INACCURATE OR IMPRECISE? EXAMINING THE POSITIVE ILLUSORY BIAS IN YOUTH WITH ADHD’S ACADEMIC SELF-APPRAISALS

by

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Abstract

Children and youth with ADHD show a positive illusory bias (PIB), where they overestimate their academic competencies (AC) relative to other performance and informant indicators. It is unclear whether the PIB renders self-views inaccurate (i.e., non-predictive of external indicators) or just imprecise (i.e., inflated, but predictive). This study examined the predictive accuracy of academic self-appraisals in 102 adolescents aged 13-17 (51 with ADHD; 51 typically-developing), and whether EFs could predict the PIB size. Youth completed math and EF tests, and self-rated their AC. Parents rated their youth’s AC and EF. Youth with ADHD performed more poorly on the math task (vs. comparison group) but showed a larger AC PIB relative to parents’ ratings, partly accounted for by EFs. However, all youths’ AC-ratings were more predictive of math performance than their parents’ AC-ratings. In all, youth with ADHD appear self-aware despite a modest PIB, but nuanced self-appraisals may depend on EFs.
Table of Contents

Abstract ................................................................................................................................. ii

List of Tables .......................................................................................................................... iv

Chapter 1: Introduction ......................................................................................................... 1
The Academic Difficulties of Children and Adolescents with ADHD .................................. 1
Poor Awareness of One’s Poor Performance .................................................................. 2
A Case for Increased Awareness in Adolescents ............................................................... 5
Inaccurate or Imprecise Assessments of Performance? .................................................. 6
Theoretical Perspectives on the PIB ................................................................................ 7
EFs Contribute to Both Task Performance and Performance Appraisal ........................ 9
The Present Research ....................................................................................................... 12

Chapter 2: Method ............................................................................................................... 14
Participants ............................................................................................................................ 14
Measures ............................................................................................................................... 15
Procedure .............................................................................................................................. 17

Chapter 3: Results .............................................................................................................. 19
Discrepancy Score Formation ............................................................................................ 19
Differences between ADHD and Comparison Group on Measures .................................. 19
  Group Differences between ADHD and Non-ADHD Youth ........................................... 21
Informant Correlations ....................................................................................................... 22
  Correlations among Youth and Parent Measures .......................................................... 23
Group Differences in the Magnitude of the PIB ............................................................... 23
Informant Reports as Predictors of Task Performance ..................................................... 24
  Informant Ratings of Competence as Predictors of Academic Task Performance ....... 25
  EF Measures as Predictors of the Size of the Academic PIB ......................................... 26

Chapter 4: Discussion ......................................................................................................... 27
The PIB as Imprecise Calibration ....................................................................................... 27
The Role of EFs in Calibration .......................................................................................... 30
Clinical Implications ......................................................................................................... 32
Limitations and Future Directions ................................................................................... 34
Conclusion ............................................................................................................................ 37

References ............................................................................................................................ 39
List of Tables

Table 1: Group Differences between ADHD and Non-ADHD Youth ........................................ 21
Table 2: Correlations among Youth and Parent Measures ..................................................... 23
Table 3: Informant Ratings of Competence as Predictors of Academic Task Performance .... 25
Table 4: EF Measures as Predictors of the Size of the Academic PIB .................................. 26
Introduction

Attention-deficit hyperactivity disorder (ADHD) is one of the most common childhood disorders affecting between five and seven percent of children and adolescents (Polanczyk & Rohde, 2007; Willcutt, 2012). ADHD is characterized by a pervasive and persistent pattern of inattentive (e.g., difficulty sustaining attention or finishing tasks) and/or hyperactive-impulsive (e.g., interrupting others or talking excessively) symptoms, beginning in childhood, in multiple settings (American Psychiatric Association, 2013). Importantly, these core symptom dimensions of inattention and hyperactivity-impulsivity are broadly associated with significant functional impairment across the social, behavioural, and academic domains (Wehmeier, Schacht, & Barkley, 2010).

The Academic Difficulties of Children and Adolescents with ADHD

In the academic domain, children and adolescents with ADHD show less proficient performance on standardized assessments of reading and math, and receive lower grades on all school subjects when compared to their typically-developing peers (Biederman et al., 2004; Loe & Feldman, 2007). Even when accounting for frequently comorbid learning and conduct disorders (August & Garfinkel, 1990; Barry, Lyman, & Klinger, 2002), their school achievement is significantly lower than what would be expected from their intellectual abilities (Barry et al., 2002). Beginning in preschool, children with ADHD show increased difficulties with learning age-appropriate reading and math skills, which begins a gap in their literacy and numeracy skills (Mariani & Barkley, 1997). This gap only expands as these children progress into elementary school, and research into adolescents with ADHD’s academic performance suggests that, for
most, this gap does not close (Frazier, Youngstrom, Glutting, & Watkins, 2007; Mariani & Barkley, 1997). Not surprisingly then, teachers of youth with ADHD are also more likely to report that they are not working to potential (Kent et al., 2010). Critically, this low academic performance is associated with a host of negative academic consequences, including a higher rate of grade failure and school drop-out (Barbaresi, Katusic, Colligan, Weaver, & Jacobsen, 2007).

**Poor Awareness of One’s Poor Performance**

Disconcertingly, however, it appears that children with ADHD may experience a double deficit. Despite showing performance weaknesses in the academic domain, children with ADHD appear to not be aware of the extent of their lower academic functioning, in that they show a *positive illusory bias* (PIB) in the self-perceptions of their abilities (Gresham, Lane, MacMillan, Bocian, & Ward, 2000). Broadly, this bias is a calibration discrepancy, in which their self-ratings of performance are discrepant with their actual performance, as reflected on standardized task assessments, or with the reports of knowledgeable others, often parents and teachers (Stone, 2000).

Of course, overestimation of one’s abilities is not unique to populations with ADHD. As proposed by Dunning, Johnson, Ehrlinger, and Kruger (2003), when individuals in general “lack skill or knowledge, they greatly overestimate their expertise and talent, thinking they are doing just fine when, in fact, they are doing quite poorly.” (p. 83). Even when individuals are not performing poorly, most individuals have a self-enhancement bias in their ratings of their personality traits, perceptions of their abilities, and outlook on the future: we generally believe we are better or more fortunate than average (Williams & Gilovich, 2008). In other words, a self-enhancing bias is normative, and for individuals who lack abilities in a certain domain, it should be expected; we should not expect to ever have complete self-awareness.
In fact, a moderately positive bias is theorized to motivate perseverance, persistence, and effort, and promote healthy adjustment (Taylor & Brown, 1988), at least in the short-term (Robins & Beer, 2001). Particularly in the academic domain, students who have lower academic performance, but greater self-enhancement biases have been shown to achieve better academic outcomes than their low-performing peers who did not self-enhance as much (Mattern, Burrus, & Shaw, 2010). Similarly, typically-developing girls who have higher perceptions of their social competence have been found to have better psychosocial adjustment (Ohan & Johnston, 2011).

