

Impact of Study Skills and Parent Education on First-Year GPA Among College Students With and Without ADHD: A Moderated Mediation Model

By: Matthew J. Gormley, Trevor Pinho, Brittany Pollack, Kristina Puzino, Melanie K. Franklin, Chelsea Busch, George J. DuPaul, Lisa L. Weyandt, [Arthur D. Anastopoulos](#)

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Abstract:

Objective: To test if the relationship between ADHD and academic achievement is mediated by service utilization and/or study skills, and if these mediation effects are moderated by parental education level. Method: A bootstrapping method within structural equation modeling was used with data from 355 first year college students meeting strict criteria for ADHD or clearly without ADHD to test the mediation and moderation effects. Results: Study skills, but not service utilization, significantly mediated the relationship between ADHD status and GPA; however, this relationship was not significant among students with at least one parent holding a master's degree or higher. Conclusion: Among first year college students study skills may be a more salient predictor of educational outcomes relative to ADHD status. Additional research into support services for college students with ADHD is needed, however, results suggest interventions targeting study skills may hold particular promise for these students.

Keywords: ADHD | college students | study skills | GPA

Article:

Across childhood and adolescence, individuals with ADHD experience behavioral, social, vocational, and academic difficulties (American Psychiatric Association [APA], 2013; DuPaul & Stoner, 2014). Recently, increasing evidence has suggested that these impairments continue beyond high school. Data from a longitudinal study demonstrated that only 73% of

adolescents with ADHD pursued post-high school education (including vocational school, junior/community college, and 4-year college), compared with 95% of high school graduates without ADHD (Kuriyan et al., 2013). That same study by Kuriyan and colleagues found that less than 30% of students with ADHD entered a 4-year institution after graduating high school, whereas 77% of control students pursued a 4-year college education. Among matriculated first-year students, 5% self-report a diagnosis of ADHD (Pryor et al., 2012).

When it comes to academic performance in college, students with ADHD often show deficits compared with students without ADHD. For example, Students with ADHD have a lower mean grade point average (GPA) than their peers without ADHD both in high school and in college, suggesting that the academic disadvantage exhibited by students with ADHD entering college continues to affect them throughout their college education (Advokat, Lane, & Luo, 2011). Students with ADHD struggle with adjustment in their first year of college, including self-reports of being more concerned about their academic performance, experiencing a greater degree of emotional distress, having more social concerns, having a lower degree of self-efficacy in making career decisions, and using more alcohol and marijuana than their peers without ADHD (Blase et al., 2009; Norwalk, Norvilitis, & MacLean, 2009; Weyandt et al., 2013). Although a portion of students with ADHD successfully complete high school and enter college, preliminary research suggests that these individuals continue to struggle with core ADHD symptoms such as poor organizational skills, difficulty with focusing on academic tasks, and forgetfulness (Lewandowski et al., 2008; Weyandt & DuPaul, 2013). The academic, social, and emotional adjustment difficulties experienced by college students with ADHD, in combination with a lack of adequate coping strategies to manage their symptoms, may present challenges for these individuals in college settings.

Most colleges offer academic support services to assist students with ADHD and other disabilities. Approximately 25% of the students who utilize disability support services are diagnosed with ADHD (Wolf, 2001). Although the specific types of services offered varies from one institution to another, the overall number and types of services available to students has increased over time (Newman et al., 2011). In general, students struggling academically and who access supports tend to have better academic outcomes than those who do not (Matthews, Croft, Lawson, & Waller, 2013). Services offered for students with ADHD might include extended time to complete tests or assignments, seating closer to the instructor, tutoring, or coaching for learning strategies and symptom management in academic settings, though the research regarding the effectiveness of each of those services is inconsistent (Clifton, 2007; Lee, Osborne, & Carpenter, 2010; Lovett, & Leja, 2015; Prevatt, Lampropoulos, Bowles, & Garrett, 2011; Wadley & Liljequist, 2013; Weyandt & DuPaul, 2013).

Despite the increasing availability of academic support services, the proportion of eligible students who actively use these services is relatively limited. Chew, Jensen, and Rosén (2009) found that 45% of students who qualified for accommodations actually utilized learning supports. Possible reasons for lack of engagement with services include students' resistance to receiving help, lack of awareness of services offered by the university, scheduling that conflicts

with the time support services offered, and feeling embarrassed about needing accommodations (Mac an Bhaird, Fitzmaurice, NiFhlonn, & O'Sullivan, 2013; Peck, Chilvers, & Lincoln, 2010). Although prior studies were not conducted solely with students with ADHD, the findings demonstrate some of the barriers to accessing disability accommodations in the university setting without adequate guidance.

Among college students, study skills predict academic outcomes including college completion (Robbins et al., 2004). Study skills deficits among children and adolescents with ADHD are well-documented (e.g., Langberg et al., 2010). Although the evidence assessing the study skills of college students with ADHD is relatively limited, several investigations suggest that group-based differences between students with and without ADHD persist into college. For example, Norwalk, Norvilitis, and MacLean (2009) assessed the relationship between ADHD symptoms and study skills in a non-clinical population of college students. Results demonstrated an inverse relationship between inattention and study skills—college students reporting higher levels of inattention reported poorer study skills, such as completing readings for class or choosing to study in a quiet area. Similarly, Reaser, Prevatt, Petscher, and Proctor (2007) used the Learning and Study Strategies Inventory, Second Edition (LASSI; Weinstein & Palmer, 2002) to compare college students with and without ADHD. Students with ADHD had higher levels of test anxiety, but lower levels of motivation, concentration, information processing, self-testing, selecting main ideas, test strategies, and time management as compared with students without ADHD.

Information regarding differences in study skills and service utilization may allow for the identification of students at greatest risk of academic failure and suggest avenues for promoting college success. Among younger students, for example, children of more educated parents are more likely to develop adaptive academic skills and are more likely to use services (Burchinal, Peisner-Feinberg, Pianta, & Howes, 2002; Zahner & Daskalakis, 1997). Although the empirical evidence is limited, there is reason to suspect that these differences will persist into college. Specifically, children of parents with more years of education may be raised with a greater emphasis on academics, and may also be more adept at navigating and accessing the various resources available on college campuses due to their parents' familiarity with these settings. Particularly as applied to students with ADHD, there are socio-demographic differences in the likelihood that students will access different resources: For example, whereas students with ADHD from the poorest 20% of the population are more than twice as likely to meet criteria for ADHD, they are only one third as likely to use medication for ADHD as compared with their wealthy counterparts (Froehlich et al., 2007).

