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Academic motivation deficits in adolescents with ADHD and associations with academic functioning

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Abstract

The present study evaluates differences in self-reported intrinsic and extrinsic academic motivation and amotivation between eighth-grade adolescents with (*n*=162) and without (*n*=140) ADHD. This study also examines associations between motivation and academic functioning with objective (i.e., grade point average, standardized reading and math scores) and cross-rater measurement (i.e., parent-reported homework performance). Multivariate analysis of variance controlling for sex, intelligence, and medication status found that adolescents with ADHD exhibited a significant motivational deficit compared to adolescents without ADHD across all areas of academic motivation, including intrinsic motivation (*d*=.49), extrinsic motivation (*d*=.43), and amotivation (*d*=.42). To examine whether motivation was differentially associated with academic impairment in the ADHD and comparison groups, a multi-group path analysis was conducted controlling for sex, intelligence, and medication status. Findings showed that motivation was differentially associated with academic impairment for adolescents with and without ADHD. For the comparison group, higher amotivation was associated with poorer homework performance and lower intrinsic motivation was associated with lower reading accuracy. In the ADHD group, higher amotivation was associated with poorer homework performance and math fluency, higher extrinsic motivation was associated with better homework performance and higher GPA, and higher intrinsic motivation was associated with higher reading accuracy. This study builds upon previous research in demonstrating that adolescents with ADHD have academic motivational deficits when compared to their peers without ADHD. Research is needed to understand the longitudinal interplay of academic motivation and academic functioning, with an eye towards developing or modifying interventions to increase academic motivation and academic success.

Key Words: attention-deficit/hyperactivity disorder; intrinsic motivation; extrinsic motivation; amotivation; academic impairment; grades

Eminent theories of attention-deficit/hyperactivity disorder (ADHD) postulate that deficits in motivational processes may underlie some of the symptoms and behaviors associated with ADHD (e.g., Johansen, Sagvolden , Aase, & Russell, 2005; Sonuga-Barke, 2005, Tripp & Wickens, 2005). However, motivation is a task specific construct, varies across settings, and needs to be evaluated in a domain specific manner (e.g., interpersonal v. academic; Schwarzer, 2014). Low *academic motivation* is an oft-suggested explanation for the significant academic impairments present in adolescents with ADHD. This is because adolescents with ADHD often report difficulty in engaging in longer, monotonous and slower paced tasks, such as homework, classwork, and studying (American Psychiatric Association [APA], 2013; Morsink et al., 2017). Despite the prevalence of academic impairment in adolescents with ADHD (DuPaul & Langberg, 2015), only four studies have examined academic-specific motivation and ADHD (Birchwood & Daley, 2010; Hogue et al., 2016; Langberg et al., 2018a; Spangenberg et al., 2017). Further, the existing ADHD and academic motivation literature has a number of significant methodological limitations, such as largely measuring motivation as a unidimensional construct, not being grounded in academic motivational theory, and lacking a comparison group (Smith & Langberg, 2018). Given that up to 80% of adolescents with ADHD experience significant learning and achievement problems (Arnold et al., 2015; DuPaul & Langberg, 2015), it is important to determine whether adolescents with ADHD have academic motivational deficits and to understand whether they are associated with academic impairment.

Self-Determination Theory of Motivation

In the current study, academic motivation is evaluated using the self-determination theory (SDT) of motivation. According to SDT, behavior is dependent upon intrinsic, extrinsic, and amotivation for the task. Intrinsic motivation is doing something due to an internal drive to

persist at an activity for the inherent satisfaction of the activity itself (Legault, 2016), such as a student who completes homework because it is interesting or satisfying to learn about that subject. Within intrinsic motivation there are three subtypes, including intrinsic motivation to know, to accomplish things, and to experience stimulation (Vallerand et al., 1992). Students who engage in intrinsically motivated behaviors become more self-determined because they are internalizing their reasons for executing a behavior (e.g., completing homework, studying for a test). Intrinsic motivation is associated with positive academic outcomes, particularly in reading and overall GPA (Dweck & Master, 2009; Lee & Zentall, 2015). Youth with ADHD, who have difficulties with academics (DuPaul & Langberg, 2015), may have lower intrinsic motivation than their typically developing peers.

Extrinsic motivation is the performance of an activity to attain an outcome separate from the activity itself (Legault, 2016; Ryan & Deci, 2000). For example, an extrinsically motivated student may engage in academic behaviors with the sole purpose of earning good grades, rather than on learning the material. Extrinsic motivation also includes three different aspects, including external regulation, introjection, and identification (Ryan & Deci, 2000; Vallerand et al., 1992). Youth with extrinsic motivation can also become self-determined to complete important tasks related to academic success, however, when students attribute achievement or academic goals to others (i.e., introjected regulation), such as their parents or teachers, extrinsic motivation is associated with negative academic outcomes (e.g., poorer grades, poor homework performance; Legault, Green-Demers, & Pelletier, 2006).

Amotivation refers to when individuals are neither intrinsically or extrinsically motivated and do not understand the reasons behind executing certain behaviors (e.g., why homework performance is important) or do not execute the behavior at all (Vallerand et al., 1992).

Amotivated students typically feel detached from their work and may believe their effort will not change the outcome (Deci & Ryan, 2002). As such, amotivation, along with multiple underlying deficits of ADHD (e.g., executive functioning deficits, delay discounting), is consistent with the oft-cited assertion that youth with ADHD engage in negative behaviors irrespective of potential long-term consequences (Patros et al., 2016).

SDT postulates that individuals start life with high levels of intrinsic motivation, but as they experience failure, their intrinsic motivation decreases, while extrinsic motivation and amotivation increase (Ryan & Deci, 2000). The middle school environment includes switching classes, less individualized attention from teachers, increased homework demands, and more didactic instruction (Langberg et al., 2016). These challenges, and associated difficulties with homework and academic functioning (DuPaul & Langberg, 2015), may increase amotivation in adolescents with ADHD. This is concerning, as amotivation is associated with the intention to drop out of high school in typically developing youth (Legault et al., 2006). Self-determination or independence may also be more difficult for adolescents with ADHD, because they have deficits in the executive functioning skills necessary for success in the middle school environment (Biederman et al., 2004; Langberg et al., 2011).