However, while much research shows that there may be motivational and cognitive limitations to truly knowing ourselves and how others see us (see Wilson & Dunn, 2004 for discussion), clinical research has also recognized that a shared commonality for those with clinical problems is that their self-appraisals are more distorted than those without psychopathology, with significant implications for adjustment (Kenny & DePaulo, 1993). Specifically, while positive illusions appear to be conducive to motivation and performance in populations without psychopathology, they do not appear to have the same benefits for children with ADHD (Owens, Goldfine, Evangelista, Hoza, & Kaiser, 2007). Two notable differences appear to characterize the PIB for this population: (1) the size of the discrepancy between estimated and actual ability is greater than what would normatively be expected, and (2) the positive bias does not appear to have motivational effects; rather, it seems to be uniquely related to global maladjustment (Ohan & Johnston, 2011; Owens et al., 2007).

Studies repeatedly show that despite their overestimation in self-perceptions, children with ADHD show less persistence and motivation on tasks than their typically-developing peers (Pelham, Hoza, Kipp, Gnagy, & Trane, 1997). For example, on laboratory tasks involving academic skills, children with ADHD perform more poorly and show less task persistence than
their typically-developing peers. Observers also evaluate them as putting in less effort than their peers. However, when asked about their performance, children with ADHD evaluate themselves as having the same level of competence as children without ADHD (Hoza, Waschbusch, Owens, Pelham, & Kipp, 2001). When adult raters’ evaluations are used to index performance, the same pattern of a greater PIB in children with ADHD is seen. When compared with their mother, father, or teacher, children with ADHD evaluate their competencies with a greater positive bias, with the largest discrepancy existing in the area where they have the greatest difficulty (Hoza et al., 2004). Of note, this bias is not limited to the academic domain. Children with ADHD see themselves in an unrealistically self-enhancing light in the social and behavioral domains as well, despite known difficulties with peer rejection and classroom conduct (Hoza, Pelham, Dobbs, Owens, & Pillow, 2002; Hoza, Waschbusch, Pelham, Molina, & Milich, 2000; Owens et al., 2007). In sum, as Owens and colleagues (2007) note, children with ADHD have “unrealistically high self-views of skills and competencies, despite histories marked with failure in numerous domains.” (p. 336).

That there is maladjustment associated with the PIB for children with ADHD suggests that the PIB should not simply be regarded as simple self-deception, but an error in calibration that has important clinical implications. While some have argued that the PIB is protective for children who experience regular failure, it is equally apparent that it can be maladaptive in the long-term (Heath & Glen, 2005); if children or youth do not realize they are lacking in certain areas, they will not be receptive to treatment or feedback, and thereby perpetuate a cycle of incompetence. As such, increasing accuracy in self-awareness through targeting the antecedent causes may be able to improve both the skill and the overall psychological health for this population. Particularly in the academic domain, accurate metacognitive attribution of one’s
performance is predictive of future task performance (Milich, Carlson, Pelham, & Licht, 1991; W. Schneider & Artelt, 2010). In sum, overestimation per se is not the concerning issue, it is the magnitude of the overestimation and its effects on task performance in ADHD populations that are problematic.

A Case for Increased Awareness in Adolescents

Most of the research into the PIB has been conducted with children with ADHD. However, a growing body of research suggests that ADHD symptoms and its associated academic and other functional impairments continue into adolescence and beyond (e.g. Ingram, Hechtman, & Morgenstern, 1999; Willoughby, 2003). At present, however, it is unclear whether the self-views of youth with ADHD are just as “unrealistic” as those held by children with ADHD. Given the persistence of ADHD and its cognitive correlates (e.g., weaknesses in executive functions) into adolescence (Biederman et al., 1996), there is compelling reason to expect that this PIB continues to exist.

At the same time, youth with ADHD may show a reduced PIB as a result of having more well-developed executive function and metacognitive regulation abilities, as well as a better ability to integrate performance feedback into one’s own conceptualizations of competence due to increasing cognitive maturity (Best & Miller, 2010; Crombie et al., 2005). Similarly, both imaging and behavioural research have suggested that children with ADHD may be characterized by a cognitive-maturation delay, where certain cognitive functions simply develop more slowly, but normally, when compared to their typically-developing peers (Berger, Slobodin, Aboud, Melamed, & Cassuto, 2013; P. Shaw et al., 2007). Given these developmental increases, it may be reasonably expected that the PIB in adolescents with ADHD is not one of “unrealistic” inaccuracy, but is reduced to one of imprecision, especially in the academic domain.
where there would expect high levels of explicit feedback (versus social/interpersonal domains where feedback is more ambiguous; Mabe & West, 1982).

**Inaccurate or Imprecise Assessments of Performance?**

The extant research of the PIB in adolescents with ADHD is limited, but research in young adults (i.e., college students) with ADHD suggests that the PIB does persist. While college students’ with ADHD do not report problems on measures of self-concept, their parents’ report of the same do indicate self-concept problems, with a large informant discrepancy (Nelson, 2013). Similarly, college students with ADHD have been found to have a significantly larger PIB in regards to their work and driving abilities than students without ADHD, despite known difficulties (Knouse, Bagwell, Barkley, & Murphy, 2005; Prevatt et al., 2012). However, what these studies do not make clear is whether the magnitude of the PIB on the part of these young adults with ADHD is large enough for concern - is it a matter of unrealistic inaccuracy or modest imprecision?

Indeed, one limitation of past studies is that they have generally examined the PIB relatively; that is, the focus is on comparing between two groups the gap between the self-rating and an external indicator (e.g., other informant or task performance). While acknowledging that individuals with ADHD seem to have a positive bias compared to those without ADHD, research has not measured to what extent this bias is inaccurate on an absolute, predictive level. In other words, the literature lacks clear delineations of varying levels of self-evaluative accuracy, despite acknowledging that different degrees of miscalibration can exist (Burson, Larrick, & Klayman, 2006). In an attempt to distinguish between varying degrees of accuracy in youths’ self-judgments, I have chosen to operationalize and utilize the terms *inaccurate* and *imprecise* to capture these differences in degrees of miscalibration. For example, it may be that the reports of
youth with ADHD are inaccurate such that they are neither informative nor predictive of any other indicator. In this case, it would be reasonable to say that their evaluations are wrong or “inaccurate.” Alternatively, however, individuals’ self-reports may be generally accurate (i.e., show some predictive relationship with an external performance indicator), but remain modestly inflated. In this case, I would describe these reports as “imprecise” (i.e., a rough estimate of ability rather than inaccurate).

Particularly with ratings that measure the discrepancy between parent/teacher and child ratings, it seems that it is inherently assumed that the adult evaluators are the more “accurate” ones, particularly when they seem to agree (Eisenberg & Schneider, 2007). But, it needs to be empirically examined, who is the better judge of academic task performance – the self or the adult? In other words, youth with ADHD may be less accurate than their typically-developing peers at evaluating themselves in the academic domain, but they may still be more knowledgeable (i.e., accurate) than their parent.

