setting. Although these domains were measured using Harter's self-concept scale due to the developmental focus, consideration of individual differences, and frequent use of this measure in PIB research, the conceptualization of self-concept in the current study pulls from all three self-concept theories discussed previously. Specifically, Bracken's emphasis on feedback from others and the environment, as well as experiences of achievement and failure, is particularly relevant to investigations of the PIB among adolescents. Furthermore, Marsh's differentiation between academic and non-academic domains was highlighted in the current study by distinguishing between academic and social self-perceptions.

Development of self-concept.

Childhood. It is typical for children to rate themselves very positively; this positive self-concept is attributed to a disconnect between the child's desired and actual self (Harter & Pike, 1984). Overly positive self-evaluations are considered to be normative between the ages of four and seven (Manning et al., 2006) and are suggested to be adaptive at this age due to increased task persistence in the face of failure (Taylor & Brown, 1988). At this point in development, children have not developed the skills required to alter their self-evaluations based on feedback from or comparisons with others (Ruble & Dweck, 1995). Additionally, this age group has difficulty differentiating between their abilities in different contexts or domains because they are

unable to recognize more than one feeling simultaneously (Harter & Pike, 1984). Middle childhood (ages of 8-11) is pinpointed as the beginning of differentiation of self-concept between domains (Harter, 1999). At this point in development children begin to have greater awareness of feedback from others and engage in more self-other comparison (Harter, 1999; Marsh, 1994). Consequently, self-perceptions become less positive and more realistic as children move from early to middle childhood (Harter & Pike, 1984).

Adolescence. Adolescence is a time when self-concept is particularly vulnerable (Harter, 1999; Marsh, 1990). This vulnerability is said to be linked to increasing differentiation across domains (Harter, 2006) and the increased importance of social factors (Harter, 1999; Marsh, 1994). Adolescents may view themselves in a way that is different from the way they are perceived by others (Demo & Savin-Williams, 1992). As differentiation between domains occurs, “multiple selves” (Harter, 1999, p. 9) emerge which are purported to stem from pressure to act differently in the different roles that emerge in adolescence. It is suggested that the cognitive development of younger adolescents does not allow for integration of perceptions across multiple domains so contradictory roles are experienced; this leads to increased vulnerability and confusion over their real or true self (Harter et al., 1997). While there is general agreement that self-concept becomes more differentiated with age, there are conflicting findings related to the stability of self-concept during adolescence. According to Bracken, global self-concept is quite stable and comparable to the stability of other learned patterns of behavior over time; however, domain-specific self-concept is considered to be much less stable and more amenable to change (Bracken et al., 2000; Crain & Bracken, 1994). Both Harter and Bracken assert that exposure to new experiences, new people, and new environments during adolescence

leads to changes in evaluations of competence across domains with age (Crain & Bracken, 1994; Harter, 1999).

Harter (1998, 1999) and Marsh (1994) suggest that the trajectory of domain specific self-concept for most adolescents is a flat u-shape, with an initial decrease in pre/early adolescence followed by a period of stability and then gradual increases through late adolescence into adulthood. This is supported by a study indicating that self-concept decreases slightly during early adolescence (age 11-13), and then both global and domain specific gradually increase over time (Marsh, Smith, Marsh, & Owens, 1988). Some researchers associate this initial decrease in self-concept with the transition to middle or junior high school (Wigfield, Eccles, MacIver, Reuman, & Midgley, 1991). Eighth grade has been suggested to mark the beginning of a gradual increase in self-concept that continues through late adolescence (Cairns, McWhirter, Duffy, & Barry, 1990; Demo & Savin-Williams, 1992), with one study indicating that age 13 marked the time when students began to highly differentiate self-concept across domains (Crain & Bracken, 1994). These findings suggest the importance of the school environment for shaping the global and domain specific self-concept of children and adolescents, and suggest that an increasing trend of self-concept is present by high school.

Few researchers have directly explored the developmental nature of domain specific self-concept among adolescents (Cole, Maxwell, Martin, Peeke, Seroszynski, Tram et al., 2001; Shapka & Keating, 2005). Most studies with adolescent samples have examined global self-concept or self-esteem and therefore do not account for differentiation across domains which may be particularly important for adolescents (Harter, 1999). The current review will focus on the two studies directly investigating the development of domain specific self-concept.

Cole and colleagues (2001) investigated self-concept across multiple domains for six years. Data from the Harter Self-Perception Profile (Harter, 1985, 1988) were collected two times per year in two cohorts of students in third and sixth grade at the beginning of the study ($N = 855$). The authors found that participants' academic competence ratings gradually increased throughout the elementary years, followed by a drop during the transition to middle school. However, the transition to high school was marked by an increase in academic self-concept followed by a period of relative stability in this domain. This provides support for a u-shaped trajectory in the academic domain. Conversely, social acceptance was marked by a positive trajectory throughout the elementary years. During the transition to middle school, social self-concept was shown to continue to increase at a very gradual rate and remain relatively stable during high school (Cole et al., 2001).

Another study examined changes in domain specific and global self-concept within two cohorts of Canadian high school students ($N = 518$; Shapka & Keating, 2005). Students completed the Harter Self-Perception Profile for Adolescents (Harter, 1988) three times over a two year period. No changes were detected during the first year of data collection, supporting the idea that adolescence is a time of stability or gradual changes in self-concept. Results after two years indicated that global self-concept remained stable over time, but social self-concept increased and scholastic competence decreased over this two year period. This study suggests that the trajectory of self-concept varies across domains. The decrease that was observed in scholastic competence was most pronounced for the students who were in ninth grade at the beginning of the study, which suggests that scholastic competence may be negatively impacted by the increasing academic demands and comparisons to others that occur during high school (Shapka & Keating, 2005).

It is imperative to gain more insight about the self-concept of adolescents because past literature does not provide a clear picture about the typical development of domain-specific self-concept. Further investigation of the academic and social self-concept of high school students is needed in order to understand whether most students view themselves realistically or in an overly positive or negative light. This is particularly important because of evidence that self-concept remains relatively stable during and after the high school years, meaning that student's accurate or biased self-perceptions as measured during high school are likely to persist throughout their lifetime. Furthermore, domain specific self-concept has been shown to relate to important outcomes. Individuals with positive self-views are suggested to have higher levels of life satisfaction (McCullough, Huebner, & Laughlin, 2000). Social self-concept is important for initiating and engaging in positive social interactions, which are seen as a key component of mentally healthy children, adolescents, and adults (Bracken, 2009). There is also evidence that there is a strong reciprocal relationship between academic achievement and higher academic self-concept among adolescents (Marsh & O'Mara, 2008; Trautwein, Ludtke, Koller, & Baumert, 2006). The academic and social domains are crucial to highlight because adolescence is a period marked by increased demands in these areas. This is of particular importance for populations that may exhibit academic and social impairments, such as children and adolescents with ADHD. The self-concept of children with ADHD has been explored in past literature, but findings do not align with traditional theories of self-concept (Owens et al., 2007). The following section will present findings related to the self-concept of children with ADHD.

Self-Concept and ADHD

Given the difficulties commonly experienced by students with ADHD, one might expect that these students may be at risk for exhibiting low self-concept. However, past research

suggests that children with ADHD have inflated positive perceptions of their abilities (e.g., Evangelista, Owens, Golden, & Pelham, 2008; Hoza et al., 2004). These overly positive self-perceptions are referred to as the positive illusory bias (PIB; Hoza, Pelham, Milich, Pillow, & McBride, 1993). The PIB has been defined as when, “children with ADHD unexpectedly provide extremely positive reports of their own competence in comparison to other criteria reflecting actual competence” (Owens et al., 2007, p. 335).

Although inflated self-perceptions are demonstrated among young children in the general population (Harter, 1999; Manning et al., 2006), it is suggested that the positive illusions observed in children with ADHD are unique (Owens et al., 2007). The development of self-concept among children with ADHD does not align with theories of self-concept which purport that positive self-concept is developed from experiences of success, and negative self-concept stems from experiences of failure (Harter, 1999); the self-perceptions of children with ADHD remain high despite frequent failure (Owens et al., 2007). Also, children with ADHD exhibit a larger discrepancy between self-reports and indicators of actual competence than what is considered normative for young children (Owens et al., 2007). Additionally, the positive illusions of children with ADHD have not been shown to be adaptive because these children continue to give up on tasks easily and have lower performance than same-age peers (Hoza et al., 2001). This is in contrast to findings regarding positive illusions in the general population being linked to more task-persistence and motivation (Taylor & Brown, 1988).

Hypotheses to explain the positive illusory bias. Efforts to explain the causes and the function of the PIB phenomenon are still ongoing. Currently, there are four primary hypotheses proposed to explain the PIB, including cognitive immaturity, ignorance of incompetence, neuropsychological deficits, and self-protection (Owens et al., 2007).

The cognitive immaturity hypothesis suggests that children with ADHD are not as cognitively mature as their same-age peers and therefore may exhibit positive illusions for much longer than what is considered typical in the normative population (Milich, 1994). This hypothesis has an underlying assumption that children with ADHD will eventually outgrow these inflated perceptions (Owens et al., 2007). One recent six-year longitudinal study (age 8-13 at beginning of this 6 year study) suggests that the PIB in the social domain was maintained over time. This suggests that cognitive immaturity may not provide an accurate explanation for the PIB because overestimations in the social domain would decrease over time if cognitive immaturity was contributing to the PIB (Hoza et al., 2010).

The ignorance of incompetence hypothesis is that children with ADHD are not able to recognize their deficits because they do not know what constitutes success in areas in which they are unskilled or incompetent (Hoza, Pelham, Dobbs, Owens, & Pillow, 2002). In support of this hypothesis, it has been shown that children with ADHD overestimate their competence most in areas where they experience the greatest impairments (Hoza et al., 2002). However, children with ADHD were shown to accurately assess the performance of others despite providing inaccurate self-ratings; this finding calls into question the promise of the ignorance of incompetence hypothesis to explain the PIB (Evangelista et al., 2008).

The neuropsychological deficit hypothesis is related to the executive functioning (EF) impairments often experienced by children with ADHD, which contributes to accurate evaluations of performance and abilities. Owens and colleagues (2007) suggest that neurologically-based deficits in the frontal lobe associated with ADHD may underlie the PIB. Patients with frontal lobe damage and problems with EF display anosognosia, a neurologically based lack of awareness of personal errors (Stuss & Benson, 1987). Similar to findings with

children with ADHD (Evangelista et al., 2008), individuals with anosognosia accurately rate the competence of others despite providing inaccurate self-evaluations (Ownsworth, McFarland, & Young, 2002; Starkstein, Jorge, Mizrahi, & Robinson, 2006). Recent research has provided preliminary support that there is a relationship between the PIB and impaired working memory and executive processes, and that children with ADHD who do not experience these cognitive impairments are able to accurately rate their competence (McQuade et al., 2011b). However, other research suggests that cognitive functioning does not have a relationship with the PIB beyond what is accounted for by ADHD and ODD symptoms (Scholtens, Diamantopoulou, Tillman, & Rydell, 2011). More research is needed to determine how impairments related to EF may contribute to the PIB.

The self-protective hypothesis to explain the PIB currently has the most empirical support. This hypothesis purports that children with ADHD display the PIB to ward off feelings of inadequacy and protect their self-image (Diener & Milich, 1997). Evidence supporting this hypothesis is provided by several studies showing that positive feedback leads to more accurate self-perceptions in the social domain (Diener & Milich, 1997; Ohan & Johnston, 2002). It is suggested that after receiving positive feedback students may no longer need to inflate self-perceptions because they feel accepted. A recent 6-year longitudinal study following students who were between the ages of 8 and 13 at the beginning of the study purports that substantial differences in the PIB between the social and behavioral domain over time provides evidence for the self-protective hypothesis (Hoza et al., 2010). Adolescents with ADHD demonstrated the PIB in the social domain despite significant social impairments; the authors suggest that significant self-protection occurs within the social domain because social aspects are highly valued during adolescence. Conversely, the PIB was not evidenced over time in the behavioral

domain. The authors suggest that this lack of self-protection may be due to normative shifts towards more defiant behavior during adolescence (Hoza et al., 2010). The self-protective hypothesis currently has the most direct empirical support of all the hypotheses discussed herein; however, the PIB is likely to be best explained by a combination of these hypotheses. More insight into the presence of the PIB in high school students with symptoms of ADHD may help to elucidate the cause and function of the PIB.

Past research on the Positive Illusory Bias. The methods used in empirical literature related to the positive illusory bias have evolved over time. Past findings related to the presence of the PIB for children with ADHD are mixed; however, differences in findings may be related to the specific methods used to investigate this phenomenon (Owens et al., 2007). Three methods have been used in past research to investigate the presence of the PIB: absolute self-perceptions, pre/post performance ratings, and discrepancy or criterion analysis (Owens et al., 2007). More recent research related to the PIB has focused on factors contributing to the presence of the PIB and/or outcomes associated with positive illusions. The following section provides descriptions of the methods and results of past studies investigating the PIB.

Absolute self-perceptions. The absolute self-perception method involves comparing mean self-concept ratings of individuals with ADHD to a control group or normative sample. For example, children with and without ADHD rate their competence and then mean levels of perceived competence are compared. Findings from past research utilizing this methodology are mixed. Several researchers have investigated global self-concept to determine if there are differences between ADHD and control groups. In an early study on the global self-perceptions of children with ADHD, Horn, Wagner, and Ialongo (1989) found that boys and girls ($N = 54$; age 7-9) with ADHD had lower overall self-perceptions than control children. Other early

studies investigating the global self-concept of young adults who were hyperactive as children (Hechtman, Weiss, & Perlman, 1980; Slomkowski, Klein, & Mannuzza, 1995) indicated that this group had lower global self-concepts than the non-hyperactive control group as adolescents (age 16-23) and young adults (age 23-30). These findings do not support the presence of overly positive self-perceptions at the level of global self-concept.

Other researchers have investigated self-concept from a hierarchical/ multidimensional perspective by gathering global and domain specific self-concept ratings. Ialongo and colleagues investigated multiple domains of self-concept and reported that the ADHD group (age 7-11) had lower academic, social, behavioral and global self-concept than a group of non-ADHD controls (Ialongo, Lopez, Horn, Pascoe, & Greenberg, 1994). Barber, Grubbs, and Cottrell (2005) also found that students with ADHD (age 8-12) exhibited significantly lower self-concept than students in the control group within the global and behavioral domains (Barber et al., 2005). Hoza and colleagues (1993) found no significant difference between performance ratings of children (age 8-13) with ADHD ($n = 27$) and non-ADHD controls ($n = 25$) in social, scholastic, behavioral, physical, and global self-concept (Hoza et al., 1993). The only significant difference was in athletic competence; boys with ADHD had more positive self-evaluations than the non-ADHD controls. This finding provides preliminary evidence for the presence of the PIB in the athletic domain; however, it remains unclear if the PIB is present because there is no measure of actual competence available for either group (Ialongo et al., 1994; Hoza et al., 1993).

Other studies have extended samples beyond those with a clinical diagnosis of ADHD. Bussing, Zima, and Perwien (2000) measured mean levels of global and domain specific self-concept in a school-based sample of special education students. Students in grade 2-4 ($N = 143$) identified as at-risk for ADHD through a school-wide screening process reported global and

domain-specific self-concept similar to ratings obtained within normative samples. However, students meeting ADHD diagnostic criteria ($N = 129$) had significantly lower self-esteem (i.e. global self-concept) than children who did not meet diagnostic criteria but exhibited ADHD symptoms. Medication status was not shown to relate significantly to self-concept ratings. Children with ADHD and internalizing symptoms were shown to provide lower ratings of domain specific self-concept. The authors suggest that the results of this study are in line with those demonstrating the PIB among students with ADHD (e.g., Hoza et al., 1993) because the students in this sample experienced functional impairments based on parent ratings yet their mean levels of domain specific self-concept remained in the average range (Bussing et al., 2000).

Ljusberg and Brodin (2007) measured the global and domain specific self-concept of students age 9-12 with attention deficits (with and without a diagnosis of ADHD) in remedial classes in Swedish schools ($N = 41$). The self-concept scores of this sample were taken at three time points before, during, and after a computer-based intervention targeting students' working memory. Self-concept ratings were compared to data from a large school-based sample of typical students in Sweden ($N = 690$). Global, academic, social, and personal self-concept ratings were found to be similar across groups, and did not change significantly across the three time points of the computer intervention. The authors suggest that students with attention difficulties in remedial classes displayed the PIB because they reported high global and domain specific self-concept despite impairments and frequent failure (Ljusberg & Brodin, 2007).

More recent studies using the absolute self-perception method have considered the intensity or severity of ADHD symptoms. Hanc and Brezinska (2009) compared ratings of competence in Polish children ($N = 117$; age 11-13) with varying degrees of ADHD symptoms and found no significant differences between groups with different levels of ADHD symptoms in

terms of self-rated social competence (including social adjustment and cooperation skills). The authors suggest that this lack of differences could be attributed to the PIB, because these students likely differ in terms of social impairment (Hanc & Brzezinska, 2009). Ratings of general competence, adaptive properties, knowledge and skills, acknowledgement, emotion, and belief in success were shown to be lower among students with higher levels of ADHD symptoms (Hanc & Brzezinska, 2009). Houck, Kendall, Miller, Morrell, and Wiebe (2011) also considered symptom severity when investigating mean global and domain-specific self-concept ratings of 145 children and adolescents (age 6-18) with an ADHD diagnosis. Findings indicated that mean self-concept ratings were lower in their ADHD sample than ratings within normative samples across all domains measured. Additionally, lower self-concept was associated with a higher total score on a measure of externalizing and internalizing symptoms (used as a broad measure psychopathology symptom severity). This study also indicated that older students and those with greater levels of internalizing symptoms were the most likely to have low self-concept ratings.

Other studies utilizing absolute self-perceptions have investigated the impact of more specific comorbid conditions, such as aggression or depression, on the presence of the PIB. Treuting and Hinshaw (2001) examined the effect of aggressive behavior on the global, behavioral, intellectual, physical, anxiety, popularity, and happiness self-perceptions of children ($N = 201$; age 7-12) with ADHD. These authors found that aggressive children with ADHD demonstrated lower self-concept than both control children and nonaggressive children with ADHD (whose ratings were the same as controls in all domains other than popularity in which they were lower; Treuting & Hinshaw, 2001). This study also examined the presence of depressive symptoms and found that aggressive children with ADHD had the highest levels of depressive symptoms and lowest global self-concept.

Gresham, MacMillan, Bocian, Ward, and Forness (1998) examined the academic and social self-perceptions of three groups of students ($N = 231$) in 3rd and 4th grade: (1) students considered to be hyperactive/impulsive, inattentive, and have conduct problems (based on internalizing and externalizing subscale scores more than two standard deviations above the gender mean on the Social Skills Rating System- Teacher [SSRS-T]; Gresham & Elliot, 1990), (2) students with scores of internalizing and externalizing symptoms on the SSRS-T one standard deviation above the mean, and (3) a non-impaired matched control group. Mean differences in student rated self-concept between groups were examined and data from other sources were used as measures of outcomes within each domain. Results indicated that there were no differences between the groups with behavior problems and the control children in social or global self-concept, but children in the two symptomatic groups had lower academic self-concept than the control group. However, it is important to note that all of the groups rated themselves within the average range of self-concept. The authors conclude that this could be seen as evidence of the PIB because outside sources (i.e. peer reports, teacher ratings, and school records) indicated that the children in the symptomatic groups had significant impairments within the academic and social domains when compared to the control group. The group displaying symptoms of ADHD and conduct problems was shown to have worse academic and social outcomes than children in the other two groups, indicating that the PIB may be greatest for those displaying ADHD symptoms. The method used in this study demonstrates one way that the absolute self-perception method can be corroborated by outside sources despite the fact that there was no direct comparison between self-ratings and a specified criterion.

When interpreting these inconclusive results, it is important to consider sample characteristics such as age, comorbidity, clinical vs. school-based recruitment, and symptom

severity. The samples in the studies by Slomkowski and colleagues (1995) and Hechtman and colleagues (1980) included adolescents/young adults age 16-30 years compared to samples of children below the age of 13 utilized in the other studies presented here. The age of participants could have an impact on the presence of the PIB and further research is needed on this topic. Also, these two studies investigated only global self-concept, which is in contrast to the majority of research on the PIB that focuses on domain-specific self-concept. Studies finding that the children with ADHD had lower self-perceptions than the control group children did not account for comorbid internalizing symptoms (Horn et al., 1989; Ialongo et al., 1994; Slomkowski et al., 1995); however, Hoza and colleagues (1993) controlled for internalizing symptomatology and found no differences between the ADHD and control groups. Trueting and Hinshaw (2001) accounted for comorbid aggression and depression and found that the group of children with ADHD who exhibited both aggressive and depressive symptoms had the lowest self-concept. This study demonstrates the importance of examining comorbid symptoms when investigating the presence of the PIB to achieve a better understanding of which symptoms may be influencing self-concept. Two studies accounting for symptom severity suggests that individuals with more symptoms have lower self-concept in multiple domains (Hanc & Brzezinska, 2009; Houck et al., 2011), while two other studies suggest that special education students with ADHD symptoms rate themselves similarly to normative samples across multiple domains (Bussing et al., 2000; Ljusberg & Brodin, 2007).

Utilizing absolute self-perceptions to examine the presence of the PIB yields mixed results and has several limitations. The primary challenge with this method is that it does not allow for comparisons between indicators of actual performance and self-ratings and instead relies solely on comparisons to youth without ADHD. Given the difficulties and impairments

experienced by most children with ADHD, it is logical that accurate self-perceptions for this group would be lower than for children without ADHD. This method does not account for any differences that exist in the actual abilities or competence between the groups of children with and without ADHD. Based on findings from studies using this methodology, it is evident that relying solely on comparisons of mean self-ratings leads to inconclusive results.

Pre/post performance ratings. Understanding of the PIB is advanced by pre-task and post-performance ratings to investigate the self-perceptions of children with ADHD. This method involves children rating their performance on a task (either before or after completing the task) and comparing these ratings to their actual performance and/or to children in a control group (Owens et al., 2007). Children with ADHD have been shown to rate their performance higher than control children, despite children with ADHD consistently performing worse on these tasks (e.g., Hoza, Wascshbusch, Owens, Pelham, & Kipp, 2001; Hoza, Waschbusch, Pelham, Molina, & Milich, 2000; Milich & Okazaki, 1991).

Past research using this method has asked children to predict their performance on tasks that such as find-a-word games, word-search puzzles, or mazes. Whalen, Henker, Hinshaw, Heller, and Huber-Dressler (1991) found that 80% of children (age 7-13) with ADHD in their sample predicted that they would complete the word-search task with perfect accuracy, compared to only 43% of the control group. Another study found that children (age 9-11) with ADHD consistently predicted better performance than children in the control group on a find-a-word task, despite experiencing less success and more frustration than the control group (Milich & Okazaki, 1991). Additionally, on a story-recall task where the performance between the ADHD and non-ADHD groups was comparable, children (grades 3-7) with ADHD were still

shown to have higher pre-task performance predications than their non-ADHD peers (O'Neill & Douglas, 1991).

Studies using post-task performance ratings have involved researcher manipulations to decide whether the child will experience success or failure with a task and then asking the children to rate their performance after the task is completed. Hoza and colleagues (2000) examined the social self-concept of boys with ADHD (age 7-13) using this method. Each student participated in one successful and one unsuccessful task that involved initiating conversation with a child actor who was hired and coached by the research team. Boys with ADHD ($n = 120$) evaluated their own task performance higher than control boys despite the fact that boys with ADHD were rated as less socially effective while boys without ADHD ($n = 65$) were rated as successfully accomplishing the task. Interestingly, the boys with ADHD were shown to have higher overestimation after the unsuccessful social interaction. This finding lends support to the hypothesis of self-protection in the social domain, because the boy's overestimation could be a method to combat feeling of inadequacy after the task was completed unsuccessfully.

An extension of the previous study was conducted to examine post-task predictions in the academic domain (Hoza et al., 2001). Children ($N = 149$; age 7-13 years) with ADHD were shown to be less successful and extend less effort than the control group on a find-a-word task. However, the post-task ratings of children with and without ADHD were comparable. This finding indicates the children with ADHD rated their ability as higher than what was actually observed and shows that boys with ADHD were overly optimistic about their poor performance (Hoza et al., 2001).

Other studies investigating the self-protective hypothesis for the PIB have combined pre-

task prediction and discrepancy analysis to explore the influence of feedback in the academic and social domains (Diener & Milich, 1997; Ohan & Johnston, 2002). Diener and Milich (1997) explored the social interactions of boys with and without ADHD ($N = 120$; age 8-11). Boys participated in two unstructured social interaction tasks and received feedback before the second interaction. Results indicated that boys with ADHD were overly positive about how much their partner liked them after the first interaction task. Between the first and second tasks half of the boys received positive performance feedback which they believed was coming from their partner. After the second social interaction scenario the boys with ADHD who received positive feedback significantly decreased their ratings of how much the other boy liked them, while comparison boys increased their ratings after they received positive feedback. The authors suggest that these results support a self-protective purpose of the PIB, because the overestimations of children with ADHD decreased once they were made to feel less defensive through the use of positive feedback (Diener & Milich, 1997).

Ohan and Johnston (2002) extended upon the work of Diener and Milich and investigated the impact of feedback in the academic and social domains. First, boys with and without ADHD (age 7-12; $n = 45$ with ADHD and $n = 43$ without ADHD) predicted their performance on a maze-completion task (academic domain) and predicted how much the teacher instructing them on the maze task (a research assistant) would like them (an indicator of functioning in the social domain). After being individually instructed on the task and completing the mazes, boys were given positive, average, or no feedback from a researcher. Boys with and without ADHD were shown to rate their academic and social performance similarly. Because the boys with ADHD had lower performance, they were shown to have larger discrepancies between their self-rated competence and their actual competence on both the academic and social tasks compared to the

control group, suggesting the presence of the PIB in both domains (Ohan & Johnston, 2002). After receiving positive feedback, boys with ADHD demonstrated a smaller difference between their actual and self-reported competence in the social domain, while boys without ADHD increased their performance estimates. The PIB in the social domain decreased when positive feedback was given among boys with ADHD. This finding was not replicated in the academic domain, as boys with and without ADHD had larger discrepancies between their actual and self-rated academic competence after receiving positive feedback. Interestingly self-ratings of social performance (and not academic performance) within the ADHD group were significantly positively correlated with a measure of global self-worth ($r = .55$) and an index of social desirability ($r = .51$; Ohan & Johnston, 2002). This study demonstrates the importance of considering each self-concept domain independently because, according to these results, the PIB may serve a self-protective function in the social domain but not the academic domain.

The studies using the pre/post task performance rating method demonstrate consistent findings that children with ADHD rate their performance higher than is warranted based on what is actually observed or higher than control children without ADHD. This method of using children's performance on a task as a basis for comparing their self-ratings is useful for identifying the PIB because it allows for comparison between actual abilities and self-ratings. However, this body of research has several limitations. First, all of these studies utilized samples of boys only, and did not account for internalizing and aggressive symptoms. An additional limitation to this method is that it is difficult to assess multiple domains of self-concept within one study because a separate task would need to be designed to assess each domain of self-concept. Also, this method only allows for the evaluation of self-concept on a specific task (e.g., find-a-word task) rather than assessing how a student perceives their abilities within an entire

domain of functioning, and it is unclear how this would generalize to other tasks within the domain. Furthermore, the academic tasks used in the studies presented herein (e.g., mazes, word-find tasks) are not representative of academic tasks that children are likely to encounter in school.

Discrepancy analysis. Currently, the most common and most recommended methodology for exploring the PIB is the discrepancy and criterion analysis (Owens et al., 2007). This method involves comparing the child's report of competence to some external source of actual competence (Owens et al., 2007). Unlike the pre/post method which investigates specific tasks, this method compares perceptions of overall abilities within a given domain. The source for the criterion can be another rater (such as a teacher or parent), or performance on an objective measure, such as an achievement test score. To calculate a discrepancy, the criterion score is subtracted from the self-rating and the result is a discrepancy or difference score. High and positive difference scores suggest overestimation of competence by the student. Studies using this methodology have yielded consistent results supporting the presence of the PIB across multiple domains (Evangelista et al., 2008; Hoza et al., 2002; 2004; Owens & Hoza, 2003).

Hoza and colleagues have conducted several studies utilizing this methodology by comparing the self-ratings of children on multiple domains of the Self-Perception Profile for Children (SPPC; Harter, 1985) with the corresponding teacher rating scale (Teacher Report of Child's Actual Behavior, Harter, 1985). Hoza and colleagues (2002) investigated the academic, social, behavioral, athletic, and physical domains, as well as global self-concept. Using the discrepancy method, boys (ages 7-13 years) with ADHD ($n = 195$) were shown to overestimate their academic (mean discrepancy score of .42), behavioral (mean discrepancy score of 1.06), and social (mean discrepancy score of .85) competence compared to teacher ratings, significantly

more than boys in the control group who were shown to underestimate their competence in across these domains ($n = 73$; Hoza, Pelham, Dobbs, Owens, & Pillow, 2002). This study also found that the self-perceptions of children with ADHD and comorbid depression were aligned with external ratings, while those with ADHD and no depressive symptoms overestimated multiple domains. In a similar study, Hoza and colleagues (2004) found evidence of the PIB in the scholastic, social, athletic, and behavioral domains for both boys and girls (ages 7-10 years) with ADHD ($n = 487$ with ADHD and $n = 287$ in the comparison group). This study also provides evidence of the presence of the PIB for children with ADHD regardless of whether the child's teacher, mother, or father served as the criterion reporter (Hoza et al., 2004). These two studies (Hoza et al., 2002; 2004) have also provided evidence that the PIB is most prominent in the child's domain of greatest deficit. For example, children who had low academic achievement were shown to have the greatest discrepancy in the academic domain (mean discrepancy score of 1.01 and 1.02 in Hoza et al., 2002 and 2004 respectively), and children with conduct problems had the greatest discrepancy in the behavioral domain (mean discrepancy score of 1.70 and .91 in Hoza et al., 2002 and 2004 respectively).

Owens and Hoza (2003) also utilized the discrepancy methodology and specifically examined how ADHD subtype may contribute to the presence of the PIB. This study, which utilized clinic and school-based recruitment methods, focused solely on the academic domain and used teacher reports and standardized achievement tests scores as two methods of comparison using a discrepancy analysis. These authors found significant differences in academic self-perceptions between children (ages 9-12 years) with primarily inattentive (IA) subtype ($n = 38$; mean discrepancy score of .14 with teacher ratings), those with hyperactive/impulsive and combined (HICB) symptoms ($n = 59$; mean discrepancy score of .54

with teacher ratings), and a non-ADHD comparison group ($n = 83$; mean discrepancy score of $-.30$ with teacher ratings). The children in the IA and control groups were shown to have academic self-perceptions that aligned with the criterion; conversely, children in the HICB group were shown to overestimate their competence compared to the two criterion measures. Larger discrepancies were found when teacher ratings were the criterion compared to standardized achievement test scores (mean discrepancy scores for HICB group were $.39$ and $.38$ for reading and math respectively, compared to $.54$ when teacher ratings were used as the indicator of competence while the IA and control groups both slightly underestimated their competence compared to achievement test scores). More severe HICB symptoms were shown to be associated with larger discrepancies; thus, higher levels of symptoms were related to greater overestimation of competence (Owens & Hoza, 2003). The results of this study suggest that subtype and symptom severity are important considerations when examining the self-perceptions of children with ADHD. This consideration may be particularly important when examining the PIB in adolescents because hyperactive symptoms are suggested to decrease with IA symptoms becoming more prevalent as children age (Wolraich et al., 2005).

A study conducted in Sweden with 635 twelve year-old children also suggests that it is important to consider the intensity of ADHD symptoms when determining the accuracy of self-perceptions (Diamantopoulou et al., 2005). These authors used self and teacher reports and peer nominations to explore the relationship between peer relations, student perceptions, and varying levels of ADHD symptoms. Findings indicate that children with higher levels of ADHD symptoms did not perceive their peer relationships to be more negative, despite teacher ratings and peer nominations suggesting that higher levels of ADHD symptoms were related to social rejection and peer dislike (Diamantopoulou et al., 2005). While low levels of ADHD symptoms

were also significantly related to peer dislike, these students reported feelings of loneliness that were more aligned with the external criterion used (teacher ratings and peer nominations; Diamantopoulou et al., 2005). Although this study did not explicitly investigate the PIB or calculate discrepancy score, these results suggest that the degree of ADHD symptoms may be an important consideration when exploring the PIB, and demonstrates the potential to view the relationship between the PIB and ADHD symptoms on a continuum rather than a diagnosis as students with subclinical symptoms were shown to exhibit significant social impairments in this study (Diamantopoulou et al., 2005). It may be even more important to capture students with subclinical symptoms in an adolescent sample since it is often suggested that ADHD symptoms may decrease over time (Barkley, 2006).

The only other study to investigate the PIB in a sample of students with a full range of ADHD symptoms ($N = 164$) suggests that the PIB in the academic and social domain persists into middle school and is most related to inattentive symptoms (Fefer, 2011). Students were divided into groups based on negative, accurate, or positive self-perceptions compared to teacher ratings and standardized achievement scores in the academic domain, and teacher ratings in the social domain. The positive and negative groups had discrepancy scores one half standard deviation above or below the mean and the number of students in each group varied based on the domain and criterion used (number of students in each group ranged from 46 to 66 depending on the criterion being used). This study is unique in that a cutoff score was used to define the PIB, rather than using statistical tests to determine if self-perceptions were significantly different in groups of children with and without an ADHD diagnosis. Levels of inattentive, hyperactive/impulsive and depressive symptoms were then compared across groups. In the academic domain both inattentive (mean of 1.18) and hyperactive/impulsive symptoms (mean of

.61) were found to be significantly higher in the PIB group compared to the other two groups (using teacher ratings as the criterion). In the social domain, inattentive symptoms (mean of 1.09) were significantly higher in the PIB group compared to the other two groups. No significant differences between groups on inattentive, hyperactive/impulsive, and depressive symptoms were detected when using achievement test scores as the indicator of academic competence (Fefer, 2011). It is interesting to note that analyses indicated that twice as much variance was accounted for by inattentive symptoms for both the academic (14%) and social (10%) domains compared to hyperactive/impulsive symptoms (6% and 10%, respectively). This is in contrast to past literature on the PIB which suggests that hyperactive/impulsive symptoms were more highly related to overestimation of competence in elementary-age children (Owens & Hoza, 2003). These findings suggest the importance of considering levels of specific symptoms when exploring the PIB in young adolescent samples.

