8-1-2023

# Academic Motivation Decreases Across Adolescence for Youth With and Without Attention-Deficit/Hyperactivity Disorder: Effects of Motivation on Academic Success

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## Recommended Citation

Smith, Zoe; Flax, Marcus; Becker, Stephen P.; and Langberg, Joshua. Academic Motivation Decreases Across Adolescence for Youth With and Without Attention-Deficit/Hyperactivity Disorder: Effects of Motivation on Academic Success. Journal of Child Psychology and Psychiatry, 64, 9: 1303–1313, 2023. Retrieved from Loyola eCommons, Psychology: Faculty Publications and Other Works, http://dx.doi.org/10.1111/jcpp.13815

The Journal of Child Psychology and Psychiatry

*Journal of Child Psychology and Psychiatry* 64:9 (2023), pp 1303–1313 doi:10.1111/jcpp.13815

# Academic motivation decreases across adolescence for youth with and without attention-deficit/hyperactivity disorder: Effects of motivation on academic success

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**Background:** This longitudinal study examined growth trajectories of academic motivation in youth with and without attention-deficit/hyperactivity disorder (ADHD) across the important developmental transition from middle school to high school, and associations with academic success. Consistent with self-determination theory (SDT) of motivation, trajectories of amotivation, extrinsic motivation, and intrinsic motivation were modeled. **Methods:** The study included a robust multi-method, multi-source assessment of academic outcomes, including homework performance ratings; reading and mathematics standardized test scores; and grade point average (GPA) obtained from school records. Participants included 302 adolescents (ages 12–14; $M_{age}$ = 13.20) in eighth grade who were specifically recruited so that approximately half ($n$ = 162) were diagnosed with ADHD and 140 adolescents comprising 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 0.30% identifying as Indigenous/Alaskan. **Results:** Adolescents with ADHD had worse academic motivation at all timepoints. Growth curve analyses indicated the academic motivation of adolescents without ADHD decreased at faster rates across the transition to high school compared to adolescents with ADHD. However, for adolescents with ADHD, amotivation, extrinsic motivation, and intrinsic motivation each predicted GPA, with higher extrinsic and intrinsic motivation also predicting better homework performance and different aspects of math performance, whereas for youth without ADHD, only amotivation and extrinsic motivation predicted GPA. **Conclusions:** Intervention and school policy implications are discussed, including the importance of fostering autonomy and internal motivation, and consideration of whether current ADHD interventions primarily foster extrinsic motivation. **Keywords:** Attention-deficit/hyperactivity disorder; self-determination theory; amotivation; intrinsic motivation; extrinsic motivation; academic success.

## Introduction

Attention-deficit/hyperactivity disorder (ADHD) is a prevalent neurobehavioral condition characterized by symptoms of inattention and/or hyperactivity/impulsivity. Academic impairment is one of the most prevalent and problematic domains of impairment associated with ADHD (Arnold et al., 2020). This is particularly true during the secondary school years when many adolescents with ADHD experience low and failing grades and high rates of school dropout. Prominent theoretical models of ADHD (e.g., Dual Pathway, Unifying Theory) hypothesize that motivational deficits, particularly as related to pursuing long-term goals, play a role in explaining educational impairment (Barkley, 1997; Sonuga-Barke, 2005). To help increase motivation to complete tasks, many studies have shown external rewards motivate youth with ADHD (Luman, Oosterlaan, & Sergeant, 2005). Consistent with these findings, most evidence-based treatments for ADHD across the life span operate by making external rewards available to help motivate youth to engage in productive behavior (e.g., classroom contingency management; self-managed reward systems like watching a favorite show after accomplishing task; Ramsay, 2020) even in environments that are not structured well for neurodiversity. However, most of the evidence about motivation and ADHD is cross-sectional and little is known about how trajectories of motivation change over time. Further, motivation is a multifaceted construct; thus, it is important to understand which aspects of motivation are most strongly associated with educational outcomes (Smith & Langberg, 2018).

### *Self-determination theory of motivation*

Self-determination theory (SDT) is a prominent motivational theory with a robust evidence-base. As outlined in Morsink, Van der Oord, Antrop, Danckaerts, and Scheres (2021), SDT has significant potential to further the field's understanding of why ADHD behaviors occur and to inform the application of treatments. SDT separates motivation into

Conflict of interest statement: No conflicts declared.

amotivation, intrinsic motivation, and extrinsic motivation. Amotivation is characterized by disorganized motivation with little regulation of goal directed behavior and a general state of discouragement and apathy. Intrinsic motivation can be thought of as autonomous engagement in an action, whereas extrinsic is engaging in an action for a reward or feeling pushed to do so (Morsink et al., 2021). Understanding motivation as a multidimensional construct may help ensure that ADHD treatments do not solely encourage a certain behavior, but also foster a sense of autonomy and well-being for completing that action. Importantly, the broader motivation literature tells us that each form of motivation is associated with different outcomes (Howard, Bureau, Guay, Chong, & Ryan, 2021).