Theoretical Perspectives on the PIB

Research examining the underlying reasons for the PIB in populations with ADHD has been to date inconclusive. Prevailing explanatory models have proposed that the PIB may be a combination of conscious inflation in individuals’ ratings and a true lack of awareness of their abilities (Ohan & Johnston, 2011). First, the conscious inflation perspective is thought to be self-protective. It is proposed that individuals with ADHD are aware of their poor performance, but threats to their self-worth lead them to consciously inflate their ratings of performance to “prove” to others that they are competent when they are asked to evaluate themselves (Diener & Milich, 1997). Ohan and Johnston (2002) found results congruent with this hypothesis in the social domain, where boys with ADHD subsequently reduced the size of their PIB after they were
provided with positive performance feedback. However, this finding was inconsistent in the academic domain, and boys with ADHD did not decrease their self-ratings after positive feedback was given. As well, although children with ADHD could be motivated by a monetary reward to make their academic self-evaluations more congruent with their teachers, the PIB did not disappear completely (Hoza, Vaughn, Waschbusch, Murray-Close, & McCabe, 2012). Interestingly, children with ADHD can evaluate the academic competencies of others, to a level that is comparable to their typically-developing peers, despite their own inaccurate self-evaluations (Evangelista, Owens, Golden, & Pelham, 2008). While the difference in accuracy observed between self- and other ratings may be due to self-protection, it may also be due to cognitive abilities that affect self-evaluations but not the evaluations of others (Evangelista et al., 2008). Together then, the self-protective hypothesis does not appear to adequately explain the PIB, and other antecedent causes may be at play.

On the other hand, an unskilled-unaware hypothesis proposes that children with ADHD may not be sufficiently equipped to accurately evaluate their abilities (Owens et al., 2007). That is, individuals who are poor performers in a certain domain are also not able to recognize what constitutes a competent performance, as the skills for performance and evaluation are intertwined (Kruger & Dunning, 1999). According to this theory, because children with ADHD have poor math skills, they are not able to adequately judge whether their work is correct or not, and thus, their evaluations are inaccurate. At the same time, this theory does not sufficiently explain why children with ADHD can evaluate the abilities of others, and why their PIB can be reduced after a monetary reward (Owens et al., 2007).

Recently, a third theory involving the role of higher-order cognitive abilities, particularly executive functions (EF) has been the focus of research. EFs are the various abilities that involve
the planning, controlling, and monitoring of goal-directed thoughts or behavior (Alvarez & Emory, 2006). Miyake and colleagues (2000) propose that there are three distinct, but related EFs, including the ability to *shift* among different mental sets, the ability to *update* information in working memory, and the ability to *inhibit* dominant responses or behavior. A growing literature has further suggested that EFs are not only relevant to effective performance on complex tasks, but also for the effective monitoring of performance on those tasks; executive dysfunction can account for poor self-awareness, a decreased ability to monitor tasks and the self, and impaired error detection (Fernandez-Duque, Baird, & Posner, 2000; Ownsworth, McFarland, & Young, 2002). In other words, should EFs be impaired, an individual would find it more difficult to make an accurate evaluation of self-errors and task difficulty, leading to an inaccurate self-assessment of one’s competencies (Fernandez-Duque et al., 2000). In children and youth with ADHD, research has implicated a range of impaired EFs (Martel, Nikolas, & Nigg, 2007; Martinussen, Hayden, Hogg-Johnson, & Tannock, 2005), and particularly in the feedback-rich academic domain, it is seen how these functions would be especially in need of use. Indeed, individuals with ADHD show higher levels of impairment in EF on both performance-based assessments that measure cognitive-task efficiency (e.g. ability to set-shift) and on informant reports that measure broader, “real-life” difficulties in behavioural functioning related to EF (e.g., occupational performance and success in task organization and goal pursuits) (Barkley & Murphy, 2010; Toplak, West, & Stanovich, 2012).

EFs Contribute to Both Task Performance and Performance Appraisal

Importantly then, EF abilities may play a dual role. EF abilities are strongly related to academic performance, with Daley and Birchwood (2010) stating that the EF deficits that so often characterize individuals with ADHD may be “at the heart of ADHD-related academic
underperformance” (p. 459). However, these same EF abilities may also be required for accurately evaluating this performance. That is, while it is known that children who have poor EF demonstrate lower math ability due to challenges with inhibition and working memory (Bull & Scerif, 2001), they may also experience difficulties recognizing that lower ability.

Working memory is the ability to hold and manipulate information to produce a response (Barkley, 1997; Whitebread, 1999), but in more complex tasks, working memory is also needed to continuously shift between the monitoring and updating of information and task demands (Miyake, 2000). It is seen here how dynamic formulation of information about the self and accurate self-appraisal may also rely particularly on these continuous monitoring functions. In other clinical disorders, working memory, particularly verbal working memory, has been implicated in problems with insight and metacognitive awareness. For example, in individuals with schizophrenia or psychosis, poor working memory is directly associated with poor insight into their symptoms, and inflated perceptions of their level of social functioning (Keshavan, Rabinowitz, DeSmedt, Harvey, & Schooler, 2004; Mutsatsa, Joyce, Hutton, & Barnes, 2006). In children who have experienced traumatic brain injury (who consequently have EF deficits), relatively better EF abilities predicted smaller discrepancies between self and peer ratings of their social competencies (Wolfe et al., 2014). Individuals who have experienced traumatic brain injury and have greater EF problems also have less self-awareness of their various impairments in their day-to-day functioning (Hart, Whyte, Kim, & Vaccaro, 2005). Together then, it appears that EFs are required to recognize that one is experiencing symptoms or problems (David, Bedford, Wiffen, & Gilleen, 2012). Critically, self-views and behaviours are tightly linked: having an accurate perception of oneself has been proposed to be a critical component of functioning, and in being able to engage in future goal-directed behavior (Markus, 1983).
This cognitive, EF-based theory of the PIB may hold increasing relevance given the equivocal evidence in the academic domain for the self-protective and unskilled-unaware hypotheses. For example, because EF deficits may disproportionately affect evaluations of the self, in a state resembling anosognosia (the inability to recognize self-impairments only) (Evangelista et al., 2008), this theory may help explain why children with ADHD can accurately evaluate others’ performance, but not their own. Indeed, neuroimaging work has shown that self and other reflection may be distinctly specific processes (Murray, Schaer, & Debbané, 2011; Zamboni et al., 2012). At the same time, because not all individuals with ADHD show EF deficits (Martel et al., 2007), it is also possible that significant dysfunction is not necessary; small variations in EF ability may be sufficient to hinder precisely calibrated metrics of self-performance.

Recent work has provided some support that various cognitive deficits (including EF, attention, and fluency) can account for the PIB in children with ADHD; however, which specific cognitive abilities were involved varied depending on the area of competency examined (McQuade et al., 2010). As well, no research has examined the specific contribution of EFs to the size of the PIB. In sum, there appear to be three primary gaps in the current literature. First, while it is clear that the PIB exists, it is unclear whether the magnitude of the PIB can be considered predictively inaccurate or just modestly imprecise. Second, despite the cognitive changes associated with adolescent development, little work has been done on examining the magnitude of the PIB and self-appraisal accuracy in adolescents with ADHD.