Understanding factors potentially explaining academic differences among college students with and without ADHD is important to better understand how colleges might provide high-quality, campus-based services to minimize these differences, and also in ensuring that students who most need these services have adequate access to these services. The present study seeks to address the aforementioned gaps in the current literature and examine the relationship

between ADHD and academic outcomes, as well as other variables that affect that relationship. To this end, the following research questions were examined:

Research Question 1: Do college students with ADHD differ with respect to academic achievement from college students without ADHD?

Hypothesis 1: Students with ADHD would have lower academic achievement, as measured by GPA relative to college students without ADHD.

Research Question 2: Is the relationship between ADHD group status and achievement mediated by the study skills the students possess and the campus-based academic and mental health services they use?

Hypothesis 2: Both study skills and service use would mediate the relationship between group status and academic achievement.

Research Question 3: Does the relationships among ADHD group status, study skills, service use, and achievement differ as a function of the level of education obtained by a student's parents?

Hypothesis 3: Parental education was hypothesized to moderate the relationship between study skills, service use, and academic achievement.

Method

Participant Recruitment

Participants were recruited as part of the Trajectories Related to ADHD in College (TRAC) project, a longitudinal study examining trajectories of functioning of college students with and without ADHD. A total of 527 students from nine colleges and universities in North Carolina, Pennsylvania, and Rhode Island were screened for the larger TRAC study. Participants were recruited through direct mailing to campus mail boxes; public postings in dining halls, counseling centers, and academic support centers; referrals from the offices of disability services; and electronic postings on listservs and campus Facebook groups. Interested students took part in a screening meeting with a research assistant to determine eligibility. Those who clearly met diagnostic criteria (described below) for either the ADHD group or the non-ADHD comparison group were considered eligible for the study and agreed to complete yearly assessments across 4 years. The final sample of the TRAC project consisted of 456 students (51.8% female, 67.5% non-Hispanic Caucasian; see Anastopoulos et al., 2015, for a full description of the sample and procedures).

Group Designation

Group status was initially determined by a multi-gating, multimodal assessment. Participants first completed childhood and past 6 months versions of the ADHD Rating Scale, which were modeled after the childhood ADHD Rating Scale (DuPaul, Power, Anastopoulos, & Reid, 1998)

and which also addressed whether or not participants were taking medication during the time frame of their ratings. With student consent, parents completed a similar version of these rating scales. At the first level of screening, eligibility for the ADHD group required an endorsement (by participants or their parents) of four or more symptoms of either hyperactivity-impulsivity or inattention both in childhood (prior to age 12) and in the past 6 months. Participants in the comparison group had three or fewer symptoms of hyperactivity-impulsivity or inattention in childhood or in the past 6 months.

At the second level of eligibility screening, participants completed a semi-structured ADHD interview, which was developed from the Diagnostic and Statistical Manual of Mental Disorders (4th ed., text rev.; DSM-IV-TR; APA, 2000) criteria for adult ADHD for use in this study and adapted to meet the Diagnostic and Statistical Manual of Mental Disorders (5th ed.; DSM-5; APA, 2013) criteria following its introduction. The interview assessed for symptom presentation and level of impairment, separately for the hyperactivity-impulsivity and inattention symptom clusters. Criteria for the ADHD group required an endorsement of six or more symptoms of hyperactivity-impulsivity and/or inattention that were present prior to the age of 12. Individuals in the comparison group could have no more than three symptoms of hyperactivity-impulsivity and/or inattention to qualify for eligibility for the study.

Participants also completed the Structured Clinical Interview for DSM Disorders (SCID-I; First, Gibbon, Spitzer, & Williams, 2002), which addressed the exclusionary criteria for a diagnosis of ADHD (i.e., inattention symptoms not better explained by another disorder). Once information was collected, all potentially eligible cases were then reviewed by a panel of four ADHD experts (i.e., the three primary investigators and a nationally recognized adult ADHD expert). Final determination of group status and comorbidity diagnoses required unanimous panel agreement. Students who did not clearly meet research criteria for the ADHD or comparison group were excluded from the study.

In sum, to be included in the comparison group, participants and their parents could endorse no more than three symptoms of ADHD on the retrospective childhood ratings scale and the current (6-month) rating scale. Similarly, participants could endorse no more than three symptoms of ADHD on the semi-structured interview. Students rated as having four symptoms on the semi-structured interview were excluded from the project to avoid the inclusion of students with subclinical ADHD and to ensure adequate differentiation between the two groups of interest.

Participant Description

Participants in the present study are a subsample of the larger TRAC project for whom educational data were available. This subsample consisted of 355 college students (51.1% female) who were recruited in their first year of college across the first 2 years of the TRAC project. All students were either 18 or 19 years old at time of recruitment ($M = 18.23$ years; $SD = 0.512$). By design, approximately half of the sample met criteria for the ADHD group (49.2%).

In addition, 55% of students with ADHD met criteria for at least one non-ADHD diagnosis relative to 11.2% of the comparison group. With respect to race, 70.6% of the sample identified as Caucasian, 13.3% identified as African American, 5.4% identified as Asian, 3.4% identified as more than 1 race, and 7.3% identified as belonging to another race. In addition, 9.6% of the current sample self-identified their ethnicity as Hispanic/Latino. Mean full scale IQ (FSIQ) score as assessed by the Wechsler Abbreviated Scale of Intelligence for this sample was 109.74 (SD = 12.04). Finally with regard to socio-economic status (SES), mean parent occupational prestige scores were 77.75 (SD = 19.46) on a scale of 100 (see Table 1).

Table 1. Demographic Variables and Comparisons.

	Current sample (N = 355)	Excluded cases (n = 101)	χ^2 or t	p
Gender (% female)	50.84	54.90	0.521	.470
Minority status (% minority)	31.64	32.35	0.019	.891
Age (years)	18.23	18.24	-0.110	.912
IQ	109.74	115.67	-3.695	<.001
SES (prestige score)	77.75	78.06	-0.134	.894
Group status (% ADHD)	49.15	52.94	0.455	.500
IA symptoms (#)	3.39	3.48	-0.253	.798
Hyperactivity symptoms (#)	2.30	2.77	-1.574	.116
CAARS DSM-IV: IA (T score)	63.02	63.80	-0.354	.723
CAARS DSM-IV: HI (T score)	51.82	53.09	0.075	.486
First-year cumulative GPA	3.01	2.96	.294	.769
Highest parent education	2.21	2.44	-2.698	.007

Note. SES = socio-economic status; CAARS = Conners' Adult ADHD Rating Scale; DSM-IV = Diagnostic and Statistical Manual of Mental Disorders (4th ed.; DSM-IV; American Psychiatric Association, 1994); IA = inattention; HI = hyperactivity-impulsivity; GPA = grade point average.