Howard et al. (2021) published a meta-analysis of SDT of motivation and associations with student outcomes, including 344 samples ($N$ = 223,209). Findings highlighted that aspects of intrinsic motivation are associated with task persistence, student success, and well-being, whereas motivation driven by a desire to obtain rewards or avoid punishment was not. Amotivation was related to low performance on multiple task and persistence-related outcomes. It is unclear whether these results apply to students with ADHD. This is concerning given that many behavioral treatments provide external motivators and rewards to engage youth with ADHD in behaviors with the hope that they will experience success and foster intrinsic motivation. Clinically speaking, when parents of youth with ADHD are asked about treatment goals, they commonly answer, "I want my child to be motivated to do these things without me having to tell them" and youth with ADHD share, "I want to be able to do this work without my parents 'nagging' me." If these are indeed goals of treatment, it is important to understand how motivation presents in individuals with ADHD, changes over time, and is associated with educational outcomes.

Adolescence is a developmental period characterized by increased demands for autonomy. Further, academic demands rapidly increase during the secondary school years and academic outcomes have significant consequences (e.g., graduation, college admission). Indeed, studies of academic specific motivation find decreases across adolescence, particularly following transitions (Madjar, Cohen, & Shoval, 2018). This study found over that the transition to middle school, students reported a greater decline in mastery goals and an increase in performance-approach goals. Similarly, using an accelerated longitudinal design with 600 students, Gnambs and Hanfstingl (2016) assessed motivation using a SDT framework and found a significant decline in *intrinsic* academic motivation during adolescence. It is unclear how trajectories of amotivation, intrinsic and extrinsic motivation change during this time for students with ADHD and how this impacts academic outcomes. It is possible that given repeated use of external rewards in ADHD interventions, trajectories of intrinsic motivation decline even more than in general student samples (Lemos & Veríssimo, 2014).

Although longitudinal studies have not been published, cross-sectional data demonstrate the importance of academic motivation during this period. In this same sample but at baseline when participants were in eighth grade, Smith et al. (2020) found that adolescents with ADHD had higher amotivation and lower intrinsic, and extrinsic motivation with moderate effect size differences relative to a comparison group. Further, each aspect of motivation was uniquely associated with academic success for eighth grade students with and without ADHD. Amotivation was the most robust predictor of academic outcomes, which is interesting since disorganization and difficulties with self-regulation are core aspects of ADHD (Barkley, 1997; Sergeant, 2000) and amotivation is characterized as disorganized motivation patterns. Understanding which aspects of motivation are longitudinally associated with academic outcomes may help create clinical and educational support systems for youth with and without ADHD in academic success.

### *Present study*

The purpose of the present study is to longitudinally evaluate trajectories of amotivation, intrinsic, and extrinsic academic motivation across the transition from middle to high school; five timepoints from the beginning of eighth to the middle of tenth grade. This study will compare academic motivation trajectories of adolescents with and without ADHD and evaluate associations between trajectories and academic outcomes in tenth grade. Comprehensive assessment of academic outcomes was completed, including standardized reading and math scores, GPA, and homework performance. Medication use and sex were significantly different by group, so were included as covariates (see Becker et al., 2019; Langberg et al., 2019), while IQ was included due to moderate association with all variables in the analyses. This study uses a strong multi-method, multi-source design with academic motivation (self-report) predicting three objective metrics (GPA, reading, math) and teacher- and parent-report of homework performance. We hypothesized that academic motivation would decline over the secondary school years, with the trajectory being steeper for adolescents with ADHD. We predicted that like Smith et al. (2020), amotivation would be the most robust predictor of outcomes for adolescents with ADHD.

## Methods

### *Participants*

Participants included 302 adolescents (ages 12–14) 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, 42 with combined presentation; females = 35.2%), with remaining participants ($n$ = 140; females = 55.7%) comprising 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 0.30% identifying as Indigenous/Alaskan.

## Procedures

This study was approved by the institutional review boards (IRB) at Cincinnati Children's Hospital Medical Center and Virginia Commonwealth Univeristy. The current study uses data from five timepoints: fall of 8th grade (T1), spring of 8th grade (T2), fall of 9th grade (T3), spring of 9th grade (T4), and fall/winter of 10th grade, except for report card grades which were collected at the end of 10th grade (T5). Parents contacted the research staff in response to recruitment materials and were administered a phone screen to determine initial study eligibility. Parents provided written consent and adolescents provided assent at the first visit. See Becker et al., 2019 and Langberg et al., 2019 for further information.

*ADHD diagnosis.* All 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). 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. Participants meeting criteria for ADHD predominantly hyperactive–impulsive presentation were not included in the broader study given the low prevalence of this presentation in adolescence and ongoing concerns about its validity after early elementary school (Willcutt et al., 2012).