Only one study has examined the PIB in both children and youth with ADHD in the academic domain. Varma (2013) found that youth with ADHD showed a PIB in their academic self-evaluations, but that they still showed significantly higher levels of self-reported learning
problems relative to typically-developing comparisons. Further, even among youth with ADHD, those who were below-average academic performers still perceived themselves as having higher levels of learning problems than average-performing youth with ADHD, consistent with the notion that the PIB is not one of gross unawareness (Varma, 2013). Nonetheless, no work has examined the predictive contribution of EF abilities on the accuracy of academic self-evaluations for this population.

The Present Research

To address these gaps, I examine the PIB in adolescents with and without ADHD in the academic domain. PIB research has largely been focused to the social domain, and almost exclusively limited to samples of younger children. As discussed, the development from childhood to adolescence brings about changes in EF ability and associated increases in metacognitive regulation. It would thus be expected that while ADHD and the PIB persist into adolescence, the magnitude of the discrepancy reduces; modest inflation in the PIB should be expected, and not gross inaccuracy.

Thus, this research has three objectives. First, I want to establish the existence of a PIB in youth with ADHD in the academic domain. Should the PIB exist, I then want to determine whether youths’ self-reports of their academic competence are predictive of (i) their performance on an objective assessment of academic achievement, and if so, (ii) whether youth-reports account for more variance in their achievement scores than their parents’ reports of their academic competence. Lastly, I want to determine whether EFs can account for the magnitude of the PIB.

I hypothesize that (1) a PIB continues to exist in the academic domain for youth with ADHD compared to youth without ADHD, (2) that despite a larger PIB, youth self-evaluations
will be still significant, albeit weaker predictors of objective competence than parent evaluations, and (3) EF abilities will be uniquely predictive of the size of the PIB.
Method

Participants

Data were collected from 109 participants between the ages of 14 and 16 years who took part in a larger study examining comprehension processes in adolescents with and without ADHD. To meet the study’s inclusion criteria for having ADHD, youth had to receive at least one clinically significant score (T ≥ 70) on the DSM-IV inattention, hyperactivity-impulsivity, or global index subscales of the Conners 3 Parent Rating Scales, and have had a prior diagnosis of ADHD by a clinical psychologist or physician. As well, all participants had to have a full-scale IQ ≥ 70. From these criteria, five participants were excluded for not having a clear diagnosis of ADHD (i.e., three had clinical Conners 3 Parent scores, but no prior diagnosis; two had insufficient data from the Conners 3 Parent), and two participants were excluded from analyses as their IQ was below 70. From the youth participants, 49 met these criteria for ADHD (32 males; 17 females). Fifty-three youth (19 males; 34 females) without a parent-reported diagnosis of ADHD who also did not receive clinically significant scores on the inattention, hyperactivity-impulsivity, or global index subscales (T ≤ 65) on the Conners 3 Parent Rating Scales served as typically-developing comparisons.

The final sample consisted of 102 adolescents (51 male; 51 female) aged 14 – 17 years (M = 15.42, SD = .90). All participants had no hearing difficulties, according to parent report. Thirty-six youth in the ADHD group (73%) were taking stimulant medication for ADHD. For consistency, and because participants were completing tasks that may be affected by medication use, youth participants were asked to not take their stimulant medication on the day they completed their measures. Six percent of youth in the typically-developing group had clinical scores on the Oppositional Defiant Disorder (ODD) subscale of the Conners-3 (T ≥ 65), and 43%
of the ADHD group had clinical ODD subscale scores \((T \geq 70)\). Maternal education level did not differ between groups \((t(96) = -.32, p > .05)\); education level was measured on a 12-point ordinal scale from no schooling to doctoral degree, with the mean level of parental education being some university.

**Measures**

**Conners 3rd Edition – Parent** (Conners 3; Conners, 2008). The Conners 3 is a reliable and well-validated diagnostic instrument for ADHD, with youth self-report and parent versions. The *Learning Problems* and *Executive Functioning* subscale scores are used in the present study. The Learning Problems subscale (e.g. “I have trouble with math”) serves as an indicator of perceived academic competence (i.e., the lower the subscale score, the higher the academic competence). Similarly, high scores on the Executive Functioning subscale (e.g. “My child has trouble keeping him/herself organized”) indicate behavioral problems associated with EF deficits and serves as an informant-based measure of broader EF impairments. For each item, respondents are asked to indicate on a four-point scale to what extent the item has been *true* in the last month. Youth completed a self-report version; parents completed a parent version.

**Test of Memory and Learning, Second Edition** (TOMAL-2; Reynolds & Voress, 2007). The TOMAL-2 is a well-validated, standardized assessment of memory abilities. From this comprehensive test, youth completed the digits-backwards subtest, which provides a measure of performance-based EF abilities (i.e., verbal working memory). Youth were presented with sequences of numbers by an examiner that increased in difficulty (i.e., length), and were then asked to repeat them back in reverse sequence.

**Woodcock-Johnson III Tests of Achievement** (WJ-III; Woodcock, McGrew, & Mather, 2001). The WJ-III is a well-validated, standardized battery of tasks that assesses several areas of
academic achievement, including math, reading, and writing. Of interest to this study is youth’s performance on the *Calculations* subtest, which assesses youth’s ability to correctly compute arithmetic questions by paper and pencil with no time limit. This measure serves as an objective, standardized indicator of youth’s academic competence.

The Calculations subtest was used as an indicator of task-based academic performance for several reasons. First, preliminary data analyses showed that parent- and self-reported learning problems were most strongly correlated with this measure among all other WJ-III subtests, suggesting that impairment in this academic area is associated with some parent and student awareness. Given that this study examines the accuracy of awareness of academic competence, it was important to select an academic skill where there is reason to believe that both parents and youth evaluating the skills have some awareness of youths’ performance. Second, low inter-correlations among scores on certain subtests in the WJ-III academic battery suggested that creating a composite of academic achievement was not appropriate.

Third, feedback for a calculations task is most likely to be specific and explicit in a school setting; the answer to a multi-digit addition or subtraction problem is marked consistently and objectively as either correct or incorrect by the teacher (versus, for example, writing tasks, which may consist of more ambiguous, variable, irrelevant, or unfocused feedback that leaves room for misinterpretation by the student; Hattie & Timperley, 2007). Given the salience of feedback for this task, and that youth should be academically familiar with math calculations, it is more likely then that any PIB observed can be attributed to causes other than not having been provided with adequate or consistent performance feedback in the past.

Fourth, it is expected that there is actually considerable underlying impairment in youth with ADHD’s performance on this task, which can assist in highlighting relevant differences in
self-appraisal. Past work has shown that those individuals with ADHD and EF deficits, especially working memory deficits, are particularly impaired in the processes involved in math calculations, including poor fact retrieval, adherence to procedural rules, and use of problem-solving strategies (Mazzocco & Kover, 2007). Of note, these weak math calculation skills are also broadly associated with poorer math problem-solving skills and general math achievement (Jordan & Montani, 1997; Jordan, Hanich, & Kaplan, 2003). Importantly then, while youth with poor math facts may be able to perform these math operations with a calculator in the classroom, its use does not necessarily result in math success in school, nor a positive self-appraisal in mathematics. In all then, this subtest provides a task where it can be expected (1) that youth with ADHD show impairment, (2) that between non-ADHD and ADHD youth, there are differences in task performance and awareness, and (3) that all youth would have received clear prior feedback with the task, and as such, be familiar with task expectations.