Screening Measures

Demographic data and family history. Students completed a demographic form to indicate their gender, age, race, and ethnicity. In addition, students were asked to self-report their family composition (i.e., number of siblings, parent's marital status, parental educational level, and parental occupation). For the current study, parent occupations were scored according to the Nam-Powers-Boyd occupational scores from the 2000 census (Nam & Boyd, 2004). This scale combines educational and occupational data to compute a single score ranging from 1 to 100. For the present study, the highest score from each student's family history was used as an indicator of SES.

ADHD Rating Scales (Parent Version, Childhood Version, and Past 6 Months). The ADHD Rating Scales include the validated ADHD Rating Scale-IV-Parent Version (DuPaul et al., 1998) as well as two other scales modeled after the ADHD Rating Scale-IV-Parent Version to capture self-report of both childhood and current ADHD symptom presentation. Each scale is an 18-item

questionnaire in which items describing inattention and hyperactive/impulsive symptoms, adapted directly from the DSM-IV ADHD symptom list, were presented alternately (i.e., with inattention symptoms as the odd-numbered items and hyperactive/impulsive symptoms as the even-numbered items). Individuals rate each item on a 4-point Likert-type scale ranging from 0 (never or rarely) to 3 (very often). The total scores on the ADHD Rating Scales were included in data analyses.

The ADHD Rating Scale–Childhood Version. This version asks participants to respond based on their symptom presentation as children (i.e., prior to age 12) and asks about behaviors both while on medication (if applicable) and off. Coefficient alphas based on the sample in the present study ranged from .78 (inattention while on medication) to .94 (inattention off medication). Correlations between hyperactivity-impulsivity ratings and the hyperactivity-impulsivity subscale of the Conners' Adult ADHD Rating Scale (CAARS) were .68 (on medication) and .86 (off medication) while correlations between inattention symptom ratings and CAARS inattention subscale scores were .45 (on medication) and .89 (off medication).

The ADHD Rating Scale–Past 6 Months. This version asks participants to respond based on their current symptom presentation (i.e., within the past 6 months) and asks about behaviors while on medication (if applicable) and off. Coefficient alphas based on the sample in the current study ranged from .75 (hyperactivity-impulsivity while on medication) to .94 (inattention off medication). Correlations between hyperactivity-impulsivity ratings and the hyperactivity-impulsivity subscale of the CAARS were .58 (on medication) and .92 (off medication), while correlations between inattention symptom ratings and CAARS inattention subscale scores were .27 (on medication) and .90 (off medication).

The ADHD Rating Scale-IV–Parent Version. This version asks parents to respond to items about their child's ADHD in childhood (i.e., between the ages of 5 and 12) and currently (i.e., within the past 6 months). If their child previously received or currently takes ADHD medication, the parent is asked to respond for their child's behaviors off medication. Coefficient alphas for childhood ratings based on the sample in the current study were .92 (hyperactivity-impulsivity) and .96 (inattention). The correlation between hyperactivity-impulsivity rating and the hyperactivity-impulsivity subscale of the CAARS was .49 and .61 for inattention symptom rating and the CAARS inattention subscale score. Coefficient alphas for current symptom ratings were .89 (hyperactivity-impulsivity) and .94 (inattention). The correlation between hyperactivity-impulsivity rating and the hyperactivity-impulsivity subscale of the CAARS was .50 and .58 for inattention symptom rating and the CAARS inattention subscale score.

Semi-Structured ADHD Interview. The Semi-Structured Interview for Adult ADHD is a clinical interview created for the present study and was used in conjunction with the ADHD Rating Scales to confirm group designation. The interview questions were based on the DSM-IV criteria

for identifying adults with ADHD. The semi-structured interview was completed by research assistants and includes 18 total questions: 9 questions asking about the individual's inattentive behavioral experiences and 9 questions asking about hyperactive/impulsive behavioral experiences. Each question can be answered with a "yes" or a "no" with follow-up questions to determine whether a given symptom is pervasive across multiple domains in the individual's life and impairs academic, social, and/or occupational functioning. The Semi-Structured Interview for Adult ADHD was used to confirm diagnostic status and assess level of impairment. Internal consistency for symptom responses was .90 for inattention and .85 for hyperactivity-impulsivity. Correlations between symptom responses and CAARS scores were .78 (inattention) and .84 (hyperactivity-impulsivity).

CAARS. The CAARS–Self-Report Long Form (CAARSS:L) is a highly valid and reliable self-report scale that measures the presence and severity of ADHD symptoms (Conners, Erdhardt, & Sparrow, 1999; Erhardt, Epstein, Conners, Parker, & Sitarenios, 1999). The CAARS-S:L is a 66-item self-report questionnaire in which respondents rate items pertaining to their behavior experiences using a 4-point Likert-type scale for each item. The responses range from 0 (not at all, never) to 3 (very much, very frequently). The CAARS-S:L has a diagnostic sensitivity of 82%, specificity of 87%, and an overall diagnostic efficiency rate of 85%. The separate symptom severity scores are divided into three groups—inattention/memory problems, hyperactivity/restlessness, and impulsivity/emotional lability. For the present study, the DSM-IV: IA (inattention) and DSM-IV: HI (hyperactivity-impulsivity) T scores are reported to provide a norm-referenced criterion of ADHD symptomology.

SCID-I. The SCID-I (First et al., 2002) is a diagnostic semistructured interview used to evaluate the presence of Axis I and Axis II disorder symptoms. It was also used in this study to ensure that ADHD symptoms are not better accounted for by another disorder. The SCID-I comprises several modules including Mood Episodes, Psychotic and Associated Symptoms, Psychotic Disorders, Mood Disorders, Substance Use Disorders, Anxiety Disorders, Somatoform Disorders, Eating Disorders, Adjustment Disorder, and an Optional Module. For this present study, only the Mood Episodes, Mood Disorders, Anxiety Disorders, Somatoform Disorders, and Eating Disorders modules were used. The SCID-I has moderate test–retest reliability ranging from .35 to .78 and good inter-rater reliability ranging from .57 to 1.0 (Lobbestael, Leurgans, & Arntz, 2011; Zanarini et al., 2000). It has also been considered the "gold standard" clinically for accurate clinical diagnoses (Shear et al., 2000; Steiner, Tebes, Sledge, & Walker, 1995).