Academic Motivation Deficits in Adolescents with ADHD

In general school samples, academic motivation declines starting in middle school (Stroet et al., 2013). For adolescents with ADHD, by the time they reach middle school, they have typically experienced repeated failures, particularly in academics (DuPaul & Langberg, 2015). These repeated failures (e.g., forgetting to turn in work and low or failing grades) may lead to academic motivation being significantly lower in adolescents with ADHD as compared to their peers. However, to date, only four studies have examined some aspect of academic motivation in

adolescence (for a review, see Smith & Langberg, 2018). One study found that symptoms of ADHD were not significantly correlated with school-oriented intrinsic motivation using a sample of 38 students with above threshold ADHD symptoms (Birchwood & Daley, 2010). In contrast, Hogue and colleagues (2016) examined two participants with ADHD, finding qualitatively that they struggled with motivation to succeed in school. Spangenberg (2017) compared adolescents with (n = 10) and without ADHD (n = 10) on achievement goal orientations for math, finding adolescents with ADHD were significantly higher on performance-avoidance and lower on mastery goal orientation, which is associated with negative academic outcomes (Dweck & Master, 2009). This suggests that students with ADHD focus more on how their performance may be perceived by others and less on trying to learn and master material. Finally, Langberg et al. (2018a) found that lower levels of adolescent-reported ability and expectancy motivation to complete homework was associated with parent- and teacher-reported homework problems in a sample of 285 adolescents with ADHD. However, this study did not compare homework motivation levels against a comparison group, so it is unclear whether adolescents with ADHD have significantly lower levels of academic motivation than their peers without ADHD.

In addition, none of the above-mentioned studies considered sex in their analyses. A review of motivation in typically developing youth found sex differences across four separate areas of motivation (Meece, Glienke, & Burg, 2006). Importantly, as ADHD is diagnosed more often in boys (Rucklidge, 2010), failure to evaluate the role of sex may lead to skewed results. Intelligence is also closely linked with motivation and academic impairment and is a potential confounding variable not examined in previous studies. Finally, studies to date have varied on how they measured motivation, with some studies using measures that have not been validated and measures that are not based upon any motivational theories (e.g., Hogue et al., 2016). Thus,

although clinically we often think of adolescents with ADHD as being less academically motivated compared to their peers, there is limited empirical evidence to support this assertion. It is also unclear what aspects of academic motivation are most strongly associated with academic functioning and whether these associations differ for adolescents with and without ADHD.

Present Study

The present study builds upon prior work by evaluating whether adolescents with ADHD show academic motivational deficits as compared to their peers and whether these deficits are associated with academic impairment and achievement. Specifically, the present study had two primary objectives:

1. The first objective was to examine whether adolescents with ADHD differ from adolescents without ADHD in academic motivation. Using the SDT of motivation, we examined group differences across intrinsic motivation, extrinsic motivation, and amotivation. Importantly, sex, intelligence, and medication were controlled for in analyses. We hypothesized that adolescents with ADHD, who often have a history of academic failure experiences (e.g., negative behavioral feedback in the classroom, missing homework assignments, and low and failing grades; DuPaul & Langberg, 2015), would report lower levels of both extrinsic and intrinsic academic motivation and higher levels of amotivation for school. We further expected that the largest difference between adolescents with and without ADHD would be present for intrinsic motivation, as SDT suggests that having more academic failures is tied to lower levels of intrinsic motivation (Ryan & Deci, 2000). This is consistent with findings from youth with ADHD, who report having the most difficulty finding intrinsic motivation to succeed (Morsink et al., 2017).

2. The second objective was to examine academic motivation in relation to academic functioning, and to explore whether associations between academic motivation and academic functioning differs for adolescents with and without ADHD. Importantly, this study assesses academic functioning in a comprehensive manner, including a multi-rater and source approach. Further, given that motivation is task specific, it is important to evaluate multiple aspects of academic performance, as the type of motivation that is most important varies based upon the nature of the task (e.g., homework v. standardized achievement test; Schwarzer, 2014). We focus on four main aspects of academic functioning where adolescents with ADHD have been shown to have significant deficits, homework, math, reading, and grades (Arnold et al., 2015; Daley & Birchwood, 2010; Langberg et al., 2018b; Massetti et al., 2008). Longitudinal studies have shown that ADHD diagnostic status in elementary school predicts lower reading and math standardized scores (Massetti et al., 2008) and adolescents with ADHD turn in 20% fewer homework assignments than their peers (Langberg et al., 2016). Additionally, multiple reviews found youth with ADHD have lower GPA than peers (e.g., Arnold et al., 2015).

   Given the independent nature of homework performance, we hypothesized that higher amotivation and/or lower intrinsic motivation would be associated with poorer homework performance. In considering math and reading achievement, previous research has shown higher achievement motivation, conceptually similar to intrinsic motivation, to be associated with higher math achievement in school-aged children with ADHD (Gut et al., 2012) and intrinsic motivation to be associated with reading achievement in children with and without ADHD (Lee & Zentall, 2015). As such, we hypothesized that lower intrinsic

motivation would be associated with poorer reading and math achievement. As grades are a compilation of many factors, including behavior, homework, and reading and math ability, we hypothesized that all facets of academic motivation would be associated with GPA. Finally, given the exploratory nature of the analyses, we did not make a priori hypotheses regarding whether the association between academic motivation and academic functioning would differ for adolescents with and without ADHD.

Methods

Participants

Participants included 302 adolescents (*Mage*=13.20) in eighth grade who were recruited from local public schools across two sites located in the Southeastern and Midwestern United States. The sample was specifically recruited so that approximately half (*n*=162) was diagnosed with ADHD (120 with predominantly inattentive presentation and 42 with combined presentation), with remaining participants (*n*=140) comprising of a comparison sample without ADHD. The sample was predominantly White (81.80%), with 7.90% identifying as bi/multiracial, 5.30% identifying as Black/African-American, 4.60% identifying as Asian, and .30% identifying as American Indian/Alaskan. There were significant group differences on intelligence, sex, medication use, and comorbidities. The ADHD group had less females and lower estimated full scale intelligence quotient (FSIQ) and higher rates of medication use and comorbidities (i.e., oppositional defiant disorder). There were no differences between groups on age, race, or levels of anxiety and depression. See Becker et al., 2019 for further details.