*Comparison group.* Participants were included in the comparison (i.e., non-ADHD) group if the parent endorsed fewer than four symptoms of ADHD using the clinical interview. All participants were assessed for common comorbid mental health conditions. Adolescents who met criteria for other common comorbid conditions (e.g., anxiety, 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 at baseline.

*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 youth. All participants were assessed for ADHD, major depressive disorder, persistent depressive disorder, generalized anxiety disorder, social anxiety disorder, separation anxiety disorder, post-traumatic stress disorder, obsessive–compulsive disorder, conduct disorder, and oppositional defiant disorder. The ChIPS has shown high internal consistency, test–retest reliability, and convergent validity.

*Wechsler Abbreviated Scale of intelligence–second edition.* Adolescents' FSIQ was estimated by the Matrix Reasoning and Vocabulary subtests (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.* The Academic Motivation Scale (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 measure includes a total score for Amotivation, Intrinsic Motivation, and Extrinsic Motivation. For the present study, the internal consistencies for the subscales were Amotivation α = .80, .79, .83, .88, .85, Intrinsic Motivation α = .95, .95, .93, .95, .96 and Extrinsic Motivation α = .93, .92, .95, .93, .90 at T1, T2, T3, T4, and T5, respectively. For growth curves, T1–T5 were used.

## Academic outcomes

*Homework performance.* The Homework Performance Questionnaire (HPQ; Power et al., 2015) was completed by parents and teachers at T5. For teacher-report, there were 19 items and for parent-report 23 items, both of which 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 student does that behavior consistently well. 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 for parents and α = .82 for teachers. Correlations between raters was $r$ = .34.

*Math.* Adolescent mathematics fluency and ability to complete increasingly difficult math problems was assessed using the WIAT-III (Wechsler, 2009). Math Fluency is a timed test assessing ability to complete basic math problems (addition, subtraction, and multiplication), whereas numeric operations allow students to move at their own pace and solve increasingly difficult math problems. The standard scores for both math fluency and numerical operations were used, which has a mean of 100 and standard deviation of 15.

*Reading.* 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.

*Grade point average (GPA).* Final academic year report cards were obtained. All grades were converted into a composite GPA based on 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).

## Analytic plan

Growth curves were modeled using M*plus* version 8 (Muthén & Muthén, 1998–2017) to examine how motivation changes across time. Group status (ADHD vs. comparison) was used as the grouping variable to examine whether amotivation, extrinsic motivation, and intrinsic motivation differed between youth with and without ADHD over time. To examine whether the three aspects of motivation predicted academic outcomes, we tested whether a linear, quadratic, or piecewise (knot point

as students enter high school) model would best fit the data. Linear random and fixed effects growth curve models were significantly better fitting (change in comparative fit index (CFI) > .01 and root mean square error of approximation (RMSEA) < .01). Model fit statistics compared the model with paths free to vary across the groups versus fixed to be equal across groups. Full information maximum likelihood (FIML) was used to address missing data, which used all observed information to estimate parameters. Various fit indices were used to examine goodness of fit, including CFI (ideal study criterion ≥ 0.95; acceptable study criterion ≥ 0.80) and RMSEA (ideal study criterion ≤ 0.05; acceptable study criterion ≤ 0.08; Hu & Bentler, 1999; Kline, 2011). All academic outcome variables were included in each model along with covariates of IQ, sex, and ADHD medication status.

## Results

All data had skewness and kurtosis values between −2 and 2 and variance inflation factors below 5 with no significant outliers. Missing data at baseline was low, with less than 1% of data missing except for GPA, which had 13.6% missing data, and teacher-reported homework performance, at 12.2%. As is typical in longitudinal work, some attrition occurred, though there were no significant differences on variables of interest. For all motivation data, missing data was at 1% for T1, 5.6% at T2, 8.2% at T3, 9.9% at T4, and 12.8% at T5. For outcomes at T5, missing data for parent-reported homework performance was 11.8%, for teacher-reported homework performance was 30.9%, reading 19.7%, numeric operations and math fluency was 19.4%, and GPA was 23.4%. FIML uses the available data to estimate missing data and is appropriate to use for this level of missing data.

### *Motivation growth curves by group*

For each aspect of motivation, group status (ADHD/comparison) was significant and models with group status were better fitting (CFI < .01, RMSEA > .01). Thus, subsequent analyses included the grouping variable. Both adolescents with and without ADHD showed a decrease in intrinsic (βADHD = −.50; βComparison = −.76) and extrinsic (βA = −.46, $p < .001$; βC = −.67) motivation over time, but decreased at different rates. Adolescents with ADHD did not show change in amotivation (β = −.02) whereas comparison youth showed an increase (β = .26). See Figure 1.

### *Academic motivation in relation to academic functioning by group*

Model fit statistics confirmed that allowing paths to be free across groups resulted in significantly better fit than fixing paths across groups. Thus, we compared groups within the analyses.