Dependent Measures

First-year GPA. With the fully informed consent of the participants, first-year cumulative GPA was primarily collected using archival information from the colleges' Registrar offices ($n = 341$). When archival information was not available (e.g., college policy prohibiting the release of

academic records), GPA data were collected using student self-report ($n = 13$). GPAs were reported on a 4-point scale ranging from 0.0 to 4.0.

LASSI–Second Edition. The LASSI is a self-report measure of “students’ awareness about and use of learning and study strategies related to skill, will, and self-regulation components of strategic learning” (Weinstein & Palmer, 2002, p. 4). The LASSI comprises 80 items that make up 10 scales; Anxiety, Attitude, Concentration, Information Processing, Motivation, Selecting Main Ideas, Self-Testing, Study Aids, Test Strategies, and Time Management. Each item is rated on a 5-point Likert-type scale (a = not at all typical of me, e = very typical of me). The 10 scales yield scores between 8 and 40 that can be converted into nationally normed percentile scores. The LASSI has adequate internal consistency and reliability (Cano, 2006; Weinstein & Palmer, 2002). For the present study, all 10 subscale scores were used as observed components of the latent study skills variable.

Service use (frequency). College service use was captured through a self-report measure, the Services for College Interview–College Version (SCSI). This interview was developed for use in the present study to collect data on service use in college. Services included on the measure were campus tutoring, academic skills assistance, writing/speaking assistance, career counseling, and disability services. The measure asked participants to report their frequency of use (i.e., 1-2 times, 3-4 times, 5-9 times, 10 or more times), if they are still currently using the service, and how helpful they believe the specific service type to be. For the present study, the student’s report of frequency for each service type was used as the observed components of the service use latent variable.

Parent education. Parent educational data were collected through self-report interview questions. All participants were asked “what is your mother’s educational level” and “what is your father’s educational level?” Answers were classified into one of three categories: no college degree (some high school, completed high school, some college), college degree (associates degree, bachelor’s degree), or master’s or higher (master’s, MD/PhD/JD/etc.) The highest reported level of parental education (for either parent) was used for analysis in this study.

Procedure

All procedures were approved by the institutional review board (IRB) at the participating university sites. During Stages 1 through 3 of the study, participants met with research assistants trained as clinical or school psychologists to complete several assessments. All meetings were held during the student’s first year of enrollment in college. For each year of participation, individuals were given a report of their functioning and a stipend of up to US\$100 based on number of stages completed.

At the first meeting (Stage 1), participants provided demographic information (e.g., gender, age, parent education level) and completed the childhood and past 6-month versions of

the ADHD Rating Scale. In addition, participants completed the CAARS and the Semi-Structured Interview of Adult ADHD. Following the meeting the ADHD Rating Scale-IV, Parent Version was sent to the participant's parents. Results from this assessment were used by the expert panel to determine eligibility and group membership. Eligible participants completed another set of assessments in a subsequent meeting, including computerized ADHD testing, additional rating scales regarding psychological disorders (e.g., depression), and a SCID. Following Stage 2, participants met with a different graduate assistant, who was blind to the student's group status. During this stage, participants responded to interview questions about social and vocational functioning, in addition to their use of campus support and other treatment services (e.g., campus tutoring, formal disability support services, medication use). In this same meeting, they completed intelligence and educational achievement testing.

Data Analytic Plan

Demographic characteristics and group comparisons were conducted using SPSS (version 21; IBM, 2012). In addition, although not a prerequisite for the bootstrapping method (Hayes, 2009), an ANOVA was conducted in SPSS to ensure a significant relationship between group status and first-year GPA. This analysis was conducted prior to the primary analysis because the theoretical model would not allow for the estimation of the direct effect of group on GPA. All structural equation modeling (SEM) analyses were conducted using Amos (version 22; Arbuckle, 2006). The bootstrapping method provides greater power for the detection of mediated effects and allows for the quantification of the actual indirect effect relative to a reliance on logical inference (Hayes, 2009). Furthermore, this method has appeal for moderated mediation because these indirect effects are calculated for all levels of a given moderator (see Figure 1).

To evaluate the model fit, three fit indices were chosen: the Tucker-Lewis Index (TLI; Tucker & Lewis, 1973), the comparative fit index (CFI; Bentler, 1990), and the root mean square error of approximation (RMSEA; Steiger, 1990). For TLI and CFI, a value of $\geq .95$ indicates a good fit (Hooper, Coughlan, & Mullen, 2008), with values $\geq .90$ and $\leq .949$ considered acceptable (Hu & Bentler, 1999). For RMSEA, a value $\leq .05$ was considered good and values $\geq .06$ and $\leq .08$ were considered acceptable (Hu & Bentler, 1999). In addition, to evaluate the model, regression weights of the items to the latent variable were assessed for statistical significance.

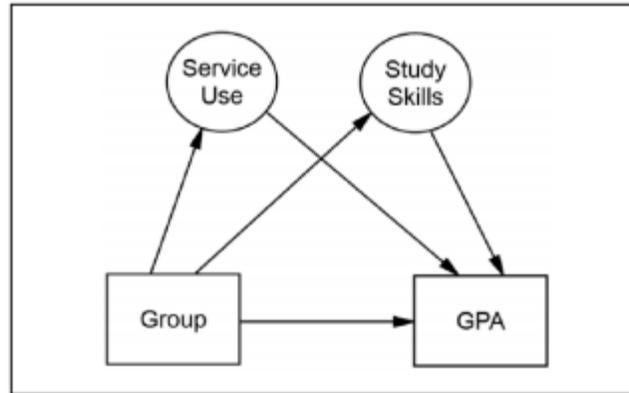


Figure 1. Full conceptual mediation model originally hypothesized.

Note. Rectangles represent observed (measured) variables. Circles represent latent variables.