To extend the findings of past researchers, Whitley, Heath, and Finn (2008) used a combination of absolute self-perception methods and discrepancy analysis to determine if the presence of the PIB was related to externalizing behaviors in general or specifically to ADHD. The self-perceptions of 27 students (age 6-13) with ADHD (based on teacher reported symptoms in the clinical range on the Child Behavior Checklist [CBCL; Achenbach, 1991] and SSRS [Gresham & Elliot, 1990]) were compared to a matched group of students who exhibited both internalizing and externalizing problems (based on teacher nominations), but who did not meet ADHD criteria ($n = 27$). Student self-perceptions were compared to teacher ratings in the academic, social, and behavioral domains. The results of this study indicated that there were no differences between the mean self-perceptions of students with ADHD and those with other emotional or behavioral problems. However, it was found that teachers rated the competence of

the students in the ADHD group significantly lower than the students in the comparison group, which indicates that teachers perceived students with ADHD to be experiencing more deficits across the academic, social, and behavioral domains. When difference scores were calculated, significant differences between groups were noted, with the ADHD group overestimating their competence in all three domains significantly more than students in the non-ADHD group (difference scores of 1.18, 1.37, and 1.68 for the ADHD group, compared to .63, .91, and 1.10 for the comparison group in the academic, behavioral, and social domains respectively). Thus students with ADHD exhibited significantly greater PIB than the other students in the academic and social domains. Although the authors suggest that this difference in discrepancies found between groups may be a result of biased teacher ratings toward students with ADHD, the findings are suggestive that the PIB may be directly related to symptoms of ADHD, rather than with behavioral difficulties in general.

Another study combining absolute self-perception and discrepancy method investigated whether children with ADHD are able to accurately rate their competence in the academic, social, athletic, physical, and behavioral domains, as well as rate a peer's academic and social performance ($N = 107$; Evangelista et al., 2008). This study was designed to elucidate whether the PIB is a function of the inability of children with ADHD to accurately rate competence in general (the ignorance of competence hypothesis), or if they only rate their own competence inaccurately. Boys and girls with ADHD overestimated their own competence (mean discrepancy scores range from .08 to .50) compared to teacher ratings in all domains (while control children underestimated with mean discrepancies ranging from -.31 through -.62); however, using the absolute method children with ADHD reported lower self-perceptions in all domains except athletic competence. This shows the importance of investigating the PIB using a

criterion rather than simply comparing self-concept scores between groups. All children in this study were also asked to share their perceptions of the academic and social competence of others through a video task. Results suggest that there was no difference in the ability of children with and without ADHD to judge the competence of others in both the academic and social domains. Both groups (with and without ADHD) were able to accurately rate the abilities of others. This study suggests that the ignorance of competence hypothesis is not a viable explanation of the PIB because children with ADHD are able to accurately judge the competence of others. Another unique aspect of this study is that students (in grades 3-5) were recruited from both clinic and community settings.

In a study investigating the PIB in relation to intervention outcomes, Mikami, Calhoun, and Abikoff (2010) used the discrepancy method to investigate the PIB among children ($N = 43$; age 6-11) with ADHD attending a summer treatment program. Findings indicate that students demonstrating the PIB (i.e., a positive discrepancy between self and counselor ratings) in the social and behavioral domains at the beginning of the eight week intervention had less response to intervention compared to students with ADHD who did not display positive illusions. Biased self-reports stayed stable over time despite the intensive intervention (mean social discrepancy score of .23 at baseline and .24 at posttest; mean discrepancy for behavioral conduct -.14 at baseline and .08 at posttest; Mikami et al., 2010). The presence of the PIB in the behavioral domain at the beginning of the intervention was shown to predict increases in conduct problems, while PIB in the social domain predicted declines in social ratings, across the eight week-intervention. This suggests that the domain in which the PIB is displayed may differentially affect treatment response, and that students with the PIB may be less responsive to intervention

in general (Mikami et al., 2010). This is one of the first studies to provide evidence that the PIB may have maladaptive outcomes for children with ADHD.

The first longitudinal study of the PIB utilized discrepancy analysis to investigate perceptions of social and behavioral competence among children (age 8-13 at start of the six year study) with and without ADHD (Hoza et al., 2010). Results from this study indicate that children and adolescents with ADHD ($n = 513$) exhibited larger and more positive discrepancies (mean time 1 to time 4 discrepancy scores of .76, .82, .71, and .64 in the social domain, and .71, .55, .05, and -.06 in the behavioral domain) between self and teacher rated competence than the control group ($n = 284$) in both the social and behavioral domains across all time points over a six year period. Interestingly, this study also noted that students with ADHD demonstrate a trend of increasing social self-perceptions during early adolescence which is similar to what has been demonstrated in normative samples. However, less increase in social self-perceptions was noted in the ADHD group compared to the normative comparative group, with a peak in overestimation in the social domain occurring at age 11.5 followed by a decreasing trend. The PIB in the behavioral domain was shown to be most pronounced at age 8 and to decrease over time so much that the mean discrepancy score indicated underestimation of competence at time four (Hoza et al., 2010). Depression and aggression were also investigated in relation to the PIB to determine if overestimation may be adaptive. Decreased PIB in the social and behavioral domain was found to be associated with higher levels of depressive symptoms, while increases in the PIB in the behavioral domain were predictive of more aggression (Hoza et al., 2010). These results indicate that the PIB in the behavioral domain may be a risk factor for aggression. It is important to note that cross-lag analyses over time indicated that more negative perceptions may be the result of depression rather than the cause (i.e., depression predicted decreased PIB over

time); therefore, the authors conclude that the PIB may not serve as a protective factor for depressive symptoms. While this study demonstrates that the cognitive immaturity perspective does not explain the PIB because the PIB persists into adolescence, the authors purport that findings support the self-protective hypothesis. Adolescents with ADHD were more likely to overestimate their competence in the social domain (an area that is valued in adolescence and therefore may require self-protection) compared to the behavioral domain (where impairments may be more accepted by peers, and therefore require less protection, because deviant behavior may be more normative during adolescence; Hoza et al., 2010). The findings of this study suggest that the development of self-concept among adolescents with ADHD is different than in the normative sample, with self-perceptions decreasing to become slightly more realistic over time in individuals with ADHD rather than the slight increasing trend in self-concept that has been demonstrated to occur during adolescence in normative samples. This evidence that the PIB persists into the high school years underscores the importance of future research investigating the PIB in adolescent samples with a range of ADHD symptoms. ADHD symptoms were shown to decrease over the six year period in this study, as would be expected based on past research showing that ADHD symptoms change over time, but it is unclear whether the decreases in the presence of the PIB were related to decreased ADHD symptoms or other factors. Because ADHD symptoms have been shown to change during adolescence, and vary based on which domain is being investigated, future research should examine the relationship between the level of general and specific ADHD symptoms and the presence of the PIB across multiple domains in adolescent samples.

Another longitudinal study was recently published to further investigate the relationship between the PIB and depressive symptoms among boys with ADHD ($N = 88$; age 8-12 at initial

time point; McQuade, Hoza, Waschbusch, Murray-Close, & Owens, 2011a). This study investigated changes in child and teacher ratings over a two to three year period as separate predictors in multiple regression analyses. The findings of this study suggest that reduced self-perceptions in the academic, social, and behavioral domains were predictive of higher depressive symptoms over two and three years (even when teacher ratings of competence were included as a control variable). Reduced self-perceptions in the social domain were found to be most strongly predictive of later depressive symptoms and a depressive attributional style (two and three years after baseline). Interestingly, teacher ratings of competence were not significantly related to depressive symptoms. The authors suggest that the PIB may serve as a protective factor when it comes to depression among students with ADHD, but that more research is needed to support the PIB as a buffer against depression (McQuade et al., 2011a). This study also calculated discrepancy scores in the academic, social, and behavioral domains at the initial time point (mean discrepancy of .41, .75, and 1.14 in the academic, social, and behavioral domains) and two to three years later (mean discrepancy of .42, .60, and .58 in the academic, social, and behavioral domains) and found little change in the PIB in the academic and social domains over time, and decreased presence of the PIB in the behavioral domain. These findings suggest that the PIB persists into early adolescence within the academic and social domains and directly informed the hypotheses for the current study related to general ADHD symptoms. More information is needed about how the PIB relates to specific ADHD symptoms among adolescents.

Members of this same research team also recently investigated the relationship between the PIB and deficits in executive processes, working memory, broad attention, and cognitive fluency among children ($N = 272$; age 7-12) with and without ADHD (McQuade, Tomb, Hoza, Waschbusch, Hurt, & Vaughn, 2011b). Only students with the C and HI subtypes of ADHD

were included in this study. Discrepancy scores were calculated between self and teacher ratings of competence in the academic, social, and behavioral domains to indicate the presence of the PIB. The authors created three subgroups of children: (1) those with ADHD and the PIB (mean discrepancy scores ranging from 1.53 to 1.70 across the three domains), (2) those with ADHD without the PIB (mean discrepancy scores ranging from .01 to -.12) and (3) control children without ADHD who also did not demonstrate the PIB (mean discrepancy scores ranging from -.09 to -.24). Different subgroups were created for each specific domain of competence because some children with ADHD demonstrate the PIB in one domain but not another (McQuade et al., 2011b). Interestingly, an investigation of the relationship between subgroup placement and depressive symptoms indicated that the ADHD group had significantly higher levels of depressive symptoms than the control and ADHD + PIB groups. Results indicated that children in the ADHD + PIB group had the greatest deficits in working memory. Furthermore, children with the PIB in the academic and social domains exhibited deficits in executive processes, while the PIB in the social domain was also related to deficits in cognitive fluency, working memory, and broad attention. The PIB in the social domain was found to be most associated with cognitive deficits overall. Executive processes were shown to partially mediate the relationship between ADHD status and the PIB across all three domains of competence. Follow-up analyses related to symptom severity indicated that the ADHD and ADHD + PIB groups differed in cognitive deficits only, and not in severity of internalizing or externalizing symptoms as rated by parents. The authors suggest that this study provides preliminary evidence that cognitive deficits related to executive functions and working memory may contribute to the presence of the PIB among children with ADHD. This study also provides evidence that not all students with ADHD

overestimate their competence thus providing an impetus for further research investigating the PIB in relation to specific level and type of ADHD symptoms (McQuade et al., 2011).

Scholtens and colleagues (2011) also examined the effects of cognitive functioning on the PIB in the social domain among children ($N = 86$; age 7-12) with a range of ADHD symptoms using different methods than those used in past studies. Specific disruptive behavior symptoms (i.e., inattention, hyperactivity/impulsivity, and ODD), and indicators of cognitive performance (i.e., working memory, inhibition, and reaction-time variability) were explored as predictors of (1) the PIB, (2) self-reported social acceptance, and (3) adult-reported social acceptance among a sample of 86 boys and girls recruited from schools and clinics. It is interesting to note that inattention was the most prominent behavior in this sample which supports past research suggesting that HI symptoms decline after middle childhood (Scholtens et al., 2011; Wolraich et al., 2005). Analysis of the PIB only included students who overestimated their competence based on discrepancy scores between self-ratings and combined parent and teacher ratings of social acceptance (mean discrepancy score of .41). Correlations indicated that the PIB was related to higher levels of disruptive behaviors and to poorer performance on the two cognitive tasks (Scholtens et al., 2011). However, regression analyses indicated that disruptive behaviors as a whole significantly contributed to the PIB, and that none of the cognitive factors explored contributed to the PIB beyond the disruptive behaviors. Interestingly, the specific ADHD (i.e., IA and HI) or ODD symptoms did not independently contribute to the PIB at a significant level. The authors suggest that this study underscores the importance of considering specific disruptive behavior symptoms when investigating the PIB because ODD symptoms were marginally significant in predicting the PIB (Scholtens et al., 2011). This study concludes by suggesting that future research in this area consider specific ADHD and ODD symptoms together and

separately, and encouraged future investigations of the relationship between the PIB and specific cognitive factors.

Another recent study investigating the social domain compared children (age 7-11) with the hyperactive/impulsive subtype of ADHD with and without the PIB (ADHD + PIB $n = 25$; ADHD – PIB $n = 61$) and a control group ($n = 38$) during a social interaction task with a confederate (i.e., trained actor) child in a laboratory (Linnea, Hoza, Tomb, & Kaiser, 2012). Participants' social behaviors during the task were observed and objectively coded to determine differences in social behaviors across the three groups of interest. Interestingly this study found that only the ADHD + PIB group significantly differed from the control group on prosocial behavior, and this group displayed the lowest level of prosocial behavior, highest levels of odd social behaviors, and the least effort during the social interaction task (Linnea et al., 2012). These students were also rated as being less entertaining and less engaged in the social interaction task. These authors suggest that the PIB may be directly related to the social impairments exhibited by children with ADHD as children in the ADHD – PIB group were not shown to exhibit high levels of social impairment in this study despite having similar symptom profiles to the ADHD + PIB group (Linnea et al., 2012).

Ohan and Johnston (2011) also investigated the PIB within the social domain using observations during a social laboratory task in addition to rating scales of social competence. Girls with and without ADHD ($N = 82$; age 9-12) participated in a computerized board game called *Girls Club* (Ohan & Johnston, 2007) which included chat centers in which the girls believed they were communicating with two other same-age girls. The messages sent in these chat centers were coded from 1 (least prosocial) to 5 (extremely prosocial). Child, parent, and teacher ratings on the Matson Evaluation of Social Skills for Youngsters (MESSY; Matson

Rotatori, & Helsel, 1983) were also used as indicators of social competence. Discrepancy scores between self-reports and mother, teacher, and coding from the lab task were used as an indicator of the PIB. The discrepancy scores of subgroups of girls with ADHD and with and without ODD and depressive symptoms were compared. The results indicated that the girls with ADHD and ODD symptoms (mean standardized discrepancy scores .40 to .82) overestimated their competence more than girls with ADHD but no ODD symptoms (mean standardized discrepancy scores of -.19 to .08) and the control group (mean standardized discrepancy scores of -.45 to -.30), suggesting that comorbid ODD symptoms influence the presence of the PIB. Girls with ADHD and comorbid depressive symptoms were shown to have less overestimation than those with comorbid depression. The authors also examined the relationship between discrepancy scores and an indicator of socially desirable responding and found that the PIB and social desirability were positively correlated for girls with ADHD and not for the control group. This association between social desirability and the PIB suggests that girls with ADHD rate themselves in a way that is self-protective and overly positive. Lastly, these same authors investigated the relationship between the PIB and indicators of adaptive functioning and found that among girls with ADHD the PIB related to negative psychosocial adjustment measured by ratings of aggression, overall impairment, and their number of friends and play dates. Conversely, overestimates of competence among control girls were related positively to these indicators of psychosocial adjustment. The results of this study suggest that the PIB in the social domain is present among girls with ADHD regardless of the indicator of actual competence (mother or teacher ratings, or performance on a lab-task), and that the PIB is greater among girls with ODD symptoms and less among girls with depressive symptoms. Additionally, the authors suggest that this study provides evidence supporting the self-protective hypothesis because girls

with ADHD presented themselves in a way that is overly positive in order to defend against feelings of inadequacy (Ohan & Johnston, 2011).

Only one other study has explored the PIB among a sample of girls with ADHD (Swanson, Owens, & Hinshaw, 2012). These authors investigated social, behavioral, and academic competence in a sample of girls (age 6-12; $n = 140$ with ADHD and $n = 88$ comparison) using the Harter's Self-Perception Profile for Children (SPPC; Harter, 1985), standardized achievement test scores, and peer nominations, as well as teacher ratings of academic performance, peer relations, social skills, and behavior. The authors also examined the relationship between competence ratings, discrepancy scores, and outcomes over a five year period. Several important findings can be gleaned from this study. First, analyses indicated no difference in discrepancies between girls with the combined type versus inattentive subtype of ADHD. Additionally, while discrepancy analyses with ratings from adults indicate the presence of the PIB among girls with ADHD (mean discrepancy scores ranges from .18 to .28), self-ratings were actually in the negative direction and teacher ratings were simply more negative; the authors suggest that the term positive illusion may misrepresent the relationship between child and teacher ratings. The PIB was not demonstrated when comparisons were made between self-perceptions and peer nominations (mean discrepancy score of .06 for the ADHD group and -.10 for comparison group) or test scores (mean discrepancy score of .10 for ADHD group and -.12 for the comparison group), suggesting that the PIB may be attributed to overly negative ratings from adults. The authors suggest that self-perceptions and other indicators of competence should be explored separately in future research, as was done in the current study, in order to more fully understand the complex relationship between self-ratings and other indicators. Lastly, longitudinal analyses from this study suggest that competence ratings from adults, external

indicators of competence (i.e., test scores or peer nominations), and discrepancy scores are all equally predictive of adolescent adjustment. The authors suggest that indicators of performance, rather than overestimation of competence, should be considered as important in predicting adolescent adjustment (Swanson et al., 2012).

Another recent study investigated whether children (age 7-12) with ADHD ($n = 178$) and comparison children ($n = 86$) were able to rate themselves in a way that matches teacher ratings when they were either (1) provided instructions to try to match teacher ratings of their competence, or (2) provided an incentive of fifty cents per question (for a possible total of eighteen dollars) if they were able to match teacher ratings of competence (Hoza, Waschbusch, Vaughn, Murray-Close, & McCabe, 2012). Results indicated that children with ADHD reduced their overestimation of competence (mean discrepancy scores for the ADHD group at baseline were .29, .50, and .91 in the academic, social, and behavioral domains) when provided instructions or incentives to do so in the academic and behavioral domains, but not in the social domain. The least biased perceptions in the academic and behavioral domains were demonstrated in the condition in which children were offered a monetary incentive for matching teacher ratings (mean discrepancy scores for the ADHD group were .09, .46, and .51 in the academic, social, and behavioral domains). However, children with ADHD never matched the accuracy of self-reports achieved within the control group even though biases decreased in these two domains. The authors suggest that these results provide support for the self-protection hypothesis in the social domain because children's rating in this domain remained unchanged despite being offered incentives. Furthermore, results demonstrate that children with ADHD were unable to rate themselves as accurately as comparison children even when provided an incentive for doing so (Hoza et al., 2012).

Another recent study on the PIB investigated the impact of various types of interactions with parents on the presence of the PIB in children with and without ADHD ($N = 56$; age 7-10; Emeh & Mikami, 2012). The goal of this study was to provide further support for the self-protective hypothesis to explain the PIB by exploring whether children's perceptions of their abilities differed based on the typical interaction style with their parent. The PIB was defined as a discrepancy score between child and teacher ratings of social and behavioral competence. Results indicated that children with ADHD demonstrated the PIB in the social and behavioral domains. All children in this study engaged in a 35 minute playgroup which consisted of free play with a total of four children per group (two with ADHD and two without ADHD). Parents were present for the duration of the playgroup and were instructed to interact with children to help them make friends. After the play group each parent-child dyad engaged in a four minute feedback session in which parents were told to give their child feedback about their social behavior that would help improve their child's peer relationships. Videotapes of the play group and feedback sessions were coded for parental praise, criticism, and warmth on a scale ranging from 0 (*behavior not present*) to 3 (*more than one major occurrence of the behavior*). Child aggression during the play group was also coded on the same scale. Parental praise was shown to be associated with lower PIB in the social and behavioral domains in the full sample (children with and without ADHD). Parent criticism was shown to be related to greater PIB in the social domain for children with ADHD, which suggests that criticism may lead children to maintain the PIB in order to protect their self-concept. The relationship between parental warmth and the PIB was not significant; however, the trend of the data provides some support for the self-protective hypothesis in that children may relax their self-protection and provide more accurate self-ratings when positive feedback is received. Praise from parents was related to greater PIB in the

behavioral domain, which is not supportive of self-protection (Emeh & Mikami, 2012). The authors suggest that this study has implications for involving parents in interventions for children with ADHD as parental warmth and decreased parental criticism should likely be encouraged to promote accuracy of self-perceptions and increase the impact of social and behavioral interventions (Emeh & Mikami, 2012).

Taken together these 16 studies investigating the PIB using the discrepancy method suggest that children and adolescents with ADHD display the PIB in multiple domains and across a variety of indicators of competence (e.g., parent or teacher ratings, standardized measures, lab tasks, peer nominations, etc.). The academic, social, and behavioral domains are most commonly investigated in past literature, with the social domain being studied most frequently. Several studies emphasize the importance of considering comorbid depression and ODD because symptoms of depression tend to decrease the presence of the PIB (Hoza et al., 2010; McQuade et al., 2011a; Ohan & Johnston, 2011), while ODD may relate to greater overestimation of competence (Ohan & Johnston, 2011). Recent research has been conducted to explore the validity of the neuropsychological deficit hypothesis for the PIB, and these studies suggest that the PIB is related to deficits in cognitive performance (McQuade et al., 2011b; Scholtens et al., 2011). McQuade and colleagues (2011b) investigated the PIB among children with HI and C subtypes and found that the PIB was present among only some children with ADHD but not others; the authors suggest that children with ADHD and the PIB experience more cognitive deficits than children with ADHD who do not display the PIB. More research with samples of children experiencing a broad range of symptoms is needed to understand the factors contributing to some students with ADHD symptoms displaying the PIB while others do not.

The self-protective hypotheses for the PIB continues to be the most well supported, with two recent studies suggesting that positive feedback may decrease the presence of the PIB in the social domain (Emeh & Mikami, 2012; Ohan & Johnston, 2011). There is still not agreement in the literature about whether the PIB is adaptive or maladaptive for students with ADHD, although more research has accumulated which suggests that the PIB may be maladaptive. One study suggests that the PIB may decrease responsiveness to behavioral interventions (Mikami et al., 2010). Longitudinal research suggests that the PIB may be a risk-factor for aggression and does not serve as a buffer against depression (Hoza et al., 2010). Another study compared psychosocial outcomes among girls with and without ADHD who overestimated their social competence and found that the PIB was related to negative psychosocial functioning for girls with ADHD, but for girls in the control group overestimation of competence was linked to positive psychosocial outcomes (Ohan & Johnston, 2011). Additional research with high school students is warranted based on preliminary findings that the PIB persists into adolescence (Fefer, 2011; McQuade et al., 2011a; Hoza et al., 2010). Two of these studies suggest that the PIB may decrease over time in adolescence. Furthermore, the two studies to investigate the relationship between the PIB and specific ADHD symptoms resulted in differing conclusions about whether the PIB is most highly related to inattentive symptoms (as was found in a sample of middle school students with a full range of ADHD symptoms; Fefer, 2011) or hyperactive/impulsive symptoms as was suggested in the study of elementary-age youth diagnosed with ADHD (Owens & Hoza, 2003). More research is needed to determine the relationship between the PIB and specific levels and types of ADHD symptoms in adolescence because symptoms of ADHD are shown to change over time with inattentive symptoms becoming more prevalent in adolescents and young adults (Wolraich et al., 2005). Examining ADHD symptoms on a continuum is

unique compared to the majority of past literature which studied the PIB among individuals with a diagnosis of ADHD; this will contribute to the current understanding of how the PIB relates to levels of the different symptoms of ADHD. Taken together, additional research is needed to determine what contributes to the presence of the PIB among children and adolescents, and to provide insight about whether this phenomenon may help or hinder students.

Limitations of past research on the PIB. One potential criticism for using this discrepancy analysis methodology is that there is some evidence that parents and teachers may have negatively biased reports of children with ADHD (Eisenberg & Schneider 2007; Whitley et al., 2008). However, given the consistency in ratings found across raters (Hoza et al., 2004), and the consistent findings demonstrating the presence of the PIB when utilizing a criterion (Evangelista et al., 2008; Hoza et al. 2002, 2004; Owens & Hoza, 2003), it is unlikely that a negative bias is accounting entirely for the PIB. Yet, utilizing perceptions from others and objective outcome measures (e.g., achievement test scores or school records) to complete discrepancy analyses is suggested as the best method for ensuring the validity of this construct (Owens et al., 2007).

The studies discussed herein have utilized the discrepancy and criterion analysis method and yield more consistent results than studies using other methods to examine the PIB. This method also addresses some of the limitations of the methods used in previous studies. All of the studies using this method provided support for the presence of the PIB in several domains of self-concept in children and adolescents (ranging in age from 7 to 19 across all studies reviewed). This method has also been used to examine the validity of several hypotheses proposed to explain the PIB in children with ADHD. However, it is important to note that the majority of these studies have used primarily elementary-age samples and clinic-based

recruitment for participants with diagnosable levels of ADHD symptoms. It is important to focus future research on older students and to utilize school-based recruitment methods in order to achieve a larger range of symptom severity including those with levels of ADHD symptoms that would not warrant a diagnosis. Obtaining an adolescent sample is particularly important given that past research has demonstrated that ADHD symptoms change over time (with IA symptoms becoming more prevalent; Barkley, 2006; Wolraich et al., 2005), and that adolescence is a critical period for self-concept development which marks the stabilization of one's domain specific self-concept (Harter, 1999). School-based recruitment of adolescents allows for the full range of ADHD symptoms to be captured (ranging from students with no symptoms to diagnosable levels of ADHD symptoms) which provides further insight about the relationship between the PIB and different levels and types of ADHD symptoms. Little is currently known about how the PIB relates to specific ADHD symptoms, with the two studies investigating this question yielding different conclusions about whether the PIB is most highly related to IA or HI symptoms (Fefer, 2011; Owens & Hoza, 2003). Furthermore, it is important that considerations learned from these studies (such as the importance of considering subtype, symptom severity, and depressive symptoms) are accounted for when examining the PIB in adolescents in order to yield comparable results. Finally, although discrepancy analysis with a criterion is recommended as the best practice in examining the PIB in samples of children, adolescents, or adults with ADHD, this method is not without limitations (Owens et al., 2007). Criticisms of difference scores are quite prevalent, and alternative methods have been proposed. The following section outlines limitations of difference scores and present an alternative analysis approach to investigate the presence of the PIB.

Limitations of Discrepancy Analysis

The discrepancy analysis or difference score method has received attention in the literature from those who support its use (De Los Reyes & Kazdin, 2004) and those who oppose it (Edwards, 2001). In the only comprehensive review of research on the PIB to date (Owens et al., 2007) an article by De Los Reyes and Kazdin (2004) is cited to support the use of standardized difference scores in the majority of research on the PIB to date. These authors suggest that standardized difference scores are superior to raw and residual difference scores in investigations of agreement and discrepancies in ratings of child psychology from different informants (De Los Reyes & Kazdin, 2004). This suggestion is made based on findings that of the three methods investigated, only standardized difference scores correlated equally with ratings from both informants. These authors caution that their results may not be applicable to broader community samples because analyses comparing the three methods were completed with data from a clinical sample of children with significant social, emotional, or behavioral concerns (De Los Reyes & Kazdin, 2004).

A more substantial body of literature has been generated to criticize the use of difference scores (Cafri, van den Berg, & Brannick, 2009; Edwards, 2001; Shanock et al., 2010). The primary concerns with difference scores that have received attention in the literature include: (1) low reliability, (2) increased Type II error rates (Edwards, 2001; Owens et al., 2007), and (3) ambiguity in interpreting results. Each of these concerns contributes to difficulty drawing meaningful conclusions from analyses using difference scores (Cafri et al., 2010). The following section outlines these challenges, and provide an overview of methods that have been proposed to overcome these challenges.

Reliability. Combining two separate ratings into one difference score results in compounded measurement error; therefore, the internal consistency reliability of difference scores tends to be lower than the reliability of the two component measures separately (Edwards, 2001, 2002). This is a particular concern when the two ratings used to create a difference score are positively correlated, as is expected in research investigating the PIB and in research on agreement in general (Edwards, 2001, 2002). Difference score reliability is affected by the reliability and variance of the component measures, as well as the covariance of the self and other ratings (Cafri et al., 2010). Increased covariance between self and other ratings leads to less reliable difference scores; however, the extent that reduced reliability has been a problem in agreement research is not well known (Cafri et al., 2010). Published research on the PIB has not reported the correlations between self and other ratings, and the reliability of difference scores is also not included in these published studies (e.g., Hoza et al., 2002, 2004). Edwards (2001) argues that even when the reliability of a difference score exceeds the recommended threshold for adequate reliability (i.e., .70), researchers using this approach should consider whether this reliability is similar to or exceeds the reliability estimates for each of the component measures. It is suggested that researchers are misguided when they proceed with using discrepancy scores based on adequate reliability of a difference score without considering the reliability of the component measures (Edwards, 2001). Because the separate component measures are suggested to be more reliable than the difference score in most cases, it is recommended that the components of the difference score are evaluated separately (Edwards, 2001). Furthermore, because reliability of a construct is a necessary prerequisite for validity, there are negative implications for the validity of the PIB when measured by a difference score (Cafri et al., 2009).

Increased type II errors. The reduced reliability of difference scores increases the likelihood of Type II error, or failure to detect a relationship between the difference score and other variables when there is a significant relationship (Edwards, 2001). In a review of articles using difference scores, Edwards (2001) suggests that several authors using difference scores argue that their findings are robust because statistical tests using this method are conservative due to increased Type II error rates. This argument has been used to make the case for using difference scores despite their known problems with low reliability. Edwards' (2001) review of the literature on difference scores indicates that difference scores may actually influence the likelihood of both Type I *and* Type II errors, depending on how this method is used. Explained variance and effect sizes decrease when difference scores are used as independent variables in analyses, thus leading to an increased likelihood of Type II error and conservative statistical tests (Edwards, 2001). However, past studies investigating correlations between difference scores and outcomes have led to liberal conclusions and increased rates of Type I error (Edwards, 2001). Several studies have considered positive correlations between difference scores and outcomes as meaningful support for their hypotheses (such as studies on the met expectation hypothesis or person-environment fit), without considering that the direction of the difference score may be important (Edwards, 2001). The results of these studies have not been replicated with more conservative statistical analyses, suggesting that the interpretation of the results of correlations between difference scores and outcomes are too liberal (Edwards, 2001). Taken together, Edward's summary of empirical studies using difference scores indicates that the use of difference scores has the potential to lead to both liberal and conservative statistical tests; however, it is most common for difference scores to lead to increased Type II errors and overly conservative estimates (Edwards, 2001).

Ambiguous interpretation. Past research on the PIB suggests that difference scores are strongly correlated with their component measures, such as self and teacher-ratings or standardized achievement measures (Owens et al., 2007). This is problematic because interpretation of significant correlations between difference scores and relevant outcomes may actually represent a relationship between the outcome and just one of the component measures (Cafri et al., 2010). When difference scores are used there is no way to know how each component uniquely contributes to the outcome of interest. Combining two different ratings into one score also leads to ambiguity in interpretation because it is unknown how the variance of each of the component measures contributes to the difference score (Cafri et al., 2010). For example, it is conceivable that the difference score variance could be influenced more by self-ratings than teacher-ratings, which would make results of analyses quite similar to results of analyses using the self-ratings alone. For this reason, it is important to check the variability of the data for both component measures before deciding to use difference scores (Cafri et al., 2010). Difference scores also pose theoretical limitations because of ambiguity in interpreting a single score accounting for two distinct constructs (e.g., self and other ratings of competence; Edwards, 2001). It is not possible to examine individual and combined effects of each of the component measures using this methodology. It is argued that difference scores oversimplify three-dimensional relationships (i.e., the relationship between self and other ratings and the outcome of interest) into a two-dimensional relationship between a difference score and relevant outcome (Cafri et al., 2010; Edwards, 2002). For this reason, the use of difference scores may provide a distorted view of complex relationships between variables (Cafri et al., 2009). Cafri and colleagues (2010) argue that “there is a loss of information that results from the use of difference scores, one that necessarily limits the extent to which theory can develop and evolve”

(p. 365). For this reason, new methodology is needed to investigate the complicated relationship between self and other ratings of competence among students with symptoms of ADHD.

Methodology to address these limitations and advance theory related to the PIB will be discussed in the following section.

An Alternative to Difference Scores

Although Owens and colleagues (2007) suggest that the standardized discrepancy score method is the current best option for investigating the PIB, these authors note that “future studies should investigate other analyses that may best evaluate the accuracy of self-perceptions while minimizing methodological limitations” (p. 341). Polynomial regression is one such method that has the potential to advance research on the PIB. A combination of polynomial regression and response surface methods has been recommended as a viable alternative to difference scores, as these methods overcome many of the limitations outlined above (Edwards, 2001, 2002; Shanock et al., 2010).

This methodology has been proposed in the field of industrial/organizational psychology, but has not yet been widely extended to other areas of research (Cohen, Nahum-Shani, & Doveh, 2010; Shanock et al., 2010). Edwards has advocated for the use of polynomial regression to directly test the relationships represented by difference scores for over a decade, and urges researchers to extend this method to research using difference scores beyond the realm of business research (Edwards, 2001, 2002; Edwards & Parry, 1993). The following section will describe this method and how it has been used in recent research.

Polynomial regression and response surface methodology. Polynomial regression allows for investigations of self and other ratings separately and for examinations of the relationship between these ratings in three dimensions (Edwards, 2002). This method is

particularly useful when the difference between two predictor variables (self and other ratings) is central to the research question which the researcher is setting out to answer (Shanock et al., 2010). Polynomial regression is accomplished through hierarchical regression in which an outcome is first regressed on self and other ratings separately. As a second step, squared self and other ratings and the interactions between self and other ratings are added (Shanock et al., 2010). These regression equations often yield complex regression coefficients and relationships between variables may be either linear or curvilinear (Edwards, 2002). Response surface tests have been proposed as a framework for interpreting the complex coefficients which result from polynomial regression (Edwards & Parry, 1993). This method, which relies on three-dimensional contour plots of polynomial regression results, allows for nuanced investigations of the relationship between over and underestimation and allows for the investigation of specific hypotheses about the relationships between self and other ratings and outcomes of interest (Edwards, 2002). In combination, polynomial regression and response surface methods can be used to answer questions about agreement and discrepancy, and provide insight about how the degree and direction of the discrepancy may impact the outcome of interest (Shanock et al., 2010).