*Extrinsic motivation.* Without grouping variable, model fit was poor (RMSEA = .08, CFI = .80, TLI = .67, SRMR = .09). Including the grouping variable, model fit was excellent (see Table 1 for details). For both groups, the intercept and slopes were significant (βAIntercept = 3.89, Slope = −.46; βCIntercept = 5.90, Slope = −.67). For the ADHD group, higher levels of extrinsic motivation at baseline predicted higher levels of GPA while for the comparison group higher levels of extrinsic motivation in 8th grade predicted better parent-reported homework performance. Both higher levels of extrinsic motivation over time for the ADHD and comparison groups predicted higher GPA with medium to strong effect sizes, but only the ADHD slope also predicted better parent-reported homework performance and higher scores on math fluency. See Table 1 and Figure 2.

*Intrinsic motivation.* Without grouping variable, model fit was poor (RMSEA = .09, CFI = .77, TLI = .76, SRMR = .10). Model fit was excellent with grouping (See Table 1). For both groups, the intercept and slopes were significant (βAIntercept = 3.04, Slope = −.50; βCIntercept = 3.65, Slope = −.76). Higher levels of intrinsic motivation in 8th grade for the comparison group predicted better parent-repor ted homework performance only, no other academic outcomes were predicted by the intercept for either group. Only the ADHD group's slope predicted academic outcomes, with higher levels of intrinsic motivation predicting higher levels of parent-repor ted homework performance, ability to solve incr easingly difficult math problems, and GPA. The intr insic motivation slope for the comparison group did not predict any academic outcomes. See Table 1 and Figure 2.

*Amotivation.* Without grouping variable, model fit was poor (RMSEA = .11, CFI = .70, TLI = .65, SRMR = .08). This model had excellent to adequate fit with grouping. Both the ADHD and comparison group had significant intercepts (βA = 2.35, βC = 2.60), but only the comparison group had a significant slope (βC = .26). Despite this, both the ADHD and comparison group slopes predicted GPA. For both groups, lower levels of amotivation predicted higher GPA. Interestingly, lower levels of amotivation in 8th grade for the ADHD group predicted higher levels of teacher- and parent-reported homework performance, numeric operations, and GPA. For the comparison group, only teacher- and parent-reported homework performance was predicted by the intercept. See Table 1 and Figure 2.

## Discussion

Examining growth trajectories of academic motivation across secondary school allows further understanding of how motivation changes *and* how that change may affect academic success for youth with and without ADHD. As expected, both youth with

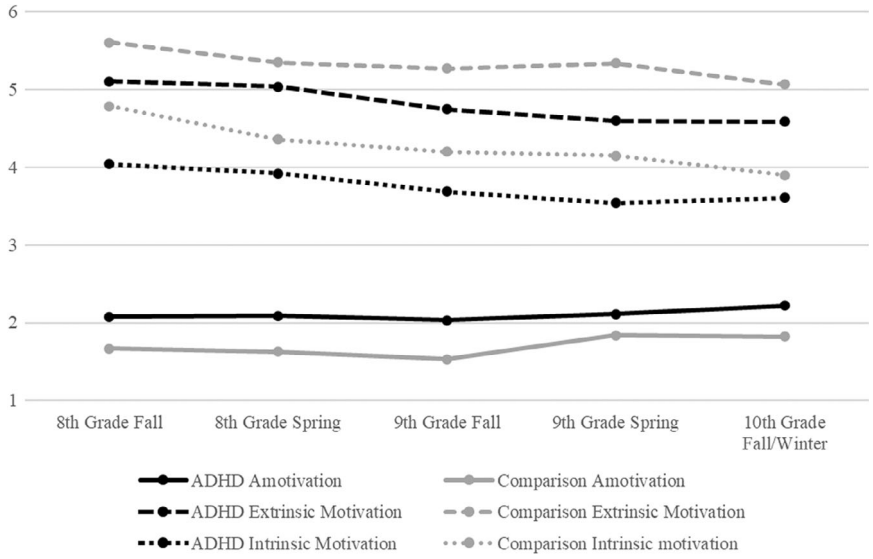


**Figure 1** Academic motivation growth curves for youth with and without ADHD. All slopes significant except for ADHD amotivation slope

and without ADHD decreased on academic extrinsic and intrinsic motivation, but surprisingly, only youth without ADHD increased on amotivation while amotivation for youth with ADHD stayed stable from 8th to 10th grade. In fact, youth without ADHD showed almost the same levels of amotivation than youth with ADHD, with only a small difference in effect sizes. In addition, contrary to hypotheses, youth without ADHD decreased in academic motivation at faster rates (intrinsic = −.67, extrinsic = −.76, amotivation = .26) than youth with ADHD (intrinsic = −.46, extrinsic = −.50, amotivation = .02), yet, consistent with prior cross-sectional work (Smith et al., 2020) youth with ADHD remained higher on amotivation and lower on intrinsic and extrinsic motivation than their peers across all time points (see Figure 1). It is possible that the steeper slopes for youth without ADHD are due to having more room to change across this time. This can be seen by the intercepts, as youth without ADHD start higher on motivation (and lower on amotivation), allowing slopes to increase or decrease at faster rates.