**Wechsler Abbreviated Scale of Intelligence (WASI; Wechsler, 1999).** The WASI is a brief, standardized, and well-normed test of verbal and non-verbal intelligence. It was administered to youth to provide a measure of general cognitive ability (IQ).

**Procedure**

All procedures were approved by the Institutional Review Board of the University of Toronto. Participants were recruited from advertisements targeted to families with youth with ADHD. Families who expressed interest were contacted by telephone by a research assistant who obtained verbal consent from the parent to provide information about their son or daughter. To determine eligibility for the study, the research assistant then administered the Conners 3 Parent by telephone. Eligible youth and parent participants were explained as to the nature of the study. Parents provided informed consent for their youth’s participation, and youth provided written
Parents were mailed a parent-measures package for one parent to complete and return by mail, while youth participants were invited to a laboratory to complete a battery of measures (lasting approximately four hours) through an individual interview with a trained research assistant, including the aforementioned measures of interest, and several tasks not detailed nor related to this present study. All participants were compensated $15 for their travel and received either an additional $15 for compensation or a certificate of volunteer hours to use to meet school requirements for volunteer service.
Results

Discrepancy Score Formation

All standardized measures completed by youth and parents were scored and normed appropriately. The resulting standard scores were converted into standardized z-scores, which were used for all subsequent analyses for consistency (unstandardized scores are reported in the tables for clarity).

To examine the size of the PIB (i.e., the agreement between different informants and measures), difference scores were calculated (see De Los Reyes & Kazdin, 2004 for discussion) to use in the analyses. The PIB was operationalized with two difference scores: (1) the youth-report Learning Problems z-score was subtracted from the parent-reported Learning Problems z-score, and (2) the Calculations z-score was subtracted from the inverse of the youth-report Learning Problems z-score. Using this method, for both scores, a positive value in the difference score is indicative of a positive bias on the part of the youth, whereas a negative value is indicative of a negative bias. As a result, there are two discrepancy indices: the difference between two informants (parent and youth) and the difference between youth ratings and actual performance.

Differences between ADHD and Comparison Group on Measures

A two-way ANCOVA was conducted to examine whether there were group differences (gender and ADHD status) on academic performance, controlling for WASI IQ. The analysis showed that youth with ADHD scored significantly lower on the Calculations task than youth without ADHD (see Table 1). There was no significant effect of gender nor a significant interaction ($p > .05$).
Four two-way ANOVAs (gender and ADHD status) revealed additional significant differences on the remaining measures administered (i.e., working memory, parent-reported EF, parent-reported learning problems, and youth self-reported learning problems). On the measures of self-reported learning problems, parent-reported learning problems, and working memory, only a main effect of ADHD status was found to be significant: youth with ADHD had higher self-reported and parent-reported learning problems, and they also scored lower on the working memory test than youth without ADHD. For parent-reported EF problems, a significant interaction was found ($F(1, 98) = 4.64, p = .034$, partial $\eta^2 = .05$), as well as significant main effects of gender and ADHD. Subsequent simple main effects analyses with Bonferroni correction showed that overall, parent-reported EF problems were higher in the ADHD group than in the non-ADHD group. Further, females with ADHD had significantly higher parent-reported EF problems in the ADHD group, but there was no significant gender difference in parent-reported EF problems in the non-ADHD group. These results are summarized in Table 1. Of interest, there are fairly large effect sizes in the differences between groups on the parent-reported measures (i.e., Learning Problems and EF problem ratings), where the effect sizes on youth-report and performance-based measures (i.e., Calculations and working memory tasks) are much more modest.
Table 1.

**Group Differences between ADHD and Non-ADHD Youth**

<table>
<thead>
<tr>
<th></th>
<th>ADHD Group</th>
<th>Non-ADHD Group</th>
<th>ADHD Gender</th>
<th>Gender</th>
<th>ADHD Gender</th>
<th>Gender</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male Mean (SD)</td>
<td>Female Mean (SD)</td>
<td>F</td>
<td>Partial η²</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calculations</td>
<td>93.91 (24.33)</td>
<td>89.41 (20.54)</td>
<td>7.24**</td>
<td>1.99</td>
<td>.07</td>
<td>.02</td>
</tr>
<tr>
<td>Task</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Learning Problems (Self-Report)</td>
<td>58.34 (12.52)</td>
<td>62.12 (10.97)</td>
<td>20.47***</td>
<td>.67</td>
<td>.17</td>
<td>.01</td>
</tr>
<tr>
<td>(Self-Report)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Learning Problems (Parent-Report)</td>
<td>72.47 (12.09)</td>
<td>73.59 (11.00)</td>
<td>119.82***</td>
<td>.11</td>
<td>.55</td>
<td>.00</td>
</tr>
<tr>
<td>(Parent-Report)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EF Ratings</td>
<td>70.91 (10.22)</td>
<td>79.59 (8.29)</td>
<td>198.43***</td>
<td>4.64*</td>
<td>.67</td>
<td>.07</td>
</tr>
<tr>
<td>Working Memory</td>
<td>9.16 (2.67)</td>
<td>9.65 (2.12)</td>
<td>4.16*</td>
<td>.11</td>
<td>.04</td>
<td>.00</td>
</tr>
</tbody>
</table>

*p < .05, **p < .01, ***p < .001
Informant Correlations

Bivariate correlations were calculated among youth-reported and parent-reported Learning Problems, Calculations performance, working memory ability, EF ratings, and the two PIB difference scores (detailed in Table 2). Pearson’s correlations showed that youth-reported Learning Problems and parent-reported Learning Problems were both moderately associated with adolescents’ performance on the math achievement measure (and did not significantly differ from each other in their association with math performance; Fisher’s \( z = .49, p > .05 \)). In addition, the parent EF ratings and working memory ability were correlated with both self- and parent- Learning Problems scores as well as the Calculations task performance. Lastly, the self and parent reports of Learning Problems were moderately correlated with each other, as were the two PIB difference scores.
Table 2

Correlations among Youth and Parent Measures

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Self-Report Learning Problems</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calculations Score</td>
<td>-.50**</td>
<td>-.55**</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PIB (Self-Report &amp; Calculations)</td>
<td>-.11</td>
<td>-.48**</td>
<td>-.48**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PIB (Self-Report and Parent-Report)</td>
<td>.44**</td>
<td>-.44**</td>
<td>.05</td>
<td>.41**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Working Memory</td>
<td>-.31**</td>
<td>-.33**</td>
<td>.53**</td>
<td>-.21*</td>
<td>.02</td>
<td></td>
</tr>
<tr>
<td>Executive Function Ratings</td>
<td>.74**</td>
<td>.36**</td>
<td>-.35**</td>
<td>-.01</td>
<td>.43**</td>
<td>-.15</td>
</tr>
</tbody>
</table>