This statistical approach has many benefits and overcomes many of the limitations related to difference scores. Decreased reliability is not a concern with this approach because component measures are investigated separately and self and other ratings are not combined into one score to be used in analyses (Edwards, 2002). Additionally, separate and joint effects of self and other ratings are investigated, which overcomes the ambiguity of interpreting difference scores accounting for two component measures. Polynomial regression/response surface determines how much each component measure (i.e., self and other ratings) contributes uniquely to the variance of the outcome of interest, and also provides insight into how agreement and

disagreement between self and other ratings relate to the outcomes (Edwards, 2002). Complex hypotheses related to agreement and disagreement cannot be examined with difference scores (Edwards, 2002). Additionally, polynomial regression combined with response surface methods can provide specific insight about whether or not the direction of the disagreement (i.e., over and under estimation) between self and other ratings influences the relationship with outcomes. This test of directional and non-directional disagreement cannot be accomplished in analyses using difference scores (Kazen & Kuhl, 2011). Difference scores assume that it is the difference between two ratings that is of interest, and consider agreement and disagreement while ignoring the levels of the ratings (Cohen et al., 2010). Polynomial regression is not based on this assumption and considers different levels of agreement and disagreement (i.e., agreement represented by self and other ratings of high performance is considered to be different than agreement when self and other ratings indicate low performance) and therefore these analyses may provide more clear depictions of the relationship between ratings from multiple sources (see Figure 1; Cohen et al., 2010). This method may be particularly well-suited for answering questions about the relationship between the PIB (overestimation of competence on the part of the student) and specific ADHD symptoms since the level of both student and teacher ratings of competence will be uniquely accounted for. This will allow for an investigation of how each competence rating relates to IA, HI, and general ADHD symptoms which will provide a more detailed understanding of how the PIB may manifest in adolescence, a time when ADHD symptoms may change (Wolraich et al., 2005) and when self-concept may become more realistic and stable (Harter, 1999). Past studies using polynomial regression and response surface analysis to answer research questions related to congruence between raters will be presented here.

Recent applications of polynomial regression/response surface. Many applications of polynomial regression/response surface methodology can be found in business literature. For example, these methods have most commonly been used in investigations of multi-source evaluations of job performance, which considers agreement and disagreement between self-ratings of performance and ratings from coworkers, subordinates, or supervisors in relation to outcomes such as productivity, leader effectiveness, job satisfaction, or demographic variables such as gender or age (Atwater, Waldman, Ostroff, Robie, & Johnson, 2005; Vecchio & Anderson, 2009). These studies found that agreement of high performance was related to more positive outcomes, and that disagreement when self-ratings were higher than other ratings were particularly problematic (Atwater et al., 2005; Vecchio & Anderson, 2009). This nuanced understanding of the impact of agreement and disagreement on work performance could not be achieved with discrepancy analyses.

Other researchers have used these methods to investigate discrepancy and agreement between actual pay and upward pay comparisons (workers were asked to report how much they thought individuals with similar experience were paid within their company), and investigated how discrepancies between actual and comparison pay related to pay satisfaction (Harris, Anseel, & Lievens, 2008). These authors found that discrepancies between actual and comparison pay (either paid more or less than comparison pay) was related to decreased pay satisfaction, while the highest levels of pay satisfaction were predicted by agreement between ratings of actual and comparison pay (Harris et al., 2008). Another study used polynomial regression to investigate how agreement/disagreement between workers' and managers' perceptions of organizational support predict team performance and team positive and negative affect (Bashshur, Hernandez, & Gonzalez-Roma, 2011). Results indicated that agreement in workers' and managers'

perceptions of high organizational support was related to positive affect and high team performance (Bashur et al., 2011). Kazen and Kuhl (2011) used polynomial regression to investigate differences between self-ratings of explicit and implicit motives among managers, and how agreement/disagreement between two motive ratings predicted manager well-being. Results demonstrated that there was a directional relationship between lower well-being scores and disagreement between explicit and implicit power motives (high implicit and low implicit). While the content of this body of research is not directly relevant to the current topic, this overview of past research using polynomial regression and response surface methods provides an example of the detailed findings that result from these analyses related to agreement/disagreement, and the type of research questions that have been investigated using these methods in the past.

Three recently published articles have extended the use of polynomial regression and response surface methods to investigations of body image (Cafri et al., 2010) and therapeutic alliance (Lo Coco, Gullo, & Kivlighan, 2012; Marmarosh & Kivlighan, 2012). Cafri and colleagues (2010) provide a detailed argument about the importance of using these more advanced statistical methods to answer research questions involving actual and ideal body image. The authors provide an extensive review and critique of past body image research using difference scores to investigate how self-ratings of an actual and ideal body relates to outcomes. Two empirical examples reanalyzing data from past studies were provided to demonstrate the range of hypotheses related to body image that could be addressed with these methods (i.e., related to the complex relationships between agreement/disagreement in self and ideal ratings, bulimic symptoms, and dieting behaviors), and to show that difference scores imposed constraints in past research which led to inaccurate conclusions in a previous study on body

image in young adolescents (Cafri et al., 2010). Lo Coco and colleagues' (2012) study of therapeutic alliance perceptions of individuals in group psychotherapy investigated whether agreement in individual and other group members' perceptions of alliance to the therapy group would predict symptom reduction. Their results indicated that high perceptions of alliance with the group for one member and the other group members predicted the greatest reduction in symptoms. One important new finding that was gleaned from this study, and could not have been shown in previous studies using difference scores, is that alliance ratings of other group members were more predictive of symptom reduction than self-ratings of alliance (Lo Coco et al., 2012). The authors suggest that more studies using these advanced statistical techniques should investigate this topic to replicate the findings related to the importance of other group members' perceptions of therapy group alliance. Marmarosh and Kivlighan (2012) explored counselor and client agreement about therapeutic alliance using polynomial regression and response surface analysis. The outcome variables explored in this research included smoothness and depth of the therapy session, as well as symptom change. These authors discovered that agreement on high therapeutic alliance was related to session smoothness and to greater symptom change, and demonstrate that these findings could not be accomplished with correlational research or difference scores that have been used in previous research on the topic (Marmarosh & Kivlighan, 2012).

The most recent study comparing discrepancy analyses and polynomial regression is particularly relevant for the current study. This study (Laird & De Los Reyes, 2013) examined how parent and adolescent agreement relates to antisocial behavior and depression. These authors conclude that difference scores do not result in valid conclusions about the relationship between agreement, discrepancy, and adolescent maladjustment. They propose that results from

polynomial regression provide more accurate conclusions about parent and adolescent ratings of conflict, parental knowledge, and rule-breaking predicting adolescent psychopathology. These authors place a specific emphasis on examining interaction terms in polynomial regression analyses and the importance of defining agreement and disagreement in a way that makes sense for the specific variables being explored (Laird & De Los Reyes, 2013). The findings from this study suggest that polynomial regression analyses could provide more comprehensive and valid conclusions about the PIB compared to discrepancy scores that have been used in the majority of past research.

Several researchers have recently published articles which provide guidelines and frameworks outlining the specific procedures for conducting and interpreting these complex analyses (Cohen et al., 2010; Shanock et al., 2010). Cohen and colleagues (2010) propose specific guidelines for the application of polynomial regression and response surface analyses to research in the social and behavioral sciences. Definitions of the statistical concepts underlying this method are provided, as well as a detailed description of the equations to be used in polynomial regression. Additionally, the authors provide an example of research investigating whether agreement/discrepancy in ratings of support received and support given predict self-esteem of employees. Lastly, the authors suggest different methods to interpret results of polynomial regression, such as the use of contour plots (i.e., response surface methods), the use of confidence intervals with the line of fit and misfit in these contour plots to make inferences about values along these lines, and the difference and mean model (DMM) to provide insight into how much the difference between ratings and their mean predict the outcome of interest (Cohen et al., 2010). Shanock and colleagues (2010) provide a very clear and well-written description of how this method can be used in future research, a step-by-step example for how to

conduct polynomial regression and response surface analyses, and discuss the benefits of this method beyond difference scores and moderated regression analyses. The primary focus of this article was to provide other researchers with all of the specific guidelines and tools (such as SPSS syntax and an Excel spreadsheet) needed to extend this method to other areas of research focused on discrepancy between the self and other ratings (Shanock et al., 2010). There is clearly a need for more empirical research using polynomial regression and response surface methods in studies focusing on agreement/disagreement between self and other ratings in order to decrease the reliance on difference scores.

Extending PIB research with polynomial regression and response surface methods.

Research on the PIB relies on comparisons between self-ratings and other indicators of competence. For this reason, polynomial regression and response surface methods can be used to extend upon past research on the PIB by investigating both agreement and disagreement between self and other ratings. Figure 1 represents the four potential combinations of self and other ratings investigated in studies using polynomial regression with response surface tests. Within the current study these quadrants represent agreement and disagreement between self and teacher ratings of academic and social competence. Past studies investigating the PIB have focused only on disagreement represented in the third quadrant of Figure 1, which represents the PIB with self-ratings that are higher than ratings provided by another individual. Using response surface tests within the current study allowed for investigations of how overestimation of competence (represented in quadrant 2) related to ADHD symptoms, as well as insight about how agreement between self and teacher ratings (either of high or low competence) predicted ADHD symptoms. Agreement on the low end of competence (represented by quadrant 1 in Figure 1) is particularly relevant to research on the PIB because past research suggests that some

students with ADHD do not demonstrate the PIB and acknowledge their impairments (McQuade et al., 2011b; Owens & Hoza, 2003). The current study is the first research on the PIB to simultaneously investigate self and teacher ratings separately while considering both agreement and disagreement about competence as predictors of ADHD symptoms.

The use of polynomial regression and response surface methods provides a means to investigate disagreement beyond simply indicating if overestimation (i.e., the PIB) is present; specific patterns of agreement and disagreement between student and teacher ratings were examined to determine how this predicted levels of general and specific ADHD symptoms (Shanock et al., 2010; see Figure 1). Polynomial regression/response surface methods have the potential to advance our understanding of the complex relationship between the PIB and ADHD symptoms, and allow for further development and refinement of theory related to the PIB.

Conclusion

It is important to conduct research with the goal of further understanding the self-concept of adolescents with symptoms of ADHD. Symptoms of ADHD persist into adolescence and contribute to impairments in the academic and social domains, with outcomes varying considerably depending on subtype (Wolraich et al., 2005). However, children with ADHD have been shown to demonstrate the PIB in multiple domains and overestimate their abilities in areas of impairment (Owens et al., 2007). Only three studies to date (Fefer, 2011; Owens & Hoza, 2003; Swanson et al., 2012) have explored the relationship between the PIB and levels of specific ADHD symptoms, with inconsistent findings about how ratings of competence relate to IA and HI symptoms. The current study used polynomial regression and response surface analyses as a method to reliably investigate the relationship between self and teacher ratings of academic and social competence and general and specific ADHD symptoms among high school

students. The goal was to advance theory about the PIB by providing a more nuanced understanding of how symptoms relate to self and other ratings of competence. The current study contributes to research on the PIB by being the first study to: (1) investigate the PIB in relation to both general and specific ADHD symptoms, (2) use polynomial regression/response surface methods to address the limitations of difference scores by investigating self and teacher ratings separately, and (3) focus exclusively on the PIB in high school students within important domains of adolescent functioning (i.e., the academic and social domains). Interestingly, a recently published article on the PIB ends with this statement:

A challenge to the field is to isolate the self-appraisals and external indicators of competent performance in this population. Given the continuing struggles of individuals with ADHD across development, it is essential that both self-views and external ratings are considered in predictive research. (Swanson et al., 2012, p. 11)

The current study follows this recommendation and is the first to address this challenge by using polynomial regression and response surface methods to investigate self and teacher perceptions of competence separately in relation to ADHD symptoms.

Chapter Three: Method

The purpose of the current study was to investigate how agreement and discrepancy between self and teacher ratings of students' academic and social competence predict the presence of specific ADHD symptoms among high school students. Overestimation, underestimation, and accuracy were determined by considering students' self-ratings of competence and competence ratings from teachers in both the academic and social domains. Three different symptom profiles were examined as the outcome variable, including overall ADHD symptoms, inattentive symptoms, and hyperactive/impulsive symptoms. Depression was also examined as a covariate in analyses to determine how the presence of depression influenced the relationship between agreement/disagreement and ADHD symptoms. The following chapter details the methods used within the current study. First, a description of participants is provided, followed by procedures for participant recruitment and data collection. Next, an explanation of the measures used to collect data from students and teachers is provided. The analyses used to answer each research question is then explained. Finally, a discussion of ethical considerations and limitations of the study is provided.

Participants

Student participants in grades nine through twelve were recruited from two large public high schools within an urban school district in the Southeastern United States. The schools were selected based on (a) the principal's and school psychologist's interest in the research and willingness to recruit teacher and student participants, and (b) having a student population of approximately 2,000 students enrolled at the school. Each school had some unique features.

School A opened in 1984. This school had specialized programs for animal science, environmental studies, automotive, engineering, and early childhood. School B was significantly newer and opened in 2009. This school has specialized programs for sports marketing, business of sports, sports medicine, veterinary medicine, culinary arts, and information technology. Both schools received a school grade of an A in 2012, and a B in 2011. More information on the demographics of these two schools can be found in Table 1.

Table 1

Total School Demographic Information

	School A <i>N</i> (%)	School B <i>N</i> (%)	Total <i>N</i> (%)
Gender			
Male	1,000 (51.4%)	1,068 (48.5%)	2,068 (49.9%)
Female	944 (48.6%)	1,134 (51.5%)	2,078 (50.1%)
Race/Ethnicity			
American Indian or Alaskan Native	4 (.2%)	4 (.2%)	8 (.2%)
Asian or Pacific Islander	89 (4.6%)	53 (2.4%)	142 (3.5%)
Black, Non-Hispanic	205 (10.5%)	163 (7.4%)	368 (8.9%)
Hispanic	641 (33%)	341 (15.5%)	982 (24.25%)
Multiracial	103 (5.3%)	11 (.5%)	114 (2.9%)
White, Non-Hispanic	932 (47.9%)	1,530 (69.5%)	2,462 (58.7%)
Eligible for Free & Reduced Lunch	634 (32.6%)	427 (19.4%)	1061 (26%)
Receiving ESL Services	99 (5.1%)	33 (1.5%)	132 (3.3%)
Students with an IEP	247 (12.7%)	203 (9.2%)	450 (10.9%)
Grade Level*			
Nine	510 (26.2%)	573 (26%)	1,083 (26.1%)
Ten	494 (25.4%)	577 (26.2%)	1,071 (25.8%)
Eleven	512 (26.3%)	482 (21.9%)	994 (24.1%)
Twelve	428 (22%)	545 (24.8%)	973 (23.4%)
Total Enrollment	1,944	2,202	4,146

Note. * School B had 25 students in a Special Education classroom who were not figured into grade level numbers.

Within this district, 55.9% of students received free and reduced lunch, 12% were English Language Learners, 15.1% of students had an IEP, and 57.3% were from an ethnic minority background during the 2011-2012 school year (New America Foundation, 2013). A comparison of this district demographic data with the information provided in Table 1 indicates that these schools have lower percentages of students in each of these categories compared to the

district as a whole; therefore, data from participants at these two schools may not be representative of the district as a whole. As can be seen in Table 1, total enrollment across both schools was 4,146 (school 1 $n = 1,944$; school 2 $n = 2,202$). Most students in the school were recruited for participation in this study since recruitment occurred within general education English classes. The initial study plan was to recruit 100 students per grade across both schools, with the goal of recruiting 800 student participants. However, parental consent forms were returned for a total of 617 students, which represents 14.9% of total enrollment across both schools. Parents declined student participation on 98 of these consent forms, and an additional 99 students did not take part in the survey despite having parental consent (i.e., they either did not come to one of the survey administrations or they did not assent). Of note, the majority of the “no” consents were returned in a class where the teacher was giving extra credit for returning the consent form with *either* a yes or no from parents. Four-hundred twenty students were present and gave assent to participate in the current study (10% of the total student body). Demographic information for study participants is provided in Table 2.

A comparison between the sample (Table 2) and the school demographic data (Table 1) suggests that a larger percentage of the current sample came from school B; this is logical considering that school B is slightly larger than school A. Females were overrepresented as a whole within the current sample, with 50.1% females within the total student body compared to 58.8% in the current sample. In terms of ethnicity, this sample appears to be well aligned with the percentages of students of each ethnic background represented at each school. The breakdown of students receiving free/reduced lunch across schools in the current sample matches school data, with school A having a higher percentage of eligible students.

Table 2

Demographic Characteristics of Student Participants

Variable	School A Sample (<i>n</i> = 190)		School B Sample (<i>n</i> = 230)		Total Sample (<i>N</i> = 420)	
	n	%	n	%	N	%
Gender						
Male	80	42.1	93	40.4	173	41.2
Female	110	57.9	137	59.8	247	58.8
Grade						
9	69	36.3	33	14.4	101	24.4
10	48	25.3	78	34.1	126	30.4
11	39	20.5	79	34.5	117	28.3
12	34	17.9	39	17.0	70	16.9
Ethnicity						
African-American	22	11.6	19	8.3	41	9.8
Asian/Pacific Islander	13	6.8	5	2.2	18	4.3
White	88	46.6	155	67.7	243	57.9
Hispanic	59	31.1	51	22.3	110	26.2
Native American/ Alaska Native	1	0.5	2	.9	3	0.7
Other	16	8.4	7	3.0	23	5.5
Free/Reduced Price Lunch*	75	39.5	40	17.5	115	27.4
Limited English Proficiency	4	0.9	1	0.2	5	1.2

*Free and reduced price lunch status was obtained from student records

Lastly, at school A there was overrepresentation of students in ninth grade (36.3% of study participants compared to 26.2% of students enrolled), whereas grade nine was underrepresented at school B (14.4% of study participants compared to 26% of students enrolled). Students in tenth and eleventh grades were overrepresented at school B (with 34.1 and 34.5% of study participants, compared to 26.2 and 21.9% of students enrolled, respectively); while students in eleventh grade were slightly underrepresented at school A (20.5% of study participants compared to 26.3% of students enrolled). Twelfth grade students were underrepresented at both school A and B (17.9 and 17% of student participants compared to 22 and 24.8% of student enrolled). Chi-square tests for independence were run to detect significant differences across

schools for all of the demographic variables. These analyses indicated significant associations between school and: (a) free/reduced lunch status, $\chi^2 (2, N = 420) = 27.93, p = .00$, with more students eligible at School A, (b) Asian/Pacific Islander ethnicity, $\chi^2 (2, N = 420) = 4.46, p = .04$, with more students at School A, (c) White ethnicity, $\chi^2 (2, N = 420) = 18.13, p = .00$, with more students at school B, (d) Other ethnicity, $\chi^2 (2, N = 420) = 4.83, p = .03$, with more students at school A, and (e) grade, $\chi^2 (3, N = 420) = 30.36, p = .00$, with more ninth grade students at School A, and more tenth and eleventh grade students at school B.

Teacher participants were recruited in addition to student participants. One English teacher and one additional teacher from an alternate subject area such as math, science, or history were recruited to complete rating scales for each student. The following sections describe the procedures used to recruit and collect data from student and teacher participants in the current study.

Procedures

Recruitment of student participants. In order to participate, students were required to be enrolled in an English class at one of the high schools included in this study during the Spring 2013 semester, and to obtain parental informed consent for their participation (see Appendix A). Students served exclusively in self-contained special education classrooms were excluded due to potential cognitive or language impairments that could have contributed to difficulty completing the survey packet. Two copies of the consent form (one to sign and return, and another for family records) were provided to all eligible students at two high schools in late January/Early February 2013 (see Appendix A). In collaboration with school administration it was determined that the best method to recruit students was through their English teachers because all high school students were required to be enrolled in an English class. Each English teacher received a

\$10 gift card to Target for their assistance with recruiting students. In order to ensure an adequate response rate, each student and teacher who returned a consent form was entered into a lottery to win a \$25 gift card to Target (given to four students and two teachers per school).

On the day of data collection, students were asked to sign a student assent form immediately prior to data collection (see Appendix B). The assent was read aloud prior to survey completion. Only participants who provided written assent completed the survey. All students present for survey completion assented for participation. Students were asked to complete a packet of rating scales which included information about their academic and social competence, symptoms of depression, and other measures of psychopathology and well-being that were not directly relevant to the current study.

Recruitment of teacher participants. In collaboration with school administrators it was determined that students would be recruited through their English classes. For this reason, a member of the research team held an informational meeting with English teachers at each school to explain the study and provide teachers with a letter of informed consent (see Appendix C). English teachers who consented to participate helped recruit student participants and completed rating scales for each student in their class who provided self-report data. English teachers also asked each student who returned their parent consent form to report information about their schedule and other teachers in order to identify secondary teachers and to assist in scheduling student survey completion during lunch periods. Each English teacher received a \$10 gift card to Target for their assistance with recruiting students. Each student's mathematics teacher was also asked to participate and provided with a letter of informed consent (see Appendix C). In the event that a student's mathematics teacher declined to participate, another teacher of a core academic subject area (e.g., science or history) was asked to participate and was provided with a

letter of informed consent. In contrast to the English teachers, the teachers of alternative subject areas did not attend an informational meeting with the research team and were not eligible for additional incentives for assistance with recruitment. Rather, these teachers were sent a consent form describing the study and received rating scales for each student participant in their class if they consented. These variations in recruitment across English and alternative teachers contributed to differences in the number of teachers participating and the number of surveys completed per teacher. A total of 388 ratings were received from 19 English teachers (range from 1-79 surveys completed with an average of 19 surveys per teacher), compared to 275 ratings from 36 teachers of alternative subject areas (range from 1-23 surveys completed with an average of 8 surveys per teacher). All teachers completing measures had known the students for at least two months and the student was currently enrolled in their class. Each teacher who returned a consent form for their own participation was entered into a lottery to win a \$25 gift card to Target (two gift cards per school). Teachers completed measures of (1) student ADHD symptoms, and (2) student academic and social competence for each student participant in their class.

Student survey administration. A packet of questionnaires, including the measures described below, was compiled into a comprehensive survey packet. Measures in the student survey packet were counterbalanced into four versions to control for order effects.

A list of students with parental consent for participation was compiled prior to data collection. Students on this list were given a pass which asked them to report to a predetermined location in the school (unoccupied classrooms, computer lab, auditorium, or media center) for survey completion during their lunch period. Data collection occurred during the Spring semester of the 2012-2013 school year; specifically, during the last week of January and the first

week of February, with make-up days scheduled throughout February. Students were asked to sit as far apart from each other as space permitted in order to ensure privacy during survey completion. Completion of the survey packet took less than 30 minutes. A member of the research team trained for the administration of this particular study read the student assent form to all students prior to survey completion. Confidentiality and the voluntary nature of the survey was explained to students, and they were assured that they could withdraw their participation at any time without any consequence. Once assent was obtained, a member of the research team walked students through several examples of the types of questions they would see within the survey packet. After being given the opportunity to ask any additional questions, participants independently completed all measures included in the questionnaire packet. Researchers monitored the room throughout survey administration to ensure accurate completion of the study materials and to answer any questions. Additionally, when a student finished their survey, a trained member of the research team checked through each survey packet to (1) make sure no pages were unintentionally missed, (2) ensure that the student answered every question they wanted to answer, and (3) check that only one response was selected per item. Each student who completed the survey received a candy bar to thank them for completing the survey.

Teacher survey administration. Informed consent was gathered from each teacher participant (see Appendix C). Throughout February, March, and April of 2013, members of the research team provided packets of rating scales to each student participant's English teacher. Alternative subject area teachers (across various subject areas including math and social studies) were also identified and provided with survey packets for students in their classes. The number of rating scales administered to each teacher was dependent on the number of student participants in each teacher's classes (average of 14 surveys per teacher; range of 1 to 79 surveys

per teacher). A total 19 English teachers and 36 teachers of alternative subjects participated in this study. English teachers completed an average of 19 surveys (standard deviation 20.25; range 1-79), and alternative teachers completed an average of 8 surveys (standard deviation 6.18; range 1-23). Teachers were provided with an envelope to hold completed surveys (to protect privacy). Completion was estimated to take five minutes per student, and teachers were given anywhere from one week to two months to complete their surveys. Of note, this timeline for teacher recruitment and participation was longer than initially anticipated. Teachers requested more time to complete measures due to busy schedules. Contact information for the Principal Investigators was provided so that teachers had a means to ask questions related to survey completion. Each teacher who completed survey packets for students in their class received two dollars cash per survey packet completed. The number of survey packets completed by each teacher ranged from 1 to 79 (average of 14); therefore incentives received ranged from 2 to 158 dollars. This process resulted in two sets of teacher data for 67.8% of the sample, and one set of teacher data for the remaining 32.2% of student participants. For the latter group, the research team was unable to secure a willing teacher to provide additional ratings.

Indicators and Measures

Multiple sources of data from students and teachers were obtained in this study including student records, student-completed surveys, and teacher-completed surveys (see Table 3).

Student records. Data were gathered from student records, including information about students' Free/Reduced Lunch (FRL) status as an indicator of socioeconomic status (SES), English Language Learner (ELL) status (to determine if data for all participating students could be used in analyses, with data from students currently being served as ELL excluded before analyses occur, $n = 5$), and Grade Point Average (GPA).

Student measures.

Demographic form. The demographic form used in this study (see Appendix D) contains questions regarding age, previous ADHD diagnosis, grade, gender, and race/ethnicity. All demographic questions include multiple choice answer sets. These data were used as covariates in regression analyses.

Self-Perception Profile for Adolescents. The Self-Perception Profile for Adolescents (SPPA; Harter, 1988; see Appendix E) is a measure of self-concept designed for use with adolescents in grades 9 through 12. The scale includes nine subscales including scholastic competence, social acceptance, athletic competence, physical appearance, job competence, romantic appeal, behavioral conduct, close friendships, and self-worth. Only three subscales tapping academic and social competence were administered for the current study: the social acceptance (five items), close friendships (five items), and the scholastic competence domain (five items) for a total of 15 items (Harter, 1988). However, the five items for close friendship were not used due to a high rate of missing data (30% of teachers skipped all 5 close friends items). Completing this measure involved two steps. First, students were asked to decide which of two opposite sentences (for example, “some kids would rather play outdoors in their spare time” but “other kids would rather watch T.V.”) best describe them. Then, students were asked to indicate whether the statement is “sort of true” or “really true” for them. This question format is called a “structure alternative format” (Harter, 1982, p. 89) and was designed to combat the tendency for children to provide socially desirable responses. Each item on the SPPA is scored from 1 (*low*) to 4 (*high*). After accounting for two reverse scored items, the five items within each domain were averaged, resulting in separate subscale means for each domain. Total scores

(subscale means) for each domain range from 1 to 4, with higher scores indicating higher perceived competence in that domain.

The SPPA has been shown to have adequate internal consistency reliability within four samples of high school students from Colorado (N ranges from 109 to 242); alphas for scholastic competence ranged from .77 to .91, .77 to .90 for social acceptance, and .79 to .85 for close friends (Harter, 1988). An exploratory factor analysis of the domain specific items (excluding self-worth) was conducted with students in grades 8-11, and a clear eight factor model with small cross loadings between domains emerged (Harter, 1988). This indicates that this scale is a meaningful measure of domain specific self-concept among adolescents. The SPPA was selected based on strong psychometric properties, prior use with high school students, availability of a directly comparable teacher measure, and because the SPPC (Harter, 1985) is most common in past research on the PIB.

Behavioral Assessment System for Children-2, Self-Report of Personality, Adolescent Version. The Behavioral Assessment System for Children-2, Self-Report of Personality, Adolescent Version (BASC-2-SRP-A; Reynolds & Kamphaus, 2004; not included in appendices due to copyright restrictions) is a measure of emotional/behavioral functioning for youth age 12-21. This 176-item measure consists of sixteen subscales and five composite scores. Within the current study only portions of this scale were administered and analyzed. The BASC-2-SRP-A was used as the primary measure of depressive symptoms (Depression subscale consists of 11 items), as well as a secondary indicator of students' perception of Interpersonal Relations (7 items). The BASC-2-SRP-A also includes a social desirability index (the L index; 15 items), which provides an indicator of socially desirable responding (Reynolds & Kamphaus, 2004). The social desirability index was not analyzed for the current study. The 5-item V index was also

administered to detect careless responding or a lack of understanding of the questions on the scale. A request for a research license agreement was submitted to gain approval for using these portions of this measure. It was recommended by the BASC-2 Research Directors to add one scale from the School Problems domain, and one additional positively-oriented scale from the Personal Adjustment domain in order to provide a variety of content and more positively-worded items within the shortened version of the measure. For this reason, the Attitude to School (7 items) and Self-Esteem (9 items) subscales were also administered but were not analyzed for the current study. The Attention Problems and Hyperactivity were also administered and not analyzed for the current study. This resulted in a 70 item measure of the BASC-2-SRP-A. Response metrics included true/false (36 items) and a scale ranging from 0 (*never*) to 3 (*almost always*) for the remaining 34 items on this shortened version of the measure. Reliability of the BASC-2 SRP is supported by moderate to high internal consistency for all subscales used in the present study. Specifically, Depression ($\alpha = .88$ for ages 12-14 and $\alpha = .86$ for ages 15-18), Interpersonal Relations ($\alpha = .79$ for ages 12-14 and $\alpha = .78$ for ages 15-18).

Three types of validity evidence are provided for the BASC-2 SRP-A including scale intercorrelations in the expected directions for all scales of interest, factor analyses suggesting good model fit, and correlations among the BASC-2 and other measures of adolescent behavior. Studies determining the construct validity of the BASC-2-SRP suggest that this measure has moderate to strong relationships with other measures of similar constructs, including the Youth Self-Report (YSR) Form from the Achenbach System of Empirically Based Assessment (ASEBA; Achenbach & Rescorla, 2001). Furthermore, the Attention problems subscale was shown to have a .59 correlation with the Inattentive subscale of the well-validated Conner's Rating Scale, and the Hyperactivity subscale of the BASC-2 has a correlation of .64 with the

Hyperactive/Impulsive subscale from the Conner's. The BASC-2-SRP-A Depression subscale was shown to highly correlate with the Children's Depression Inventory (CDI; $r = .69$). This measure was selected due to its strong psychometric properties within a large school-based general population sample which was representative of U.S. demographics, as well as within a large clinical sample (age 8-18). This scale is also commonly used by school psychologists.

Teacher measures.

Teacher's Rating Scale of the Child's Actual Behavior. The Self-Perception profile for Adolescents Teacher's Rating Scale (SPPA-TRS; also referred to as the Teacher Rating Scale of Student's Actual Behavior; Harter, 1988; see Appendix F) is directly comparable to the SPPA and is used to assess student domain-specific competence. Five items for each of the domains—Scholastic Competence, Social Acceptance, and Close Friendships—were used in the current study, for a total of 15 items. Only two items per subscale were pulled from Harter's original measure, with the other three items per subscale created to align with the Adolescent version of this measure. Permission was granted by the author of this measure (S. Harter, personal communication, July 11, 2012) to administer additional items (Harter, 1988). Items completed by teachers were directly compared to the corresponding items from the SPPA. To complete this measure, teachers were first asked to decide which of two opposite sentences best described the actual competence of the target student. For example, "This child is really good at his/her schoolwork OR This child can't do the school work assigned." Secondly, the teacher was asked to indicate whether he or she believes the statement was "sort of true" or "really true" for the student. Each item on the SPPA-TRS is scored from 1 to 4, with one indicating low perceptions of student competence and four indicating high teacher perceptions of student competence. After accounting for items that are reverse scored, items within each domain were averaged, resulting

in separate subscale means for each domain. The Close Friends subscale was not analyzed in the current study due a very high rate of missing teacher data on those items (29% of teachers skipped all five Close Friends items but completed items corresponding to the social and academic subscales). When available, ratings from two teachers were averaged to increase the reliability of teacher ratings and so that one representative score could be used for the purpose of analyses. The robustness of results were explored by repeating analyses using single teacher ratings and results were similar. Averaging the Harter scales across multiple raters has been done in other studies investigating the PIB, with multiple teacher ratings (Hoza et al., 2004), parent and teacher ratings (Scholtens et al., 2011), and ratings from 6-8 counselors in a summer treatment program (Mikami et al., 2010).

Specific psychometric properties for the teacher rating scale are not reported in the manual; however, there is evidence of high internal consistency reliability (alpha coefficients of .96 and .93 for the Scholastic Competence and Social Acceptance domains, respectively) of an earlier version of this rating scale which included seven items per domain (including the items retained in the current measure; Harter, 1982). This early version of the scale did not include the Close Friendship subscale (Harter 1982). According to the developer of these scales, items per subscale were reduced to two items during scale revisions because teacher ratings were highly reliable with just two items (S. Harter, personal communication, August 29, 2009). The author of this scale suggests that the alpha coefficients of the revised two item SPPA-TRS subscales (which includes all three subscales of interest) range from .80 to .90 (S. Harter, personal communication, August 29, 2009). In selecting the two items, developers chose items that most contributed to the alpha coefficient (Harter, 1988). One recent study investigating the PIB used the social acceptance subscale of the current two-item version of the SPPA-TRS and found

adequate internal consistency with parents ($\alpha = .77$) and teachers ($\alpha = .82$; Scholtens et al., 2011). No data on the internal consistency of the two-item close friendship and scholastic competence subscales were found in past literature, and three additional items were added in consultation with the author of this measure (see Table 6 for scale reliability in the current study).

Vanderbilt ADHD Diagnostic Teacher Rating Scale. The Vanderbilt ADHD Diagnostic Teacher Rating Scale (VADTRS; Wolraich, Feurer, Hannah, Baumgaertel, & Pinnock, 1998; see Appendix F) is a 43-item scale that was used for teacher report of the presence and severity of IA and HI displayed by a student in their classroom. The VADTRS items directly correspond to ADHD diagnostic criteria (APA, 2000). To complete this scale, the teacher was asked to respond in the context of age-appropriate behaviors for the student. Nine items each assess IA and HI symptoms, which allowed for the investigation of general ADHD symptoms as well as specific ADHD symptoms separately, consistent with a bifactor model. Examples of items from these scales include: “Is forgetful in daily activities” and “fidgets with hands or feet or squirms in seat”, respectively. The VADTRS also includes items that can be used to screen for coexisting conditions including oppositional/conduct and anxious/depressive behaviors (17 items). Example items from these scales include “is spiteful and vindictive” and “is self-conscious or easily embarrassed”, respectively. ADHD and comorbid symptoms are rated on a scale from 0 (*never*) to 3 (*very often*). The teacher also rated eight items that relate to functional impairment in the academic and classroom behavior domains. While the initial plan for this study was for teachers to complete the teacher version of the BASC-2 for each student; the brief VANDTRS performance items were selected instead in an effort to reduce the total number of items on the teacher surveys. Specific performance items include “written expression” and “assignment

completion.” The performance measures are rated from Problematic (1) to Above Average (5). Within the current study, the degree of IA, HI, and overall ADHD symptoms were considered for each student participant, with the degree of these symptoms ranging from 0 to 3 (IA and HI were averaged across the 9 items of the VADTRS representing each subtype, whereas overall ADHD symptoms were the average of all 18 symptoms). Ratings from multiple teachers were averaged (when available) to enhance reliability and so that one representative score could be used for the purpose of analyses. However, the robustness of results was explored when analyses were repeated using single teacher ratings of ADHD symptoms as well, and all results were similar.