Procedures

Adolescents in eighth grade and their parents were recruited across two consecutive years. The study was approved by the Cincinnati Children's Hospital Medical Center and

Virginia Commonwealth University Institutional Review Boards. Potential participants were recruited via flyers and letters provided to schools. Separate flyers were made to target adolescents with attention problems and adolescents broadly. Schools distributed the recruitment materials (i.e., an information packet) to all eighth grade families by e-mail and/or at events attended by eighth grade parents at the beginning of the school year. Interested families (n=405) contacted the research team to complete a phone screen to ensure they were in eighth grade, regular education classes, and not diagnosed with an organic sleep condition. Families meeting the phone screen criteria (n=360) were invited to receive a comprehensive assessment, which 313 families attended. At the beginning of this assessment, written informed consent and adolescent assent were obtained through interview and families were provided with a copy of the signed consent/assent documents. Participants and their parents completed their respective versions of the Children's Interview for Psychiatric Syndromes (ChIPS; Weller, Weller, Fristad, Rooney, & Schecter, 2000) and rating scales, and participants were administered the Wechsler Abbreviated Scale of Intelligence, Second Edition (WASI-II; Wechsler, 2011) and selected subtests of the Wechsler Individual Achievement Test, Third Edition (WIAT-III; Wechsler, 2009). Parent, adolescent, and teacher ratings were collected using Research Electronic Data Capture (Harris et al., 2009). Inclusion criteria included: (1) enrolled in eighth grade; (2) estimated Full Scale IQ (FSIQ)≥80 based on the WASI-II (Wechsler, 2011); and (3) enrolled in regular education classes. Exclusion criteria were: (1) meeting criteria for autism spectrum disorders, bipolar disorder, or a dissociative or psychotic disorder; (2) previous diagnosis of an organic sleep disorder (e.g., obstructive sleep apnea, narcolepsy, restless leg syndrome, periodic limb movement disorder) according to parent report during the phone screen, and (3) not meeting criteria for either the ADHD or comparison groups as described below.

ADHD diagnosis. All potential participants underwent a comprehensive ADHD diagnostic evaluation in accordance with criteria of the Fifth Edition of the Diagnostic and Statistical Manual for Mental Disorders (DSM-5; APA, 2013). Participants met criteria for ADHD on the basis of the parent version of the ChIPS (P-ChIPS; Weller et al., 2000). To be eligible for participation in the ADHD group, adolescents were required to meet all DSM-5 criteria for either the ADHD combined presentation or predominantly inattentive presentation on the P-ChIPS, including: at least six symptoms of inattention at clinically significant levels; presence of ADHD symptoms prior to age 12 years, presence of ADHD symptoms in two or more settings (e.g., home, school), evidence that symptoms contribute to impairment in home, academic, and/or social functioning; and symptoms of ADHD are not better explained by another mental disorder (e.g., anxiety, depression). Adolescents that met criteria for ADHD predominantly hyperactive/impulsive presentation were not included in the larger study from which these data were pulled (Becker et al., 2019).

Comparison group. Participants were included in the comparison (i.e., non-ADHD) group if the parent endorsed fewer than four symptoms of ADHD in both domains (i.e., inattention, hyperactivity/impulsivity) on the P-ChIPS. All participants were assessed for common comorbid mental health conditions (i.e., mood and anxiety disorders, disruptive behavior disorders, obsessive-compulsive disorder). Adolescents who met criteria for other common comorbid conditions (e.g., ODD, anxiety, and depression) but not ADHD were eligible for inclusion in the comparison group.

Measures

Parents reported on youth's demographics, including sex, race, age, and medication.

Children's Interview for Psychiatric Syndromes (ChIPS). The ChIPS (Weller, Weller,

Fristad, Rooney, & Schecter, 2000) is a structured diagnostic interview for administration to parents and children (children ages 6–18) and has a parent (P-ChIPS) and child version (ChIPS). The ChIPS has shown high internal consistency and test-retest reliability (Fristad, Teare, Weller, Weller, & Salmon, 1998) and high convergent validity in relation to the *Diagnostic Interview for Children and Adolescents—Revised–Child Version* (DICA-R-C; Fristad et al., 1998). A recent review of child and adolescent diagnostic interviews (Leffler, Riebel, & Hughes, 2015) found five separate studies documenting that the ChIPS has good concurrent validity with other validated diagnostic interviews, including the DICA-R-C and the *Schedule for Affective Disorders and Schizophrenia for School Aged Children* (K-SADS).

Wechsler Abbreviated Scale of Intelligence –Second Edition (WASI-II). Adolescents' FSIQ was estimated by the Matrix Reasoning and Vocabulary subtests of the WASI-II (Wechsler, 2011). This two subtest short form has been found to be a reliable and valid estimate of FSIQ (Sattler, 2008). In the present study, FSIQ was used as a covariate in analyses.

Academic Motivation Scale (AMS). The AMS is a self-report measure of 28 items reporting on different aspects of academic motivation (Vallerand et al., 1992). A seven-point Likert scale is used (e.g., 1=*Does not correspond at all*, 4=*Corresponds moderately*, 7=*Corresponds exactly*). This scale has six subscales: Intrinsic Motivation Knowledge (e.g., "experience pleasure and satisfaction while learning new things"), Intrinsic Motivation Accomplishment (e.g., "experience pleasure while surpassing myself in my studies"), Intrinsic Motivation Stimulation (e.g., "experience pleasure when in discussions with interesting teachers"), Extrinsic Motivation Identified Regulation (e.g., "school will enable me to enter the job market"), Extrinsic Motivation Introjected Regulation (e.g., "to show I am an intelligent person"), and Extrinsic Motivation External Regulation (e.g., "to have a better salary later on").

The total scores are also used, with a total score for Amotivation (e.g., "I can't see why I go to school and frankly, I couldn't care less"), Intrinsic Motivation, and Extrinsic Motivation available. Internal consistency in previous studies ranged from .76 to .86, with a confirmatory factor analysis finding seven distinct factors of motivation (i.e., three subscales of intrinsic motivation, three subscales of extrinsic motivation, and amotivation; Vallerand et al., 1992). Test-retest reliability is good, ranging from .71 to .83 for all subscales. For the present study, the internal consistencies for the subscales were Intrinsic Motivation Knowledge α=.90, Intrinsic Motivation Accomplishment α=.86, Intrinsic Motivation Stimulation α=.87, Extrinsic Motivation Identified Regulation α=.86, Extrinsic Motivation Introjected Regulation α=.89, Extrinsic Motivation External Regulation α=.83, Amotivation α=.80, Total Intrinsic Motivation α=.95, and Total Extrinsic Motivation α=.93.