**p < .001, * p < .05

Group Differences in the Magnitude of the PIB

As the zero-order correlations showed that the two PIB differences scores were moderately correlated with each other, a MANOVA was conducted on the two difference scores based on ADHD status. The MANOVA showed a significant multivariate effect of ADHD status (Wilk’s Lambda = 0.78, F(2, 90) = 14.10, p < .001, partial $\eta^2 = .22$). The moderate effect size suggests considerable variance in the size of the PIB can be attributed to whether youth have ADHD or not. Follow-up univariate tests showed that the effect was attributed to significant
differences in the PIB difference between parent-reported Learning Problems and youth-reported Learning Problems ($F(1, 100) = 18.22, p < .001$, partial $\eta^2 = .15$), where the ADHD group ($M = .36, SD = .89$) showed a positive bias, and the non-ADHD group ($M = -.33, SD = .75$) showed a negative bias. No between-groups difference existed for the difference score between youth-reported Learning Problems and their Calculations score (ADHD: $M = -.07, SD = 1.05$; Non-ADHD: $M = .07, SD = .86; p > .05$).

Informant Reports as Predictors of Task Performance

As both parent- and youth-reported Learning Problems were correlated with Calculations performance, a multiple linear regression analysis was conducted to examine their predictive contributions. Youth-reported and parent-reported Learning Problems z-scores were simultaneously entered as predictors in this exploratory regression analysis. The model was significant, with both youth- and parent-reported Learning Problems accounting for unique variance in the prediction of the math scores. Contrary to hypothesis, the youth-reported Learning Problems was a stronger predictor than parent-reported Learning Problems. The analysis was repeated to examine a moderation model with ADHD group status, which showed that there was no significant interaction ($p > .05$). These results are summarized in Table 3.
Table 3.

**Informant Ratings of Competence as Predictors of Academic Task Performance**

<table>
<thead>
<tr>
<th></th>
<th>( \beta )</th>
<th>( t )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Youth-rated Learning Problems</td>
<td>-.39**</td>
<td>-3.77</td>
</tr>
<tr>
<td>Parent-rated Learning Problems</td>
<td>-.27*</td>
<td>-2.63</td>
</tr>
</tbody>
</table>

Adjusted \( R^2 = .33, F(2, 99) = 26.17, p < .001 \)

** \( p < .001 \), * \( p < .05 \)

A second multiple regression analysis was conducted to examine whether parent-reported EF impairment ratings and performance on an objective measure of working memory were significant predictors of the PIB, operationalized using both difference scores. Age was also entered as an exploratory predictor to see whether developmental changes within this small age range (14-17) would predict the size of the PIB (but no specific hypotheses were made). All predictors were entered using a stepwise method. The EF subscale score was a significant predictor for the difference score between parent-reported Learning Problems and youth-reported Learning Problems (Model 1), and the performance-based assessment of working memory was a significant predictor for the difference score between youth-reported Learning Problems and Calculations score (Model 2). These results are detailed in Table 4.
Table 4.

*EF Measures as Predictors of the Size of the Academic PIB*

<table>
<thead>
<tr>
<th></th>
<th>PIB (Self/Parent Report)</th>
<th>PIB (Calculations/Self Report)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$\beta$</td>
<td>$t$</td>
</tr>
<tr>
<td>Working Memory</td>
<td>.09</td>
<td>.95</td>
</tr>
<tr>
<td>Executive Functioning</td>
<td>.43**</td>
<td>4.78</td>
</tr>
</tbody>
</table>

Model 1: PIB (Self/Parent Report): Adjusted $R^2 = .18$, $F(1, 100) = 22.82$, $p < .001$

Model 2: PIB (Calculations/Self-Report): Adjusted $R^2 = .03$ $F(1, 100) = 4.55$, $p < .05$

** $p < .001$, * $p < .05$
**Discussion**

This study had three objectives. The first goal was to verify that the PIB did exist in youth with ADHD, where it was predicted that youth with ADHD would have a larger PIB than youth without ADHD. A second aim was to assess whether parent or youth evaluations of youths’ academic competencies would account for more unique variance in an objective measure of academic competence, where it was hypothesized that parents’ evaluations would be the stronger predictor, although youth evaluations would also remain significant. The last major objective was to determine whether EF abilities could account for the size of the PIB, where it was hypothesized that they would each account for unique variance. Each of these hypotheses will be discussed in turn.

**The PIB as Imprecise Calibration**

The results show that youth with ADHD score lower than a typically-developing comparison group of youth without ADHD on an academic math performance task, consistent with a large body of literature on the academic outcomes of children and youth with ADHD (Loe & Feldman, 2007). Specifically, students with ADHD tend to complete mathematical problem solving and computation tasks less accurately and more slowly than students without ADHD on (Lucangeli & Cabrele, 2006), in part because these tasks rely heavily on many EFs, including inhibition and working memory, of which youth with ADHD are known to have difficulties (Holmes & Adams, 2006; M. Rogers, Hwang, Toplak, Weiss, & Tannock, 2011). Consistent with this pattern of findings, parents of youth with ADHD in the present study reported lower perceptions of their youth’s academic competence (i.e., higher learning problems), and less proficient EF abilities when compared to their typically-developing peers, again, in line with previous research (e.g., Eisenberg & Schneider, 2007). Of note, youth with ADHD had lower EF
abilities on both a standardized performance measure (working memory) and on an ecological, informant-based measure (EF impairment ratings) (see Toplak, Bucciarelli, Jain, & Tannock, 2008).

While there were academic and EF difficulties for youth with ADHD, there was only partial support for the hypothesis that a greater PIB continues to persist into adolescence for those with ADHD. When asked to evaluate their own academic competence, the self-evaluations of youth with ADHD were more incommensurate than youth without ADHD when compared to parent evaluations, providing support for this hypothesis. That is, youth with ADHD showed ratings that were more discrepant from their parents’ ratings than youth without ADHD. However, the gap between youth’s academic self-perceptions and their performance on an objective academic task did not significantly differ between youth with ADHD and typically-developing youth. As well, youth with ADHD’s self-perceptions of academic competence were also significantly lower than youth without ADHD, suggesting that there is some general recognition that they are having difficulties in the academic domain, despite concerns that these may be underestimated (see Varma, 2013).

Given this impression that youth with ADHD appear to be somewhat aware of their difficulties in the academic domain, it was also examined whether their self-ratings would be predictive of their performance on an objective math task. Consistent with the “imprecision” hypothesis, it was found that youth with ADHD’s self-ratings of academic competency were indeed predictive of their math task performance and were correlated with their parents’ ratings. More notably, however, youths’ self-ratings of academic competency were a stronger predictor of math task performance than their parents’ reports of the same, contrary to hypothesis.
Taken together, these findings extend the limited body of work looking at the developmental status of the PIB in adolescents with ADHD by suggesting that the PIB in adolescence may be more modest, and thus, its saliency more dependent on the comparative measure used. Varma (2003) found similar measurement differences: when a multi-point Likert-scale is used, youth exhibit a PIB when evaluating their ADHD symptoms when compared to parent informants; however, when the Likert-points are collapsed to result in a dichotomous choice (i.e., “yes/no”), parents and adolescents show adequate agreement. Whereas studies with children with ADHD have shown that they have a greater PIB when indexed against performance and informant comparisons (see Introduction for discussion), in this sample of youth, a greater PIB was only found when indexing their ratings against informant comparisons.