The VADTRS is reported to have adequate internal consistency for both the Inattention (coefficient alpha = .92) and the Hyperactivity/Impulsivity (coefficient alpha = .90) with an economically and ethnically diverse standardization sample from Tennessee (Wolraich et al., 1998). In a study sampling from Spain, Germany, and urban and suburban U.S. regions, internal consistencies ranged from .95 to .96 for Inattention items, and from .87 to .93 for Hyperactivity and Impulsivity items (Wolraich, Lambert, Baumgaertel, Garcia-Tornel, Fuerer, Bickman, et al., 2003b). Internal consistencies ranged from .91 to .94 across samples from an urban elementary school system (Wolraich et al., 2003a). Using confirmatory factor analysis, Wolraich and colleagues (1998) found that data most strongly supported a two-factor solution (Inattention and Hyperactivity/Impulsivity separately) rather than considering all the symptoms together or as three separate symptoms (e.g., Inattention, Hyperactivity, and Impulsivity).

Table 3

Measures Administered and Analyzed for the Current Study

Construct	Scale/Subscale
Student Survey	
Student Demographics	Student demographic form
Academic Self-Perceptions	Self-Perception Profile for Adolescents (SPPA) Scholastic Competence Subscale
Social Self-Perceptions	SPPA Social Acceptance
Depression	BASC-2-SRP-A Depression subscale
Social Functioning	BASC-2-SRP-A Interpersonal Relations subscale
Careless responding/limited understanding	BASC-2-SRP-A V-Index
Teacher Survey	
Academic Competence	Teacher's Rating Scale of the Student's Actual Behavior (SPPA-TRS) Scholastic Competence subscale
Social Competence	SPPA-TRS Social Acceptance subscale
ADHD Symptoms	Vanderbilt ADHD Diagnostic Teacher Rating Scale (VADTRS) Inattention and Hypactive/Impulsive subscales
Impairment at School	VADTRS Performance Items

Analyses

A series of statistical analyses were performed to answer the research questions addressed in this study. Prior to performing data analysis, data were entered into Excel 2010 and then imported into SPSS 21 and Mplus 7.1 statistical software which was used for all analyses. Steps in data-preparation included: developing a procedure to account for missing data (i.e., use an average of available items if more than two-thirds of the data on a given scale were available for each participant); screening for outliers; running descriptive statistics to determine the mean, standard deviation, range, skew, and kurtosis for each variable (see Table 5); and examining the correlation matrix to determine the bivariate associations between all variables of interest in this study (see Table 7). Particular attention was given to correlations between the social subscale of the SPPA and the Interpersonal Relations subscale of the BASC-2-A-SRP, and the academic subscale of the SPPA-TRS with classroom performance items from the VADTRS. These correlations provided a secondary source of information about competence, to see if responses to

the VADTRS items (which teachers may be more familiar with) correlate with ratings of the same domain on the SPPA. Correlations between teacher ratings were also examined for ADHD symptom and competence ratings. Validity indices on the BASC-2-A-SRP measure were also calculated to provide information about biased responding.

The assumptions of polynomial regression were then examined. Polynomial regression/response surface methods are based on the assumption that the measurement models underlying each construct (student and teacher ratings) are equivalent. Invariance testing of the factor loadings and intercepts within confirmatory factor analysis (CFA) for the SPPA and SPPA-TRS was used to provide a rigorous test of this key assumption. The following section provides an overview of the analyses used to answer the research questions of interest in the current study.

Research question analyses. Each of the following research questions was addressed using discrepancy analysis as well as polynomial regression and response surface methods:

1. How does agreement and disagreement between self and teacher ratings of competence (academic and social domains) predict the level of general ADHD symptoms among high school students?
2. How does agreement and disagreement between self and teacher ratings of competence (academic and social domains) predict the level of HI symptoms among high school students?
3. How does agreement and disagreement between self and teacher ratings of competence (academic and social domains) predict the level of IA symptoms among high school students?

Two separate analyses, one for each domain of competence (e.g., academic and social), were conducted to investigate symptoms as outcome variables in analyses with self and teacher ratings as predictors. Six polynomial regression analyses with response surface methods were conducted, with these analyses repeated for significant covariates. However, it is suggested that the base rate of discrepancies within the sample be examined as a prerequisite for conducting polynomial regression (Shanock et al., 2010). To accomplish this, standardized difference scores (such as those used in past research on the PIB) were calculated between self and teacher ratings. Any participant with one predictor variable (e.g., student rating) half a standard deviation above or below the other predictor variable (e.g., teacher rating on the same construct) was considered to have a discrepancy based on methods proposed by Fleenor and colleagues (1996). Percentages of cases of agreement and disagreement were then examined in both the academic and social domains (see Table 12). This preliminary analysis was conducted to determine the practical value of completing more complex analyses. If very few discrepant values were identified in the data then it would not make sense to proceed with analyses focused around agreement and disagreement. Based on results of Fefer (2011), it was expected that approximately one third of the sample would demonstrate overestimation of competence using this method.

The identified discrepancies between self-ratings and teacher-ratings in the data provided a rationale for moving forward to conduct analyses. Discrepancy analyses using MANOVA were completed as a first step to enhance comparability to past research on the PIB (e.g., Hoza et al., 2004). Before running polynomial regressions, competence rating variables were centered around 2.5 (the midpoint of the 4-point scale used by the SPPA and SPPA-TRS) to enhance interpretability and reduce potential issues related to multicollinearity as recommended by

Edwards (2002) and Shanock and colleagues (2010). The next step of the polynomial regressions was to create six new variables, three in both the academic and social domains: (1) the square of the centered self-competence rating, (2) the interaction (i.e., cross-product) between centered self and teacher ratings, and (3) the square of the centered teacher rating of student competence. To conduct polynomial regressions, demographic covariates (i.e., age and gender) and depressive symptoms were entered into the polynomial regression model first. Next, the outcome variable of interest for each specific research question was regressed (overall ADHD, IA, or HI depending on the specific research question) on the centered simultaneously entered predictor variables (self and teacher ratings). Polynomial regression equations typically take this form:

$$Z = b_0 + b_1X + b_2Y + b_3X^2 + b_4XY + b_5Y^2 + e \quad (1)$$

For the purpose of the current study, Z represents the dependent variable of ADHD symptoms (overall symptoms, IA, or HI depending on the research question being investigated), X is the first predictor (i.e., self-ratings of competence), Y is the second predictor (i.e., teacher ratings of competence), X^2 is the square of the self-ratings predictor, Y^2 is the square of the teacher ratings predictor, XY is the cross product, b_0 is the intercept, b_1 through b_5 represent the estimated coefficients, and e is the error (Kazen & Kuhl, 2011). When results of the regression analyses were obtained, the variance of the outcome explained by the regression equation was examined by looking at R^2 (Kazen & Kuhl, 2011; Shanock et al., 2010). If R^2 was significantly different than zero then the coefficients from this regression analysis were used with response surface methods. The response surface pattern was graphed as a three-dimensional visual representation to ease the interpretation of results related to the complex relationship between the competence ratings and symptoms. Specifically, four surface

test values were examined and graphed: a_1 through a_4 . These were calculated with the coefficients obtained from the regression analyses. The slope of the line of perfect agreement was represented by a_1 , which was calculated by adding b_1 (the unstandardized beta coefficient for the first predictor, in this case self-ratings of competence) to b_2 (the unstandardized beta coefficient for the second predictor, teacher-ratings of competence). The curvature of the line of perfect agreement was assessed by a_2 , which was calculated by adding b_3 (the unstandardized beta coefficient for squared self-ratings), b_4 (unstandardized beta coefficient for the interaction between self and teacher ratings), and b_5 (unstandardized beta for squared teacher ratings). The slope of the line of incongruence (which represents the direction of the discrepancy between self and teacher ratings) was assessed by a_3 , which was calculated by subtracting b_2 (unstandardized beta coefficient of teacher-rating) from b_1 (unstandardized beta coefficient for self-rating). The curvature of this line of incongruence (which is the indication of the degree of the discrepancy between self and teacher ratings) was represented by a_4 which is equal to $b_3 - b_4 + b_5$ (unstandardized beta coefficient for squared self-ratings minus unstandardized beta coefficient for cross-product of self and teacher ratings plus unstandardized beta for squared teacher ratings). Three-dimensional graphs using these four response surfaces were developed for each research question, for a total of six graphs, using an Excel template available through Shanock (2010). As can be gathered from the description of the four response surfaces above, these graphs were examined to determine: (1) how self-teacher agreement relates to ADHD symptoms, (2) the degree of discrepancy between ratings which best predicts the presence of these symptoms, and (3) how the direction of the discrepancy between self and teacher ratings affects the presence of ADHD symptoms. These analyses offer more information than discrepancy scores about the relationship between self and teacher ratings and ADHD symptoms. An enhanced understanding

of the PIB will serve to advance current knowledge of the PIB within the field of school psychology.

Ethical Considerations

Precautions were taken throughout the current study to protect all participants. Approval from the University of South Florida Institutional Review Board (IRB) and the Department of Assessment and Accountability within the collaborating local school district was obtained prior to data collection to ensure that precautions were taken to protect human research participants throughout the entirety of this research project. Approval was received in January 2013 for data collection to occur during the Spring 2013 semester.

A parental consent form outlining the goals and procedures for the project was distributed so that parents were aware of all aspects of the study and could make an informed decision about whether or not to allow their son or daughter to participate. All of the potential risks and benefits associated with the child's participation in the study were included in this parent consent letter. The letter also included the contact information for the PI so that parents were provided with an opportunity to discuss questions or concerns pertaining to the nature of the project. A student assent form outlining the risks and benefits was also provided to students, and each student was given the choice of whether or not to participate. Additionally, time was provided to answer students' questions and inform students of their option to withdraw from the study at any time. Participating students' teachers were also provided with a copy of a consent letter (see Appendix C) describing the study purpose and the timeframe for survey completion. This letter also included contact information for the PI to provide teachers with the opportunity to ask any questions they had.

Participants' confidentiality was ensured in part by examining data only in aggregate; individual students will not be identifiable in any published documents. All students were assigned a code number for the database, and their data include this code number but not their names. The file linking the code numbers to student names was kept in a locked and separate location from the data. All completed survey packets were kept in a locked filing cabinet which could only be accessed by the PI. The one exception to confidentiality was shared with all participants (in consent and assent forms) with an emphasis on the fact that responses would *not* be shared *unless* a student indicated that they intended to harm themselves or someone else, or had depression scores in the clinical range (greater than 70). In this case, the student's name was provided to the school psychologist so that he or she could determine if additional follow-up was needed (a total of nine names were shared across the two schools due to elevated depression scores, and no students indicated an intent to harm themselves/others).

Chapter Four: Results

This chapter presents the results of statistical analyses used to answer the research questions for the current study. First, procedures used to check data entry accuracy and screen the data gathered are presented. Preliminary analyses will follow, which include descriptive statistics, scale reliabilities, and correlations among all variables of interest. Results of invariance testing through confirmatory factor analysis (CFA) are then presented to test the assumption of measurement equivalence across student and teacher measures. Results of discrepancy analyses within each domain are then shared in order to relate the results of this study with past research on the PIB, and so that the results obtained with this more commonly used method can be compared to the new methodology used in the current study. Lastly, the research questions described previously will be answered with results of polynomial regression and response surface analyses examining how self and teacher ratings of competence predict overall ADHD, inattentive, and hyperactive/impulsive symptoms within both the academic and social domains.

Preliminary Analyses

Accuracy of data entry. Student and teacher survey data were hand-entered into an excel database by graduate student members of the USF ADHD research team. The data entry file was set up with restrictions so that a cell would be highlighted if a value outside of the expected range was entered. Upon completion of data entry, all data were visually inspected for any numbers out of the possible range of responses and every tenth survey packet was checked for data entry errors by a member of the research team. When an error was found in one or more cells, the entire survey directly before and after the survey with the error was checked for

accuracy. This process resulted in a total of 11.4% of surveys being checked (127 of 1114 surveys across students and teachers). A total of 15 errors were detected across these 127 packets, with an average accuracy rate of 99.86% (15 cells out of 10,567 total cells checked contained errors) across student and teacher data.

Validity of data. Student scores on the BASC-2-SRP-A V index were examined to determine the validity of student survey data. The V index is a validity indicator which contains five items that are highly unlikely to be true for students and are used to indicate careless responding or failure to understand the measure (Reynolds & Kamphaus, 2004). The BASC manual indicates that students with scores ranging from 4-12 are in the “extreme caution” range. Five students had V index scores between 4 and 8. A member of the research team visually inspected the raw protocols for these five students for endorsement of impossible items (e.g., answering *Always* to the question “I have just returned from a 9 month trip on an ocean liner” or “I get phone calls from popular actors”). Each of these students endorsed more than one of the impossible items included on this scale and were therefore eliminated from the dataset due to the questionable validity of their responses.

Additionally, student English Language Learner status was determined through examination of school records. The five students identified as having Limited English Proficiency (LEP) were excluded from further analyses as they may have had difficulty understanding and responding accurately to the survey measures.

Handling of missing data. Any participant with missing data on an entire measure of interest was excluded from the dataset. Five participants were excluded due to missing all SPPA items, and nine additional participants were excluded due to missing teacher data (i.e., no teachers returned surveys about those nine participants). To retain students with only a few

items missing it was determined that all means would be calculated based on the availability of at least two-thirds of the data on that measure (i.e., at least 3 out of 5 items on the SPPA and TRS; at least 6 out of 9 items on the VADTRS). There were no instances where an average could not be calculated using the two-thirds rule for the academic and social domains of the SPPA, the academic domain of the SPPA-TRS, and the IA symptoms on the VADTRS. There were four instances where there was not enough data to calculate means in the social domain for the TRS, and two cases with more than two-thirds of data missing on the HI items of the VADTRS; however, these participants were retained due to having complete data in the academic domain and for IA symptoms. The remaining sample to be used in subsequent analyses consisted of 395 student participants (see Table 4). This sample is very similar to the total sample presented previously ($N = 420$; see Table 2).

Data screening. The sample consisting of 395 participants with complete student and teacher data was then screened using SPSS version 21 to identify the presence of univariate outliers. Based on data screening procedures suggested by Tabachnick and Fidell (2007), univariate outliers were defined as data with z -scores greater than positive or negative 3.3 on any variable of interest. Five univariate outliers for depressive symptoms were identified (z scores range from 3.33 to 4.29); however, all participants were retained because their average and total scores for the BASC-2-SRP-A were within defined limits. Each of these five participants' scores were within the clinical range of depressive symptoms with a T score of above 70. Additionally, six univariate outliers were detected for mean IA symptoms (z scores range from 3.43 to 3.63). Each of these participants had a mean score of three IA symptoms, and a total for IA symptoms of 27.

Table 4

Demographic Information for Student Sample

Variable	School A Sample (<i>n</i> =177)		School B Sample (<i>n</i> =218)		Total Sample (<i>N</i> = 395)	
	<i>n</i>	%	<i>n</i>	%	<i>N</i>	%
Gender						
Male	77	43.5	87	39.9	164	41.5
Female	100	56.5	131	60.1	231	58.5
Grade						
9	66	37.3	30	13.8	96	24.3
10	45	25.4	73	33.5	118	29.9
11	38	21.5	77	35.3	115	29.1
12	28	15.8	38	17.4	66	16.7
Ethnicity						
African-American	20	11.3	18	8.3	38	9.6
Asian/Pacific Islander	12	6.8	4	1.8	16	4.1
White	85	48.0	147	67.4	232	58.7
Hispanic	53	29.9	49	22.5	102	25.8
Native American/ Alaska Native	1	0.6	2	0.9	3	0.8
Other	13	7.3	6	2.8	19	4.8
Free/Reduced Price Lunch*	69	39.0	37	17.0	106	26.8

Note. *Free and reduced price lunch status was obtained from student records

These participants were retained because these scores were within the expected range on the VADTRS for students and indicate elevated ADHD symptoms. Fourteen cases were identified as univariate outliers for HI symptoms (z range from 3.46 to 6.68). These participants had mean levels of HI symptoms of 2 and 3, with total scores ranging from 15 to 27; all of these scores were within the expected range for the VADTRS and were indicative of high levels of HI symptoms. All participants detected as univariate outliers due to high levels of symptoms of interest were retained for analyses because students with higher levels of symptoms are of particular interest in the current study, and all scores were within the possible ranges of the measure.

Descriptive statistics. Descriptive statistics for the measures of interest in the current study are presented in Table 5. Means, standard deviations, range, skew, and kurtosis of each of the variables were calculated. Overall, symptom means were low; however, a full range of symptoms is evidenced within the current sample (see Table 5). Twenty-four students (6.1% of the total sample) reported that they were diagnosed with ADHD on the demographic measure. This number is just slightly below prevalence from past studies, which suggest that 7-10% of school aged children are diagnosed with ADHD (Barbaresi et al., 2002; Froehlich et al., 2007). Skew and kurtosis were included to assess for univariate normality. All of the competence ratings were approximately normally distributed (skew and kurtosis between -1.0 and +1.0), while each of the symptom variables (i.e., IA, HI, and depressive symptoms) were outside normal limits. Inspection of the data indicated that all levels of symptoms were within the range allowable by the symptoms scales used within the current study. Because the skew and kurtosis for the hyperactive/impulsive and overall ADHD symptom variables were higher than others, these variables were transformed (square root transformation used as suggested by Tabachnick and Fidell (2007) for instances of moderately positive skew). This transformation resulted in more acceptable levels of skew and kurtosis for both variables (see Table 5). Analyses were run with and without these variables transformed and results differed. Due to the substantial improvement in skew and kurtosis resulting from the square root transformation, results of analyses with transformed hyperactive/impulsive and overall ADHD variables are reported for all analyses. The decision to use transformed variables was made because the analyses used for this study require normally distributed data and using transformed variables allows this assumption of normality to be met.

Table 5

Means, Standard Deviations, Ranges, Skew, and Kurtosis of All Measures

Variable	<i>N</i>	<i>M</i>	<i>SD</i>	Range	Skew	Kurtosis
Inattentive Symptoms (VADTRS)	395	0.54	0.63	0-3	1.54	2.20
Hyperactive/Impulsive Symptoms (VADTRS)	393	0.16	0.36	0-2.89	3.55	16.02
Hyperactive/Impulsive Symptoms- Transformed (VADTRS)	393	0.23	0.34	0-2	1.55	1.98
Overall ADHD Symptoms (VADTRS)	393	0.35	0.44	0-3	2.05	5.43
Overall ADHD Symptoms- Transformed (VADTRS)	393	0.46	0.37	0-2	0.49	-0.36
Depressive Symptoms (BASC-2-SRP-A)	395	0.43	0.41	0-2	1.31	1.75
Academic Self-Perceptions (SPPA)	395	2.96	0.65	1-4	-0.34	-.47
Social Self-Perceptions (SPPA)	395	3.05	0.66	1-4	-0.49	-0.19
Teacher Ratings of Academic Competence (SPPA-TRS)	395	3.15	0.68	1-4	-0.70	-0.07
Teacher Ratings of Social Competence (SPPA-TRS)	395	3.17	0.57	2-4	-0.46	-0.36
Academic Discrepancy Scores (Student- Teacher)	395	-0.19	0.78	-2-2	0.30	0.31
Social Discrepancy Scores (Student- Teacher)	391	-0.13	0.77	-3-2	-0.19	0.34

Note. Higher scores reflect increased levels of the construct indicated by the variable name. The untransformed ADHD and HI variables were not used for analyses; these are included here to compare to the transformed variables used for analyses.

Measure reliability. Prior to subsequent analyses, all scales of interest within the study (i.e., SPPA and SPPA-TRS academic and social domains, VADTRS inattentive and hyperactive/impulsive subscales, and the BASC-2-SRP-A depression subscale) were analyzed to determine their internal consistency. Cronbach's alpha coefficients, an index of scale reliability, were calculated. Alpha coefficients of .70 or above are considered to indicative of adequate internal consistency for research purposes (Nunnally, 1978). Coefficients ranged from .79 (SPPA Academic and Social Competence) to .96 (Inattentive subscale of VADTRS), indicating acceptable estimates of reliability for each scale (see Table 6).

Table 6

Cronbach's Alpha (α) for all Measures

Scale Name	Number of Items	Cronbach's Alpha (α)
Academic subscale of SPPA	5	.79
Social subscale of SPPA	5	.79
BASC-2-SRP-A Depression subscale	11	.81
Academic subscale of SPPA-TRS	5	.95
Social subscale of SPPA-TRS	5	.91
Inattentive subscale of VADTRS	9	.96
Hyperactive/Impulsive subscale of VADTRS	9	.92

Correlational analyses. Pearson product-moment correlation coefficients among all variables of interest in the current study are presented in Table 7. The academic subscale of the SPPA and the corresponding teacher rating on the SPPA-TRS were moderately correlated ($r = .31, p < .01$), while there was only a small correlation between student and teacher versions of the social subscale ($r = .22, p < .01$). Moderate correlations are evident between the academic and social subscales for students ($r = .34, p < .01$) and teachers ($r = .48, p < .01$).

A large positive correlation was found between the HI and IA symptom subscales of the VADTRS ($r = .56, p < .01$). This is in line with past research suggesting that these two symptoms are highly correlated (e.g., Wolraich et al., 2003). It was expected that there would be large positive correlations with the ADHD symptom variables (HI and IA) and total ADHD symptoms ($r = .81$ and $.94$, respectively, $p < .01$). A large negative correlation was evident between inattentive symptoms and teacher ratings of academic competence ($r = -.73, p < .01$). This is in line with research suggesting that greater levels of IA symptoms are associated with significant academic impairments (Short et al., 2007). Moderate negative correlations were detected between depressive symptoms and self-perceptions in the academic and social domains

($r = -.30$ and $-.39$ respectively, $p < .01$). This was expected as higher levels of depressive symptoms are associated with lower self-concept in adolescents (Gladstone & Kaslow, 1995).

The academic and social accuracy variables (i.e., teacher competence ratings subtracted from student competence ratings in each domain) were shown to be significantly correlated with the individual measures that make-up those scores. Large positive correlations were evident between the accuracy variables and the student ratings, and large negative correlations were detected between the accuracy variables and the corresponding teacher ratings ($r = .57$ and $-.61$ in the academic domain, and $r = .70$ and $-.55$ in the social domain, $p < .01$).

It is promising that two of the highest positive correlations were found between the two student-rated indicators of social competence (the Interpersonal Relations subscale of the BASC-2-SRP-A and the Social subscale of the SPPA; $r = .72$, $p < .01$), and two teacher rated indicators of academic competence (Academic Performance subscale of the VADTRS and the Academic competence subscale of the SPPA-TRS; $r = .86$, $p < .01$). These strong correlations provide an indicator of validity for the SPPA-TRS competence ratings used in analyses.

Measurement Invariance

Invariance testing using confirmatory factor analysis (CFA) was conducted to test the equivalence of the teacher and student competence measures (SPPA and SPPA-TRS). This was an important first step in order to determine if the assumption of measurement equivalence was met before moving forward with polynomial regression. These analyses were conducted using Mplus 7.1 (Muthén and Muthén, 2012) and used maximum likelihood estimations. Longitudinal factorial invariance procedures (Widaman, Ferrer, & Conger, 2010) were used rather than multi-group invariance testing because student and teacher data were linked (see Figure 2).

Table 7

Correlations Between All Variables of Interest

Variable	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
1. Academic Self-Perceptions	1										
2. Social Self-Perceptions	.34**	1									
3. Academic Teacher Ratings	.31**	.03	1								
4. Social Teacher Ratings	.14**	.22**	.48**	1							
5. Inattentive Symptoms	-.22**	.06	-.73**	-.31**	1						
6. Hyperactive/Impulsive Symptoms	-.12*	.14**	-.23**	.03	.56**	1					
7. ADHD Symptoms	-.20**	.10	-.62**	-.24**	.94**	.81**	1				
8. Depressive Symptoms	-.30*	-.39**	-.08	-.13*	.07	-.04	.04	1			
9. Academic Accuracy	.57**	.26**	-.61**	-.30**	.45**	-.11*	.37**	-.19**	1		
10. Social Accuracy	.19**	.70**	-.33**	-.55**	.28**	.15**	.26**	-.24**	.45**	1	
11. Interpersonal Relations (BASC-2-SRP-A)	.32**	.72**	.05	.20**	-.04	.05	-.01	-.52**	.23**	.47**	1
12. Academic Performance VADTRS	.34**	.07	.86**	.41**	-.62**	-.21**	-.53**	-.09	-.46**	-.25**	.08

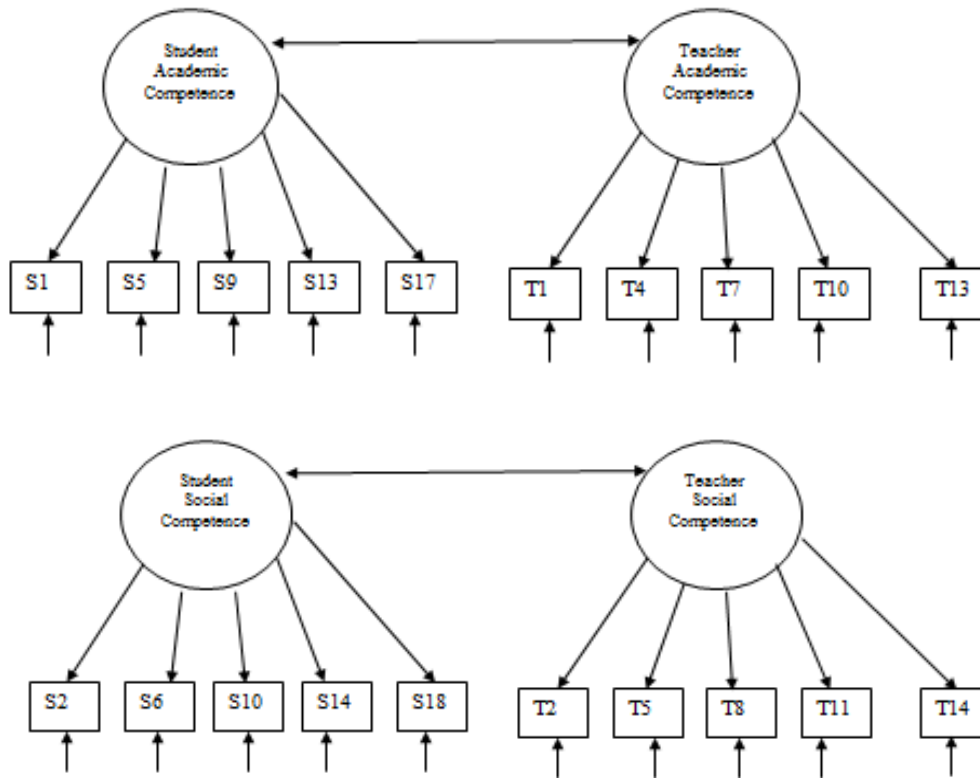


Figure 2. Confirmatory factor analysis model used to test measurement invariance of corresponding items for student self-rating of their competence (SPPA; Harter, 1988) and teacher rating of student competence (SPPA-TRS; Harter, 1988). Numbers represent scale items (Academic: S1=T1, S5=T4, S9=T7, S13=T10, S17=T13; Social domain: S2=T2, S6=T5, S10=T8, S14=T11, S18=T14).

The measurement models underlying the SPPA and SPPA-TRS academic and social scales each include two correlated factors (i.e., academic competence and social acceptance). Each subscale includes five items as shown in Figure 2, and in Tables 8 and 10. Based on methods proposed by Widaman and colleagues (2010), the CFA model was first fit with configural invariance and minimal constraints separately for both the academic and social domains (see Tables 8 and 10). This was then followed by an examination of metric invariance and scalar invariance within both the social and academic domains. An explanation of these methods and the results are provided below. The fit of these models was evaluated by considering a variety of fit indices together as

there is no consensus in the literature about what index is best for difference purposes. These indices include: root mean square error of approximation (RMSEA), the standardized root mean square residual (SRMR), and the comparative fit index (CFI). According to criteria set by Kline (2005), RMSEA values between .05 and .08 indicate an adequate fit, while a CFI value of .90 or greater is considered to be adequate. Hu and Bentler (1999) suggests that CFI values greater than .95 are needed to consider fit adequate, and suggest that SRMR should be less than .08. Chi-square tests of model fit were also examined to determine the extent of chi-square change across models relative to the change in degrees of freedom. This process involves comparing the chi-squares obtained in a sequence of models that are more restrictive due to added constraints placed on loadings and intercepts (Widaman et al., 2010). Comparing chi-square values across these models provides information about how much worse the fit of the model becomes at each step. It is expected that chi-square values increase as the model becomes more restrictive; however, the level of change in chi-square needed to accept or reject the hypothesis tested at each step is dependent on the change in the degrees of freedom between the models compared. Cole, Gondoli, and Peeke (1998) suggest that chi-square should not be the only fit index considered when investigating models with large sample sizes. These authors suggest that small discrepancies between the model and the data can lead to a significant chi-square within large samples, and assert that other indices (such as those included in Tables 9 and 11) be examined to determine if the size of discrepancy is large enough to be concerning.

Configural invariance tests the hypothesis that the factors being examined are associated with identical items (i.e., same number of factors and patterns of loadings)

across the student and teacher measures (Gregorich, 2006). Within this model the first item loading and intercept were set equal for identification (see Tables 8-11). The latent mean for teachers was fixed to 0 and teacher variance was set to 1.0, while the latent mean and variance was estimated freely for the student measure (Widaman et al., 2010). All fit indices investigated provided evidence of adequate fit for this model within the academic and social domains (see Tables 9 and 11). The results obtained for this baseline model with no equality constraints indicate that the academic and social factors of the SPPA and SPPA-TRS consist of the same set of items across groups.

Since the configural models evidenced adequate fit, the metric invariance model was investigated separately for the academic and social domains to determine if these factors have the same meaning across students and teachers (Gregorich, 2006). Metric invariance requires factor loadings for corresponding items to be equal across groups. Latent mean and variance were again set to 0 and 1.0, respectively, for teachers and were estimated freely for students.

Academic domain. In the academic domain, fit indices for the metric model provide evidence of adequate fit with the exception of the slightly elevated RMSEA (see Table 9). However, the change in the chi-square test for model fit was significant ($p < .001$) for four degrees of freedom; this indicates a lack of metric invariance across student and teacher measures of academic competence. This means that factor pattern coefficients were significantly different for students and teachers; therefore, the items on the SPPA and SPPA-TRS do not relate to the construct of academic competence the same way across both groups of respondents. The next step was to investigate metric invariance for individual sets of items in the academic domain (see Table 9). Change in

chi-square demonstrated that only two pairs of items demonstrate metric invariance within the academic domain of the SPPA and SPPA-TRS (items T10/S13 and TA13/S17; see Tables 8 and 9). However, when the loadings for both of these sets of items were constrained to be equal the model once again did not demonstrate evidence of metric invariance. It is important to note that all other fit indices, beyond chi-square tests, indicated good model fit for the majority of individual items (with the exception of the RMSEA for S9/T7; see Tables 8 and 9). Cole and colleagues (1998) suggest that these other fit indices should be considered highly with larger sample sizes, and would suggest that this model demonstrates at least partial measurement invariance. However, results using change in chi-square suggest the presence of non-uniform differential item functioning (DIF), meaning that items representing academic competence function differently across groups and differently across the five items representing academic competence. For this reason, caution should be used when drawing conclusions related to discrepancies between self-rated and teacher-rated academic competence.

Social domain. In the social domain all fit indices for the metric model provided evidence of adequate fit (see Table 11). The change in the chi-square test for model fit was not significant ($p > .05$) for four degrees of freedom; this indicates that the assumption of equal factor loading for the items across adolescent and teacher informants was tenable. This means that items on the SPPA and SPPA-TRS related to the construct of social competence the same way across both groups of respondents.

Table 8

Academic Competence: Configural Model

Student Ratings						Teacher Ratings					
Item	Unstandardized factor loading	SE	Intercept	SE	Error	Item	Unstandardized factor loading	SE	Intercept	SE	Error
“Some students...”						“This individual...”					
S1 “feel that they are just as smart as others their age”	1.00	--	2.96	.05	0.45	T1 “Just as smart as others his/her age”	1.00	--	3.46	.03	0.12
S5 “pretty slow at finishing their schoolwork”	0.82	.09	2.71	.05	0.69	T4 “is pretty slow at finishing their schoolwork”	1.19	0.06	3.08	.04	0.23
S9 “do very well on their classwork”	0.66	.07	3.29	.04	.35	T7 “does well at classwork”**	1.09	.05	3.28	.04	.19
S13 “have trouble figuring out the answers in school”	0.96	.08	2.74	.04	.36	T10 “has trouble figuring out the answers in school”	1.16	.05	3.22	.04	.14
S17 “feel that they are pretty intelligent”	1.06	.08	3.08	.04	.27	T13 “is intelligent”**	1.02	.04	3.44	.03	.10

Note. Correlation between student academic competence and teacher ratings of student academic competence is .29. ** = item included in the original Harter teacher measure. Latent mean differences indicate a significant difference in the academic domain, the latent student mean was .84 units lower than the teacher.

Table 9

Model Fit Statistics- Academic Domain

Model	χ^2	df	$\Delta\chi^2$	Δdf	Reference Model	CFI	RMSEA	SRMR
1. Configural	122.01	34	--	--	--	0.96	0.08	0.03
2. Metric	159.74	38	37.74	4	1 ($p < .001$)	0.95	0.09	0.08
Loading for individual items were tested one at a time.								
3. Metric T4/S5	132.09	35	10.08	1	1 ($p < .001$)	0.96	0.08	0.05
4. Metric T7/S9	142.91	35	20.90	1	1 ($p < .001$)	0.95	0.09	0.07
5. Metric T10/S13	124.93	35	2.92	1	1 (ns)	0.96	0.08	0.04
6. Metric T13/S17	122.20	35	0.20	1	1 (ns)	0.96	0.08	0.04
7. Metric (loadings for T10/S13 and TA13/S17 equal)	129.40	36	7.39	2	1 ($p < .05$)	0.96	0.08	0.05

Note. Configural = all parameter estimates except for those used to identify the model were freely estimated. Metric = Item factor loadings were constrained to be equal. Scalar = Item intercepts were constrained to be equal. CFI = Comparative Fit Index; RMSEA = Root Mean Square Error of Approximation; SRMR = Standardized Root Mean Square Residual.