Homework Performance Questionnaire (HPQ). The Homework Performance Questionnaire (HPQ; Power et al., 2015) was completed by parents. The thirteen HPQ items that were administered in this study use a five-point scale, each with corresponding percentages to indicate the amount of time a given behavior occurs. Items were worded in the positive so that 90-100% of the time indicates that the child does that behavior consistently well (e.g., student writes down homework assignments independently or manages homework time well). Thus, higher scores indicate better homework performance. The HPQ has demonstrated high internal consistency (α = .85-.91) and convergent validity with other measures of homework (Power et al., 2015). Internal consistency was α = .91.

Grade point average (GPA). Final academic year report cards were obtained for all participants. All grades were converted into GPAs for core subject areas (English/Language Arts, Social Studies, Math, Science) with a range from 0.0 to 4.0 (0.0 = F, 4.0 = A).

Vanderbilt ADHD Diagnostic Rating Scale (VADRS). The VARDS is a DSM-IV-R based scale that includes all 18 DSM-IV symptoms of ADHD, eight symptoms of oppositional defiant disorder (ODD), and 14 symptoms of conduct problems (Wolraich et al., 2003). Parents rate how frequently each symptom occurs on a four-point Likert scale (0 = *Never*, 3 = *Very Often*). The VADRS has excellent psychometric properties (Wolraich et al., 2003) and for the present study internal consistencies were inattentive $\alpha = .95$, hyperactive/impulsive $\alpha = .90$, ODD $\alpha = .91$, and conduct problems $\alpha = .62$.

Wechsler Individual Achievement Test, third edition (WIAT-III). Adolescent mathematics fluency was assessed using the WIAT-III (Wechsler, 2009). To minimize distractions, the WIAT-III was administered in a one-on-one setting in a quiet testing room. Math Fluency is a timed test assessing ability to complete basic math problems. The standard score was used, which has a mean of 100 and standard deviation of 15.

Adolescent reading accuracy and decoding was assessed using the WIAT-III (Wechsler, 2009). Two separate reading subtests were administered. The Word Reading subtest has adolescents read words from a card, while Pseudoword Decoding has adolescents read nonsense words as if they were real words. The Basic Reading standard score, which is generated based upon the summed performance of these subtests, was used in analyses. For the WIAT-III Basic Reading standard score, there is a mean of 100 and standard deviation of 15.

Analytic Plan

Bivariate correlations between study variables were examined. Next, three between-subjects multivariate analyses of variance (MANOVAs) were conducted. First, a MANOVA was conducted with academic outcomes (i.e., GPA, homework performance, math, reading), with group as the independent variable controlling for sex as a covariate. The next MANOVA

included the three intrinsic motivation (i.e., knowledge, accomplishment, stimulation) and three extrinsic motivation (i.e., identified regulation, introjected regulation, external regulation) subscales, with group status and sex as independent variables. The last MANOVA included the three total scores from the AMS, including amotivation, intrinsic motivation, and extrinsic motivation, with group status and sex as the independent variables. Both MANOVAs examining motivation controlled for IQ. If multivariate effects were significant, post-hoc follow-up univariate ANOVAs were conducted for each variable. To control for family-wise errors, Holm-Bonferroni corrections were used (Holm, 1979).

Next, a multigroup regression analysis (Byrne, 2013) was conducted in Mplus Version 7 (Muthén & Muthén, 1998 –2012) with group status (ADHD vs comparison) being used as the grouping variable. This analysis evaluated which aspects of motivation were associated with academic impairment, controlling for IQ, sex, and medication status. For the path analysis, the three intrinsic motivation subscales, the three extrinsic motivation subscales, and the amotivation subscale were entered into a single path model. Model fit statistics compared the model with paths free to vary across the groups (i.e., examining differential relations between motivation variables and outcomes across the two groups) versus fixed to be equal across groups (i.e., assuming these relations to be the same for the two groups). A nonsignificant chi-square change statistic would indicate that the fixed model should be retained in favor of parsimony. Full information maximum likelihood (FIML) was used to address missing data, which used all observed information to estimate parameters. Both unstandardized and standardized coefficients are presented in Figure 1. Standardized coefficients can be used to gauge relative importance of paths and interpreted as *r*-values (Durlak, 2009) with values greater than .10 indicating a small effect, values greater than .30 indicating a medium effect, and values greater than .50 indicating

a large effect (Cohen, 1988).

Results

Intercorrelations among study variables are presented in Table 1 for both ADHD and comparison groups. All data had skewness and kurtosis values between -2 and 2 and variance inflation factors below 5. There were no significant outliers. Missing data was low, with less than 1% of data missing with the exception of GPA, which had 13.6% missing data. FIML uses the available data to estimate missing data and is appropriate to use for this level of missing data. As expected, results of the MANOVA controlling for sex (Wilks' Lambda=.62, $F(5, 253)=31.65$, $p<.001$, $\eta^2=.39$) revealed that adolescents with ADHD have significantly lower GPAs ($F(1, 258)=72.12$, $p<.001$, $\eta^2=.22$), homework performance ($F(1, 299)=136.54$, $p<.001$, $\eta^2=.31$), FSIQ ($F(1, 299)=10.31$, $p=.001$, $\eta^2=.03$), math fluency ($F(1, 299)=38.20$, $p<.001$, $\eta^2=.11$), and reading accuracy ($F(1, 299)=16.01$, $p<.001$, $\eta^2=.05$).

Group Differences in Academic Motivation

The MANOVA examining the specific academic motivation facets revealed a statistically significant multivariate effect of group status, Wilks' Lambda=.95, $F(6, 291)=2.53$, $p=.021$, $\eta^2=.05$, but no effect of sex or interaction of group and sex. As a result, six post-hoc univariate ANOVAs were run to identify the location of the significant differences between individuals with and without ADHD on the six subscales of academic motivation. Across every subscale of motivation, adolescents with ADHD reported significantly lower levels of academic motivation than adolescents without ADHD.