## Academic outcomes

*GPA.* In 8th grade, higher extrinsic motivation and lower amotivation were both associated with better GPA for youth with ADHD. Interestingly, for youth in the comparison group GPA was not associated with any aspect of motivation in 8th grade. For the comparison group, higher extrinsic motivation strongly predicting higher GPA and lower amotivation moderately predicting higher GPA. For youth with ADHD, GPA was the only outcome that all three aspects of motivation predicted, with intrinsic motivation being the strongest predictor of GPA. GPA being the most common academic outcome (and only one for comparison youth) may reflect that, since GPA is a culmination of learning activities (e.g., all subjects, all types of activities such as tests, homework, and projects), multiple areas of motivation are needed for a higher GPA. It is surprising, however, that GPA was not predicted by intrinsic motivation for comparison youth, as that has been cited as a strong indicator of academic achievement for typically developing youth (Easton, Johnson, & Sartain, 2017). When students who already feel competent in their academic skills (i.e., comparison group) are given reinforcers such as grades, intrinsic motivation may be undermined (Easton et al., 2017).

*Homework performance.* In 8th grade, lower amotivation was moderately associated with both teacher and parent-reported homework performance for youth with and without ADHD. This suggests that parents and teachers at this milestone age (last year of middle school) are focused on increasing goal setting and motivation toward homework. For youth without ADHD, higher intrinsic and extrinsic motivation were also moderately to weakly associated with better parent-reported homework performance, which was not the case for youth with ADHD. It may be that the high levels of amotivation in 8th grade for both adolescents with and without ADHD takes parents' focus, while typically developing adolescents, who have fewer negative interactions with parents than adolescents with ADHD (Markel & Wiener, 2014), may have the room and energy to foster different aspects of motivation toward homework completion.

Change in intrinsic motivation strongly and extrinsic motivation moderately predicted parent-reported homework performance for youth with ADHD but no change in motivation over time predicted homework performance for youth without ADHD. This might

**Table 1** Motivation growth curves predict academic outcomes for youth with and without ADHD

| Extrinsic motivation | | | | |
|---|---|---|---|---|
| RMSEA = .05 CFI = .98 TLI = .96 SRMR = .04 | | | | |
| ADHD: Intercept = 3.89*** Slope = −.46*** Comparison: Intercept = 5.90*** Slope = −.67** | | | | |
| | ADHD | | Comparison | |
| Predictors | Intercept | Slope | Intercept | Slope |
| HPQ Teacher | .05 | .11 | .12 | .32 |
| HPQ Parent | −.05 | .32** | .24* | −.07 |
| Reading | .12 | .01 | −.08 | .01 |
| Math Fluency | −.04 | .22* | .10 | .11 |
| Numeric Operations | .08 | .12 | .15 | .05 |
| GPA | .25** | .34*** | .23 | .64*** |
| Covariates | | | | |
| IQ | −.04 | | .04 | |
| Sex | .14 | | .06 | |
| Medication | −.04 | | .04 | |
| **Intrinsic motivation** | | | | |
| RMSEA = .03 CFI = .99 TLI = .98 SRMR = .04 | | | | |
| ADHD Intercept = 3.04*** Slope = −.50*** Comparison: Intercept = 3.65*** Slope = −.76*** | | | | |
| | ADHD | | Comparison | |
| Predictors | Intercept | Slope | Intercept | Slope |
| HPQ Teacher | .11 | .27 | .14 | .30 |
| HPQ Parent | .02 | .63*** | .36*** | −.13 |
| Reading | .10 | .08 | −.10 | −.03 |
| Math Fluency | .02 | .23 | .17 | −.19 |
| Numeric Operations | .13 | .29* | .15 | −.26 |
| GPA | .21 | .39** | .18 | .29 |
| Covariates | | | | |
| IQ | −.03 | | −.01 | |
| Sex | .13 | | −.01 | |
| Medication | −.02 | | .01 | |
| **Amotivation** | | | | |
| RMSEA = .05 CFI = .97 TLI = .94 SRMR = .05 | | | | |
| ADHD: Intercept = 2.35*** Slope = .02 Comparison: Intercept = 2.60*** Slope = .26* | | | | |
| | ADHD | | Comparison | |
| Predictors | Intercept | Slope | Intercept | Slope |
| HPQ Teacher | −.33** | −.19 | −.33* | .01 |
| HPQ Parent | −.28** | .05 | −.41*** | −.04 |
| Reading | −.01 | .05 | .01 | −.09 |
| Math Fluency | −.14 | .05 | −.18 | .19 |
| Numeric Operations | −.35** | −.09 | −.12 | −.16 |
| GPA | −.39*** | −.28* | −.21 | −.38** |
| Covariates | | | | |
| IQ | −.17* | | −.02 | |
| Sex | −.06 | | −.09 | |
| Medication | .08 | | −.01 | |