Next, scalar invariance was investigated by constraining the intercepts of all items to be equal across student and teacher measures. Intercepts are similar to mean scores and represent the extent to which the item was endorsed. The first loading and intercept were set equal for identification across teacher and student informants. The latent mean for teachers continued to be fixed to 0 and teacher variance was set to 1.0, while the latent mean and variance was still estimated freely for the student measure (Widaman et al., 2010). Within the social domain, the change in chi-square with these additional constraints was significant ($p < .01$) suggesting that the intercepts were significantly different for students and teachers. Intercepts for each set of corresponding items were then set to be equivalent one at a time and the chi-square change was used to determine the presence of scalar invariance. Each of these analyses indicated a significant change

in chi-square value meaning that student and teacher intercepts differed. One additional scalar model with the two sets of items demonstrating the least change in chi-square (T5/S6 and T11/S14) set equal was examined to determine the presence of partial measurement invariance; however, the change in chi-square for this model was also significant for two degrees of freedom, with student ratings lower than teacher ratings. Therefore, the hypothesis that intercepts were equivalent across students and teachers was not tenable and scalar invariance was not achieved in the social domain. It is important to note that the other fit indices examined demonstrated adequate fit for all scalar models with individual item sets constrained to be equal, with the exception of items T8/S10 (as seen in Tables 10 and 11). These findings provide evidence of uniform DIF because loadings are equivalent but intercepts differ across groups. When examining latent intercepts, teacher ratings on these items were consistently higher than student ratings. Taken together these results support partial invariance of the measurements of social competence across informants and suggest additional cautions are needed in interpreting informant discrepancies using polynomial regression because teachers were more likely to highly endorse these social competence items than students.

Taken together these results indicate that the measurement models for the SPPA and SPPA-TRS are operating somewhat differently for students and teachers within both the academic and social domains. Unequal factor loadings were identified within the academic domain, with lack of evidence of metric invariance. This suggests that students and teachers respond to items within the academic factor differently.

Table 10

Social Competence: Configural Model

Student						Teacher					
Item	Unstandardized factor loading	SE	Intercept	SE	Error	Item	Unstandardized factor loading	SE	Intercept	SE	Error
S2 “find it hard to make friends”	1.00	--	3.08	.05	.49	T2 “has a hard time making friends”	1.00	--	3.30	.04	.11
S6 “have a lot of friends”	1.03	.08	3.10	.05	.35	T5 “does not have a lot of friends”**	1.05	.04	3.19	.04	.12
S10 “are very hard to like”	0.49	.07	3.08	.04	.60	T8 “very hard to like”	0.49	.04	3.58	.03	.24
S14 “are popular with others their age”	0.94	.08	2.88	.04	.32	T11 “is popular”**	1.03	.04	2.95	.04	.20
S18 “feel that they are socially accepted”	0.83	.08	3.11	.04	.43	T14 “is socially accepted”	0.71	.04	3.49	.03	.19

Note. Correlation between student social competence and teacher ratings of student social competence is .23. ** = item included in the original Harter teacher measure. Latent mean differences indicate a significant difference in the social domain, the latent student mean was .33 units lower than the teacher.

Table 11

Model Fit Statistics- Social Domain

Model	χ^2	<i>df</i>	$\Delta\chi^2$	Δdf	Reference Model	CFI	RMSEA	SRMR
1. Configural Model	86.71	34	--	--	--	0.97	0.06	0.05
2. Metric Model	92.35	38	5.64	4	1 (<i>ns</i>)	0.97	0.06	0.06
3. Scalar Model (all intercepts equal)	222.61	42	130.26	4	2 ($p < .001$)	0.89	0.10	0.10
Intercepts for individual items were tests one at a time.								
4. Scalar (T5 and S6 equal)	98.10	39	5.75	1	2 ($p < .05$)	0.97	0.06	0.06
5. Scalar (T8/S10 equal)	152.09	39	59.74	1	2 ($p < .001$)	0.93	0.09	0.08
6. Scalar (T11/S14 equal)	99.64	39	7.30	1	2 ($p < .01$)	0.96	0.06	0.06
7. Scalar (T14/S18 equal)	112.01	39	19.66	1	2 ($p < .001$)	0.96	0.07	0.07
8. Scalar (T5/S6 and T11/S14 equal)	100.77	40	8.42	2	2 ($p < .05$)	0.96	0.06	0.06

Note. Configural = all parameter estimates except for those used to identify the model were freely estimated. Metric = Item factor loadings were constrained to be equal. Scalar = Item intercepts were constrained to be equal. CFI = Comparative Fit Index; RMSEA = Root Mean Square Error of Approximation; SRMR = Standardized Root Mean Square Residual.

While metric invariance was established in the social domain, scalar invariance was not demonstrated. This suggests that students and teachers rate social competence differently, with students rating themselves lower than teachers. Although polynomial regression analyses are conducted with observed variables, these analyses provide information about the latent measurement model that should be taken into account when drawing conclusions from polynomial regression results. Despite the fact that polynomial regression relies on the assumption of congruence of measurement models, past research has failed to investigate this assumption through rigorous invariance testing as was conducted within the current study. Results from previous analyses using

polynomial regression may be strengthened by an enhanced understanding of the measurement models underlying the indicators utilized for polynomial regression and how this may influence results. Although full measurement invariance was not established, it is still appropriate to move forward with polynomial regression because partial measurement invariance is considered acceptable and is more common than full invariance (Schmitt & Kuljanin, 2008), and all of the fit indices taken together indicate adequate model fit for both domains. This analysis is particularly important because past research using polynomial regression has completely skipped this step of comparing measures across groups. This study provides an initial model for how these measures could be explored in the future. An understanding of how these measures are operating across students and teacher provides information to inform the interpretation of the results of MANOVA and polynomial regression results.

Base Rates of Discrepancies

Determining how many participants within the sample have discrepancies between the two predictor variables (i.e., the student and teacher competence ratings) is recommended as an essential step before conducting polynomial regression analyses (Shanock et al., 2010). This was accomplished by subtracting teacher competence ratings (SPPA-TRS) from student competence ratings (SPPA) within the academic and social domains. Raw scores were used since these scales are on the same metric. Any participant with one competence rating half a standard deviation above or below the other ratings was considered to have discrepant values. The standard deviation of the mean raw accuracy scores was used for this calculation. This method of determining groups for agreement and disagreement has been used in past literature (e.g., Fefer, 2011;

Fleenor et al., 1996; Shanock et al., 2010). As can be seen in Table 11, slightly less than half of the sample were shown to have accurate perceptions of competence in the academic and social domain compared to teacher ratings, while slightly over half of the students in this sample significantly over or underestimated their competence compared to teacher ratings. These data provide a rationale for further exploring discrepancies between student and teacher ratings of competence.

Table 12

Frequencies of SPPA scores over, under, and in-agreement with SPPA-TRS scores

Agreement Groups	<i>n</i>	Percentage of Sample	Mean SPPA	Mean SPPA-TRS
Academic Domain	<i>N</i> = 395			
Student overestimation	98	24.81%	3.34	2.50
In agreement	169	42.78%	3.11	3.26
Student underestimation	128	32.41%	2.46	3.49
Social Domain	<i>N</i> = 391			
Student overestimation	115	29.41%	3.48	2.72
In agreement	164	41.94%	3.13	3.27
Student underestimation	112	28.64%	2.46	3.49

Note. SPPA and SPPA-TRS are measured on a 4-point scale with higher numbers representing greater competence ratings.

Discrepancy Analysis

Prior to comparing groups on key outcome variables, chi-square tests for independence were used to determine if students in the three competence discrepancy groups (overestimate, underestimate, accurate) differed in terms of grade or gender.

Gender was significantly related to grouping across the academic, $\chi^2 (2, N = 395) = 7.72, p = .02$ and social domain, $\chi^2 (2, N = 391) = 11.05, p = .00$. In the academic domain, 37% of females and 26% of males were in the underestimation group, 42% of females

and 44% of males were accurate, and 21% of females and 30% of males overestimated their competence compared to teacher ratings. In the social domain 35% of females and 20% of males were in the underestimation group, 39% of females and 46% of males were accurate, and 26% of females and 35% of males overestimated their competence compared to teacher ratings. Grade was not shown to be related to grouping across either domain.

In order to replicate the discrepancy method that has been used in the majority of past research on the PIB, discrepancy grouping (i.e., positive, accurate, or negative) was used as the independent variable in multivariate analysis of variance (MANOVA). Prior to completing these analyses the assumptions of MANOVA were examined. The data screening procedures outlined previously suggest that there is some non-normality within the current sample (i.e., presence of univariate outliers and higher than desirable skew/kurtosis values). However, this is not considered to be a concern because a sample size of 395 students will allow for robust results despite instances of non-normality (Tabachnick & Fidell, 2007). The linearity assumption was examined by generating a matrix of scatterplots to determine if a linear relationship existed between all pairs of dependent variables. Evidence of non-linearity was noted in the examination of these scatterplots; therefore the linearity assumption was not satisfied. The next step in this analysis plan included using methods that allow for investigations of non-linear relationships, so this was not viewed as particularly concerning either. The assumption of multicollinearity was examined by looking at the correlations between all dependent variables; this assumption was met as the highest correlation between IA and HI symptoms at .56 is within acceptable limits. The homogeneity of variance-covariance

matrix assumption was investigated by examining Box's M statistics; there is evidence of unequal covariance within the academic, Box's $M = 57.75$, $F(12, 486810.01) = 4.756$, $p < .001$ and social, Box's $M = 46.90$, $F(12, 578019.63) = 3.86$, $p < .001$ domains with significant Box's M statistics. However, Tabachnick and Fidell (2007) suggest that Box's M is too strict with larger sample sizes, is very sensitive to violations of normality, and violations of this assumption are more robust when sample sizes per group are large. Knowing that assumptions of MANOVA have been violated suggests that caution should be used when interpreting these results. Further precautions were taken when interpreting multivariate test statistics by examining Pillai's Trace for significance instead of the more common Wilks' Lambda as this indicator is suggested to be more robust to violations of assumptions and is robust when groups are unequal (Tabachnick & Fidell, 2007).

Results of MANOVA are presented separately for the academic and social domains. One-way between-groups MANOVA was performed to investigate ADHD symptoms across groups of students with varying accuracy of self-perceptions based on teacher ratings of competence. Accuracy groups are presented in Table 12 and methods to determine groupings are described in the previous section related to base rates of discrepancies. Three dependent variables were examined in MANOVA analyses: inattentive symptoms, hyperactive/impulsive symptoms (square root transformed), and depressive symptoms. In order to enhance comparability of these analyses to the polynomial regression analyses described later, an ANOVA with overall ADHD symptoms was also conducted for each domain. The independent variable was group

membership (underestimation, accurate, or overestimation) based of discrepancies between self and teacher ratings.

Academic domain. Statistically significant differences between self-perception group means were found among the combined symptoms variables (inattentive, hyperactive/impulsive, and depressive symptoms), Pillai's Trace 0.20, $F(6, 778) = 14.53$, $p < .001$; partial eta squared = .10. Univariate main effects were then examined given the significance of the omnibus test. Significant main effects were found using a Bonferroni adjusted alpha of .017 (.05/3). These included inattentive symptoms $F(2, 390) = 34.68$, $p < .001$, partial eta squared = .15, hyperactive/impulsive symptoms $F(2, 390) = 4.33$, $p < .05$, partial eta squared = .02, and depressive symptoms $F(2, 390) = 4.55$, $p < .05$, partial eta squared = .02. These partial eta squared values indicate that more variance in group membership can be explained by inattentive symptoms (15%) compared to hyperactive impulsive (2%) and depressive symptoms (2%). Tukey post-hoc comparisons consisted of conducting pairwise comparisons to determine which symptoms were related to underestimation, accurate, and overestimation self-perceptions groups. A Bonferroni adjusted alpha of .017 (.05/3) was used to determine significance. Results indicate that the overestimation self-perception group had significantly higher inattentive symptoms when compared to the underestimation and accurate self-perception groups (which did not significantly differ from each other on IA symptoms). The overestimation self-perception group also had higher hyperactive/impulsive symptoms when compared to the underestimation self-perception group. When considering depressive symptoms, the underestimation self-perception group had significantly higher depressive symptoms

compared to the overestimation self-perceptions group, while the accurate group did not significantly differ from the other two groups.

An ANOVA with overall ADHD symptoms as the dependent variable was significant $F(2, 390) = 28.22, p < .001$, partial eta squared = .13. Tukey post-hoc tests were conducted to determine how overall ADHD symptoms were related to underestimation, accurate, and overestimation self-perceptions groups in the academic domain. Results indicate that the overestimation group had significantly higher ADHD symptoms compared to the underestimation and accurate self-perception groups (mean = 0.68). The group with accurate academic self-perceptions had higher ADHD symptoms than the underestimation group, and lower ADHD symptoms than the overestimation group (mean = 0.43). The underestimation group had significantly lower ADHD symptoms than the other two groups (mean = 0.33).

Social domain. Statistically significant differences between self-perception group means were found among the combined symptoms variables (inattentive, hyperactive/impulsive, and depressive symptoms), Pillai's Trace 0.15, $F(6, 770) = 10.00, p = .00$; partial eta squared = .07. Given the significance of the omnibus test, univariate main effects were examined. Significant main effects were found using a Bonferroni adjusted alpha of .017. These included inattentive symptoms $F(2, 386) = 18.40, p = .000$, partial eta squared = .09, hyperactive/impulsive symptoms $F(2, 386) = 6.01, p = .003$, partial eta squared = .03, and depressive symptoms $F(2, 386) = 10.01, p = .000$, partial eta squared = .05. These partial eta squared values indicate that more variance in group membership can be explained by inattentive symptoms (9%) compared to depressive symptoms (5%) and hyperactive/impulsive symptoms (3%). Tukey post-hoc

comparisons consisted of conducting pairwise comparisons to determine which symptoms were related to underestimation, accurate, and overestimation self-perceptions groups. Each comparison was tested at the .017 (.5/3) Bonferroni adjusted significance level. Results indicate that the overestimated self-perceptions group had significantly higher inattentive and hyperactive/impulsive symptoms when compared to the underestimation and accurate self-perception groups (which did not significantly differ from each other on either IA and HI symptoms). When considering depressive symptoms, the underestimation self-perception group had significantly higher depressive symptoms when compared to the overestimation and accurate self-perceptions groups (which did not significantly differ from each other on depressive symptoms).

An ANOVA with overall ADHD symptoms as the dependent variable was also significant $F(2, 386) = 17.05, p < .001$, partial eta squared = .08. Tukey post-hoc tests were conducted to determine how overall ADHD symptoms were related to underestimation, accurate, and overestimation self-perceptions groups in the social domain. Results indicate that the overestimation group had significantly higher ADHD symptoms compared to the underestimation and accurate self-perception groups (mean = 0.62). The group with accurate academic self-perceptions had higher ADHD symptoms than the underestimation group, and lower ADHD symptoms than the overestimation group (mean = 0.40). The underestimation group had significantly lower ADHD symptoms than the other two groups (mean = 0.38).

Polynomial Regression and Response Surface Results

The next step was to conduct polynomial regression analyses to investigate self and teacher ratings separately in relation to ADHD symptoms. A primary purpose of this

study was to explore this methodology in order to enhance understanding of how the degree and direction of the discrepancy between self and teacher ratings in the academic and social domains relate to symptoms of ADHD. First, the predictor variables of self and teacher ratings of academic and social competence were centered around the midpoint as has been recommended in past literature (Edwards, 2002; Shanock et al., 2010). Next, new predictor variables were created within each domain including the square of each of the centered competence ratings and the cross-product of the self and teacher ratings. Separate analyses were conducted with overall ADHD, IA, and HI symptoms regressed on the simultaneously entered predictor variables to address each research question. Before analyses were completed the assumptions of independence and normality of residuals were checked. The Durbin-Watson test value of 1.89 (close to 2) indicated independence of residuals, while the Kolmogorov-Smirnov test *p* values of .000 suggests a non-normal distribution of residuals for all outcome variables of interest. However, this indicator of normality often shows signs of violation in larger samples. Multicollinearity was also considered as this is a possible limitation of polynomial regression; however, correlations between each predictor variable are reasonable (provided in results tables for each polynomial regression analysis below) and centering variables limits the potential for multicollinearity. The specific research questions to be answered with this method include:

1. How does agreement and disagreement between self and teacher ratings of competence (academic and social domains) predict the level of general ADHD symptoms among high school students?
2. How does agreement and disagreement between self and teacher ratings of

competence (academic and social domains) predict the level of HI symptoms among high school students?

3. How does agreement and disagreement between self and teacher ratings of competence (academic and social domains) predict the level of IA symptoms among high school students?

Academic domain.

Overall ADHD symptoms. The results of polynomial regression on overall ADHD symptoms using self and teacher ratings of academic competence as predictors are presented in Table 13. The R^2 value was significant, $R^2 = .45$, $F(5, 387) = 62.17$, $p = .000$. This suggests that results should be evaluated using response surface analyses and that almost 45% of the variance in ADHD symptoms is accounted for by the variables within this regression equation. The coefficient for the teacher ratings of academic competence was significant. The coefficient for the cross product, teacher rating squared, and self-rating variables were not significant. Most importantly, two response surfaces ($a1$ and $a3$) were significant. Surface $a1$ represents the slope of the line of perfect agreement and is the sum of the regression coefficient for the student rating of academic competence ($b1$) and the regression coefficient for the teacher rating of academic competence ($b2$). The significant negative value for $a1$ indicates ADHD symptoms decrease as both self and teacher ratings increase. In other words, lower academic competence ratings from the student and teacher predict higher ADHD symptoms. Surface value $a3$ represents the slope of the line of incongruence and is calculated by finding the difference between the regression coefficients for self and teacher ratings ($b1 - b2$). A significant positive value for slope along the line of incongruence ($a3$) indicates

that ADHD symptoms are higher when the student rating of academic competence is higher than the teacher rating (i.e., when PIB is present).

Table 13

Correlations between Predictors and Results of Polynomial Regression with Self–Teacher Ratings of Academic Competence Discrepancy Predicting ADHD Symptoms

	1	2	3	4	<i>B</i>	SE
Intercept					0.71**	0.03
1. Self-Rating (Centered)	--				-0.02	0.03
2. Teacher Ratings (Centered)	.09	--			-0.36**	0.03
3. Self-Rating ²	-.35	.16	--		-0.01	0.03
4. Self X Teacher	-.41	-.38	-.43	--	0.03	0.04
5. Teacher Rating ²	-.01	-.54	.04	-.19	0.02	0.03
<i>R</i> ²					0.45**	
		Coefficient			SE	<i>t</i> value
Surface value: <i>a</i> ₁		-0.38			0.05	-8.13**
Surface value: <i>a</i> ₂		0.01			0.06	0.12
Surface value: <i>a</i> ₃		0.34			0.04	7.96**
Surface value: <i>a</i> ₄		-0.06			0.05	-1.03

Note. *N* = 393. The outcome variable of overall ADHD symptoms is square root transformed. Self and Teacher ratings measured on a 1-4 scale with higher numbers representing higher perceived competence. *a*₁ = slope of the line of perfect agreement, *a*₂ = curvature of the line of perfect agreement, *a*₃ = slope of the line of incongruence *a*₄ = curvature of the line of incongruence.

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

Covariates. Depression, grade, and gender were entered as the first step into three separate regression equations to control for these demographic variables as potential covariates. These results were investigated to determine how potential covariates influence the relationship between self and teacher ratings of academic competence and overall ADHD symptoms. With depression entered as a first step, the *R*² was not significant, *R*² = .00, *F*(1, 391) = 1.10, *p* = .295; therefore response surfaces were not investigated. Grade was also not shown to significantly change the relationship between academic competence ratings and ADHD symptoms, *R*² = .00, *F*(1, 391) = .14, *p* = .713. When gender was entered as a first step in the polynomial regression equation the *R*²

value was significant, $R^2 = .05$, $F(1, 391) = 20.18$, $p = .000$. This value indicates that approximately 5% of the variance accounted for by the regression equation can be explained by gender (with males having higher ADHD symptoms than females), and 47% of the variance (see Table 14) can be explained by all variables included in the regression equation (i.e., gender, centered self and teacher ratings, and square and cross product of self and teacher ratings of academic competence). However, as can be seen in Table 14, accounting for gender in the polynomial regression and response surface analyses did not produce changes in the significance of the response surface values. The graphed response surface results from this analysis are presented in Figure 3.

Table 14

Correlations between Predictors and Results of Polynomial Regression with Gender as Covariate, Academic Competence Measures as Predictors and ADHD Symptoms as the Outcome

	Model 1			Model 2					B	SE
	B	SE	1	2	3	4	5			
Intercept	0.39**	0.02							0.66**	0.03
1. Gender (Male)	0.17**	0.04	--						0.12**	0.03
2. Self-Rating (Centered)			-.11	--					-0.04	0.03
3. Teacher Rating (Centered)			.13	.07	--				-0.35**	0.03
4. Self-Rating ²			.02	-.35	.16	--			-0.01	0.03
5. Self X Teacher			.00	-.40	-.38	-.43	--		0.03	0.04
6. Teacher Rating ²			-.05	-.01	-.54	.04	-.19		-0.02	0.03
R^2	0.05**			0.47**						
	Coefficient	SE	t value							
Surface value: a_1	-0.38	0.05	-8.16**							
Surface value: a_2	0.00	0.05	0.07							
Surface value: a_3	0.31	0.04	7.15**							
Surface value: a_4	-0.06	0.05	-1.09							

Note. $N = 393$. The outcome variable of overall ADHD symptoms is square root transformed. Self and Teacher ratings measured on a 1-4 scale with higher numbers representing higher perceived competence. Gender: 1 = Male, 0 = Female. a_1 = slope of the line of perfect agreement, a_2 = curvature of the line of perfect agreement, a_3 = slope of the line of incongruence a_4 = curvature of the line of incongruence. * $p < .05$, ** $p < .01$.

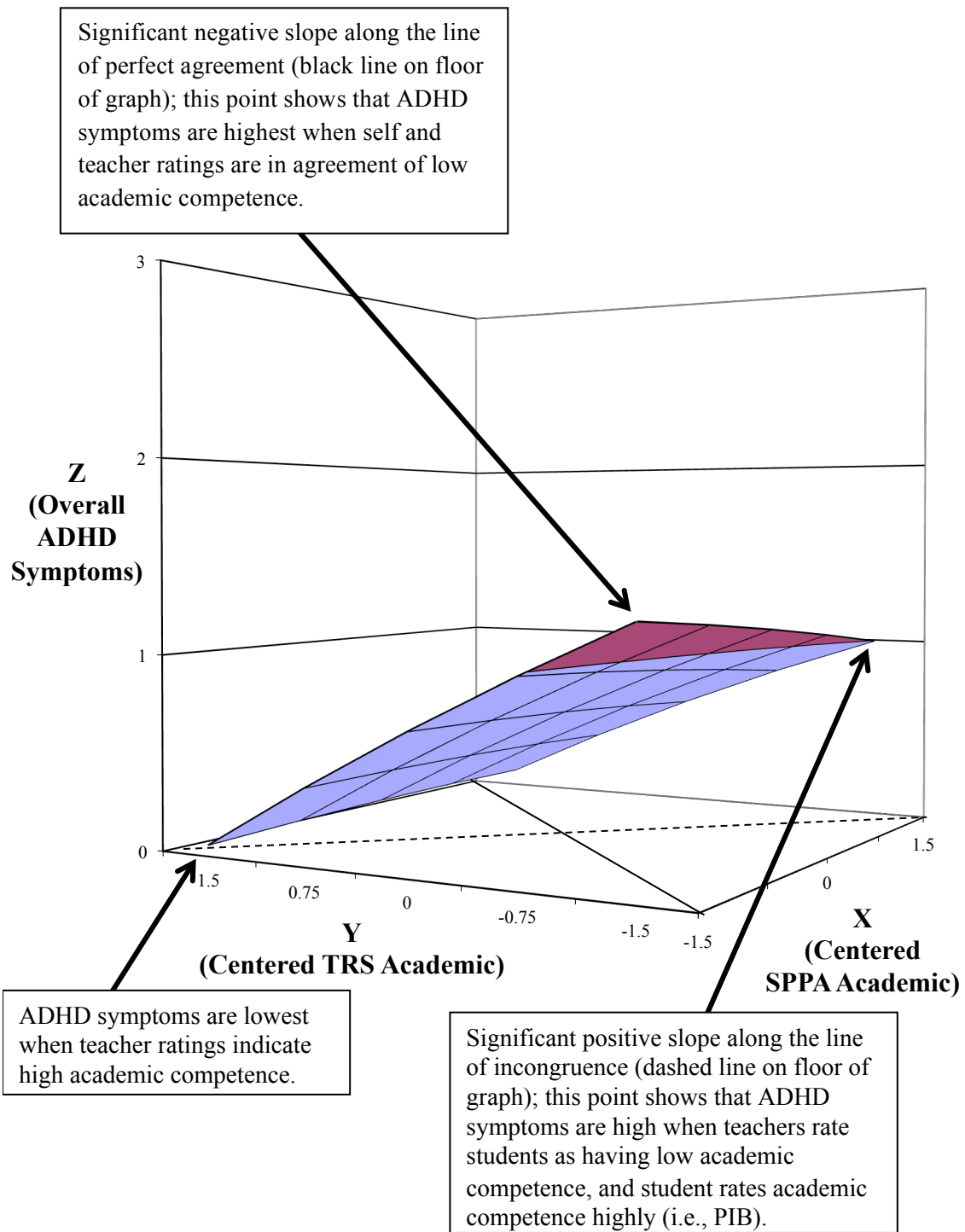


Figure 3. Response surface graph of overall ADHD symptoms as predicted by student perceptions of academic competence-teacher perceptions of academic competence discrepancy (with gender as covariate).

Hyperactive/Impulsive Symptoms. The results of polynomial regression with student and teacher ratings of academic competence as predictors of Hyperactive/Impulsive symptoms are presented in Table 15. The R^2 value was significant, $R^2 = .09$, $F(5, 387) = 7.39$, $p = .000$; this suggests that 9% of the variance in hyperactive/impulsive symptoms was accounted for by the variables within this regression equation. The significant R^2 value indicates that results should be evaluated using response surface analyses (Shanock et al., 2010). Only the coefficient for teacher ratings of academic competence was statistically significant ($p < .05$). The coefficients for the student ratings of competence, the squared competence variables, and the cross-product were not significant. When response surface values were examined only one was shown to be significant, $a1$, representing the slope of the line of perfect agreement. The significant negative value for this surface indicates that high self and teacher ratings of academic competence predict low levels of hyperactive/impulsive symptoms, and that lower ratings of academic competence from both respondents predict higher levels of HI symptoms.

Covariates. Depression, grade, and gender were entered as the first step into three separate regression equations to control for these demographic variables as covariates. These results were investigated to determine if these potential covariates influenced the relationship between self and teacher ratings of academic competence and HI symptoms. With depression entered as a first step, the R^2 was not significant, $R^2 = .00$, $F(1, 391) = .04$, $p = .838$ and therefore response surfaces were not investigated. Grade was also not shown to significantly change the relationship between academic competence ratings and HI symptoms, $R^2 = .00$, $F(1, 391) = .14$, $p = .709$. However, gender was shown to be a significant covariate, $R^2 = .02$, $F(1, 391) = 8.78$, $p = .003$).

Table 15

Correlations between Predictors and Results of Polynomial Regression with Self–Teacher Ratings of Academic Competence Discrepancy Predicting Hyperactive/Impulsive Symptoms

	1	2	3	4	B	SE
Intercept					0.35**	0.03
1. Self-Rating (Centered)	--				-0.04	0.04
2. Teacher Ratings (Centered)	.09	--			-0.14**	0.04
3. Self-Rating ²	-.35	.16	--		-0.02	0.04
4. Self X Teacher	-.41	-.38	-.43	--	0.06	0.04
5. Teacher Rating ²	-.01	-.54	.04	-.19	0.03	0.03
<i>R</i> ²					0.09**	
	Coefficient				SE	<i>t</i> value
Surface value: <i>a</i> ₁	-0.18				0.05	-3.36**
Surface value: <i>a</i> ₂	0.01				0.05	0.28
Surface value: <i>a</i> ₃	0.10				0.05	1.89
Surface value: <i>a</i> ₄	-0.11				0.08	-1.41

Note. *N* = 393. The outcome variable of hyperactive/impulsive symptoms is square root transformed. Self and Teacher ratings measured on a 1-4 scale with higher numbers representing higher perceived competence. *a*₁ = slope of the line of perfect agreement, *a*₂ = curvature of the line of perfect agreement, *a*₃ = slope of the line of incongruence *a*₄ = curvature of the line of incongruence.

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

This value indicates that 2% of the variance accounted for by the regression equation can be explained by gender (with males having more hyperactive/impulsive symptoms than females), while 10% of the variance can be explained by all variables included in the regression equation (see Table 16). However, entering gender as a first step in polynomial regression did not produce changes in the significance of the response surface values (see Table 16). The response surface graph for the results of this analysis is shown in Figure 4.

Table 16

Correlations between Predictors and Results of Polynomial Regression with Gender as Covariate, Academic Competence Measures as Predictor, and HI Symptoms as the Outcome

	Model 1			Model 2					B	SE
	B	SE	1	2	3	4	5			
Intercept	0.19**	0.02							0.31**	0.03
1. Gender (Male)	0.10**	0.03	--						0.09**	0.03
2. Self-Rating (Centered)			-.11	--					-0.05	0.04
3. Teacher Rating (Centered)			.13	.07	--				-0.13**	0.04
4. Self-Rating ²			.02	-.35	.16	--			-0.02	0.04
5. Self X Teacher			.00	-.40	-.38	-.43	--		0.06	0.04
6. Teacher Rating ²			-.05	-.01	-.54	.04	-.19		-0.03	0.03
R^2	0.02**			0.10**						
	Coefficient	SE	t value							
Surface value: a_1	-0.18	0.05	-3.32**							
Surface value: a_2	0.01	0.05	0.81							
Surface value: a_3	0.08	0.05	0.15							
Surface value: a_4	-0.11	0.08	0.15							

Note. $N = 393$. The outcome variable of hyperactive/impulsive symptoms is square root transformed. Self and Teacher ratings measured on a 1-4 scale with higher numbers representing higher perceived competence. Gender: 1 = Male, 0 = Female. a_1 = slope of the line of perfect agreement, a_2 = curvature of the line of perfect agreement, a_3 = slope of the line of incongruence a_4 = curvature of the line of incongruence.

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

Inattentive Symptoms. The results of polynomial regression with student and teacher ratings of academic competence as predictors of Inattentive symptoms are presented in Table 17. The R^2 value was significant, $R^2 = .557$, $F(5, 389) = 97.92$, $p = .000$; this significant value suggests that we should move forward with response surface analyses, and that approximately 56% of the variance in inattentive symptoms was accounted for by the variables within this regression equation.

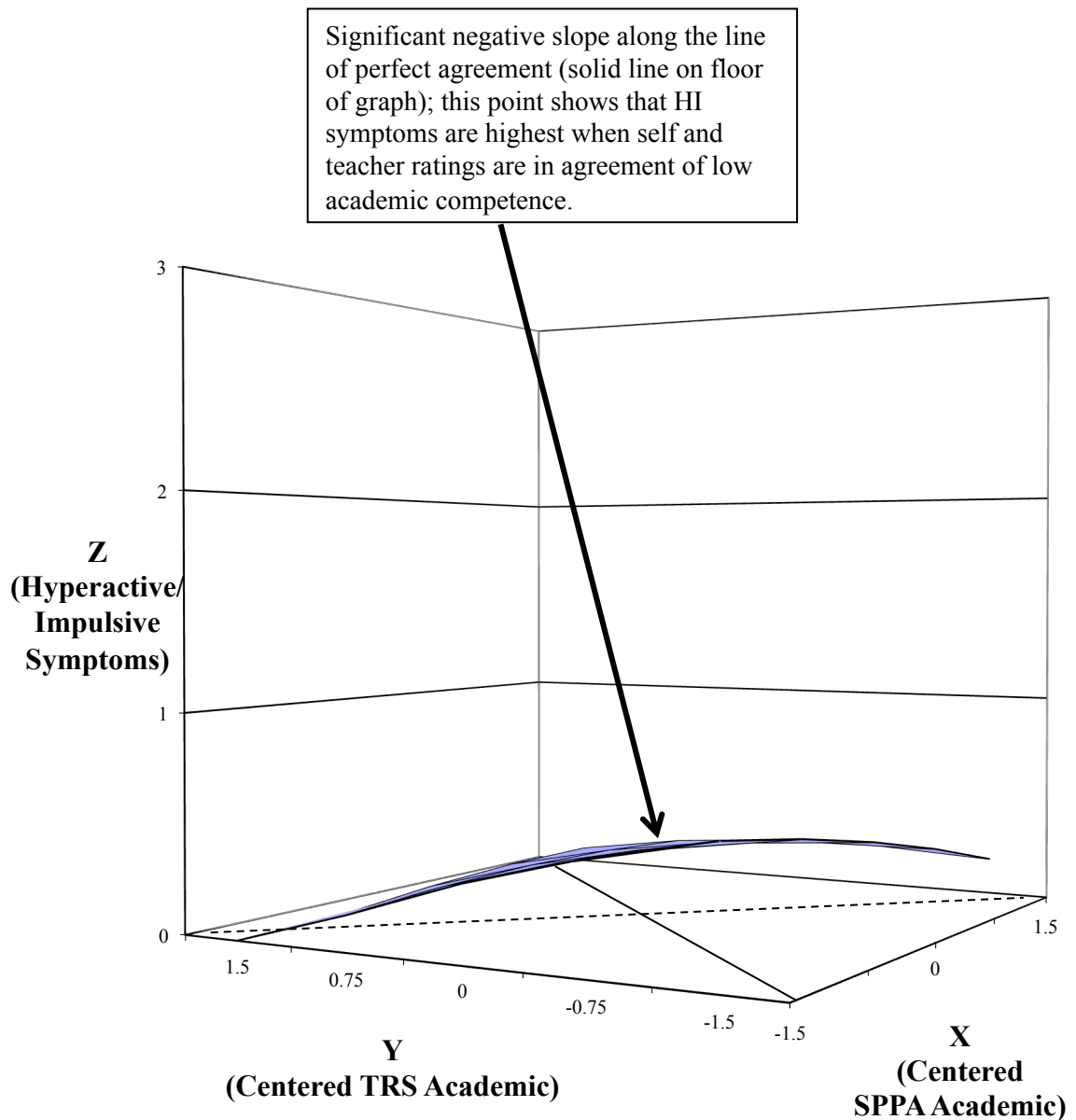


Figure 4. Response surface graph of overall HI symptoms as predicted by student perceptions of academic competence-teacher perceptions of academic competence discrepancy (with gender as covariate).