The MANOVA examining academic motivation total scores also revealed a statically significant multivariate effect of group status, Wilks' Lambda=.94, $F(3, 294)=6.01$, $p=.001$, $\eta^2=.06$, but no effect of sex on motivation nor sex by group interaction. As a result, three post-

hoc univariate ANOVAs were run to identify the location of the significant differences between individuals with and without ADHD on the three total scores on the AMS. Adolescents with ADHD reported significantly lower levels of intrinsic and extrinsic academic motivation when compared to adolescents without ADHD. As expected, adolescents with ADHD reported higher levels of amotivation than adolescents without ADHD. See Table 2 for univariate effect sizes for all motivation subscales and total scores from the AMS.

Academic Motivation in Relation to Academic Functioning

In the multi-group path analysis examining motivation in relation to academic impairment, model fit statistics confirmed that allowing paths to be free across groups resulted in significantly better fit than fixing these paths across groups, $\Delta\chi^2$ (18) = 46.78, $p < .001$, $r = .39$. This suggests that there are differences in the relationship between aspects of motivation and academic impairment for adolescents with and without ADHD. Thus, we compared groups within the same analyses.

For adolescents with ADHD, four motivation scales were differentially associated with homework performance, GPA, and lower levels of math fluency and reading accuracy and decoding while controlling for IQ, sex, and medication status (see Figure 1). Higher levels of both amotivation and extrinsic introjected regulation motivation were associated with poorer parent-reported homework performance. Greater amotivation was also associated with lower levels of math fluency. Only higher intrinsic motivation for knowledge was significantly associated with higher reading accuracy. Finally, higher levels of extrinsic external regulation were associated with higher GPA. In contrast, among adolescents without ADHD, only two motivation scales were associated with homework performance and difficulties with reading (see Figure 1). Similar to adolescents with ADHD, greater amotivation was associated with poorer

parent-reported homework performance, but was not associated with math fluency. In addition, lower intrinsic motivation for accomplishment was associated with lower reading accuracy in the comparison group. See Table 3 for coefficients and standard errors.

Discussion

The present study evaluated whether adolescents with and without ADHD differ on intrinsic motivation, extrinsic motivation, and amotivation and whether these aspects of academic motivation were differentially associated with academic impairment. Importantly, this is the largest study to date to examine academic motivation deficits in adolescents with and without ADHD, finding that adolescents with ADHD have significantly lower levels of academic extrinsic and intrinsic motivation and higher levels of amotivation than their peers without ADHD. Consistent with hypotheses, group differences were largest for intrinsic motivation (d = .49). Interestingly, sex was not a significant predictor of motivation for adolescents with or without ADHD. In the multi-group path analysis, aspects of motivation were differentially associated with homework performance, GPA, math fluency, and reading accuracy for adolescents with ADHD compared to adolescents without ADHD. For adolescents with ADHD, higher intrinsic motivation for knowledge was associated with higher reading scores, extrinsic motivation for external motivators was the only area of motivation associated with grades, and amotivation was negatively associated with multiple areas of academic impairment. These findings and potential clinical implications are discussed in more detail below.

Academic Motivational Deficits between Adolescents with and without ADHD

Across all areas of this academic motivation, including amotivation, intrinsic motivation (i.e., intrinsic motivation to know, accomplish, stimulate), and extrinsic motivation (i.e., extrinsic motivation for external, introjected, and identified regulation), adolescents with ADHD showed a

motivational deficit compared to peers without ADHD. This fits with prior research and theory suggesting that adolescents with ADHD struggle with self-regulation of motivation (Sonuga-Barke, 2005, Tripp & Wickens, 2005), particularly for goal-directed behavior like academic work (Martin, 2012; 2013). In this study, group differences were largest for intrinsic motivation, in particular intrinsic motivation for accomplishment (d = .47) and knowledge (d =.46). This suggests that adolescents with ADHD are significantly less likely than their peers to engage in academics because they are interested in a topic or because they believe working hard will lead to a sense of accomplishment. Importantly, when adolescents with ADHD have lower beliefs in their ability to accomplish work, they have more homework problems and a lower percentage of homework turned in (Langberg et al., 2018a).

Within the domain of extrinsic motivation, the largest difference between adolescents with and without ADHD was for extrinsic identified regulation (d = .40). Although differences were lower for extrinsic motivation subscales, this finding nevertheless suggests that adolescents with ADHD find it particularly difficult to recognize that completing academic tasks facilitates longer term goals, such as earning good grades, getting a specific job, or going to college. This fits with the larger literature that finds adolescents with ADHD to often struggle with motivation to adhere to long-term goals and need shorter, more concrete goals for success (Martin, 2012). Interestingly, the smallest difference between groups was for extrinsic external regulation, which includes being motivated by external incentives such as parents providing a reward system for homework completion or punishment for each assignment not completed. This finding may be important for intervention, as research has found adolescents with ADHD to be responsive to immediately available rewards and incentives (Mies et al., 2019).

Academic Impairment

Homework performance. In this study, greater academic amotivation was associated with poorer homework performance for both adolescents with and without ADHD, though a stronger relationship was found between amotivation and homework performance in the ADHD group ($\beta = -.27$) than the comparison group ($\beta = -.18$). Participants in this sample were in eighth grade, a point at which adolescents are typically expected to complete homework independently, without parental assistance (Langberg et al., 2011). Adolescents with ADHD struggle with multiple aspects of completing homework, including remembering the correct assignment, focusing on completing the assignment, and turning it in (Power et al., 2006). Previous research in typically developing adolescents has shown that amotivation is linked to multiple negative academic outcomes, including negative cognitions about homework ability, academic underachievement, self-esteem, and dropout rates (Legault et al., 2006). It is likely that students who are amotivated do not understand the importance of or reasons behind homework completion (Ryan & Deci, 2000), and thus are less likely to be motivated to complete it. This effect may be compounded in students with ADHD who are also not motivated to complete homework because the consequences are long-term, rather than immediate (e.g., not completing homework will have consequence at end of quarter when grades are given, not immediately; Martin, 2012).