These findings also challenge the common assumption that parents are more knowledgeable about their children’s academic abilities than the youths themselves. Given that the PIB was only evident when youth-ratings were compared with parent-ratings, and that youth ratings were stronger predictors of objective academic task performance than parent ratings, the question of whether parent informants are as informative for older adolescents as they are for younger children deserves future research examination. Relatedly, youth with ADHD have been found to be predictively accurate at evaluating their own symptoms of inattention (Connors, Connolly, & Toplak, 2012). However, while much work has focused on comparing the congruence between youth and parent reports, the predictive aspect of youths’ reports has often been neglected (Volz-Sidiropoulou, Boecker, & Gauggel, 2013). Particularly at the intersection of mathematics and adolescence, where there would be an increased level of explicit performance feedback and independence in completing academic work expected, adolescents may truly be more knowledgeable than their parents about their academic competencies.
Furthermore, future research may benefit from examining whether parents as a group are showing a negative bias in evaluating their youth’s academic competencies. It may be that parents of youth with ADHD may be the biased ones (e.g., basing this judgment on outdated or polarized information), given that all youths’ academic self-ratings were shown to be more predictive of academic task performance, and that youth without ADHD had more congruent self/parent ratings.

The Role of EFs in Calibration

The second objective was to examine the cognitive correlates of this imprecision. Parent-reported EF problems and youths’ working memory abilities both partly predicted the magnitude of the youths’ PIB discrepancy, with the parent-reported EF ratings being a stronger predictor. Of particular interest was that this finding was not moderated by ADHD status. Together, these findings suggest EF abilities may be critical to the nuanced calibration of self-evaluations, and provide support for the argument that EF abilities play a dual role to both task performance and task evaluation.

While the exact mechanism of action of these cognitive functions in the PIB remain uncertain, Beer (2012) proposes that positive illusions are a default cognitive heuristic, and that EFs are needed to synthesize several sources of information – both positive and negative – into an integrated and realistic response about the self. Should EFs be impaired, this integration does not occur, and a greater PIB exists. The EF of working memory may be particularly critical for this holding and integration in the academic domain, given the salience of feedback that may be incongruous with youths’ default, positive self-perceptions. Thus, formulating a precisely calibrated self-evaluation may be dependent on the effective use of the episodic buffer (Baddeley...
& Hitch, 1974) to be able to hold, manipulate, and integrate several episodic and semantic sources of information about the self.

Put another way, self-enhancement is a default, shortcut state that needs to be overridden by higher-cognitive processing (Toplak, West, & Stanovich, 2011). In youth with ADHD, it may be then that slightly lower functioning in this integration processing has corresponding deficits in precisely formulating an accurate evaluation about the self. Consistent with this reasoning, young adults with ADHD have been found to provide more positively-inflated global (i.e., integrated) evaluations of their work and driving skills, despite showing a generally accurate recognition of their competencies when these skills are separated and evaluated as component behaviours (Prevatt et al., 2012). Hence, global self-knowledge may be inaccurate simply due to a loss or disorganization of information when putting this self-appraisal together.

Importantly, the lack of an interaction effect in these findings suggest that slight variations in EF ability can already predict the precision of self-appraisal; EF abilities were predictive of the magnitude of the PIB for both youth with and without ADHD. In other words, even in youth with no ADHD but slightly lower EF, there is still less precise calibration of one’s self-evaluations. These results further bolster the notion that precise self-appraisal is dependent on specific cognitive abilities, and the PIB may simply be particularly evident in individuals with ADHD due to their more significant EF problems.

Accordingly, a PIB has been found to exist in other populations, other than ADHD, who also demonstrate EF problems, including children with highly aggressive behavior and children with learning disabilities (Brendgen, Vitaro, Turgeon, Poulin, & Wanner, 2004; Heath & Glen, 2005; McLean & Hitch, 1999; Séguin, Boulerice, Harden, Tremblay, & Pihl, 1999). In addition, some research shows that children with high-functioning autism, who also have difficulties with
perspective-taking and EF, may show self-enhancing biases as well (Bauminger, Shulman, & Agam, 2004; Ozonoff, Pennington, & Rogers, 1991; Scheeren, Begeer, Banerjee, Terwogt, & Koot, 2010). Thus, significantly lower EFs may serve to be a common antecedent linkage among populations that show a maladaptive PIB. In sum, these findings support the double-deficit, in line with Kruger and Dunning (1999): youth with ADHD’s impairments in EF hinder their ability on academic tasks, and at the same time, act as a barrier to obtaining an accurate evaluation of their own performance.

**Clinical Implications**

The findings that (1) there is a predictive relationship between youth’s academic self-ratings and their academic task performance, and (2) that it is stronger than their parents’ ratings of the same, suggest that youth with ADHD, at least in the academic domain, are likely to be valid informants who have self-awareness of their competencies and limitations. In fact, they may remain the best option to report on their own abilities in this area, despite the inflation that is observed when their ratings are compared to parent informant.

More broadly, these results highlight how due consideration should be given to balancing whether the adult or the youth may be more knowledgeable in providing an accurate evaluation, keeping in mind that informant validity may vary depending on the domain and method of evaluation. For example, Sibley and colleagues (2012) find that youth are not the most knowledgeable in self-reporting their symptoms of ADHD, but that teachers also have much to add to informing ADHD diagnoses. Thus, a combination of different, corroborating informants may be the best option in evaluating youths’ competencies in general.

At the same time, the important caveat of EF abilities must be taken into consideration, given that it was found that EFs can predict the magnitude of the PIB. In other words, while
youth with ADHD are generally accurate, and not all youth with ADHD necessarily show EF impairments, at some point, EF impairment is likely to render certain individuals’ self-evaluations inaccurate rather than imprecise. Thus, clinicians should consider measuring EFs along with any youth self-reports, and be cognizant that EF deficits may result in self-evaluative deficits. This implication becomes particularly important as youth develop through adolescence, as EF deficits in individuals with ADHD persist into and past adolescence, and may emerge to be particularly evident in early adulthood, given the increase in the complexity of tasks that these older individuals are required to perform (Wender, Wolf, & Wasserstein, 2001). In fact, lower EFs in adults with ADHD may be the primary factor responsible for poor adaptive functioning (Stavro, Ettenhofer, & Nigg, 2007). Of note, given that recent work shows that youth with ADHD may also show a PIB in the self-reports of their EF problems (Steward, Tan, Delgaty, Gonzales, & Bunner, 2014), it would be important to measure EF in ecologically-valid ways (i.e., informant report) to determine whether youth self-reports on other competencies should be relied upon. In sum, it is seen that EF data can provide clinicians with a wealth of information as to whether youth self-report on other competencies may be accurate.