Similar to findings from the previous analysis with overall ADHD symptoms, coefficients for the centered teacher ratings and squared teacher rating of academic competence were significant, while coefficients for the cross product and self-rating variables were not significant. Of greater significance, three out of the four surface values calculated for this equation were significant. Specifically, both $a1$ and $a2$ which represent the slope and curvature of the line of perfect agreement were significant. A significant negative surface value for $a1$ suggests that the outcome variable, inattentive symptoms, decreases as self and teacher ratings of academic competence increase. In other words, higher levels of inattentive symptoms are related to lower self and teacher ratings. Furthermore, a significant positive value for $a2$ suggests that there is a non-linear relationship between self and teacher academic competence ratings and inattentive symptoms, and that there is upward curving along the slope of the line of perfect agreement creating a convex surface on the three-dimensional graph (Shanock et al., 2010). Surface value $a3$ was also significant and positive which suggests that inattentive symptoms are higher when the PIB is present (i.e., when student ratings are higher than teacher ratings). An investigation of the response surface graph (Figure 5) shows that inattentive symptoms are very low when students and teachers both rate the students as highly competent academically, and when teacher ratings are higher than student ratings.

Covariates. Depression, grade, and gender were entered as the first step into three separate regression equations to control for these demographic variables as covariates. These results were investigated to determine how these potential covariates influence the relationship between self and teacher ratings of academic competence and IA symptoms.

Table 17

Correlations between Predictors and Results of Polynomial Regression with Self–Teacher Rating of Academic Competence Discrepancy Predicting Inattentive Symptoms

	1	2	3	4	<i>B</i>	SE
Intercept					0.94**	0.04
1. Self-Rating (Centered)	--				-0.03	0.05
2. Teacher Ratings (Centered)	.09	--			-0.83**	0.05
3. Self-Rating ²	-.35	.16	--		-0.03	0.05
4. Self X Teacher	-.40	-.38	-.43	--	0.06	0.06
5. Teacher Rating ²	-.01	.54	.04	-.20	0.15**	0.04
<i>R</i> ²					0.56**	
		Coefficient			SE	<i>t</i> value
Surface value: <i>a</i> ₁		-0.86			0.07	-12.41**
Surface value: <i>a</i> ₂		0.18			0.07	2.52*
Surface value: <i>a</i> ₃		0.80			0.07	11.60**
Surface value: <i>a</i> ₄		0.06			0.09	0.68

Note. *N* = 395. Self and Teacher ratings measured on a 1-4 scale with higher numbers representing higher perceived competence. *a*₁ = slope of the line of perfect agreement, *a*₂ = curvature of the line of perfect agreement, *a*₃ = slope of the line of incongruence *a*₄ = curvature of the line of incongruence.

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

With depression entered as a first step, the *R*² was not significant, *R*² = .005, *F*(1, 393) = 1.93, *p* = .166; therefore response surfaces were not investigated. Grade was also not significant, *R*² = .00, *F*(1, 393) = .09, *p* = .767. However, gender was significant, *R*² = .04, *F*(1, 393) = 17.08, *p* = .000. This value indicates that 4% of the variance accounted for by the regression equation can be explained by gender (with males having higher IA symptoms), while 57% of the variance can be explained by all variables included in the regression equation (all forms of self and teacher academic competence ratings and gender). However, entering gender as a first step in polynomial regression did not change the significance of the response surface values (see Table 18). The graphed response surface results from this analysis are presented in Figure 5.

Table 18

Correlations between Predictors and Results of Polynomial Regression with Gender as Covariate, Academic Competence Measures as Predictors and IA Symptoms as the Outcome

	Model 1			Model 2					B	SE
	B	SE	1	2	3	4	5			
Intercept	0.43**	0.04							0.88**	0.04
1. Gender (Male)	0.26**	0.06	--						0.16**	0.04
2. Self-Rating (Centered)			-.11	--					-0.05	0.05
3. Teacher Rating (Centered)			.13	.07	--				-0.81**	0.05
4. Self-Rating ²			.03	-.35	.16	--			-0.03	0.05
5. Self X Teacher			.00	-.40	-.38	-.43	--		0.06	0.06
6. Teacher Rating ²			-.05	-.00	-.54	.04	-.20		.15	0.04
R^2	0.04**			0.57**						
	Coefficient	SE	t value							
Surface value: a_1	-0.86	0.07	-12.37**							
Surface value: a_2	0.18	0.07	2.55*							
Surface value: a_3	0.76	0.07	10.98**							
Surface value: a_4	0.06	0.09	.66							

Note. $N = 395$. Self and Teacher ratings measured on a 1-4 scale with higher numbers representing higher perceived competence. Gender: 1 = Male, 0 = Female. a_1 = slope of the line of perfect agreement, a_2 = curvature of the line of perfect agreement, a_3 = slope of the line of incongruence a_4 = curvature of the line of incongruence.

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

Social domain.

Overall ADHD symptoms. The results of polynomial regression on overall ADHD symptoms using self and teacher ratings of social competence as the predictors are presented in Table 19. The R^2 value was significant, $R^2 = .11$, $F(5, 383) = 9.08$, $p = .000$, suggesting that results should be evaluated using the four surface values within a response surface graph. This R^2 value indicated that 11% of the variance in ADHD symptoms was accounted for by the predictors in this regression equation. The coefficients of the individual predictors (self and teacher ratings of social competence) were significant, as well as teacher ratings squared.

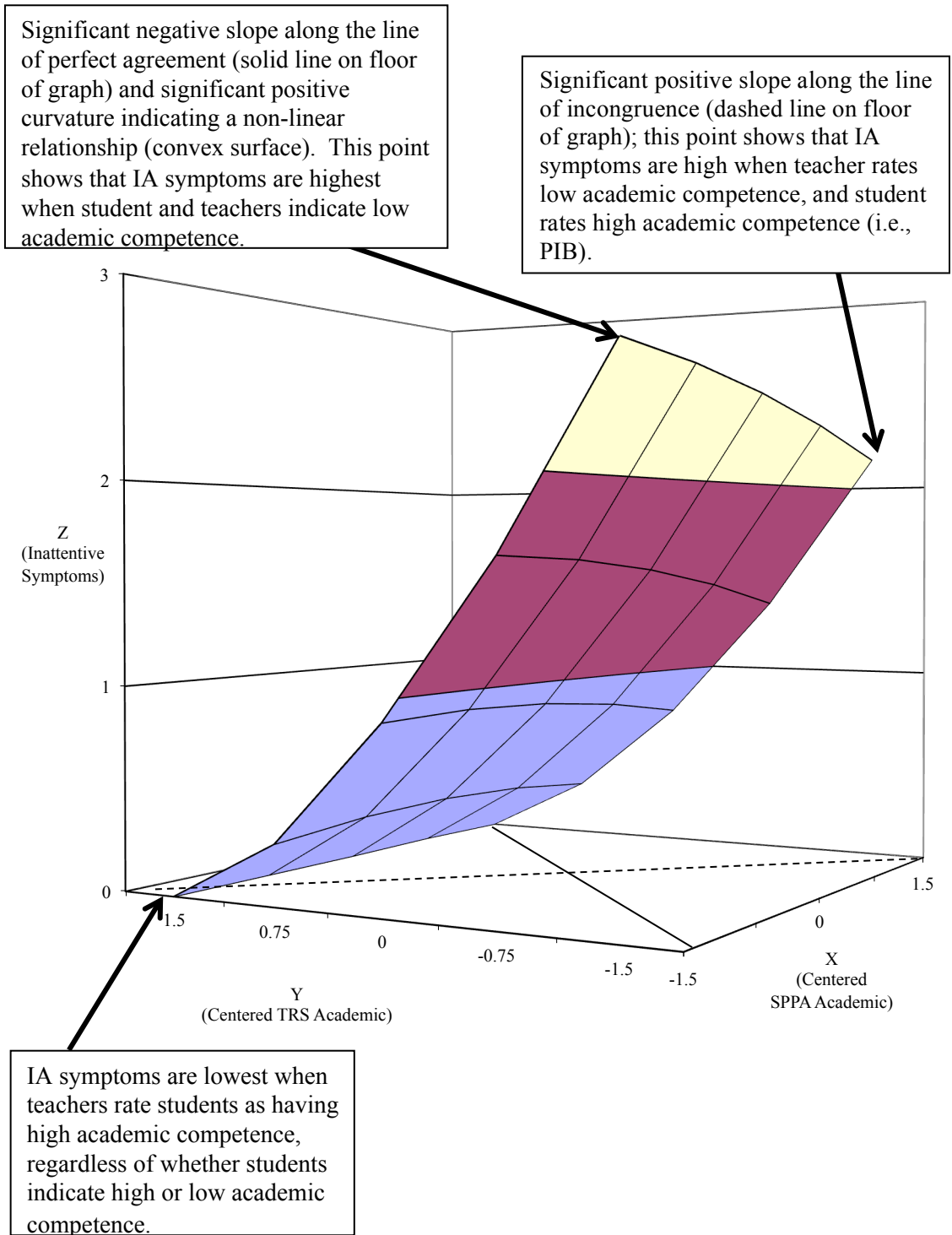


Figure 5. Response surface graph of IA symptoms as predicted by student perceptions of academic competence-teacher perceptions of academic competence discrepancy (with gender as covariate).

The cross-product and self-rating squared variables were not significant. More importantly, two surface values were shown to be significant. These surface values, a_3 and a_4 , represent the slope and curvature of the line of incongruence (Shanock et al., 2010). A significant positive value for slope along the line of incongruence (a_3) indicates that ADHD symptoms are higher when the student rating is higher than the teacher rating (i.e., when a PIB is present). A significant positive value for curvature along the line of incongruence (a_4 , $X = -Y$) is indicative of a convex surface, with ADHD symptoms increasing more sharply as the discrepancy between self and teacher ratings of competence increases.

Covariates. Depression, grade, and gender were entered as the first step into three separate regression equations to control for these demographic variables as covariates. These results were investigated to determine if these potential covariates influenced the relationship between self and teacher ratings of social competence and overall ADHD symptoms. With depression entered as a first step, the R^2 was not significant, $R^2 = .003$, $F(1, 387) = 1.09$, $p = .297$; therefore, response surfaces were not investigated. Grade was also not significant, $R^2 = .000$, $F(1, 387) = .15$, $p = .702$. However, gender was significant, $R^2 = .05$, $F(1, 387) = 21.91$, $p < .001$. This value indicates that 5% of the variance accounted for by the regression equation can be explained by gender, while 14% of the variance can be explained by all variables included in the regression equation (all forms of self and teacher social competence ratings and gender).

Table 19

Correlations between Predictors and Results of Polynomial Regression with Self–Teacher Ratings of Social Competence Discrepancy Predicting ADHD Symptoms

	1	2	3	4	<i>B</i>	SE
Intercept					0.50**	0.04
1. Self-Rating (Centered)	--				0.12*	0.05
2. Teacher Ratings (Centered)	.10	--			-0.25**	0.06
3. Self-Rating ²	-.44	.01	--		0.05	0.03
4. Self X Teacher	-.64	-.21	-.11	--	-0.10	0.05
5. Teacher Rating ²	.15	-.75	-.01	-.25	0.10*	0.05
<i>R</i> ²					0.11**	
		Coefficient			SE	<i>t</i> value
Surface value: <i>a</i> ₁		-0.13			0.08	-1.64
Surface value: <i>a</i> ₂		0.05			0.06	0.78
Surface value: <i>a</i> ₃		0.37			0.08	4.68**
Surface value: <i>a</i> ₄		0.24			0.06	3.84**

Note. *N* = 389. The outcome variable of overall ADHD symptoms is square root transformed. Self and Teacher ratings measured on a 1-4 scale with higher numbers representing higher perceived competence. *a*₁ = slope of the line of perfect agreement, *a*₂ = curvature of the line of perfect agreement, *a*₃ = slope of the line of incongruence *a*₄ = curvature of the line of incongruence.

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

The coefficient for the cross-product of self and teacher was statistically significant with gender added as a covariate. However, entering gender as a first step in polynomial regression did not change the significance of the response surface values (see Table 20).

The response surface graph resulting from this analysis is presented in Figure 6.

Hyperactive/Impulsive Symptoms. The results of polynomial regression on hyperactive/impulsive symptoms using self and teacher ratings of social competence as predictors are presented in Table 21. The *R*² value was significant, *R*² = .03, *F*(5, 383) = 2.65, *p* = .022; this suggests that results should be evaluated using the four surface values within a response surface graph. This *R*² values indicates that 3% of the variance in hyperactive/impulsive symptoms was accounted for by the predictors in this regression equation. Only the coefficient for the centered self-rating of social competence was

found to be significant. However, response surface results align with the findings with overall ADHD symptoms as the outcome variable. Specifically, surface values a_3 and a_4 were shown to be significant. A significant positive value for slope along the line of incongruence (a_3) indicates that hyperactive/impulsive symptoms are higher when the student rating is higher than the teacher rating (i.e., when a PIB is present). A significant positive value for a_4 is indicative of a convex surface, with higher hyperactive/impulsive symptoms present with greater discrepancy between self and teacher ratings.

Table 20

Correlations between Predictors and Results of Polynomial Regression with Gender as Covariate, Social Competence Measures as Predictors, and ADHD Symptoms as the Outcome

	Model 1			Model 2					<i>B</i>	SE
	<i>B</i>	SE	1	2	3	4	5			
Intercept	0.39**	0.02							0.43**	0.04
1. Gender (Male)	0.18**	0.04	--						0.15**	0.04
2. Self-Rating (Centered)			-0.13	--					0.10*	0.05
3. Teacher Rating (Centered)			.05	.09	--				-0.24**	0.06
4. Self-Rating ²			.07	-.44	.01	--			0.06	0.04
5. Self X Teacher			-.00	-.63	-.21	-.11	--		-0.10*	0.05
6. Teacher Rating ²			.02	.15	-.74	-.01	-.25		0.10*	0.05
<i>R</i> ²	0.05**			0.14**						
	Coefficient	SE	<i>t</i> value							
Surface value: a_1	-0.14	0.08	-1.82							
Surface value: a_2	0.06	0.06	0.99							
Surface value: a_3	0.33	0.08	4.30**							
Surface value: a_4	0.26	0.06	4.12**							

Note. $N = 389$. The outcome variable of overall ADHD symptoms is square root transformed. Self and Teacher ratings measured on a 1-4 scale with higher numbers representing higher perceived competence. Gender: 1 = Male, 0 = Female. a_1 = slope of the line of perfect agreement, a_2 = curvature of the line of perfect agreement, a_3 = slope of the line of incongruence a_4 = curvature of the line of incongruence.

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

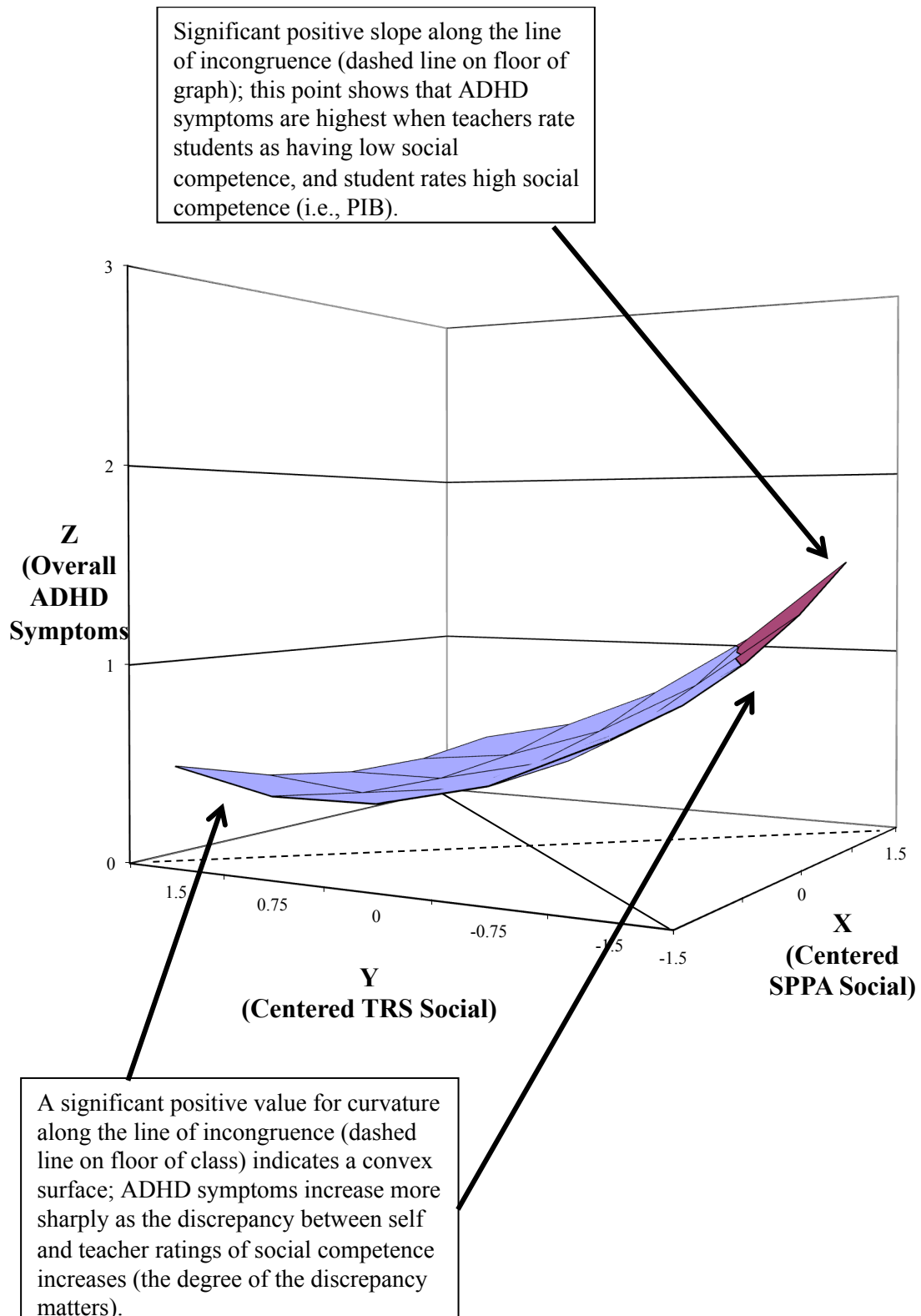


Figure 6. Response surface graph of overall ADHD symptoms as predicted by student perceptions of social competence-teacher perceptions of social competence discrepancy (with gender as covariate).

Table 21

Correlations between Predictors and Results of Polynomial Regression with Self–Teacher Ratings of Social Competence Discrepancy Predicting HI Symptoms

	1	2	3	4	<i>B</i>	SE
Intercept					0.18**	0.03
1. Self-Rating (Centered)	--				0.10*	0.05
2. Teacher Ratings (Centered)	.10	--			-0.06	0.06
3. Self-Rating ²	-.44	.01	--		0.03	0.03
4. Self X Teacher	-.25	-.21	-.11	--	-0.06	0.05
5. Teacher Rating ²	.15	-.75	-.01	-.25	0.05	0.05
<i>R</i> ²					0.03**	
		Coefficient			SE	<i>t</i> value
Surface value: <i>a</i> ₁		0.04			0.07	0.55
Surface value: <i>a</i> ₂		0.02			0.06	0.39
Surface value: <i>a</i> ₃		0.16			0.07	2.09**
Surface value: <i>a</i> ₄		0.14			0.06	2.36**

Note. *N* = 389. The outcome variable of hyperactive/impulsive symptoms is square root transformed. Self and Teacher ratings measured on a 1-4 scale with higher numbers representing higher perceived competence. *a*₁ = slope of the line of perfect agreement, *a*₂ = curvature of the line of perfect agreement, *a*₃ = slope of the line of incongruence *a*₄ = curvature of the line of incongruence.

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

Covariates. Depression, grade, and gender were entered as the first step into three separate regression equations as described previously. Similar to the previous covariate analyses explained, the *R*² values for depression, *R*² = .00, *F*(1, 387) = .04, *p* = .836 and grade level, *R*² = .00, *F*(1, 387) = .20, *p* = .657 were not significant and therefore these response surfaces were not further investigated. However, as with the previous analyses, gender was significant, *R*² = .02, *F*(1, 387) = 9.27, *p* = .002. The *R*² value indicates that 2% of the variance accounted for by the regression equation can be explained by gender, while 5% of the variance can be explained by all variables included in the regression equation (all forms of self and teacher social competence ratings and gender). Only the coefficients for gender were significant for both models. It is important to note that including gender in the polynomial regression changed the significance of response

surface $a3$ (see Table 22). In the previous analyses without gender as a covariate the response surface values for $a3$ and $a4$ were shown to be significant; however, with gender included in analyses only surface value $a4$ was significant. This change in the significance of $a3$, the response surface value that is most informative about the presence of the PIB, suggests that accounting for gender decreases the relationship between HI symptoms and student overestimation of competence. The unstandardized regression coefficients obtained across all analyses suggest that males had higher ADHD symptoms (overall, HI, and IA) than females. The significant positive value for $a4$ indicates a convex surface along the line of incongruence. This means that HI symptoms are higher when there is a larger discrepancy between self and teacher ratings of social competence, even when gender is accounted for. The graphed response surface values can be seen in Figure 7.

Inattentive Symptoms. The results of polynomial regression on inattentive symptoms using self and teacher ratings of social competence as the predictors are presented in Table 23. The R^2 value was significant, $R^2 = .14$, $F(5, 385) = 12.82$, $p = .000$; this suggests that results should be evaluated using the four surface values within a response surface graph. This R^2 value of .14 indicates that 14% of the variance in inattentive symptoms was accounted for by the predictor variables in this regression equation. Similar to the results for overall ADHD symptoms, the coefficients of the individual predictors (self and teacher ratings of social competence) were significant, as well as teacher ratings squared ($p < .01$). The cross-product and self-rating squared variables were not significant. More importantly, three surface values were shown to be significant. These surface values ($a1$, $a3$, and $a4$) represent the slope of the line of

perfect agreement, the slope of the line of incongruence, and the curvature along the line of incongruence, respectively (Shanock et al., 2010). The significant negative value for a_1 indicates that inattentive symptoms decrease as both self and teacher ratings increase. In other words, higher IA symptoms are related to lower ratings of both self and teacher ratings of social competence. A significant positive value for slope along the line of incongruence (a_3) indicates that inattentive symptoms are higher when the student rating is higher than the teacher rating. A significant positive value for surface value a_4 suggests that the response surface is convex, meaning that inattentive symptoms would increase more sharply as the degree of the discrepancy between self and teacher ratings increases.

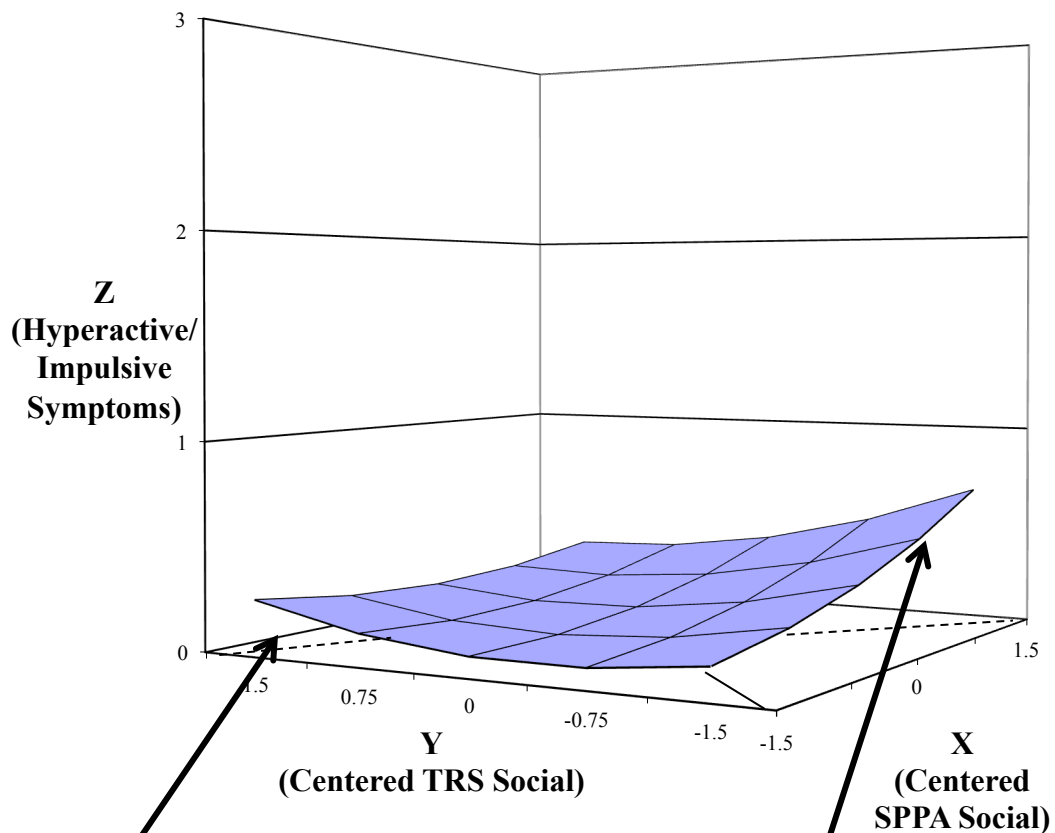
Table 22

Correlations between Predictors and Results of Polynomial Regression with Gender as Covariate, Social Competence. Measures as Predictors and HI Symptoms as the Outcome

	Model 1			Model 2					B	SE
	B	SE	1	2	3	4	5			
Intercept	0.19**	0.02							0.14**	0.04
1. Gender (Male)	0.10**	0.03	--						0.09**	0.04
2. Self-Rating (Centered)			-.13	--					0.08	0.05
3. Teacher Rating (Centered)			.05	.09	--				-0.05	0.06
4. Self-Rating ²			.07	-.44	.01	--			0.04	0.03
5. Self X Teacher			-.00	-.63	-.21	-.11	--		-0.06	0.05
6. Teacher Rating ²			.02	.15	-.74	-.01	-.25		0.05	0.05
R^2	0.02**			0.05**						
	Coefficient	SE	t value							
Surface value: a_1	0.03	0.07	0.46							
Surface value: a_2	0.03	0.06	0.53							
Surface value: a_3	0.13	0.07	1.80							
Surface value: a_4	0.15	0.06	2.55**							

Note. $N = 389$. The outcome variable of hyperactive/impulsive symptoms is square root transformed. Self and Teacher ratings measured on a 1-4 scale with higher numbers representing higher perceived competence. Gender: 1 = Male, 0 = Female. a_1 = slope of the line of perfect agreement, a_2 = curvature of the line of perfect agreement, a_3 = slope of the line of incongruence a_4 = curvature of the line of incongruence.

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



A significant positive value for curvature along the line of incongruence (dashed line on floor of class) indicates a convex surface, this was the only significant surface value for this graph. This suggests that hyperactive/impulsive symptoms increase with greater discrepancies between self and teacher ratings of social competence (with *either* student over or underestimation of competence).

Figure 7. Response surface graph of HI symptoms as predicted by student perceptions of social competence-teacher perceptions of social competence discrepancy (with gender as covariate).

Table 23

Correlations between Predictors and Results of Polynomial Regression with Self–Teacher Rating of Social Competence Discrepancy Predicting IA Symptoms

	1	2	3	4	<i>B</i>	SE
Intercept					0.65**	0.06
1. Self-Rating (Centered)	--				0.23**	0.08
2. Teacher Ratings (Centered)	.10	--			-0.56**	0.10
3. Self-Rating ²	-.44	.01	--		0.04	0.06
4. Self X Teacher	-.64	-.21	-.12	--	-0.20	0.08
5. Teacher Rating ²	.15	-.75	-.01	-.24	0.26**	0.08
<i>R</i> ²					0.14**	
		Coefficient			SE	<i>t</i> value
Surface value: <i>a</i> ₁		-0.33			0.14	-2.43*
Surface value: <i>a</i> ₂		0.10			0.10	1.00
Surface value: <i>a</i> ₃		0.79			0.12	6.43**
Surface value: <i>a</i> ₄		0.50			0.12	4.08**

Note. *N* = 391. Self and Teacher ratings measured on a 1-4 scale with higher numbers representing higher perceived competence. *a*₁ = slope of the line of perfect agreement, *a*₂ = curvature of the line of perfect agreement, *a*₃ = slope of the line of incongruence *a*₄ = curvature of the line of incongruence.

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

Covariates. Depression, grade, and gender were entered as the first step into three separate regression equations as described previously. Similar to the previous covariate analyses explained, the *R*² values for depression, *R*² = .01, *F*(1, 389) = 1.88, *p* = .171 and grade level, *R*² = .000, *F*(1, 389) = .10, *p* = .755 were not significant and therefore these response surfaces were not further investigated. However, as with the previous analyses, gender was significant, *R*² = .04, *F*(1, 389) = 17.90, *p* < .001. This value indicates that 4% of the variance accounted for by the regression equation can be explained by gender, while 17% of the variance can be explained by all variables included in the regression equation (all forms of self and teacher social competence ratings and gender). However, entering gender as a first step in polynomial regression did not change the significance of the response surface values (see Table 24). The graph of these response surface values can be seen in Figure 8.

Table 24

Correlations between Predictors and Results of Polynomial Regression with Gender as Covariate, Social Competence. Measures as Predictors, and IA Symptoms as the Outcome

	Model 1			Model 2					B	SE
	B	SE	1	2	3	4	5			
Intercept	0.43**	0.04							0.55**	0.06
1. Gender (Male)	0.27**	0.06	--						0.22**	0.06
2. Self-Rating (Centered)			-.13	--					0.19*	0.08
3. Teacher Rating (Centered)			.05	.09	--				-0.54**	0.10
4. Self-Rating ²			.07	-.44	.02	--			0.54	0.06
5. Self X Teacher			.00	-.24	-.21	-.12	--		-0.20*	0.08
6. Teacher Rating ²			.01	.15	-.75	-.01	-.24		0.27**	0.08
<i>R</i> ²	0.04**			0.17**						
	Coefficient	SE				<i>t</i> value				
Surface value: <i>a</i> ₁	-0.35	.14				-2.59*				
Surface value: <i>a</i> ₂	0.12	0.10				1.22				
Surface value: <i>a</i> ₃	0.73	0.12				6.05**				
Surface value: <i>a</i> ₄	0.52	0.12				4.32**				

Note. *N* = 391. Self and Teacher ratings measured on a 1-4 scale with higher numbers representing higher perceived competence. Gender: 1 = Male, 0 = Female. *a*₁ = slope of the line of perfect agreement, *a*₂ = curvature of the line of perfect agreement, *a*₃ = slope of the line of incongruence *a*₄ = curvature of the line of incongruence.

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

Summary of Results

In sum, discrepancies between self-ratings and teacher-ratings of competence were detected within this sample of high school students. Only 43% and 42% of adolescents in this sample were in agreement with their teachers regarding their academic and social competence, respectively. This finding provided a rationale for moving forward with more complex analyses to better understand discrepancies between self and other ratings of competence.

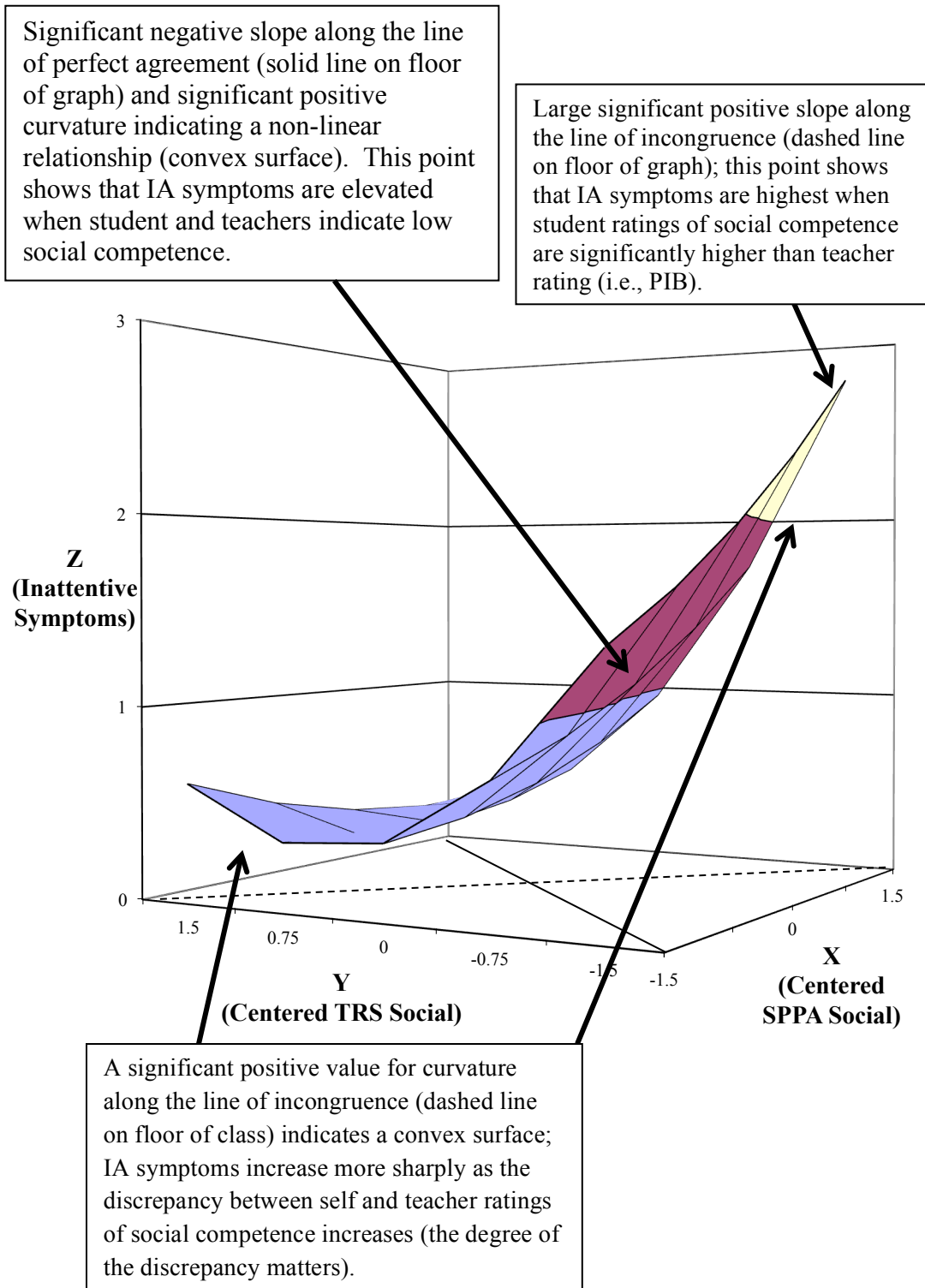


Figure 8. Response surface graph of IA symptoms as predicted by student perceptions of social competence-teacher perceptions of social competence discrepancy (with gender as covariate).