Interestingly, for the ADHD group, having higher levels of extrinsic motivation introjected regulation was associated with poorer homework performance. This suggests that when adolescents with ADHD focus on pleasing others as motivation to complete homework, they experience more homework problems. This is consistent with previous work that has found when behavior is less self-determined (e.g., attributed to others' expectations), performance suffers (Legault et al., 2006; Ryan & Deci, 2000). However, it is important to note that intrinsic

motivation introjected regulation and homework performance were not significantly associated in the bivariate correlation analyses, indicating that replication is needed before placing too much confidence in this finding.

Reading accuracy. In typically developing samples, it is well-established that intrinsic motivation is associated with multiple aspects of reading (Baker & Wigfield, 1999; Froiland & Oros, 2013). The present study suggests different aspects of intrinsic motivation may be most salient for adolescents with and without ADHD. The findings from this sample suggest that when adolescents without ADHD are motivated to read accurately using intrinsic motivation for accomplishment, they have poorer scores. This is contrary to previous literature that suggests focusing on mastery through intrinsic motivation for accomplishment enhances reading achievement (Baker & Wigfield, 1999). As intrinsic motivation for accomplishment is associated with lower levels of self-determination (Legault et al., 2006; Ryan & Deci, 2000), it could be that focusing on a feeling of accomplishment as adolescents' reason to read words accurately may not be a motivator for success.

In contrast, intrinsic motivation for knowledge was associated with higher reading accuracy and decoding scores in adolescents with ADHD. Research on reading, motivation, and ADHD suggests that starting in elementary school, students with ADHD show lower levels of intrinsic motivation to read when compared to typically developing peers, with the difference in intrinsic motivation associated with later reading impairment (Lee & Zentall, 2012; Lee & Zentall, 2015). For adolescents with ADHD, it may take greater effort to instill intrinsic motivation, as they are already behind their peers starting in elementary school; however, interventions focused on increasing intrinsic motivation may help to improve reading accuracy (Lee & Zentall, 2012).

Math fluency. For adolescents with ADHD, higher levels of amotivation was associated with lower math fluency scores. With math, students often work on problems independently, have to follow multiple steps to successfully complete a problem, and are taught through lectures, which may be particularly difficult for adolescents with ADHD as they struggle to work independently, follow multi-step instructions, and sustain attention (APA, 2013; Denney, Rapport, & Chung, 2005; DuPaul & Langberg, 2015). Adolescents with ADHD are also more likely to give up when faced with difficult tasks (Morsink et al., 2017), which may manifest as amotivation. Adolescents with ADHD may view themselves as being less competent with math and struggle to build ownership or autonomy over their math work, which according to SDT may decreases motivation (Deci & Ryan, 2000).

GPA. Although we hypothesized that all aspects of motivation would be associated with GPA, only increased extrinsic motivation for external regulation was significantly associated with higher GPA, and this association was only present for adolescents with ADHD. This suggests that, for adolescents with ADHD, external demands to complete schoolwork (e.g., parents requiring specified homework time) and focusing on external rewards for doing work (e.g., adolescents wanting to go to class to earn good grades) may lead to better grades. This is consistent with previous research that suggests adolescents with ADHD are more sensitive to external rewards, particularly immediately available rewards (Mies et al., 2019). This is, in part, the rationale for interventions that provide sincere and specific praise when youth with ADHD engage in challenging academic tasks such as homework (Langberg et al., 2018b; Martin, 2013). This is also the rationale for using goal-oriented interventions, which find that when adolescents with ADHD create specific, short-term, achievable goals, they often have success in working towards these goals (Martin, 2012; 2013). It may be that intrinsic motivation is more difficult to

instill in youth with ADHD, as “love of learning” is a difficult goal to operationalize, while “earn a certain grade” is specific and commonly measured in intervention studies.

Limitations and Future Directions

The present study should be interpreted in light of several limitations. The cross-sectional nature of the study does not allow conclusions to be drawn about causality or the direction of the effects regarding motivation and academic impairment. As discussed earlier, youth with ADHD often experience failure early in their academic careers. As such, it is likely that the association is bi-directional, with academic failure and impairment leading to decreased motivation, which in turn leads to future academic impairment. As the SDT of motivation suggests, context plays a large role in whether youth are motivated to complete tasks and how motivation changes across time (Ryan & Deci, 2000). However, only one study to date has longitudinally examined motivation in youth with ADHD (Lee & Zentall, 2015), focusing on elementary to middle school students. This dearth of longitudinal studies makes it difficult to draw conclusions about directionality (Smith & Langberg, 2018). Secondly, although the sample in this study has multiple strengths, 81% of the adolescents were White. As this does not match current census demographic breakdowns, results may not generalize well and need to be replicated in other samples. Importantly, there are multiple covariates and variables that affect motivation and academic impairment that were not able to be evaluated in this study. For example, comorbidities, including oppositionality, conduct problems, and depression may all be associated with motivation. In the present sample, these variables were not strongly associated with motivation at the bivariate level, but it will be important to consider a broader array of potential covariates in future work. Similarly, as ADHD is considered a multifaceted disorder (i.e., inattention, hyperactivity, impulsivity), each symptom domain or presentation may differentially

impact academic motivation. As such, examining ADHD heterogeneously will help to discern clinical profiles that may be more or less associated with academic motivation and how and when to intervene. Unfortunately, it is relatively unknown how existing interventions may increase or decrease academic motivation for adolescents with ADHD. Thus, current interventionists should use motivation as an outcome to understand if existing intervention do increase academic motivation, and if so, what aspects of that intervention increased motivation.

Conclusions

This study builds upon previous research in demonstrating that adolescents with ADHD have greater academic motivational deficits than adolescents without ADHD, with differences consistent across aspects of intrinsic motivation, extrinsic motivation, and amotivation compared to adolescents without ADHD, suggesting multiple avenues for intervention. Interventions could include building up students' growth mindsets (Martin, 2013), behavioral contingencies (Langberg et al., 2018b), using the cognitive behavioral framework to increase academic self-esteem (Eddy et al., 2018), and motivational interviewing to increase academic motivation (Sibley et al., 2016). Additional research should focus on how to increase academic motivation in adolescents with ADHD, what aspects of current interventions may increase motivation, and whether existing interventions need to be modified.