*Note.* $p < .05$ = *, $p < .01$ = **, $p < .001$ = ***.

indicate that at home, parents are fostering autonomy support for their youth with ADHD to complete homework as their adolescents get older (Langberg et al., 2018; Morsink et al., 2021; Patall et al., 2018). This may seem contradictory to expectations, as often adolescents start to demand increased autonomy from their parents; however, for adolescents with ADHD, parents might recognize the need for additional support to achieve academic success.

*Reading.* For both groups, no aspect of motivation was associated with reading in 8th grade nor did change in motivation over time predict later reading success. This was surprising, as prior longitudinal

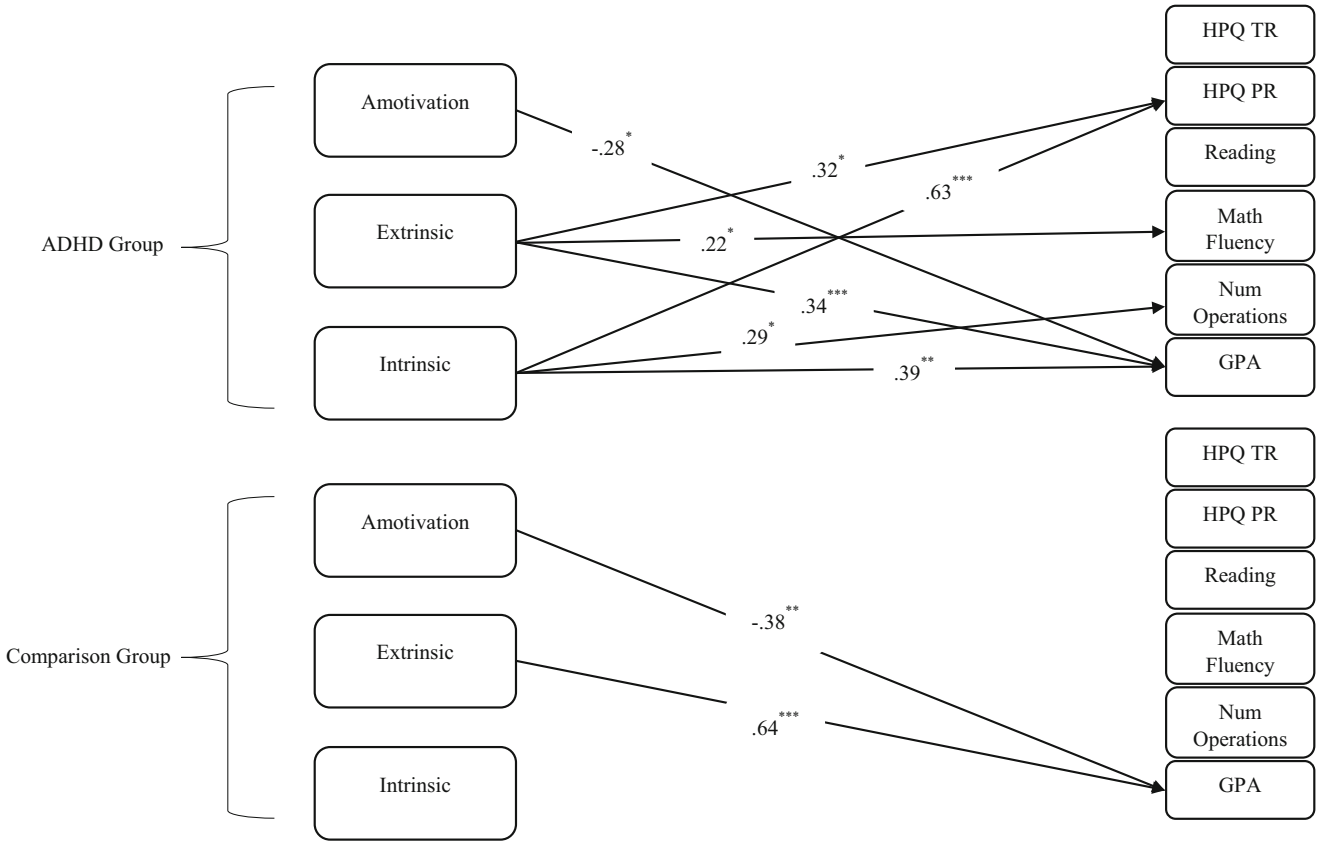


**Figure 2** Growth curve slopes predict academic achievement for youth with and without ADHD. Analyses were examined separately for each aspect of academic motivation. They are depicted together for ease of comparison. Covariances and nonsignificant paths are not shown for readability. Results are controlling for FSIQ, sex and medication status, which are not shown for readability. Standardized coefficients (β) are reported to gauge relative importance of each significant path. *$p < .05$; **$p < .01$; ***$p < .001$