GPA = grade point average

Results

First, the demographic variables of the current sample were compared with those cases excluded from the current analyses due to missing data (see Table 1). Results indicated that the excluded cases did not differ with respect to gender, minority status, age, number of inattention and hyperactivity-impulsivity symptoms, and first-year GPA. However, significant differences were found with respect to parent's education level ($p = .01$) and FSIQ ($p < .001$). Next, the demographic data for each level of parent education were compared (see Table 2). Groups did not differ in gender, age, and inattention or hyperactivity-impulsivity symptoms. There were significant differences between groups on minority status such that percentage of minority students declines as parent education increases. Groups also differed with respect to IQ such that IQ scores increased as parent education increased. Therefore, both minority status and IQ were included in the model as covariates. In addition, groups differed on ADHD status with the highest percentages of ADHD being among parents with a master's degree or higher and the lowest percentage among parents with a college degree. The groups also differed with regard to first-year cumulative GPA and FSIQ with both variables increasing as parent education increases. Finally, results of the ANOVA to test diagnostic status differences indicated that students in the comparison group ($M = 3.15$, $SD = .72$) had higher GPAs relative to students in the ADHD group ($M = 2.84$, $SD = .78$) and this difference was statistically significant, $F(1, 358) = 14.927$, $p < .001$, $\eta^2_p = .40$.

To test the hypothesis that parental education moderated the mediation effects of service use and study skills on relationship between group status and first-year GPA, a SEM of the full model was attempted; however, results indicated the model was unidentified. Examination of the regression weights indicated that ADHD status was not a significant predictor of service use, and service use was not a

significant predictor of GPA. Therefore, service use was removed from the model. A post hoc test of service use indicated poor model fit (TLI = .361, CFI = .604, RMSEA = .103) and no evidence of mediation (Group \geq GPA remained significant ($p = .669$) and group to service use ($p = .210$) and service use to GPA ($p = .669$) were both non-significant). Therefore, the remaining analyses included only study skills as a mediator between group and GPA with parent educational level serving as a moderator.

Initial model fit was not acceptable and therefore modification indices were examined to increase fit (Browne & Cudeck, 1993; see Table 3). The majority of modification suggestions dealt with correlating the measurement error terms for the LASSI subscale scores. Therefore, the first set of modifications consisted of covarying these residuals contingent on a modification index of 10 or higher. These modifications resulted in improved fit to an acceptable level for RMSEA and CFI; however, TLI failed to indicate an acceptable fit. Additional modifications correlating the LASSI subscale residuals were implemented as indicated by Amos resulting in a good (RMSEA = .50) or acceptable (TLI = .910, CFI = .948) fit (see Table 3). The final model with all modifications is presented in Figure 2. Results of the measurement model are presented in Table 4.

Table 2. Demographic Variables and Comparisons by Parent Education Level.

	No degree (n = 64)	College degree (n = 153)	MA+ (n = 138)	χ^2 or F	p
Gender (% female)	57.14	51.63	46.76	1.81	.404
Minority status (% minority)	50.80	32.03	22.30	16.32	<.001
Age (years)	18.27	18.20	18.24	0.43	.651
IQ	105.91	108.81	112.51	7.59	<.001
SES (prestige score)	77.36	80.23	75.24	2.32	.100
Group status (% ADHD)	49.21	41.83	57.55	6.90	.032
IA symptoms (#)	3.00	3.54	3.39	0.64	.528
Hyperactivity symptoms (#)	2.03	2.36	2.34	0.38	.681
CAARS DSM-IV: IA (T score)	60.75	64.99	61.88	1.44	.238
CAARS DSM-IV: HI (T score)	50.91	53.40	50.49	1.323	.268
First-year cumulative GPA	2.81	2.99	3.12	3.73	.025

Note. SES = socio-economic status; CAARS = Conners' Adult ADHD Rating Scale; DSM-IV = Diagnostic and Statistical Manual of Mental Disorders (4th ed.; DSM-IV; American Psychiatric Association, 1994); IA = inattention; HI = hyperactivity-impulsivity; GPA = grade point average.

Table 3. Fit Statistics for Each Model.

Model	χ^2	TLI	CFI	RMSEA
Three group	700.495 ($p < .001$)	.747	.797	.099
Mods (10+)	283.935 ($p < .001$)	.884	.935	.067
Mods (remaining)	199.960 ($p < .001$)	.910	.948	.050

Note. For TLI and CFI, a good fit is $\geq .95$, acceptable fit is $\geq .90$ and $\leq .949$. For RMSEA, good fit is $\leq .06$ and acceptable fit is $\geq .061$ and $\leq .80$. TLI = Tucker–Lewis index; CFI = comparative index; RMSEA = root mean square error of approximation.