Comparisons of groups of students whose ratings of academic and social competence indicated overestimation, underestimation, or agreement compared to teacher ratings showed that symptoms of ADHD (i.e., inattentive and hyperactive/impulsive symptoms) were highest among students who overestimated their competence, compared to those with lower or accurate self-perceptions. Results of polynomial regression and response surface analyses, summarized in Table 25, suggest that the relationship between self and teacher ratings and ADHD symptoms is more complex. Specifically, results in the academic domain indicate that ADHD symptoms (overall ADHD, HI, and IA) are high when student and teacher ratings of academic competence are low (represented by quadrant 1 in Figure 1) *and*, for overall ADHD and IA symptoms, when self-ratings are higher than teacher ratings (i.e., the PIB; quadrant 3 of Figure 1). Results in the academic domain also suggest that there is a non-linear relationship between self and teacher ratings and IA symptoms, which has likely been missed in previous research using discrepancy scores which has only examined linear relationships. In the social domain, the slope and the curvature of the line of incongruence were both significant for overall ADHD, IA and HI symptoms when gender was not included in the analysis. The significant and positive a_4 surface values indicate a convex surface, with symptoms increasing more sharply as the degree of the discrepancy between self and teacher ratings increases. It is interesting that this finding related to the relationship between the degree of the discrepancy and ADHD symptoms was only found in the social domain. The significant slope, represented by a_3 , aligns with findings in the academic domain such that all ADHD symptoms were higher when self-ratings are higher than teacher ratings of social competence (i.e., the PIB as represented by quadrant 3 of Figure 1). It is important

to note that gender accounted for a significant amount of variance across all analyses; results indicate that males in this sample had significantly higher levels of all ADHD symptom variables (overall, HI, and IA) than females. However, adding gender as a covariate only changed results for HI symptoms in the social domain. With gender accounted for, surface value $a3$ (which provides the most information about the presence of the PIB) was no longer significant for HI symptoms in the social domain (see Table 25). A combination of visual inspection of the response surface graphs and examination of significant surface values across domains shows that the relationship between self and teacher ratings and symptoms is most pronounced for IA symptoms, with results showing that agreement represented by quadrant one of Figure 1, *and* disagreement represented by quadrant three of Figure 1 (i.e., the PIB) predict higher IA symptoms.

Table 25

Summary of Response Surface Value Coefficients with Gender as Covariate

	Academic Domain			Social Domain		
	ADHD	HI	IA	ADHD	HI	IA
Slope of line of perfect agreement ($a1$)	-0.38**	-0.18**	-0.86**	-0.14	0.03	-0.35*
Curvature of line of perfect agreement ($a2$)	0.00	0.01	0.18*	0.06	0.03	0.12
Slope of line of incongruence ($a3$)	0.31**	0.08	0.76**	0.33**	0.13	0.73**
Curvature of line of incongruence ($a4$)	-0.06	-0.11	0.06	0.26**	0.15**	0.52**

Chapter Five: Discussion

The current study investigated how agreement and discrepancy between self and teacher rating of competence predict levels of hyperactive/impulsive, inattentive, and overall ADHD symptoms. A primary purpose of this study was to propose polynomial regression and response surface analyses as a novel approach to understanding the PIB in relation to ADHD symptoms. A unique aspect of this study compared to previous literature is that invariance testing was conducted to determine whether the self and teacher versions of the SPPA performed similarly across these raters. Discrepancy analyses using MANOVA were conducted to compare the level of ADHD symptoms across students with underestimations, accurate, and overestimations of competence. These analyses align with the majority of past research on the PIB and allow for comparisons with polynomial regression results. Polynomial regression and response surface analyses were used to provide a more nuanced understanding of how agreement and disagreement in student and teacher competence ratings may predict ADHD symptoms. This chapter summarizes the key findings from these analyses, compares results obtained with the two different approaches, and relates findings to existing literature. Implications for research and practice, limitations, and future directions are also included.

Key Findings from Descriptive Analyses

Findings from descriptive analyses demonstrate that a full continuum of ADHD symptoms was represented within the sample, with the average IA symptoms ranging from 0 to 3, and the average HI symptoms ranging from 0 to 2.89. Results also show that IA symptoms are more prevalent among the high school students in this sample than HI symptoms. This finding is aligned with past research suggesting that IA symptoms are more common than HI symptoms among adolescents (Fefer, 2011; Short et al., 2007; Wolraich et al., 2005).

Descriptive statistics of competence ratings suggests that, overall, both students and teachers rate students as highly competent across the academic and social domain (mean of 2.96 or greater on a 1-4 scale). Ratings across the academic and social domains are very similar, with the mean of social competence scores slightly higher than academic competence ratings across student and teacher ratings. Correlational analyses suggest that, although group means are similar across domains, students and teachers differentiate between academic and social competence. This is evidenced by moderate correlations between ratings of academic and social competence for students and teachers, and is in line with self-concept literature that suggests that adolescence is the developmental period where self-perceptions become more differentiated across domains (Harter, 2012). An additional interesting finding from descriptive analyses is that mean discrepancy scores (student rating - teacher rating of academic and social competence) were negative, suggesting that many students underestimate their competence compared to teacher ratings. Furthermore, correlations between self and teacher ratings of competence were moderate in the academic domain and low in the social domain, suggesting that student

and teacher ratings of competence were not always similar. This finding is supported by the results of the base rate discrepancy analysis indicating that student and teacher competence ratings were in agreement for less than half of the sample across both domains.

Exploring the Harter Scales

This study provided additional information about the self and teacher versions of the SPPA that can be applied to future research exploring ratings of competence. Specifically, preliminary analyses indicated that these scales demonstrate high reliability across students and teachers, with higher internal consistency found for teachers. Additional items were added to the teacher version, in consultation with the author of the instrument, in order to enhance comparability between measures. The high reliability estimates within the current study suggest that adding three additional items to the scale improved score reliability; the original two-item measure is reported to have internal consistency ranging from .80 to .90 across domains (S. Harter, personal communication, August 29, 2009).

The current study also provided insight about teachers' reactions to this measure. It is particularly telling that 30% (117 teachers) left all of the items on the Close Friends subscale blank, while providing full responses to the academic and social acceptance subscales, even with these five items interspersed throughout the measure. This suggests that teachers did not feel comfortable rating items related to students' close friendships, while they were able to rate the broader construct of social acceptance. Future investigation of teacher reactions to this subscale is warranted in order to understand teachers' rationale for leaving these items blank while completing the social acceptance

scale. This could be accomplished by interviewing teachers about their interpretation of items on the Close Friends subscale. The patterns of responding in the current study suggest that teachers were more comfortable rating broader dimensions of social competence, specifically social acceptance, compared to answering more specific questions about whether or not students have close friends to confide in. The Close Friends subscale was not used for the current study due to the high occurrence of missing data on this subscale. In addition to exploring teacher reactions to this subscale, future research should consider different methods to collect information about the friendships of high school students, such as peer nominations as has been done in past research (Diamantopoulou et al., 2005).

The measurement invariance of the self and teacher versions of the Harter measures was also explored through confirmatory factor analysis. While the self and teacher versions of the Harter measures are commonly used in research on the PIB, none of this literature has acknowledged measurement equivalence. This is an important missing piece within the existing PIB literature that this study has addressed. One study comparing parent and teacher ratings of student competence (but not self-ratings) suggested that the parent and teacher measures were equivalent across student gender and grade (Cole et al. 1998); however, these authors chose to consider fit indices beyond change in chi-square to determine equivalence. It is important to consider that the current study considered a combination of change in chi-square as well as other fit indices to determine invariance. The analyses conducted support configural invariance across both social and academic domains, meaning that the factors under investigation (i.e., academic and social competence) were associated with the same items across the student and

teacher measures. However, metric invariance was not supported in the academic domain based on change in chi-square. This means that the items which make up this subscale may function differently across students and teachers, and across individual items within this domain. Metric invariance was supported within the social domain; however, scalar invariance testing indicated that item intercepts differed across students and teachers. Partial invariance of measurements of social competence was demonstrated through these analyses, with less support provided for the academic domain. These results suggest that caution is needed in drawing conclusions from research using these measures to assess discrepancies, particularly because polynomial regression assumes measurement equivalence (Shanock et al., 2010). This study provides a framework for analysis of measurement equivalence that can inform future research, with results suggesting that previous research in this area should be interpreted cautiously due to the failure to explore the equivalence of the Harter measures.

Discrepancy Analysis

A first step to the discrepancy analysis was to examine base rates of discrepancies in the academic and social domain. Students were divided into groups based on whether they overestimated, underestimated, or had accurate perceptions of their academic and social competence compared to their teachers' rating. More than half of the participants in this study exhibited discrepant competence ratings, suggesting that the PIB persists into adolescence in the academic and social domains as has been demonstrated in recent literature (Fefer, 2011; Hoza et al., 2010; McQuade et al., 2011a). Chi-square tests of gender across these discrepancy groups suggested that gender was related to grouping across both domains, with more females in the negative group, and more males in the

positive group. This is aligned with past literature suggesting that females are prone to lower self-perceptions during adolescence (Harter, 2012), and with the majority of past research on the PIB which has been conducted with boys with ADHD (e.g., Hoza et al. 2002). Currently there is not consensus in the PIB literature related to gender; however, past studies suggest that the PIB is present among both genders (Ohan & Johnston, 2011; Hoza et al., 2000). The results of the current study support the presence of the PIB across both genders, but suggest that the PIB is more common among males. It is important to acknowledge that this finding could be influenced by the fact that ADHD symptoms are more common among males (Froehlich et al., 2007). Future research should include gender when investigating the PIB so that results from this study can be replicated, and to gain an increased understanding of how gender influences the relationship between agreement/disagreement of competence and ADHD symptoms.

In order to compare the results of the present study with previous explorations of the PIB (e.g., Fefer, 2011; Hoza et al., 2004) ANOVA and MANOVA analyses were used to investigate the presence of ADHD symptoms across discrepancy groups. Results indicate that the discrepancy groups differ in terms of overall ADHD, IA, HI, and depressive symptoms across the academic and social domains. Overall ADHD symptoms were shown to account for 13% of the variance in group membership within the academic domain, and 8% in the social domain. Inattentive symptoms were shown to account for more variance in group membership (15% in the academic domain and 9% in the social domain) compared to depressive (2% in the academic domain, 5% in social domain) and hyperactive/impulsive symptoms (2% in academic domain, 3% in social domain). Results were consistent across domains such that overall ADHD, inattentive, and

hyperactive/impulsive symptoms were highest in the positive self-perception group, and depressive symptoms were highest in the negative discrepancy group. There are conflicting results in the existing literature about how HI and IA symptoms or subtypes relate to the PIB. Owens and Hoza (2003) found that elementary-age students diagnosed with the HI or Combined subtype of ADHD were more likely to overestimate their competence in the academic domain than those with IA subtype. However, the results obtained in a study investigating academic and social self-perceptions among middle school students are in line with those in the current study and suggest that IA symptoms are most related to the PIB among school-based samples of young adolescents (Fefer, 2011). Additional research is needed to determine the relationship between the PIB and specific ADHD symptoms throughout development. It is possible that the PIB is most related to HI symptoms in younger children, as was supported by Owens and Hoza (2003), and then with IA symptoms as these symptoms become more prevalent in adolescence (Short et al., 2007).

A meta-analytic review of previous research also supports the findings regarding higher depressive symptoms among students with lower perceived competence (Gladstone & Kaslow, 1995). Previous studies investigating depression among students with ADHD with and without comorbid depression found that students with comorbid depression did not overestimate their competence like non-depressed peers, suggesting that depression may lead to more accurate self-evaluations for students with ADHD (Hoza et al., 2002; 2004; 2010). A study with an elementary school-based sample (non-ADHD) investigated the influence of depressive symptoms on self-perceptions and found

that depression was related to low perceived competence in the social domain (Kistner, David-Ferdon, Repper, & Joiner, 2006).

In sum, the current study is aligned with past research supporting the presence of the PIB among adolescents (e.g., Hoza et al., 2010), with less than half of the sample included in the accurate self-perception group. Gender was shown to relate to discrepancy grouping, with a greater percentage of males in the positive group and females in the negative group. This findings is aligned with past research suggesting that females may have lower self-concepts than their male counterparts during the adolescent years (Harter, 2012). The results of discrepancy analyses are also consistent with findings suggesting that student overestimation of competence compared to teachers is related to ADHD symptoms, while depressive symptoms are more common among students with lower perceived-competence (e.g., Hoza et al., 2010; Kistner et al., 2006). This study also contributes to mixed findings related to specific ADHD symptoms; with results suggesting that IA symptoms are most common among the positive self-perception group. This finding replicates the findings from one previous study with middle school students (Fefer, 2011), but contrasts findings with younger children (Owens & Hoza, 2003).

Results from Novel Measurement Approach

Polynomial regression and response surface methods were proposed as a new and improved method to answer the research questions set forth in the current study. Self and teacher ratings were entered separately into polynomial regression equations to determine how agreement and disagreement between these ratings of competence predict the level of general and specific ADHD symptoms. These analyses were explored within the

academic and social domains, and the ADHD outcome variables represented the full continuum of overall ADHD, HI, and IA symptoms rather than a diagnosis as has been investigated in most previous research in this area (e.g., Owens & Hoza, 2003). This analysis approach had never been used within PIB literature before, and provided a more nuanced understanding about how the degree and direction of the discrepancy between self and teacher ratings predict symptoms of ADHD. This methodology allowed for agreement and disagreement to be investigated along a continuum of competence ratings.

In the academic domain, all three of the ADHD variables explored (i.e., overall ADHD, HI, and IA symptoms) were shown to be high when students and teachers were in agreement that the student was impaired in the academic domain (i.e., agreement on low competence as represented by quadrant 1 of Figure 1). This finding is consistent with one of the initial hypotheses the current study. Specifically, based on past research (Owens & Hoza, 2003) it was hypothesized that students with high levels of IA symptoms may perceive and report their impairments across domains, and therefore self-ratings would be aligned with teacher ratings at the low end of the competence rating. While this hypothesis was supported, particularly because IA symptoms accounted for the greatest proportion of variance across the regression equations, it was not anticipated that agreement of low competence would also predict HI and overall ADHD symptoms. It is important to note that the slope of the line of incongruence, representing disagreement between students and teachers, was also significant and positive for overall ADHD and IA symptoms. This suggests that self-ratings higher than teacher ratings (i.e., the PIB) were also predictive of higher ADHD and IA symptoms. This finding supports the hypothesis that high student and low teacher ratings (i.e., the PIB) would predict

ADHD symptoms; however, it was not hypothesized that IA symptoms would be highly related to the PIB due to a lack of existing research with older adolescents. While previous research indicates that the PIB is present in the academic domain among students with an ADHD diagnosis (e.g., Hoza et al., 2002), the HI subtype of ADHD was suggested to be most related to the PIB among elementary age students (Owens & Hoza, 2003), and IA symptoms were shown to be higher among middle schools students who demonstrate the PIB (Fefer, 2011). These mixed findings suggest that the relationship between the PIB and specific ADHD symptoms may change throughout development; future longitudinal studies to further explore this topic are warranted.

These results obtained with self and teacher ratings of academic competence as predictors highlight the rationale for using polynomial regression over difference scores and suggest that the relationship between the PIB and ADHD symptoms may be more complex than past research suggests. Specifically, this analysis method indicated that IA and overall ADHD symptoms were related to agreement *and* disagreement between self and teacher ratings in the academic domain; while HI symptoms were only significantly related to agreement of low competence. These findings are unique compared to past literature, and could be used to explain some of the contradictory findings about whether or not the PIB is present among students with ADHD (McQuade et al., 2011b; Owens & Hoza, 2003; Whitley et al., 2008). This method allows for more specific information about the direction of agreement (i.e., low or high competence) whereas discrepancy analyses group all students who rate themselves similarly to teachers regardless of how highly students and teachers rate competence.

In the social domain, only IA symptoms were shown to be predicted by self and

teacher ratings that were in agreement about low competence (as represented by quadrant 1 of Figure 1). This is in line with the hypotheses outlined at the beginning of this study, and is in line with past research suggesting that some students with ADHD provide accurate reports of their impairments (McQuade et al., 2011b; Owens & Hoza, 2003, Swanson et al., 2012). However, IA symptoms were also predicted by self-ratings that were higher than teacher ratings (i.e., the PIB). As was hypothesized, overall ADHD symptoms were also higher when students overestimated their competence compared to teachers. Interestingly, HI symptoms were not shown to be significantly related to the PIB in the social domain when gender was taken into account. Including gender as a covariate changed the significance of the surface value that is most informative about the presence of the PIB when HI symptoms were the outcome variable; this surface value was significant for HI until gender was included in the regression equation. This suggests that gender should be considered in future research examining the PIB because males in this study were shown to have more ADHD symptoms (overall, HI, and IA) compared to females and this difference influenced results in the social domain. Interestingly, analyses of competence ratings in the social domain indicated a relationship between the degree of the discrepancy between self and teacher ratings and all three ADHD symptom variables (as represented by a significant and positive a_4 surface value; see Table 25). Specifically, the convex surface of the graphs in the social domain (see Figure 6-8) suggest that symptoms of ADHD increase more sharply as the discrepancy between self and teacher ratings of social competence increases. Visual inspection of the response surface graphs, along with the significant slope of the line of incongruence for overall ADHD and IA symptoms, indicate that this finding is particularly strong when

self-ratings are high and teacher ratings are low (i.e., the PIB). These findings replicate the results of a previous study by Diamantopoulou and colleagues (2005) which suggest that students with higher levels of ADHD symptoms overestimated their social abilities more than students with lower levels of ADHD symptoms. This result is also partially aligned with one of the only other studies to investigate IA and HI symptoms; this study with elementary-age youth suggested that more severe symptoms within the HI/Combined subtype group were associated with larger discrepancies with self-ratings higher than teacher ratings (Owens & Hoza, 2003).

Taken together, the results of analyses within the social domain suggest that the presence of the PIB may be more pronounced within the social domain when compared to the academic domain. One previous longitudinal study that included adolescents with ADHD suggested that the PIB persists in the social domain and not in the behavioral domain from childhood to adolescence (Hoza et al., 2010). These findings, which indicate that the presence of the PIB may vary by domain during adolescence, align with self-concept research suggesting that differentiation across domains is more common during this developmental stage (Harter, 2012).

The varied results gleaned from polynomial regression and response surface analyses with ADHD symptom variables as outcomes suggest the importance of exploring ADHD within a bifactor conceptualization (Martel et al., 2010a). Overall ADHD, HI, and IA symptoms were all shown to demonstrate different relationships with self and teacher ratings of competence across the academic and social domains. This is aligned with findings suggesting that overall ADHD and specific symptom variables are differentially related to external variables such as behavior problems and

personality/temperament (Martel et al., 2011). An additional benefit of using the bifactor model to guide the way ADHD was explored within the current study is that analysis with overall ADHD symptoms allow for closer comparisons with the majority of past research on the PIB that considered ADHD diagnosis regardless of subtype (e.g., Hoza et al., 2004). Furthermore, additional investigation of specific ADHD symptoms contributes to understanding the relationship between the PIB and IA or HI symptoms since past research is inconclusive. Only three studies to date have explored the relationship between the PIB and levels of specific ADHD symptoms, with one (Fefer, 2011) suggesting that IA symptoms were most related to the PIB, another (Owens & Hoza, 2003) suggesting that HI symptoms were most related to the PIB, and the last determining that there was no difference in the PIB based on ADHD subtypes (Swanson et al., 2012). It is important to note that these previous investigations used an ADHD subtype conceptualization to investigate relationships with the PIB and therefore did not consider overall ADHD symptoms. Martel and colleagues (2011) suggest that the bifactor model is more useful than a subtype conceptualization to describe the heterogeneous presentation and outcomes associated with the presence of different ADHD symptoms. The use of a bifactor model is also well suited for investigating ADHD symptoms on a continuum as was done in the current study, rather than classifying students by ADHD diagnosis as has been explored in the majority of past literature (e.g., Owens & Hoza, 2003).

Past literature has not accomplished this more nuanced understanding of agreement and disagreement, or been able to account for both the degree and direction of discrepancies between self and other competence ratings. For this reason, there is little

literature to draw from to make sense of these response surface results specifically. However, past research can help to make sense of the differences that were detected across the academic and social domains and across different symptom profiles. It is possible that agreement at the low end of the competence scales was more common in this high school sample compared to the younger samples used in past research because the presence of the PIB may decrease over time, with some domains decreasing more than others (Hoza et al., 2010; McQuade et al., 2011a). This findings may also be explained by the changes in ADHD symptoms over time, with IA symptoms becoming more prevalent than HI symptoms during adolescence (Wolraich et al., 2005). The PIB was most highly related to IA symptoms across all analysis types and across both domains of competence in the current study. It is important to note that IA symptoms were more common than HI symptoms in the current sample; it is possible the adolescents with high IA symptoms were once experiencing high levels of HI symptoms that changed over time. According to the cognitive immaturity hypothesis children with ADHD symptoms may eventually outgrow inflated self-perceptions (Owens et al., 2007). Perhaps this is related to changes in symptoms that results in decreased positive illusions? More information is needed to fully understand how changes in ADHD symptoms over time influence the presence of the PIB.

Based on the self-protective hypothesis for the PIB, it is also possible that the feedback received in the academic and social domains could influence student perceptions of competence (Diener & Milich, 1997; Emeh & Mikami, 2012; Ohan & Johnston, 2002). Ohan and Johnston (2002) found that positive feedback decreased the presence of the PIB in the social domain (i.e., student ratings became more accurate after

receiving positive feedback about a social interaction) and increased the discrepancy between student and teacher ratings in the academic domain. These authors conclude that these results provided support for the self-protective hypothesis in the social domain and not the academic domain since students have a decreased need for self-protection after receiving positive feedback. Ohan and Johnston (2002) urge other researchers to investigate why these differences between the social and academic domain were detected and do not provide insight into why the response to feedback in the academic and social domains differ. Hoza and colleagues (2012) also provided evidence of a self-protective function of the PIB in the social domain in particular by demonstrating that student ratings of social competence did not change even when monetary incentives were provided for matching teacher ratings (while ratings in the academic and behavioral domains were more influenced by incentives).

High school students are likely to have received an accumulation of both positive and negative feedback by the time they reach high school. Students who demonstrate ADHD symptoms may be more likely to receive negative feedback due to impairments in the academic and social domains. It is possible that an accumulation of negative feedback over time has maintained the PIB and the need for self-protection for some adolescents with ADHD symptoms. Feedback received in the academic domain is likely to be more frequent and objective compared to feedback in the social domain. Academic feedback comes in the form of grades, written and verbal feedback on assignments, test scores, and report cards. It is important to note that there are no comparable mechanisms for feedback within the social domain; social feedback is likely to be more subtle and difficult to interpret for adolescents with symptoms of ADHD. This difference in the

academic and social domain may explain the different findings across the academic and social domains in the current student. Furthermore, the PIB may be more prevalent in the social domain because adolescents may value social competence more highly than academic competence and therefore require more self-protection in the domain with greater value. Developmental literature outside the realm of ADHD and the PIB suggests that adolescents' perceptions of the value of school and academic success decreases beginning at the transition to middle school (Anderman, 1999). Conversely, social acceptance and popularity are shown to become more important than other domains beginning in early adolescence (Brown, 2004; Hoza, 2007; LaFontana & Cillessen, 2010). In one previous study adolescents with ADHD were more likely to overestimate competence in the social domain (an area of great value to adolescents) compared to the behavioral domain where impairments may be more accepted by peers and therefore require less protection (Hoza et al., 2010). Perhaps some students in the current study feel that they require less self-protection in the academic domain? Academic impairment may be more acceptable to adolescent peers than social difficulties.

It is also important to acknowledge that the specific impairments demonstrated by the students with higher ADHD symptoms in this sample could have influenced the differences across the academic and social domains. In contrast to past research on the PIB (e.g., Owens & Hoza, 2003) with younger students, the students in this sample demonstrated higher levels of IA symptoms, with high HI symptoms being relatively uncommon among study participants. This finding is in line with past research suggesting that HI symptoms are less common among adolescents (Wolraich et al., 2005). This is particularly relevant because IA symptoms are most associated with

significant academic impairments (Short et al., 2007), and the social impairments displayed by students with predominantly IA symptoms tend to be more discrete compared to their peers with high HI symptoms. Specifically, students with IA symptoms are often rated as more withdrawn and shy, whereas students with HI symptoms are rated as more aggressive, disinhibited, and less liked by peers (Hodgens et al., 2000). The specific impairments associated with IA symptoms may have influenced the direction of both self and teacher ratings of competence across domains, with students being more aware of their academic impairments compared to their more subtle social difficulties.

Contributions to the Literature

The current study contributes to existing literature on the PIB in several ways. This is the first study to investigate symptoms on a continuum within a bifactor conceptualization of ADHD by measuring the full range of overall ADHD, IA, and HI symptoms. The varied results of analyses with each of these ADHD symptom variables as the outcome emphasize the importance of considering overall symptoms, as well as specific subtypes, when investigating agreement and disagreement between students and teachers. Specific ADHD symptoms may be one factor that contributes to whether or not students demonstrate positive illusions. Future research should explore what other characteristics contribute to students reporting their competence in a way that is accurate versus inflated, and what outcomes relate to agreement and disagreement. Preliminary research suggests that increased social impairments (Linnea et al., 2012), deficits in cognitive processes such as working memory (McQuade et al., 2011b), and increased criticism from parents (Emeh & Mikami, 2012) may distinguish students with the PIB

from those without. More research is needed to understand what contributes to varied presentations in competence ratings in addition to ADHD symptoms. The methods utilized within the current study will allow future research to explore characteristics associated with agreement and disagreement between student and teacher ratings.

This study also has several unique sample characteristics that will contribute to the literature. The majority of past research on the PIB has used clinically referred samples to explore this phenomenon. The use of a school based sample in the current study allowed for an investigation of the degree of specific ADHD symptoms and accuracy of competence ratings within the academic and social domains because students with the full range of ADHD symptoms were included in the study sample. Examining symptoms on a continuum accounted for students who have high IA or HI symptoms, but may not meet the designated cut-off scores used in previous research (e.g., Owens & Hoza, 2003). This is also the first study to focus exclusively on the PIB among high school students. It is important to be cognizant of this older sample when comparing results from this study to previous research because past research on ADHD (Wolraich et al., 2005) and self-concept (Bracken, 2009; Harter, 2012; Marsh et al., 2005) suggest that both of these constructs change over time (with IA symptoms becoming more common than HI, and self-concept becoming more differentiated and stable in adolescence). This study also includes a more culturally and socioeconomically diverse sample than the primarily Caucasian participants utilized in past studies on this topic. Additionally, the sample for the current study includes both males and females, with more females than males; this is not common in past research as the majority of studies have included all or majority male participants. Results of this study suggest that gender is significantly

related to discrepancy grouping *and* to ADHD symptoms as an outcome variable. Future research should account for gender when exploring the PIB in order to better understand this phenomenon across males and females. Incorporating depressive symptoms, grade, and gender within this research design also adds to the sparse body of past research that has accounted for these variables and provides areas for the extension of future research questions related to covariates.

Regarding measurement, this is the first study on the PIB to explore the use of polynomial regression and response surface tests to address the limitations of difference scores and investigate self and teacher ratings separately. The use of polynomial regression with response surface extends upon the discrepancy method by testing whether student and teacher ratings have unique relationships to ADHD symptoms that are overlooked with the discrepancy method. Cohen and colleagues (2010) call for increased use of polynomial regression analyses within the social sciences, and Laird and De Los Reyes (2013) demonstrate that these more complex analyses are more comprehensive and accurate than what can be accomplished with difference scores. The current study provides a model for how to extend this methodology to an area where it has never before been used. One of the greatest contributions of this study is to demonstrate how to measure the PIB without a reliance on difference scores as has been done in the majority of past research (i.e., the 16 studies reviewed previously). This use of polynomial regression in the current study provides a direct response to a recent article by Swanson and colleagues (2012) which includes a call for research investigating self and other indicators of competence together and separately.

This study also used invariance testing to evaluate the equivalence of teacher and student measures, something that has not been done in previous research using polynomial regression. A literature search for examples of this method resulted in only one study comparing students and teacher ratings (Brekelmans, Mainhard, Brok, & Wubbels, 2011). A review article by Schmitt and Kuljanin (2008) suggests that the vast majority of research in this area compares groups of respondents separated by age or ethnicity, with no reference to comparisons across different raters (e.g., students and teachers). These authors suggest that the use of invariance testing is increasing over time, and significantly more research is needed related to partial invariance because this is much more common than achieving full measurement invariance (Schmitt & Kuljanin, 2008). This review acknowledges that there is very little guidance available for researchers who want to determine how to make a case about whether an instrument is appropriate for use based on results suggesting partial invariance (Schmitt & Kuljanin, 2008). An important contribution of the current study is to provide a framework for the systematic evaluation of equivalence across measures to be conducted before measures are directly compared in discrepancy or polynomial regression analyses. Furthermore, these analyses represent a preliminary step in moving this area of research towards a latent variable framework. Edwards (2009) suggests that latent variable modeling is an important future direction needed to further strengthen congruence research by merging polynomial regression and structural equation modeling. These important contributions to the literature on positive illusions will allow for further development and refinement of theory related to the PIB in order to inform school psychology research and practice.

Taken together, this study contributes to PIB literature by (a) considering ADHD symptoms on a continuum within a bifactor conceptualization that is aligned with the new DSM-5 (APA, 2013), (b) exploring a school-based sample of diverse high school students, (c) being the first to explore the PIB using polynomial regression and response surface analyses to provide a greater understanding of the relationship between self and teacher ratings and specific ADHD symptoms, and (d) providing a framework for determining equivalence across self and teacher ratings.

Implications for School Psychologists

Exploring agreement and disagreement in competence ratings between students and teachers has the potential to inform the practices of school psychologists and other professionals working with youth with ADHD symptoms. The results of this study suggest that the relationship between ADHD symptoms and competence ratings is more complex than was initially thought; some students with ADHD symptoms provide inflated reports while others accurately report their competence and this may vary by domain. The current study does provide evidence that the PIB persists into adolescence for students with elevated ADHD symptoms (particularly IA symptoms), and that the PIB is present in both the academic and social domains among this high school age sample. It is particularly important for school psychologists to further understand the presence of both the PIB and agreement within the academic and social domains because these areas are often the target of assessment and intervention efforts for struggling high school students, including those with ADHD symptoms.

Unfortunately, there is little guidance in the literature regarding the specific actions that should be taken for students with ADHD symptoms who either agree with

their teachers about their low competence, or provide inflated ratings of competence compared to teachers. Future research investigating whether or not the PIB is found to be adaptive or maladaptive, and specific characteristics associated with overestimation or agreement in competence ratings, is needed to inform future intervention efforts. Insight related to the hypothesis that best explains the PIB for students with symptoms of ADHD will likely lead to prevention or intervention efforts that either decrease or maintain current self-perceptions. Furthermore, a better understanding of students who have low self-ratings of competence that are in agreement with teachers will provide greater insight about whether efforts should be made to improve perceptions of competence for these students or if accurate perceptions are more adaptive. Some emerging literature suggests that positive illusions may be problematic. Harter (2012) suggests that overestimation and underestimation of competence compared to external sources in the academic domain may compromise learning because students with inaccurate self-perceptions were shown to select easier tasks. Hoza and colleagues (2010) suggest that the PIB among students diagnosed with ADHD may be a risk factor for increased aggression, and that the PIB may not serve as a protective factor against depression. Another study found that estimations of social competence were related to negative psychosocial outcomes for girls with ADHD, but related to positive outcomes for girls without ADHD (Ohan & Johnston, 2011). Additionally, preliminary research regarding the link between the PIB and social behaviors suggests that the PIB may be directly related to the social impairments exhibited by children with ADHD (Linnea et al., 2012). This study compared students with the HI subtype of ADHD with and without the PIB and found that those with the PIB exhibited significantly greater social deficits than children with

ADHD but no PIB (Linnea et al., 2012). These findings suggest that the PIB is likely maladaptive and indicate that interventions for these students prior to adolescence may be warranted, particularly because comorbid internalizing and externalizing disorders are increasingly common for adolescents with ADHD (Carlson & Mann, 2000). It is important to note that other recent research suggests the positive illusions could be adaptive. Specifically, recent research related to mental health problems and life satisfaction suggests that students who were unaware of their academic challenges maintained high levels of subjective well-being (i.e., happiness) despite exhibiting mental health symptoms (Suldo, Frank, Chappel, McMahan, & Bateman, 2013). This finding lends further support to the self-protective hypothesis to explain the PIB. Future research is needed to directly explore the relationship between the PIB and well-being to understand whether the PIB may serve an adaptive function.

Regarding intervention, findings from previous literature suggest that the presence of the PIB decreases the effectiveness of behavioral interventions (Hoza & Pelham, 1995; Mikami, Calhoun, & Abikoff, 2010). Children who do not believe that they are experiencing difficulty in a given domain may not fully engage in the complex behavioral interventions that may be necessary to see improvements within their areas of impairment. This is particularly problematic since a likely intervention approach for both types of students identified within the current study (low competence agreement and PIB) would be to provide skills-based interventions to improve academic and social skills, which could lead to accurate yet improved self-ratings of competence. There is some promising research suggesting that attributions in both the academic and social domains can be changed through intervention (Hudley, Graham, & Taylor, 2007). Frey and

colleagues (2005) showed that a school-based social emotional learning curriculum was effective in decreasing hostile attributions. These findings suggest that the biased perceptions of children demonstrating the PIB may be an appropriate target for school-based intervention efforts. This discussion underscores the fact that more research is needed in order to provide information to school psychologists about how to best serve students with ADHD with inflated *and* accurate competence ratings. It may be particularly important to intervene prior to adolescence for students with the PIB, if intervention is in fact warranted, because research suggests that self-concept remains stable through adolescence and adulthood and is not likely to change over time (Harter, 2012).