research examining youth with and without ADHD found strong connections with intrinsic motivation and reading (Lee & Zentall, 2017), but, when grouped with other academic outcomes, this study did not reflect those findings for youth without ADHD. There are multiple possibilities for why intrinsic motivation did not predict reading performance in this study. One may be due to the measurement of reading used, as basic reading scores reflect word reading accuracy and not comprehension, which may be a better measurement for youth in secondary school. In addition, most work has examined intrinsic motivation in school-aged children (ages 5–11; Toste et al., 2020), while this study examined the important developmental period of adolescence and the transition to high school. It could be that, by the time students reach adolescence, intrinsic motivation may not be a key driver of work completion. This would reflect the SDT, where school context (e.g., performance and test-driven environment) affects student internal motives (e.g., needs, cognitions, emotions), leading to motivated actions that are driven by external motivators (e.g., grades and parent/teacher expectations; Morsink et al., 2021). Thus, youth without ADHD may 'learn out' of intrinsic motivation by the time they are in early high school because of the context in which our students learn (e.g., test-score driven environment, privileges for individuals who test well).

*Mathematics.* For youth with ADHD, higher levels of extrinsic motivation and intrinsic motivation both predicted better homework performance and higher GPA but differed on the two aspects of math examined in this study. Extrinsic motivation predicted math fluency, the ability to complete simple math problems during a timed task, while intrinsic motivation predicted better outcomes on numeric operations, an independent math worksheet with increasingly difficult problems. It is possible that creating timed tasks for youth with ADHD adds a level of urgency and may feel like an external motivator (e.g., poor grade if do not complete quickly), but to succeed on a task that is self-driven and self-paced, internal motivation is needed for academic success. Interventions could focus on increasing motivation to persevere with math tasks that are both time related (e.g., timed quizzes) and self-directed (e.g., homework, classwork).

*Academic motivators.* Extrinsic motivation for both groups played a significant role in academic success. For youth with ADHD, this may be partially due to the types of treatments developed for them,

which often use reinforcements to help increase motivation and engagement in boring or difficult tasks (Paulus, Ohmann, & Popow, 2016). For both groups, however, it is likely there is something larger at play. Academic success is focused on obtaining a high GPA as the school context, teachers, parents, and peers put emphasis on high test scores, homework, and "teach to the test" type of education (Obama, n.d.; Jennings & Bearak, 2014). This is not to blame teachers, parents, or youth, but instead to recognize that the systems our students learn in reflect *what* is meant by "success" and *how* students achieve this success academically (McGuinn, 2012). Thus, although intrinsic motivation clearly played a role for youth with ADHD, it is possible that intrinsic motivation is not fostered and in fact undermined by external reinforcers like grades and standardized testing in our current middle and high school education curriculum to improve academic success and interpersonal well-being (Morsink et al., 2021).

Further, this study suggests typically developing adolescents are not using the intrinsic motivational style. Instead of blaming the adolescents, we should look at the school systems and the incentives that are created. Currently, teachers and administrators are incentivized to have students test well on national performance benchmarks (Sojourner, Mykerezi, & West, 2014). Likely, this leads to teaching practices that focus on the performance (extrinsic motivators) instead of learning and growth (intrinsic motivators). The findings in this study may reflect this larger nation-wide push for education to focus on external motivators (e.g., grades, test scores, getting into college), which leads to lower levels of intrinsic motivation, critical thinking, and love of learning (Burton, Lydon, D'Alessandro, & Koestner, 2006). This is reflected that for both groups, intrinsic and extrinsic motivation decreased. In addition, as laid out in Morsink et al. (2021), there are costs to using external motivators, including worse performance quality, affect, and well-being. Extrinsic motivators can undermine the effect of intrinsic motivation for youth without ADHD, though this needs to be examined further for youth with ADHD (Lemos & Veríssimo, 2014).

### *Implications for school-based interventions*

So, how to help our students? A school-based daily-diary study found that when teachers supported student autonomy by providing choices, conside student preferences/interest, communicating rationales for importance of an activity, providing opportunities for asking questions, and avoiding uninteresting activities, student' autonomous (intrinsic) motivation increased (Patall et al., 2018). When students perceived that their teachers were thwarting their autonomy (i.e., using controlling messages, suppressing student perspectives, using uninteresting activities), extrinsic and amotivation increased. This study highlights the importance of training teachers in autonomy promoting teaching practices for all youth. In addition, *how* academic success is measured is incredibly important. Most research and educational context focus on grades and academic subject skills, but this does not necessarily reflect the learning, growth, and critical thinking we hope to impart on students.