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Table 1. *Bivariate associations.*

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1. Amotivation	--	-.33***	-.27***	-.35***	-.32***	-.27***	-.31***	-.29***	-.08	-.08	-.20*	-.23**	-.35***	-.09	-.02	-.00	.10	.03
2. Intrinsic	-.21**	--	.71***	.94***	.92***	.94***	.70***	.75***	.38***	-.09	.22*	.21*	.17	-.01	-.01	.01	-.14	-.05
3. Extrinsic	-.18*	.73***	--	.68***	.74***	.59***	.92***	.89***	.83***	.04	.13	.14	.21*	.06	.04	.04	-.01	-.01
4. Intrinsic Knowledge	-.24**	.95***	.73***	--	.80***	.84***	.68***	.68***	.39***	-.06	.19*	.21*	.12	-.03	.01	.03	-.11	-.04
5. Intrinsic Accomplish	-.12	.92***	.74***	.81***	--	.80***	.69***	.78***	.42***	-.12	.19*	.15	.19*	-.01	-.02	.01	-.09	-.02
6. Intrinsic Stimulation	-.22**	.92***	.55***	.82***	.76***	--	.58***	.64***	.28**	-.06	.22**	.23**	.17	.00	-.03	-.01	-.19*	-.08
7. Extrinsic Identified	-.24**	.69***	.93***	.74***	.66***	.53***	--	.71***	.72**	.08	.15	.19*	.25**	.04	.07	.11	-.03	.01
8. Extrinsic Introjected	-.15	.72***	.89***	.68***	.77***	.550***	.73***	--	.55***	-.05	.10	.13	.15	.10	.01	-.03	-.07	-.11
9. Extrinsic External	-.08	.53***	.89***	.56***	.54***	.39***	.81***	.63***	--	.11	.11	.04	.16	.02	.04	.05	.09	.11
10. Reading	-.07	.02	.00	.08	-.03	.02	.03	-.04	.02	--	.24**	-.03	.15	-.07	.36***	-.00	-.00	-.08
11. Math	-.17*	-.00	-.02	.04	-.06	.02	-.02	-.04	.01	.44***	--	.24**	.34**	-.08	.07	-.04	-.22**	-.14
12. Homework	-.26**	.02	-.05	.05	-.02	.04	.04	-.13	-.03	.08	.21**	--	.31***	.06	.03	-.08	-.25**	-.13
13. GPA	-.31***	.11	.10	.16	.02	.12	.17*	-.00	.10	.27**	.44***	.47***	--	.20*	.30**	.14	-.08	-.21*
14. Sex	-.06	.13	.14	.09	.18*	.11	.14	.18*	.06	-.09	-.20*	.12	.03	--	.00	-.02	.13	.02
15. FSIQ	-.17*	-.03	-.04	.06	-.10	-.05	.03	-.13	.00	.57***	.36***	.16*	.41***	-.03	--	.02	.11	-.09
16. Med Status	.08	-.02	-.04	-.00	-.03	-.03	-.04	-.04	-.04	.03	-.03	.07	.02	.12	.09	--	.01	.03
17. ODD	.16*	-.04	-.07	-.05	-.05	-.02	-.07	-.06	-.08	.15	.11	-.29***	-.21*	-.04	.02	.10	--	.58***
18. CD	.18*	-.12	-.14	-.16*	-.11	-.05	-.18*	-.13	-.06	.03	.00	-.29***	-.28**	-.08	-.07	.08	.64***	--

Note. ADHD group below the diagonal, comparison group above diagonal. GPA = grade point average, FSIQ = full scale intelligence quotient, ODD= oppositional defiant symptoms, CD= conduct problems, Sex coded as female = 2, male = 1, Medication status coded as no medication = 0, medication = 1. Medication status includes medication for ADHD, behavioral/emotional problems, and sleep problems. * $p<.05$, ** $p<.01$, *** $p<.001$.

Table 2. *Differences in academic motivation between adolescents with and without ADHD*

Motivation Scales	ADHD Mean (SD)	Comparison Mean (SD)	*F*-statistic (df)	*p*-value	Cohen's *d*
Intrinsic Knowledge	4.29 (1.71)	5.04 (1.53)	15.61, (1, 296)	<.001	.46
Intrinsic Accomplishment	3.93 (1.62)	4.66 (1.52)	15.96, (1, 296)	<.001	.46
Intrinsic Stimulation	3.47 (1.64)	4.16 (1.66)	13.11, (1, 296)	<.001	.42
Extrinsic Identified Regulation	5.21 (1.57)	5.77 (1.24)	11.72, (1, 296)	.001	.40
Extrinsic Introjected Regulation	4.43 (1.80)	5.06 (1.57)	10.312, (1, 296)	.001	.37
Extrinsic External Regulation	5.19 (1.61)	5.70 (1.22)	9.28, (1, 296)	.001	.36
Amotivation	2.28 (1.76)	1.76 (1.05)	13.59, (1, 299)	<.001	.43
Intrinsic Motivation	3.90 (1.54)	4.62 (1.47)	17.10, (1, 299)	<.001	.49
Extrinsic Motivation	4.94 (1.50)	5.51 (1.18)	13.32, (1, 299)	<.001	.42

Note. ADHD=attention deficit/hyperactivity disorder, df=degrees of freedom. Each MANOVA controlled for sex and intelligence. *d*=.20 is small, *d*=.50 is medium, and *d*=.80 is large.