Despite the emphasis on the PIB in adolescence being modest, a mildly inflated PIB does not necessarily mean inconsequential, given the knowledge of the far ranging academic and adjustment difficulties that youth with ADHD continue to face. Given the findings that (1) the PIB is more one of mild miscalibration, and (2) can be partly accounted for by EF, clinical work may benefit from targeting these EF processes to improve calibration. Historically, much clinical work has attempted to focus on “teaching” accurate self-perception skills, often through introspection (e.g. Abikoff, 1991; L. Thompson & Thompson, 1998), but these methods may be of limited value should subsequent processes of evaluation integration depend on EF abilities. As
discussed, Prevatt and colleagues (2012) found that global judgments result in a greater PIB than individual skill judgments, suggesting that the route to improving self-appraisals may be in targeting these EF pathways and ensuring that individuals with ADHD are evaluating themselves in a guided and structured bottom-up manner, to prevent the neglect of important information.

Similarly, interventions that focus on improving EF abilities (e.g., self-monitoring and goal-setting) may be more gainful opportunities to target the dual route of improving both academic skills and self-evaluations. Targeting the manifestations of EF (e.g., planning behaviours) may be advantageous in the academic domain, and interventions that promote the use of planning and metacognitive strategies in mathematics for youth with ADHD have garnered some empirical support for their effectiveness (Iseman & Naglieri, 2011). As well, increasing the salience of clear, explicit, and specific feedback for all youth may also serve to be an important factor in promoting the self-monitoring and self-regulation of their learning (Zimmerman, 1990).

**Limitations and Future Directions**

This study provides preliminary insight into the existence of the PIB in adolescents in the academic domain, but this work does have certain limitations. First, while this study used a measure of academic learning problems that included items related to perceptions of math abilities, and which was highly correlated with math task performance, the Learning Problems subscale of the Conners 3 remains a broad assessment of difficulties in school, and so the constructs on the self-report measure and the performance-task measure are not entirely concordant. Similarly, the cognitive assessment of EF is limited to an objective assessment of working memory; however, this is only one distinct aspect of the diverse abilities that fall under EF. As such, these measures are limited by their operationalization of academic learning.
problems and EF, which may have underpowered relationships with the size of the PIB. Nonetheless, this study is a first step to demonstrating EF’s contributions, and future work would benefit from using additional external criterion measures (e.g., teacher-rated academic competence).

Second, while it was found that adolescents’ self-evaluations are actually predictively accurate, it is unclear if this level of predictive accuracy applies to younger children as well. To this question, there may be two possibilities: (1) that younger children are also rather accurate and the PIB is generally one of imprecision for them as well, or (2) there is a developmental shift from inaccuracy to imprecision, such that younger children are inaccurate but adolescents are imprecise. While the developmental trajectory of the PIB in the academic domain still cannot be determined with certainty, prior cross-sectional research examining the PIB in both children aged 9-12 and adolescents aged 14-18 show that there is a considerable reduction in the magnitude of the PIB, at least in regards to their self-evaluations of their level of ADHD symptoms (Varma, 2013). The present study provides some support that the same may hold true in self-evaluations in the academic domain. Thus, while it was demonstrated that youth’s self-perceptions were more predictive of actual competence than parent ratings were, a longitudinal study that examines the predictive validity of children and youth’s self-ratings across time would be needed. Similarly, this study found that EFs are important in accounting for the size of the PIB in adolescents. But, longitudinally examining EF abilities and its associations with the magnitude of the PIB over development is needed, particularly given the knowledge of the cognitive maturation lag in youth with ADHD (P. Shaw et al., 2007).

Third, while this study suggests that poor EF may commonly account for a maladaptive PIB in multiple domains and psychopathologies, past work has also shown that that the specific
cognitive factors involved appear to be somewhat domain specific (McQuade et al., 2010). Thus, extending this line of investigation to examine whether the role of these executive abilities generalize to other domains of functioning (e.g., behavioural or interpersonal) and in different populations that exhibit similar metacognitive deficits will be needed to empirically examine this hypothesis.

Lastly, while these findings extend the cognitive-abilities theory underlying the PIB, much of the variance in the PIB remains unaccounted for, and may be due to other social-cognitive antecedents that should not be neglected in future research. The role of memory retrieval is a particularly relevant candidate for further investigation. At present, it is unclear what retrieval and information processing mechanisms youth with ADHD are utilizing when formulating their self-evaluations. For example, retrieving semantic (i.e., “I know I’ve learned this math skill before”) versus episodic (i.e., “How did I do on my last math test?”) knowledge would lead to different self-evaluations. Alternatively, youth with ADHD may be selectively retrieving a particular episode of success to base their judgment, rather than selecting representative exemplars of their performance in the academic domain, which may in turn account for a PIB.

As well, examining which social-comparative group on which youth with ADHD use to base their self-evaluation would also be informative. For example, top performing students on an exam have been found to show a negative bias, because they assume that other students must have done as well as themselves (Ehrlinger, Johnson, Banner, Dunning, & Kruger, 2008). It is seen that how socially-comparative judgments are made depends on the information used as the basis for self-evaluation and does not necessary reflect deliberate distortion. Accordingly, in typical populations, positive biases are reduced when individuals are provided with information
about others’ performances for anchoring (Moore & Small, 2007). Research has not applied the same paradigm to populations with ADHD to examine which comparative group or information for judgment these youth are using. Should youth with ADHD be comparing themselves to other students who have ADHD, or to their peers with learning difficulties, their self-evaluation may be higher, or more inflated than if they compared themselves to students without ADHD, or to the entire class as a whole, reflecting a “big-fish-little-pond effect” (see Marsh, 1987). Likewise, it is notable that youth without ADHD showed a slight negative bias when compared to how their parents rated them. This negative bias may be because youth without ADHD use a different comparison group than youth with ADHD (e.g., all students in the class vs. a subset of the class). Further research is needed to test this hypothesis empirically, as well as how EFs may influence individuals’ abilities to use anchoring information. In sum, there is some knowledge of why youth with ADHD may be imprecise, but before we can improve their calibration, research needs to examine how they got to this imprecise answer.

Conclusion

I find that youth with ADHD show a greater PIB than youth without ADHD in the self-perceptions of their academic abilities when compared to their parents’ ratings. However, all youths’ ratings remained significant predictors of performance on an objective math task, and youth’s ratings were more accurate than their parents’ ratings of the same, suggesting that the PIB in youth with ADHD is still one of poor calibration and modest imprecision rather than gross inaccuracy. Furthermore, EFs were found to be partially responsible for the size of the bias in all youth, regardless of ADHD status, suggesting that this cognitive feature, among others, may be responsible for nuanced metacognitive regulation, and should be targets for future research and intervention.
References


Miyake, A. (2000). The Unity and Diversity of Executive Functions and Their Contributions to


memory, and academic achievement in adolescents referred for attention


Volz-Sidiropoulou, E., Boecker, M., & Gauggel, S. (2013). The Positive Illusory Bias in
Children and Adolescents With ADHD: Further Evidence. *Journal of Attention Disorders.*
doi:10.1177/1087054713489849


doii:10.1146/annurev.psych.55.090902.141954