To fully understand SDT in an educational setting, internal and external motivators as well as psychological needs (i.e., autonomy, relatedness, competence) as mediators need to be included to examine intervention effectiveness. One way to examine this would be to understand how common ADHD interventions in classrooms, like daily report cards, affect student' autonomy motivation, basic psychological needs, and overall well-being. Based upon a review on school-based interventions and one specifically examining outcomes of daily report cards, there is currently no intervention that examines how the use of these interventions affect student well-being and motivators to complete work, particularly for students with ADHD (Iznardoet al., 2020; Paulus et al., 2016). We know that higher levels of well-being for all youth increase academic success and perseverance (Burton et al., 2006), but little is known about the mechanisms on how to foster that for youth with ADHD. It is likely that interventions will need to include treatment that fosters autonomy growth such as motivational interviewing (MI; Miller & Rollnick, 2013). A few current ADHD interventions include MI (e.g., Boyer et al., 2015; Sibley et al., 2016), but to our knowledge, no ADHD-specific school-based intervention has been created using this method. In addition, we know that therapeutic processes such as a strong working alliance and engagemetn with students and parents are key elements of treatment delivery for youth with ADHD (Breaux et al., 2018).

It is also important to note that many school-based interventions for youth with ADHD have focused on elementary school students (e.g., Pfiffner et al., 2007) or pull-out, one-on-one brief interventions for adolescents (e.g., Langberg et al., 2018). Although effective and important treatments, school districts rarely can implement Tier III services (one-on-one individual treatment) despite it often being a favorable intervention, especially for youth with ADHD. Thus, creating group-based, autonomy supportive interventions will be impactful for all students using Tier I/Tier II frameworks and will be more likely to be more widely implemented in school districts even without significant behavioral health resources.

### *Future directions, limitations, and conclusions*

Strengths of this study include the longitudinal design, using self-report of motivation, and parent- and teacher-reported outcomes as well as objective

academic outcomes for reading, math, and GPA. To fully examine the SDT, however, further work needs to include basic psychological needs of autonomy, relatedness, and competence as mediators, examine outcomes outside of academic success (e.g., well-being, healthcare utilization; Morsink et al., 2021), and expand our definition and measurement of academic success.

There are limitations to the current study. Importantly, this study is not representative of students who attend school in under resourced school districts. Social determinants of health and well-being, such as being unhoused, discrimination in classrooms (e.g., racism), food insecurity, and safety in school affect youth motivation and academic success (Malone et al., 2022). Although not examined explicitly in this study, it can be assumed based on demographic characteristics of students in this study that most were not coping with these factors of oppression. Work in motivation, academic success, and school-based interventions need to prioritize youth that experience these life inequities to fully understand how to help youth across school districts. Research has shown that Tier 1 interventions that promote positive school racial climate and elements of culturally responsive practices improve well-being and academic outcomes for students that have identities that are systemically oppressed (Malone et al., 2022). This is aligned with autonomy support and improving basic psychological needs, that predict better student academic and well-being outcomes. Although it is a strength of our study that we include cross-rater measures and standardized testing, measures of academic success need to be broadened. As noted earlier, secondary education often focuses on reading comprehension and reading to learn, not accuracy, so including an objective measure of reading comprehension will be beneficial. Another way to broaden our definition and measurement of academic success is to include measures of critical thinking and other aspects of learning that are not focused on in the current study. Finally, it will be important to understand how aspects of mental health affect motivation, as mental health is heterogeneous and may impact motivation differently (e.g., some aspects of anxiety increase motivation, while others decrease it; Elmelid et al., 2015; Smith et al., 2019).

## Conclusions

In conclusion, this study used a longitudinal design to understand changes in motivation across an important developmental period, finding motivation decreases across the transition from middle school to high school for adolescents with and without ADHD. Multiple aspects of change in this motivation predicted academic success, suggesting areas of intervention to increase these academic outcomes. As suggested by Morsink et al. (2021), academic outcomes should not be the sole focus of research that examines academic motivation, so future work should include how well-being is affected by motivation as well as how basic psychological needs affect motivation.

## Acknowledgements

This research was supported by award number R305A160126 from the Institute of Education Sciences (IES), U.S. Department of Education. The authors have declared that they have no competing or potential conflicts of interest.

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### Key points

- Adolescents with and without ADHD report lower levels of academic motivation from 8th to 10th grade, though youth with ADHD still report lower levels of motivation than their peers.
- The change in motivation affects academic success for both adolescents with and without ADHD, however; adolescents with ADHD show more associations with motivation predicting homework performance, mathematics, and GPA.
- For both youth with and without ADHD, GPA was the most common academic outcome predicted, which may reflect that GPA is a culmination of learning activities, so multiple areas of motivation may be needed for a higher GPA.
- Extrinsic motivators like GPA may undermine the effectiveness of intrinsic motivation for typically developing youth.
- Interventions may benefit from including treatment that fosters autonomy growth like motivational interviewing.

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Accepted for publication: 22 March 2023