Table 3. *Multigroup path analyses coefficients and standard errors*

Dependent Variable	Motivation Subscale	ADHD Coefficient (SE)	*p*-value	Comparison Coefficient (SE)	*p*-value
Homework Performance					
	Amotivation	**β = -.27(.08)*****	**<.001**	**β = -.18 (.09)***	**.041**
	Introjected Regulation	**β = -.41 (.13)****	**.002**	β = -.02 (.14)	.874
	Identified Regulation	β = .30 (.16)	.067	β = .29 (.16)	.069
	External Regulation	β = - .10 (.13)	.443	β = -.16 (.13)	.208
	Intrinsic Knowledge	β = .08 (.18)	.638	β = .03 (.17)	.866
	Intrinsic Accomplish	β = .06 (.16)	.701	β = -.18 (.18)	.303
	Intrinsic Stimulation	β = .03 (.14)	.832	β = .25 (.16)	.122
GPA					
	Amotivation	β = -.12 (.09)	.157	β = 0.10 (.09)	.264
	Introjected Regulation	β = -.23 (.17)	.188	β = .25 (.15)	.095
	Identified Regulation	β = -.16 (.18)	.371	β = -.19 (.171)	.278
	External Regulation	**β = .38 (.13)****	**.005**	β = -.10 (.137)	.478
	Intrinsic Knowledge	β = -.29 (.18)	.120	β = .12 (.18)	.484
	Intrinsic Accomplish	β = .23 (.18)	.190	β = -.04 (.19)	.812
	Intrinsic Stimulation	β = -.00 (.15)	.988	β = -.17 (.18)	.330
Math Fluency					
	Amotivation	**β = -.18 (.08)***	**.022**	β = -.15 (.09)	.080
	Introjected Regulation	β = .00 (.14)	.999	β = -.18 (.15)	.215
	Identified Regulation	β = -.14 (.17)	.419	β = .05 (.163)	.767
	External Regulation	β = .10 (.13)	.458	β = .06 (.13)	.620
	Intrinsic Knowledge	β = .28 (.18)	.127	β = -.03 (.17)	.852
	Intrinsic Accomplish	β = -.28 (.16)	.085	β = .12 (.18)	.498
	Intrinsic Stimulation	β = .04 (.15)	.779	β = .20 (.17)	.223
Reading Accuracy and Decoding					
	Amotivation	β = -.07 (.08)	.376	β = -.12 (.09)	.186
	Introjected Regulation	β = -.11 (.14)	.449	β = -.03 (.15)	.824
	Identified Regulation	β = .00 (.17)	.999	β = .29 (.17)	.075
	External Regulation	β = .02 (.13)	..890	β = .06 (.13)	.612
	Intrinsic Knowledge	**β = .37 (.18)***	**.042**	β = -.07 (.17)	.684
	Intrinsic Accomplish	β = -.19 (.16)	.249	**β = -.38 (.18)***	**.033**
	Intrinsic Stimulation	β = -.09 (.15)	.538	β = .12 (.17)	.439

Note. Standardized coefficients (β) are reported as a way to gauge relative importance of each path. SE = Standard Error, GPA = grade point average, * $p < .05$, ** $p < .01$, *** $p < .001$.

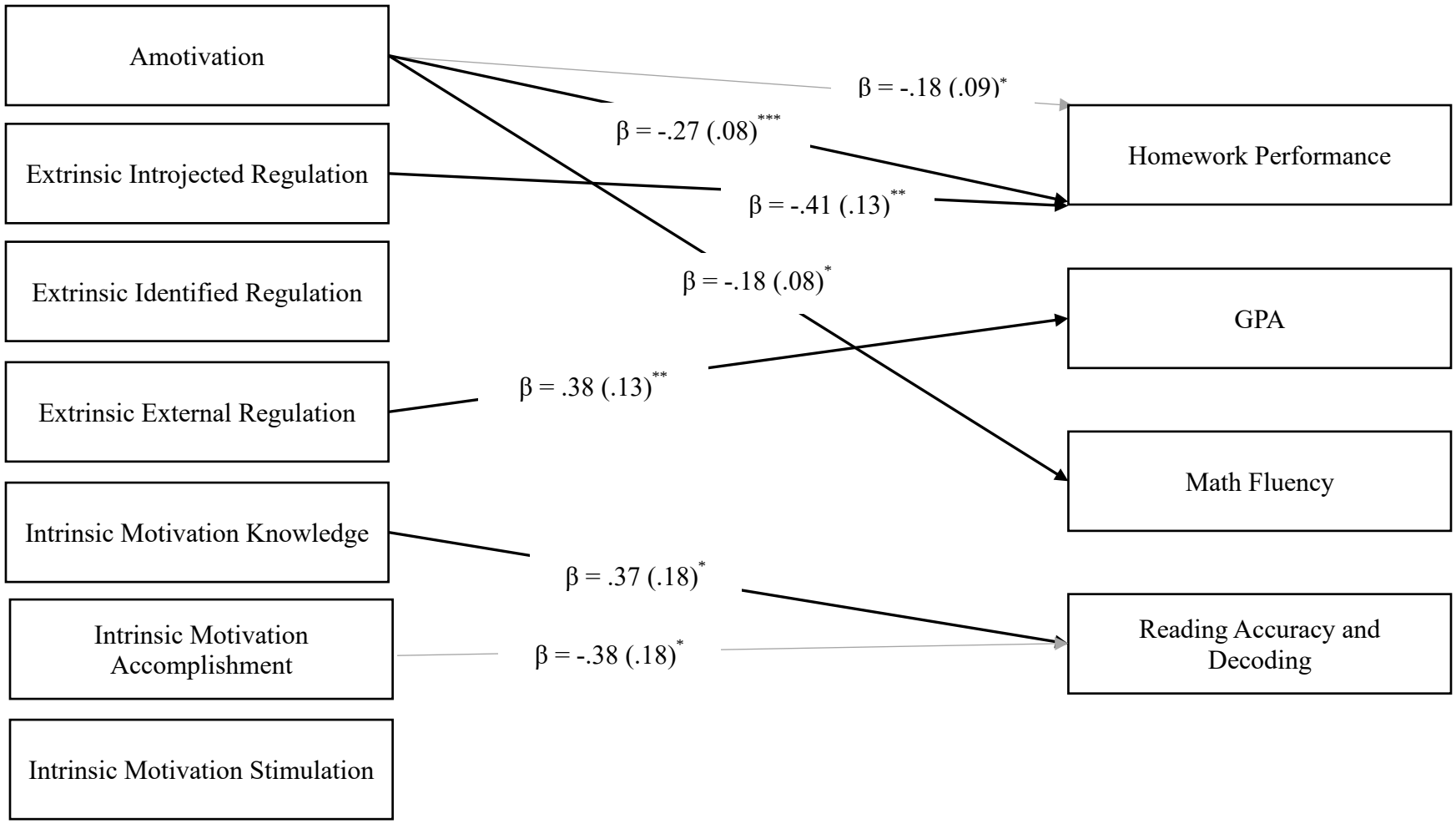

Figure 1. Path model with thicker black lines showing significant paths for ADHD group and thin grey lines showing paths for comparison group. Covariances and nonsignificant paths are not shown for readability. Results are controlling for FSIQ, sex and medication status, which are not shown for readability. Standardized coefficients (β) are reported as a way to gauge relative importance of each significant path. * $p < .05$, ** $p < .01$, *** $p < .001$