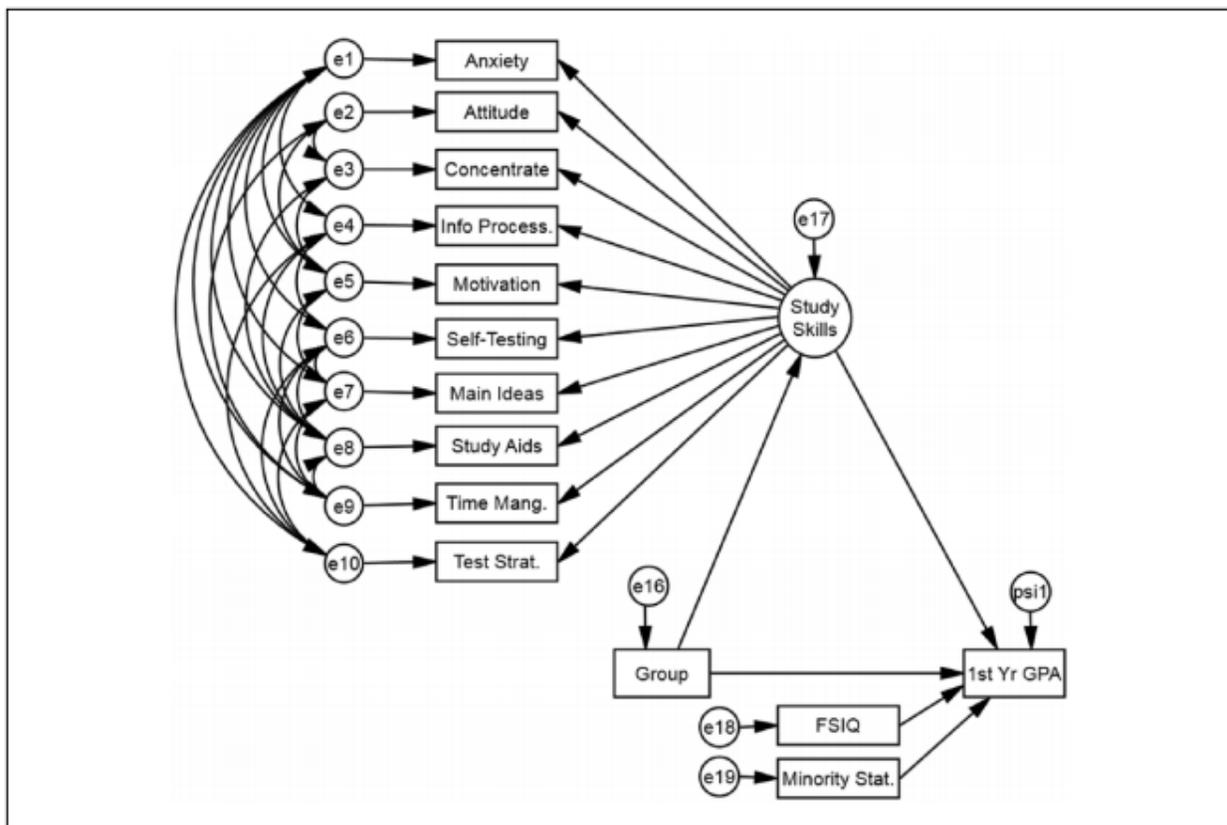


Figure 2. Final model with all modifications included.

Note. Rectangles represent observed (measured) variables. Circles represent latent variables. Info Process. = Information Processing; Minority stat. = minority status; time management; test strat. = test strategies; FSIQ = full scale IQ; GPA = grade point average

Given the acceptable level of fit, the output was examined for estimates of regression weights in addition to the direct and indirect effects of Group and Study Skills (see Table 5). Among students of parents with no college degree, group status ($p = .273$), minority status ($p = .848$), and FSIQ ($p = .994$) were not significant predictors of GPA. Conversely, group status did

significantly predict study skills, such that comparison student's study skills value was 1.9 points higher relative to students in the ADHD group ($p < .001$). Similarly, results indicated that each increase in a student's study skills value was associated with a 0.43 increase in their GPA and this was statistically significant ($p < .001$).

Among students whose parents had a college degree, group status ($p = .269$) and minority status ($p = .240$) again did not significantly predict GPA. Alternatively, being in the comparison group was associated with a 1.54-point increase in study skills ($p < .001$). In addition, for every 1-point increase in FSIQ, GPA increased by 0.01 points ($p = .04$). Results indicated that for every unit increase in study skills, GPA increased by .22 points and this effect was statistically significant ($p < .001$).

Finally, among students with a parent who has a master's degree or higher, group status ($p = .111$), minority status ($p = .972$), and FSIQ ($p = .077$) were not associated with GPA. Similar to the other levels of parent education, group status was significantly associated with study skills such that students in the comparison group had study skills scores that were 1.95 points higher relative to students in the ADHD group ($p < .001$). Unlike the other two levels of parental education, the study skills of students with parents holding a master's degree or higher was not significantly related to first-year GPA ($p = .260$).

Results of the moderated mediation analysis are presented in Table 6. Among students whose parents had an education level less than a college degree, the direct effect of study skills on GPA was significant ($p = .001$, 95% confidence interval [CI] = [.235, .660]). The direct effect of group status on study skills was also significant ($p = .001$, 95% CI = [1.204, 2.666]). The direct effect of group status on GPA was non-significant ($p = .316$); however, the indirect effect of group on first-year GPA was significant ($p = .001$, 95% CI = [.399, 1.350]) suggesting that the relationship between group and GPA is significantly mediated by study skills for this group of students.

Similarly, among students with at least one parent having a college degree, the direct effect of study skills on GPA was significant ($p = .001$, 95% CI = [.102, .334]). The direct effect of group status on study skills was also significant ($p < .001$, 95% CI = [1.111, 2.006]). The direct effect of FSIQ on GPA approached significance ($p < .052$, 95% CI = [.000, .017]). The direct effect of group status on GPA was non-significant ($p = .287$), and the indirect effect of group on first-year GPA was significant ($p = .001$, 95% CI = [.150, .526]), again indicating that the relationship between group and GPA is significantly mediated by study skills for this group of students.

Finally, among first-year students with at least one parent holding a master's degree or higher, only the direct effect of group status on study skills was significant ($p = .001$, 95% CI = [1.477, 2.394]). The direct effects of study skills on GPA ($p = .301$) and group status on GPA ($p = .132$) were both non-significant. In addition, the indirect effect of group status on GPA was non-significant ($p = .324$) indicating no mediation effect for study skills.

Table 4. Unstandardized Regression Weights, Standard Errors, CR, and p Values of the Measurement Model.

	Estimate	SE	CR	p
No college degree				
Test strategies	20.47	2.60	7.87	<.001
Time management	19.12	2.35	8.13	<.001
Study aids	9.66	2.65	3.65	<.001
Select main ideas	20.30	2.31	8.80	<.001
Self-testing	14.08	2.65	5.31	<.001
Motivation	21.29	2.59	8.23	<.001
Information processing	13.66	2.24	6.09	<.001
Concentration	21.76	2.29	9.52	<.001
Attitude	15.01	2.14	7.01	<.001
Anxiety	12.17	2.95	4.13	<.001
College degree				
Test strategies	21.49	1.74	12.35	<.001
Time management	19.90	1.69	11.75	<.001
Study aids	7.78	2.01	3.88	<.001
Select main ideas	18.03	1.70	10.63	<.001
Self-testing	13.29	1.81	7.33	<.001
Motivation	21.51	1.85	11.63	<.001
Information processing	11.44	1.78	6.45	<.001
Concentration	23.47	1.73	13.57	<.001
Attitude	18.71	1.80	10.37	<.001
Anxiety	15.76	1.85	8.51	<.001
Master's or higher				
Test strategies	18.02	1.58	11.41	<.001
Time management	16.42	1.65	9.95	<.001
Study aids	7.10	1.94	3.65	<.001
Select main ideas	17.77	1.75	10.17	<.001
Self-testing	12.70	1.71	7.43	<.001
Motivation	17.62	1.84	9.59	<.001
Information processing	9.99	1.77	5.66	<.001
Concentration	22.03	1.63	13.55	<.001
Attitude	14.92	1.73	8.64	<.001
Anxiety	14.28	1.73	8.26	<.001

Note. CR = critical ratio

Discussion

This study aimed to expand the existing literature focusing on the relationship between ADHD and academic outcomes in college, as well as other variables that affect that relationship. Consistent with our initial hypotheses we found that (a) students with ADHD obtain lower first-year GPAs relative to students without ADHD, (b) students with ADHD also have lower self-rated study skills relative to students without ADHD, (c) parent educational level moderated the impact of study skills on first-year GPA, (d) parent educational level moderated the impact of group status on first-year GPA, and (e) study skills significantly mediated the relationship between ADHD status and GPA, and this effect was moderated by parent educational level.