Regarding assessment, although it is well documented that students with ADHD do not accurately report externalizing behavior (Barkley et al., 2002), the PIB suggests that some students with ADHD may also provide inaccurate reports of their abilities in multiple domains, while others are likely to provide accurate reports. This may be particularly relevant for an adolescent population considering that self-report is used more commonly in evaluations with adolescents compared to young children. An important area for future research is to investigate if a student's tendency to overestimate competence is impacted by the measurement method used (e.g., interviews, open-ended questionnaires, or more traditional rating scales). This would allow school psychologists to choose the best method for gathering self-report information from adolescents with ADHD symptoms. A greater understanding of the PIB may impact how school psychologists use self-report data and provide insight into what symptom profiles are associated with inaccurate reports. These findings also highlight the importance of getting

data from multiple sources when conducting evaluations related to ADHD as these data will help to paint a fuller picture of the students' abilities and impairments, and also provide insight about whether the student is demonstrating the PIB compared to external indicators of competence. Thus, more research on the agreement and disagreement in competence ratings could provide insight into how school psychologists can best support students with ADHD. Increased understanding and awareness that the PIB may persist into adolescence for students with ADHD, while others accurately report their impairments, may lead to more careful consideration of how to assess and intervene for students with specific behavioral risk factors such as ADHD symptoms or the PIB.

Limitations of the Current Study

Precautions were taken when carrying out this research project to ensure that valid results were obtained and to address threats to validity. However, this study is not without limitations. Population validity, the ability to generalize results from the sample to a larger population, is one potential limitation of this research project. Some unique participant characteristics may limit the populations to which results of this study can be generalized. It must be considered that students who agreed to participate in the research study and returned their parental consent forms may differ from other high school students who declined to participate or did not return a parental consent form.

Precautions were taken by comparing the study sample to the demographics of both of the participating high schools through the use of descriptive statistics to ensure that all sub-populations of students represented at these schools were included in the study sample. The high schools in this study were selected based in part on their diverse student population from varied ethnic and socioeconomic backgrounds.

The use of self-report and teacher report methods is a potential limitation to this study design. The use of self-report methods for research addressing questions related to self-perceptions is unavoidable; however, precautions were taken to ensure that the self-report measures used demonstrate strong psychometric properties and have been used with populations similar to those within the current study. The SPPA was selected for use in the current study for these reasons. Additionally, all ratings from student self-report measures were considered to be representing student perceptions rather than as representing their actual abilities or impairments. Comparing self-reports to indicators of actual competence (such as teacher reports or performance on a task) is recommended as the best practice methodology for research on the PIB (Owens et al., 2007). The current study also utilized a well-validated secondary measure of student perceptions of competence. This measure, the BASC-2-A self-report, also included validity indices to detect socially desirable responding and careless responding by students. This provided an indication of whether self-report was impacted by biased or haphazard responding.

The use of teacher reports could also be considered a limitation to this study. It may be particularly important to acknowledge the limitation that teachers are reporting both ADHD symptoms and student competence. Using the same reporter for one of the predictors and the outcome variable could be viewed as a limitation due to shared variance; however, this is often done in past research using polynomial regression and response surface (e.g., Harris et al., 2008; Kazen & Kuhl, 2011). Additionally, the nature of high school scheduling could limit the ability of teachers to provide accurate ratings of social and academic competence; however, teacher reports were used for this study because teachers have opportunities to observe their students in both academic and social

settings. An additional limitation worth noting is the range of surveys completed by each teacher; some teachers completed one survey while another teacher completed 79 (with an average of 19 surveys for English teachers and 8 for Math teachers). This range was the product of recruiting students through their English classes, with some English teachers effectively recruiting many students for participation. Ratings from two teachers were averaged in order to increase the reliability of teacher ratings of symptoms and competence and to decrease the potential impact of biased teacher responding. Teachers are suggested to be the most relevant reporters for students' daily behavioral concerns (Gadow, Drabick, Loney, Sprafkin, Salisbury, Azizian, & Schwartz, 2004). Mitsis, McKay, Shultz, Newcorn, and Halperin (2000) suggest that when behavior in school is of interest, parent input cannot replace teacher input.

Some previous research has suggested that biased teacher ratings for students with ADHD contribute to the PIB rather than overestimates on the part of the student (Eisenberg & Schneider, 2007; Swanson et al., 2012; Whitley et al., 2008). Although unstandardized regression coefficients from polynomial regression are not typically interpreted, it is important to note that the significant negative coefficients for teacher ratings across all analyses in the academic domain suggest that lower teacher ratings are related to higher ADHD symptoms. Interestingly, this pattern of low teacher ratings was not as prominent in the social domain, as self-ratings and cross-products were significant as well. While this could be perceived as indicative of teacher bias in the academic domain, this should also be expected if teachers are rating competence accurately because it is well documented that students with high ADHD symptoms experience impairments across the academic and social domains (Bussing et al., 2010), with IA symptoms being

most associated with academic impairments (Short et al., 2007). Past studies on the PIB have found consistency across raters (Hoza et al., 2004; Scholtens et al., 2011) and demonstrated the presence of the PIB using criteria such as a lab task or an achievement test (Evangelista et al., 2008; Hoza et al., 2002, 2004; Ohan & Johnston, 2011; Owens & Hoza, 2003). Additionally, findings from the current study suggest that some students report low competence that aligns with teacher ratings suggesting that the teachers' low reports may be accurate. Additionally, the mean teacher ratings within both the academic and social domains were very high within the current study and teachers rated students as demonstrating the full range of competence from low to high. For these reasons taken together, it seems unlikely that a negative teacher bias is responsible for the presence of the PIB in this study.

Although polynomial regression and response surface methods represent an improvement on difference scores, there are some limitations of this method that should be considered. One of the primary limitations of these methods is the fact that the analyses rely on the assumption that the predictors are measured without error (Edwards, 2002). It has been suggested that investigating the use of latent variable modeling with this method is an important area for future research (Edwards, 2009). The current study conducted invariance testing on the competence measures to account for measurement error and ensure the comparability of these measures; this represents a significant improvement over past research which has failed to acknowledge the assumption of measurement equivalence. However, only partial invariance was demonstrated based on the change in chi-square; therefore, caution should be used when drawing conclusions based on results of analyses comparing self and teacher competence ratings. It is

important to note that there were slight wording variations across student and teacher competence ratings; this is a limitation because this may have contributed to the results of invariance testing (see Tables 8 and 10). Another limitation of polynomial regression and response surface is that agreement/disagreement can only be examined as predictor variables, rather than dependent variables. This is not necessarily a problem in this study because the research questions to be addressed warrant the use of self and teacher ratings as predictors.

Conclusions and Future Directions

Findings gleaned from the current study suggest that previous studies on the PIB had oversimplified the complex relationship between self and teacher competence ratings and ADHD symptoms. In the introduction to this study it was stated that it is important to understand if adolescents with symptoms of ADHD demonstrate the PIB like children with ADHD, or whether their self-perceptions become more realistic and differentiated across domains. The answer to this question turned out to be “it depends” as some students with elevated symptoms may accurately report their impairments, particularly in the academic domain, while other students with elevated ADHD symptoms may overestimate their competence compared to teacher ratings. The results of this study also suggest that gender should be included in future investigations of this subject area, as gender was a significant covariate across all polynomial regression analyses (with males having higher ADHD symptoms than females), and was shown to be significantly related to discrepancy grouping as well (with more males overestimating competence and more females underestimating competence). More information is needed to draw conclusions about the PIB among girls with ADHD; past research suggests that girls with ADHD

display the PIB (Ohan & Johnston, 2011) but also have lower self-perceptions compared to boys with ADHD (Ek, Westerlund, Holmberg, & Fernell, 2008). It is important for future research to investigate additional characteristics, beyond ADHD symptoms, that may distinguish between students who are aware of their impairments, and those who overestimate their competence.

This study serves as the introduction of polynomial regression and response surface analysis to research focused on self and teacher competence ratings. This novel measurement approach represents a significant advancement over discrepancy scores which are quite limited in their interpretability regarding agreement and disagreement between students and teachers. Both more traditional discrepancy analyses and the novel approach of polynomial regression results were included in this study to promote comparisons of results across these very different methods, and to illustrate how this novel approach provides more insight into the PIB. This study also demonstrates how to investigate measurement equivalence, a key assumption of polynomial regression, prior to comparing self and teacher competence ratings.

An important yet challenging task for future research in this area will be to develop alternative indicators of competence across domains of competence. For example, in the current study ratings from multiple teachers were utilized which represents advancement over past methods, but still may not provide the most complete and objective indicator of student competence. In the future, methods such as direct observation, task performance measures, peer or teacher nomination, or additional rating scales could be utilized as indicators of competence in the social domain, and achievement tests, school record data, or performance measures could be used to measure

the academic domain. This will also allow for research on the PIB to be extended to older adolescents and young adults, for whom teacher ratings may not be available. Mixed methods research should also be considered for future investigations of the PIB, as qualitative data gathered from focus groups or interviews with students with and without the PIB may provide more insight than survey methodology about the function and maintaining factors related to this intriguing phenomenon. Extensions upon current survey methodology, including further application of polynomial regression as well as latent variable modeling, may provide insight about factors that discriminate students whose ratings are aligned with other indicators from those who demonstrate the PIB.

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Appendices

Appendix A: Parent Consent Letter (Modified to fit in current document)



Dear Parent or Caregiver:

This letter provides information about a research study that will be conducted by Sarah Fefer, Lisa Bateman, and Dr. Julia Ogg from the School Psychology program at University of South Florida (USF). Our goal in conducting the study is to investigate the experiences of adolescents exhibiting behavioral risk factors.

- ✓ Who We Are: Sarah Fefer, M.A. and Lisa Bateman, M.A. are School Psychology doctoral students at USF. Dr. Julia Ogg, our faculty advisor, is an Assistant Professor in the School Psychology Program in the College of Education at USF. We are planning the study in cooperation with the principal and administrators at your high school to ensure the study provides information that will be helpful to the schools.
- ✓ Why We Are Requesting Your Child's Participation: This study is being conducted as part of a project entitled, "Perceptions of Competence and Life Satisfaction: Exploring Behavioral Risk Factors Among High School Students" (IRB#10101). Your child is being asked to participate because they are a student at a participating high school, and are enrolled in an English and Math class.
- ✓ Why Your Child Should Participate: We need to learn more about how to help students be successful during the high school years. The information that we collect from students and teachers may help increase our overall knowledge of difficulties students frequently encounter in school and help support students' success. Please note that your child will not be paid for participation in the study. However, all students who return parental consent forms will be entered into a drawing for a gift certificate (\$25), regardless of if you allow your child to participate or not. Students who complete the surveys will also receive a small item to thank them for participation (such as a food item or pen).
- ✓ What Participation Requires: If you give permission for your child to participate in the study, he or she will be asked to complete a paper-and-pencil questionnaire. The questionnaire will ask about your child's behaviors (e.g., his/her perception of their ability to pay attention and focus), his/her perceptions of how he/she does academically and socially [i.e., getting along with peers], how satisfied he/she is with his/her life, and how depressed he/she feels. Completion is expected to take your child about 30 minutes. We will personally administer the questionnaires along with a trained team of researchers from USF. Questionnaires will be administered to students who have parent permission to participate. Each child's teacher will also complete a questionnaire about your student's academic and social competence and their behavior. Participation will occur during the school day during this Spring semester. In addition, students' school records will be reviewed for academic achievement information as well as to determine eligibility for free/reduced lunch and English language learner status. This is a one-time study and will not involve any follow-up. The data collected from the teacher surveys and from your student's questionnaires will be

kept in a secure location for five year and then destroyed. The educational data obtained from your student's records will be destroyed when the study is completed (i.e., closed).

- ✓ Please Note: Your decision to allow your child to participate in this research study is completely voluntary. You are free to allow your child to participate in this research study or to withdraw him or her at any time. If you choose not to allow your child to participate, or if you withdraw your child at any point during the study, this will in no way affect your relationship with the high school, USF, or any other party.
- ✓ Confidentiality of Your Responses and Your Child's Responses: There is minimal risk to your child for participating in this research. We will be present during administration of the questionnaires, along with a team of trained researchers, in order to provide assistance to your child if he or she has any questions or concerns. Your child's privacy and research records will be kept confidential to the extent of the law. Authorized research personnel, employees of the Department of Health and Human Services, and the USF Institutional Review Board may inspect the records from this research project, but you and your child's individual responses will not be shared with school system personnel or anyone other than us and our research assistants. Your child's completed questionnaire will be assigned a code number to protect the confidentiality of his or her responses. Only we will have access to the locked file cabinet stored at USF that will contain: 1) all records linking code numbers to participants' names, and 2) all information gathered from school records. Please note that although your child's specific responses on the questionnaires will not be shared with school staff, if your child indicates that he or she intends to harm him or herself, we will provide your child's name to the school mental health counselors and ask that they follow up with your child to ensure your child's safety. We will also let mental health counselors know if your child scores high on a measure of depression. The mental health counselors will determine if additional follow-up is needed.
- ✓ What We'll Do With Your Responses and Your Child's Responses: We plan to use the information from this study to inform educators and psychologists about helping all students be successful in school. The results of this study may be published. However, the data obtained from you and your child will be combined with data from other people in the publications. The published results will not include your name or your child's name or any other information that would in any way personally identify your child.
- ✓ Questions? If you have any questions about this research study, please contact Dr. Julia Ogg at (813) 974-9698. If you have questions about your child's rights as a person who is taking part in a research study, you may contact a member of the Division of Research Compliance of the University of South Florida at (813) 974-5638.
- ✓ Do You Want to Participate or Have Your Child Participate? To permit your child to participate in this study, complete the attached child consent form and have your child turn it in to his or her teacher.

Sincerely,

Sarah Fefer, M. A.
School Psychology Doctoral Student

Lisa Bateman, M.A.
School Psychology Doctoral Student

Julia A. Ogg, Ph.D.
Assistant Professor of School Psychology
USF College of Education

Consent for Child to Take Part in this Research Study

I do not give permission to let my child take part in this study.

I freely give my permission to let my child take part in this study. I understand that this is research. I have received a copy of this letter and consent form for my records.

Printed name of child

Child's English Teacher

Date

Signature of parent of child taking part in the study

Printed name of parent

Statement of Person Obtaining Informed Consent

I certify that participants have been provided with an informed consent form that has been approved by the University of South Florida's Institutional Review Board and that explains the nature, demands, risks, and benefits involved in participating in this study. I further certify that a phone number has been provided in the event of additional questions.

Signature of person obtaining consent

Printed name of person obtaining consent

Date

Appendix B: Student Assent Letter (modified to fit in current document)



Hello!

This letter explains a research study in which we would like you to take part. Our goal in conducting the study is to learn more about your thoughts, feelings, and attitudes related to school, family, friends, and life in general.

- ✓ Who We Are: Sarah Fefer, M.A. and Lisa Bateman, M.A. are School Psychology doctoral students at USF. Dr. Julia Ogg, our faculty advisor, is a school psychology professor in the College of Education at USF. We are planning the study in cooperation with the principal and administrators to ensure the study provides information that may be helpful to the schools.
- ✓ Why We are Asking You to Take Part in the Study: This study is being conducted as part of a project entitled, "Perceptions of Competence and Life Satisfaction: Exploring Behavioral Risk Factors Among High School Students" (IRB#10101). You are being asked to participate because you are in an English and Math class at a participating high school. All students in an English class in which your teacher has agreed to participate in this study will be asked to participate.
- ✓ Why You Should Take Part in the Study: We need to learn more about how to help students be successful during their high school years. The information that we collect from you may help increase our overall knowledge of difficulties frequently encountered in school. Please note you will not be paid for your participation in the study. However, all students who complete and return parental consent forms, regardless of whether or not your parents agree to allow you to participate in this study, will have a chance to win a gift card (\$25). You will also receive a small item to thank you for completing the survey (such as a food item or a pen).
- ✓ What Will Happen if You're in the Study: If you choose to take part in the study you and your teachers will be asked to complete a paper-and-pencil questionnaire during school hours. The questionnaire will ask about your behaviors, your perceptions of how you perform academically and in getting along with your peers, how satisfied you are with your life, and how depressed you feel. It will take you about 30 minutes to complete the 1 time only questionnaire. After you finish, a researcher will look over your questionnaire to ensure that you have answered all of the questions you intended to answer with only one response. If you choose to take part in the study, we will also look at some of your school records including your grades, English language learner status, and reduced lunch status. This is a one-time study and will not involve any follow-up. The data collected from you and your teachers will be kept in a secure location for five years and then destroyed. The educational data obtained from your records will be destroyed when the study is completed (i.e., closed).
- ✓ Please Note: Your involvement in this study is voluntary (it's your choice). By signing this form, you are agreeing to take part in this study. Your decision to take part, not to take part, or to stop taking part in the study at any time will not affect your student status or your grades; you will not be punished in any way. If you choose not to take part, it will not affect your relationship with your high school, USF, or anyone else.

- ✓ **Privacy of your Involvement:** Your privacy and research records will be kept confidential (private, secret) to the extent of the law. People approved to do research at USF, people who work with the Department of Health and Human Services, the USF Institutional Review Board, and its staff, and other individuals acting on behalf of USF may look at the records from this research project. However, your responses to the surveys will not be shared with people in the school system or anyone other than us and our research assistants. Your surveys will be given a code number to protect the confidentiality of your responses. Only we will have the ability to open the locked file cabinet stored at USF that will contain: 1) all records linking code numbers to names, and 2) all information gathered from school records. All records from the study (completed surveys, information from school records) will be destroyed in five years. Please note that although your specific responses and comments will not be shared with school staff, if you say or write that you may harm yourself or someone else, or if your responses on specific surveys indicate extreme emotional distress, we will contact district mental health counselors to make sure everyone is safe. The district mental health counselor may meet with you to make sure you are safe.

- ✓ **What We'll Do With Your Responses:** We plan to use the information from this study to learn more about how to help students be successful during the teenage years. The information that we collect from you may help increase our overall knowledge of difficulties frequently encountered in school. The results of this study may be published. However, your responses will be combined with other students' responses in the publication. The published results will not include your name or any other information that would identify you.

- ✓ **Questions?** If you have any questions about this research study, please contact Dr. Julia Ogg at (813) 974-9698. If you have questions about your rights as a person who is taking part in a research study, you may contact a member of the Division of Research Compliance of the University of South Florida at (813) 974-5638.

Thank you for taking the time to take part in this study.

Sincerely,

Sarah Fefer, M. A.
School Psychology Doctoral Student

Lisa Bateman, M.A.
School Psychology Doctoral Student

Julia A. Ogg, Ph.D.
Assistant Professor of School Psychology
USF College of Education

Assent to Take Part in this Research Study

I give my permission to take part in this study. I understand that this is research. I have received a copy of this letter and assent form.

Signature of student

Printed name of student

Date

Statement of Person Obtaining Assent

I certify that participants have been provided with an assent form that has been approved by the University of South Florida's Institutional Review Board and that explains the nature, demands, risks, and benefits involved in participating in this study. I further certify that a phone number has been provided in the event of additional questions.

Signature of person obtaining assent

Printed name of person obtaining assent

Date

Appendix C: Teacher Consent Letter (modified to fit in current document)



Dear Teacher:

This letter provides information about a research study that will be conducted by Sarah Fefer, Lisa Bateman, and Julia Ogg from the School Psychology Department at University of South Florida (USF). Our goal in conducting the study is to investigate the experiences of adolescents exhibiting behavioral risk factors.

- ✓ Who We Are: Sarah Fefer, M.A. and Lisa Bateman, M.A. are School Psychology doctoral students at USF. Dr. Julia Ogg, our faculty advisor, is an Assistant Professor in the School Psychology Program in the College of Education at USF. We are planning the study in cooperation with the principal and administrators to ensure the study provides information that will be helpful to the schools.
- ✓ Why We Are Requesting Your Participation: This study is being conducted as part of a project entitled, "Perceptions of Competence and Life Satisfaction: Exploring Behavioral Risk Factors Among High School Students" (IRB#10101). You are being asked to participate because you are a teacher of at least one student who is a participant in the study.
- ✓ Why You Should Participate: We need to learn more about how to help students be successful during the teenage years. The information that we collect from teachers may help increase our overall knowledge of difficulties frequently encountered in school and help support students' success. You will have a chance to win a \$25 gift card for returning your consent form, as well as receive another gift card for participating (\$2 per student packet completed). If you assist with recruiting students for the study then you will receive another \$10 gift card.
- ✓ What Participation Requires: You will be asked to complete questionnaires about the behavior of each of your students who is a participant in the study. Specifically, you will be asked about your students' academic and social competence and their behavior. Completion of the questionnaires is expected to take approximately 5 minutes per student.
- ✓ Please Note: Your decision to participate in this research study must be completely voluntary. You are free to participate in this research study or to withdraw from participation at any time. If you choose not to participate, or if you withdraw at any point during the study, this will in no way affect your relationship with your high school, USF, or any other party.
- ✓ Confidentiality of Your Responses: There is minimal risk for participating in this research. Your privacy and research records will be kept confidential to the extent of the law. Authorized research personnel, employees of the Department of Health and Human Services,

the USF Institutional Review Board and its staff, and other individuals acting on behalf of USF may inspect the records from this research project, but your individual responses will not be shared with school system personnel or anyone other than the USF research team. Your completed questionnaire(s) will be assigned a code number to protect the confidentiality of your responses. Only the USF research team will have access to the locked file cabinet stored at USF that will contain all records linking code numbers to participants' names.

- ✓ What We'll Do With Your Responses: We plan to use the information from this study to inform educators and psychologists about helping all students be successful in school. The results of this study may be published. However, the data obtained from you will be combined with data from other people in the publication. The published results will not include your name or any other information that would in any way personally identify you.
- ✓ Questions? If you have any questions about this research study, please contact Dr. Julia Ogg at (813) 974-9698. If you have questions about your rights as a person taking part in a research study, you may contact a member of the Division of Research Compliance of the University of South Florida at (813) 974-5638.
- ✓ Want to Participate? To participate in this study, please sign the attached consent form.

Sincerely,

Sarah Fefer, M. A.
School Psychology Doctoral Student
USF College of Education

Lisa Bateman, M.A.
School Psychology Doctoral Student
USF College of Education

Julia A. Ogg, Ph.D.
Assistant Professor of School Psychology
USF College of Education

Consent to Take Part in this Research Study

I freely give my permission to take part in this study. I understand that this is research. I have received a copy of this letter and consent form for my records.

Signature of teacher

Printed name of teacher

Date

Statement of Person Obtaining Informed Consent

I certify that participants have been provided with an informed consent form that has been approved by the University of South Florida's Institutional Review Board and that explains the nature, demands, risks, and benefits involved in participating in this study. I further certify that a phone number has been provided in the event of additional questions.

Signature of person
obtaining consent

Printed name of person
obtaining consent

Date

Appendix D: Demographic Form

Demographic Form

1. Gender

1. Male 2. Female

2. Ethnicity

1. African American/Black 4. Hispanic
 2. Asian/ Pacific Islander 5. Native American/ Alaska Native
 3. White 6. Other (Specify _____)

3. Age

- 13 16 19
 14 17 20
 15 18 21

4. Grade

- 9 11
 10 12

5. Have you ever been diagnosed with Attention-Deficit/Hyperactivity Disorder (ADHD)?

1. Yes 2. No

Appendix E: Self-Perception Profile for Adolescents (SPPA)

What I Am Like (SPPA)

Each question below talks about two kinds of students, and we want to know which students are most like you. First, we want you to decide if you are more like the student on the left side or the right side. Next, decide whether that is sort of true for you, or really true for you. For each item, you only check one box. Look at the sample sentences below (a and b), sometimes you will check one side, other times you will check the other side of the page, but you **only check one box per row**. Do NOT check both sides of an item.

	Really True for Me	Sort of True for Me	SAMPLE SENTENCES		Sort of True for Me	Really True for Me	
a.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Some students like to go to movies in their spare time	BUT	Other students would rather go to sports events.	<input type="checkbox"/>	<input type="checkbox"/>
b.	<input type="checkbox"/>	<input type="checkbox"/>	Some students like to eat hamburgers	BUT	Other students would rather eat hotdogs.	<input checked="" type="checkbox"/>	<input type="checkbox"/>
1.	<input type="checkbox"/>	<input type="checkbox"/>	Some students feel that they are just as smart as others their age	BUT	Other students aren't so sure and wonder if they are as smart.	<input type="checkbox"/>	<input type="checkbox"/>
2.	<input type="checkbox"/>	<input type="checkbox"/>	Some students find it hard to make friends	BUT	For other students it's pretty easy.	<input type="checkbox"/>	<input type="checkbox"/>
3.	<input type="checkbox"/>	<input type="checkbox"/>	Some students are able to make really close friends	BUT	Other students find it hard to make really close friends.	<input type="checkbox"/>	<input type="checkbox"/>
4.	<input type="checkbox"/>	<input type="checkbox"/>	Some students are often disappointed in themselves	BUT	Other students are pretty pleased with themselves.	<input type="checkbox"/>	<input type="checkbox"/>
5.	<input type="checkbox"/>	<input type="checkbox"/>	Some students are pretty slow in finishing their school work	BUT	Other students can do their school work more quickly.	<input type="checkbox"/>	<input type="checkbox"/>
6.	<input type="checkbox"/>	<input type="checkbox"/>	Some students have a lot of friends	BUT	Other students don't have very many friends.	<input type="checkbox"/>	<input type="checkbox"/>
7.	<input type="checkbox"/>	<input type="checkbox"/>	Some students do have a close friend they can share secrets with	BUT	Other students do not have a really close friend they can share secrets with.	<input type="checkbox"/>	<input type="checkbox"/>
8.	<input type="checkbox"/>	<input type="checkbox"/>	Some students don't like the way they are leading their life	BUT	Other students do like the way they are leading their life.	<input type="checkbox"/>	<input type="checkbox"/>

9.	<input type="checkbox"/>	<input type="checkbox"/>	Some students do very well at their classwork	BUT	Other students don't do very well at their classwork.	<input type="checkbox"/>	<input type="checkbox"/>
10.	<input type="checkbox"/>	<input type="checkbox"/>	Some students are very hard to like	BUT	Other students are really easy to like.	<input type="checkbox"/>	<input type="checkbox"/>
11.	<input type="checkbox"/>	<input type="checkbox"/>	Some students wish they had a really close friend to share things with	BUT	Other students <i>do</i> have a close friend to share things with.	<input type="checkbox"/>	<input type="checkbox"/>
12.	<input type="checkbox"/>	<input type="checkbox"/>	Some students are happy with themselves most of the time	BUT	Other students are often not happy with themselves.	<input type="checkbox"/>	<input type="checkbox"/>
13.	<input type="checkbox"/>	<input type="checkbox"/>	Some students have trouble figuring out the answers in school	BUT	Other students almost always can figure out the answers.	<input type="checkbox"/>	<input type="checkbox"/>
14.	<input type="checkbox"/>	<input type="checkbox"/>	Some students are popular with others their age	BUT	Other students are not very popular.	<input type="checkbox"/>	<input type="checkbox"/>
15.	<input type="checkbox"/>	<input type="checkbox"/>	Some students find it hard to make friends they can really trust	BUT	Other students <i>are</i> able to make close friends they can really trust.	<input type="checkbox"/>	<input type="checkbox"/>
16.	<input type="checkbox"/>	<input type="checkbox"/>	Some students like the kind of person they are	BUT	Other students often wish they were someone else.	<input type="checkbox"/>	<input type="checkbox"/>
17.	<input type="checkbox"/>	<input type="checkbox"/>	Some students feel that they are pretty intelligent	BUT	Other students question whether they are intelligent.	<input type="checkbox"/>	<input type="checkbox"/>
18.	<input type="checkbox"/>	<input type="checkbox"/>	Some students feel that they are socially accepted	BUT	Other students wished that more people their age accepted them.	<input type="checkbox"/>	<input type="checkbox"/>
19.	<input type="checkbox"/>	<input type="checkbox"/>	Some students <i>don't</i> have a friend that is close enough to share really personal thoughts with	BUT	Other students do have a close friend that they can share personal thoughts and feelings with.	<input type="checkbox"/>	<input type="checkbox"/>
20.	<input type="checkbox"/>	<input type="checkbox"/>	Some students are very happy being the way they are	BUT	Other students wish they were different.	<input type="checkbox"/>	<input type="checkbox"/>

Appendix F: Teacher Survey

Student Name _____

Rater's Name _____ Subject Area Taught _____

How long have you known this student (in months)? _____

What is this student's current letter grade in your class? _____

TEACHER'S RATING SCALE OF THE STUDENT'S ACTUAL BEHAVIOR

For each student, please indicate what you feel he/she is actually like, in your opinion. First decide whether you feel the individual is more like the teenagers described on the left or the right side of each statement. Then, for that side only, indicate whether that statement is **really true**, or just **sort of true**, for that individual. (If you feel that you do not have enough information to make a judgment on a given question, just leave that item blank.)

	Really True	Sort of True		OR		Sort of True	Really True
1.	<input type="checkbox"/>	<input type="checkbox"/>	This individual is just as smart as others his/her age		This individual is not as smart as others her/her age	<input type="checkbox"/>	<input type="checkbox"/>
2.	<input type="checkbox"/>	<input type="checkbox"/>	This individual has a hard time making friends.		Making friends is easy for this individual	<input type="checkbox"/>	<input type="checkbox"/>
3.	<input type="checkbox"/>	<input type="checkbox"/>	This individual is able to make close friends		This individual finds it hard to make really close friends	<input type="checkbox"/>	<input type="checkbox"/>
4.	<input type="checkbox"/>	<input type="checkbox"/>	This individual is pretty slow at finishing their schoolwork		This individual can do their school work more quickly.	<input type="checkbox"/>	<input type="checkbox"/>
5.	<input type="checkbox"/>	<input type="checkbox"/>	This individual does not have a lot of friends		This individual does have a lot of friends	<input type="checkbox"/>	<input type="checkbox"/>
6.	<input type="checkbox"/>	<input type="checkbox"/>	This individual doesn't have a close friend he/she can really trust		This individual does have a close friend that he/she can really trust	<input type="checkbox"/>	<input type="checkbox"/>
7.	<input type="checkbox"/>	<input type="checkbox"/>	This individual does well at classwork.		This individual doesn't do very well at classwork	<input type="checkbox"/>	<input type="checkbox"/>
8.	<input type="checkbox"/>	<input type="checkbox"/>	This individual is very hard to like		This individual is very easy to like	<input type="checkbox"/>	<input type="checkbox"/>

9.	<input type="checkbox"/>	<input type="checkbox"/>	This individual does not have a really close friend to share things with	OR	This individual does have a close friend to share things with	<input type="checkbox"/>	<input type="checkbox"/>
10	<input type="checkbox"/>	<input type="checkbox"/>	This individual has trouble figuring out the answers in school	OR	This individual can almost always figure out the answers in school	<input type="checkbox"/>	<input type="checkbox"/>
11	<input type="checkbox"/>	<input type="checkbox"/>	This individual is popular with others their age	OR	This individual is not that popular	<input type="checkbox"/>	<input type="checkbox"/>
12	<input type="checkbox"/>	<input type="checkbox"/>	This individual has a close friend they can share secrets with	OR	This individual does not have a really close friend they can share secrets with	<input type="checkbox"/>	<input type="checkbox"/>
13	<input type="checkbox"/>	<input type="checkbox"/>	This individual is intelligent	OR	This individual is not that intelligent	<input type="checkbox"/>	<input type="checkbox"/>
14	<input type="checkbox"/>	<input type="checkbox"/>	This individual is socially accepted	OR	This individual is not accepted by others their age	<input type="checkbox"/>	<input type="checkbox"/>
15	<input type="checkbox"/>	<input type="checkbox"/>	This individual does not have a friend that is close enough to share really personal thoughts with	OR	This individual does have a close friend that they can share personal thoughts and feelings with.	<input type="checkbox"/>	<input type="checkbox"/>

VANDERBILT ADHD DIAGNOSTIC TEACHER RATING SCALE

Each rating should be considered in the context of what is appropriate for high school students. Please rate (by circling the correct number) how frequently you feel this student does each of the following. Please circle only one number for each item.

		Never	Occasionally	Often	Very Often
1	Fails to pay attention to details or makes careless mistakes in schoolwork	0	1	2	3
2	Has difficulty sustaining attention to tasks or activities	0	1	2	3
3	Does not seem to listen when spoken to directly	0	1	2	3
4	Does not follow through on instruction and fails to finish schoolwork (not due to opposition behavior or failure to understand)	0	1	2	3
5	Has difficulty organizing tasks and activities.	0	1	2	3
6	Avoids, dislikes, or is reluctant to engage in tasks that require sustaining mental effort.	0	1	2	3
7	Loses things necessary for tasks or activities (school assignments, pencils, or books)	0	1	2	3

8	Is easily distracted by extraneous stimuli.	0	1	2	3
9	Is forgetful in daily activities	0	1	2	3
10	Fidgets with hands or feet or squirms in seat	0	1	2	3
11	Leaves seat in classroom or in other situations in which remaining seated is expected	0	1	2	3
12	Runs about or climbs excessively in situations in which remaining seated is expected	0	1	2	3
13	Has difficulty playing or engaging in leisure activities quietly	0	1	2	3
14	Is "on the go" or often acts as if "driven by a motor"	0	1	2	3
15	Talks excessively	0	1	2	3
16	Blurts out answers before questions have been completed	0	1	2	3
17	Has difficulty waiting in line	0	1	2	3
18	Interrupts or intrudes on others (e.g., butts into conversations or games)	0	1	2	3
19	Loses temper	0	1	2	3
20	Actively defies or refuses to comply with adults' requests or rules	0	1	2	3
21	Is angry or resentful	0	1	2	3
22	Is spiteful and vindictive	0	1	2	3
23	Bullies, threatens, or intimidates others	0	1	2	3
24	Initiates physical fights	0	1	2	3
25	Lies to obtain goods for favors or to avoid obligations (i.e., "cone" others)	0	1	2	3
26	Is physically cruel to people	0	1	2	3
27	Has stolen items of nontrivial value	0	1	2	3
28	Deliberately destroys others' property	0	1	2	3

PERFORMANCE

	Problematic		Average		Above Average	
Academic Performance						
1.	Reading	1	2	3	4	5
2.	Mathematics	1	2	3	4	5
3.	Written Expression	1	2	3	4	5
Classroom Behavioral Performance						
1.	Relationships with peers	1	2	3	4	5
2.	Following directions/rules	1	2	3	4	5
3.	Disrupting class	1	2	3	4	5
4.	Assignment completion	1	2	3	4	5
5.	Organizational skills	1	2	3	4	5