Table 5. Unstandardized Regression Weights, Standard Errors, CR, and p Values of the Structural Model

	Estimate	SE	CR	p
No college degree				
Group → GPA	-0.29	0.26	-1.10	.273
Group → Study skills	1.90	0.31	6.08	<.001
Study skills → GPA	0.43	0.10	4.21	<.001
Minority status → GPA	0.04	0.19	0.19	.848
FSIQ → GPA	0.00	0.01	-0.01	.994
College degree				
Group → GPA	-0.15	0.13	-1.11	.269
Group → Study skills	1.54	0.20	7.89	<.001
Study skills → GPA	0.22	0.05	3.98	<.001
Minority status → GPA	-0.13	0.11	-1.17	.240
FSIQ → GPA	0.01	0.01	2.05	.040
Master's or higher				
Group → GPA	0.27	0.18	1.59	.111
Group → Study skills	1.95	0.22	8.85	<.001
Study skills → GPA	0.07	0.06	1.13	.260
Minority status → GPA	-0.01	0.15	-0.04	.972
FSIQ → GPA	0.01	0.01	1.77	.077

Note. CR = critical ratio; GPA = grade point average; FSIQ = full scale IQ

Table 6. Bias-Corrected Lower and Upper Bounds, and p Values for the Direct and Indirect Effects.

	Lower bound (95%)			Upper bound (95%)			Two-tailed p value		
	Study skills	FSIQ	Group	Study skills	FSIQ	Group	Study skills	FSIQ	Group
Above college degree									
Direct									
GPA	.235	-.020	-0.864	.660	.021	0.275	.001	1.00	.316
Study skills			1.204			2.666			.001
Indirect									
GPA			0.399			1.350			.001
College degree									
Direct									
GPA	.102	.000	-0.420	.334	.017	0.124	.001	.052	.287
Study skills			1.111			2.006			<.001
Indirect									
GPA			.150			0.526			.001
Master's or higher									
Direct									
GPA	-.065	-.002	-0.089	.214	.020	0.636	.301	.098	.132
Study skills			1.477			2.394			.001
Indirect									
GPA			-0.141			0.412			.324

Note. FSIQ = full scale IQ; GPA = grade point average

Previous research suggests that college students with ADHD obtain lower GPAs relative to those without ADHD (Advokat et al., 2011). The present study replicated these findings among a first-year sample, such that students with ADHD were found to have lower GPAs relative to students without ADHD. In addition, past research has found students with ADHD have inferior study skills relative to their non-ADHD peers. For example, Robbins and colleagues (2004) reported that students with ADHD typically have higher levels of test anxiety, but lower levels of motivation, concentration, information processing, self-testing, selecting main ideas, test strategies, and time management as compared with students without ADHD. The present study created a single latent study skills variable and therefore cannot shed light on differences for specific components of study skills; however, the results are similar in that students with ADHD had lower general study skill scores relative to their peers without ADHD.

Importantly, the present study also identified parent educational level as a moderating variable on the effects of ADHD status and study skills on GPA. Specifically, among students whose parents had less than a master's degree, ADHD group status was indirectly and significantly related to GPA via study skills. Alternatively, among students with a parent holding a master's degree or higher, ADHD status was not associated with GPA when accounting for the effect of study skills. These results suggest that having a parent with a master's degree or higher may counter the impact of ADHD status on first-year GPA. Specifically, it is possible that the academic benefit of high parent education found in previous research (e.g., Allen, 1999) compensates for the negative impact of ADHD symptomology on academic performance in college (Weyandt, & DuPaul, 2013). In similar fashion, the level of study skills was not related to first-year GPA for students with parents holding a master's degree or higher. It is possible that the non-significant findings are due to a ceiling effect in GPA; however, strong conclusions cannot be made based on the present analysis. It is likely that the non-significant relationship between study skills and GPA at this level partially explains the non-significant indirect effect of group status on GPA.

Finally, the present study is the first to report that the relationship between ADHD status and first-year GPA is mediated by study skills. Furthermore, this mediation is moderated by parent educational status even when controlling for the potentially confounding factors of minority status and FSIQ. Specifically, results indicated that when study skills are included as a mediator, the direct relationship between group status and GPA becomes non-significant. This finding is favorable because study skills are theoretically malleable compared with one's ADHD status. Moreover, it seems that improving and adapting study skills would have positive influences on students' level of academic success in college, particularly among students whose parents have a less than a master's degree.

The findings also revealed a significant impact of FSIQ on GPA in the initial regression analysis among students with at least one parent holding a college degree, but not for students without any college degree, or a master's degree or higher. This effect was no longer significant using the bias-corrected bootstrapping model; however, it was only slightly outside traditional significance levels suggesting it may still be an important variable to consider. It is unclear why

FSIQ would differentially predict GPA based upon parent educational level. It is possible that the large impact of FSIQ on GPA is masked by other variables included in the present model (e.g., study skills) explaining a lack of significance in the other groups.

Contrary to our initial hypothesis regarding mediators between ADHD status and first-year GPA, service use was not a significant mediator for our sample. There are several possible reasons for this finding. First, because data were obtained from first-year students, it is possible that students did not have an opportunity to use university services to an extent that would impact on GPA. Stated differently, the level or degree of support services may have been too low to have an effect on academic outcomes at the time when data were collected. This is particularly plausible given the relatively high self-reported helpfulness of services by students. Across all service types, 88% of students reported services were at least “moderately helpful” and 57% of students suggested services were “very helpful.” Given the high helpfulness ratings and relatively brief period of time for which services could impact academic outcomes, longitudinal studies of service use over time may yield a greater association with GPA. Second, students with ADHD may underutilize available services (Chew et al., 2009) and this could lessen the impact of service use as a mediator between ADHD status and GPA. There are several reasons why college students and, in particular, college students with disabilities may not access campus services, including perceived stigma of doing so, a desire to be self-sufficient, insufficient knowledge about services, or perception of services as ineffective (Marshak, Van Wieren, Ferrell, Swiss, & Dugan, 2010). These problems may be compounded for college students with disabilities who seek to access services through offices for disability services, as these services typically require students to complete a costly and time-consuming independent psychological evaluation (Thomas, 2000). Finally, it is possible that ADHD status and service use are independent predictors of GPA and are not related to each other. Again, tracking these data over time would be an optimal method to explicate the relationships among ADHD status, service use, and academic outcomes.

The findings from the present study should be interpreted in light of its limitations. The cross-sectional data used in this study preclude causal attributions for the relationships described, and future longitudinal research is suggested to explore possible causal relationships. Second, modification indices were required to achieve acceptable model fit; however, all of the modifications were correlations between the error terms between the LASSI subscales. Given the correlations among the LASSI subscales (Weinstein & Palmer, 2002), it is reasonable that the residuals associated with each subscale of this measure would covary. A third limitation of the present study is the use of the bootstrapping method to estimate indirect effects. Specifically, this method cannot accommodate missing data, and therefore approximately 22% of our total sample was excluded due to incomplete data. Furthermore, participants excluded from the current analysis were found to have significantly higher IQ scores and to have parents with significantly higher levels of education relative to participants included in this study. It is unclear in what ways these differences are meaningful given that both groups were equivalent in terms of other demographic characteristics, ADHD symptomology, and academic performance. Nevertheless, it

is possible that students excluded from the present analysis represent a clinically meaningful group. Fourth, both study skills and service use were measured using self-report only and, thus, correlations could be affected by shared method and source variance.

Fifth, the present study focused on more traditional forms of services (e.g., academic tutoring) and did not ask students specifically about their engagement with coaching. It is important to note, however, that many of the services typically associated with coaching (e.g., time management, organization) were included in the “Academic Skills Assistance” variable for the present study. Although this variable fails to capture the entirety of ADHD coaching interventions, the results of the present study may have implications for coaching services at the college level. Sixth, the current analysis did not control for the influence of pharmacological treatments for ADHD. Only 23% (48% of the ADHD group) of the present sample reported using at least one medication for ADHD-related difficulties. The complexity of the model in addition to the relatively small number of participants in the ADHD group ($n = 174$) prohibited a follow-up analysis of medication impact for participants with ADHD. However, given the high rates of medication usage among adults with ADHD future research should include medication in the prediction of academic functioning among this population (Barkley, Murphy, & Fischer, 2008). Finally, the present study is limited due to the multiple methods employed to obtain cumulative GPA. Although the majority of data were obtained through the student’s registrar’s office, some colleges would not release student academic information even with the student’s permission. In such cases, student self-report was used to obtain cumulative GPA.

Overall, study skills and high levels of parent education appear to be important contributors to the relationship between ADHD and academic outcomes. Specifically, future research should address the role of study skills among this population. Further design and evaluation of interventions that target study skills measured by the LASSI should be conducted. Surprisingly, group status was not a significant predictor of service utilization, and service utilization was not a significant predictor of GPA. Service use therefore was removed from the model and should be reconsidered in future research. For example, colleges offer several services for students both with and without disabilities designed to facilitate retention and academic success, such as tutoring, counseling, socialization, and first-year experiences (Robbins, Oh, Le, & Button, 2009). If service utilization is not effective in providing academic and/or psychosocial support for college students, additional research should investigate the type and dosage of college services, and begin to implement those accordingly. For example, coaching has been found effective for college students with ADHD (Anastopoulos & King, 2015; Prevatt et al., 2011), and there are data suggesting that engagement with coaching increases usage of other services (Parker & Boutelle, 2009). Given these findings, future studies should specifically evaluate the use and outcomes of ADHD coaching. Alternatively, these findings may represent measurement issues. Specifically, the self-report measure of support services could lack the reliability and validity necessary to accurately predict outcomes. For example, reliance on retrospective self-report could result in under- or over-reporting of service use and provides no information regarding the quality of the services received or the motivation to follow through

with such services. Finally, results from the present study demonstrate that screening study skills may better predict academic achievement in college relative to disability status. These findings suggest that to improve academic success among college students with ADHD, interventions should include strategies to improve and adapt study skills, a conclusion supported by the recent findings of Anastopoulos and King (2015). Given that the present study was conducted among first-year college students, it is likely that targeting study skills prior to matriculation at college would be beneficial for students with ADHD.

Declaration of Conflicting Interests

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Author Biographies

Matthew J. Gormley, MEd, is a doctoral student in the School Psychology program at Lehigh University. His research interests focus on the development and implementation of interventions and service delivery methods to ensure continuous high-quality support for individuals with ADHD through both major and minor transitions across the lifespan.

Trevor Pinho, MEd, is a doctoral student in School Psychology program at the Lehigh University College of Education. His research interests include the mental health of adolescents and transition-age students in schools.

Brittany Pollack, MEd, is a doctoral student in the School Psychology program at Lehigh University. Her research interests include externalizing and internalizing behavior disorders in children and adolescents, with a focus on social functioning.

Kristina Puzino, MS, is a doctoral student in the School Psychology program at Lehigh University. Her research interests broadly encompass pediatric school psychology. Specifically, Kristina's research include pediatric sleep medicine among students with ADHD.

Melanie K. Franklin, MEd, is a doctoral student in the school psychology program at Lehigh University. Her research interests include early intervention for ADHD, anxiety disorders, and childhood obesity.

Chelsea Busch, MEd, is a doctoral student in school psychology program at Lehigh University. Her research interests include implementing integrated behavioral health and pediatric school psychology practices in both primary care and school settings.

George J. DuPaul, PhD, is professor of School Psychology at Lehigh University (Bethlehem, PA). His research interests include assessment and treatment of ADHD across the lifespan, schoolbased intervention for students with behavior disorders, and pediatric school psychology.

Lisa L. Weyandt, PhD, is a professor at the University of Rhode Island, Department of Psychology, and a member of the Interdisciplinary Neuroscience Program. Her interests include ADHD in college students, prescription stimulant misuse, executive functions, and clinical neuroscience.

Arthur D. Anastopoulos, PhD, is a professor in the Department of Human Development and Family Studies at the University of North Carolina at Greensboro, where he also directs an ADHD specialty clinic. His research focuses on the manner in which ADHD unfolds across the lifespan, with a current interest in the assessment and treatment of college students with ADHD.