From Orientation to Graduation:
Predictors of Academic Success for Freshmen with ADHD

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Abstract

More students with attention-deficit/hyperactivity disorder (ADHD) are pursuing higher education. Existing studies have investigated the postsecondary educational outcomes of college students with ADHD, finding that these students typically have lower academic performance and higher dropout rates than their non-ADHD peers. Far fewer studies address the reasons for these poor outcomes. The current study sought to better understand which pre-college and college factors are related to the (1) academic performance (i.e., cumulative grade point average) and (2) retention of college students with ADHD. Data collected through direct testing and self-report ratings were analyzed for 228 first year college students with ADHD. Results indicated that two pre-college factors, gender (i.e., being male) and lower standardized test scores, significantly predicted lower GPA. Conversely, only one college factor, greater motivation, was found to significantly predict higher GPA and retention. Taken together, findings draw attention to several variables that both secondary and postsecondary institutions can target for intervention to support a more successful transition to college. Additionally, findings highlight the need for future research to elucidate factors related to college academic success for students with ADHD.

Keywords: Attention Deficit/Hyperactivity Disorder, undergraduate college students, academic performance

Improved diagnostic measures and treatment options are enabling more students with attention-deficit/hyperactivity disorder (ADHD) to pursue postsecondary education. Although students with ADHD are more likely to be enrolled in 2-year community college, technical, or vocational schools (Kuriyan et al., 2013; Morningstar et al., 2015), more of these students are enrolling in 4-year colleges and universities (Eagen et al., 2014). This rise in college attendance among students with ADHD highlights a need for further research addressing how to best serve this population. In particular, although college students with ADHD have worse academic functioning than their peers, including lower academic performance and higher dropout rates (Advokat et al., 2011; DuPaul et al., 2009; Koch et al., 2018), studies have not thoroughly investigated why this is the case.

Academic Functioning of College Students with ADHD

Students with ADHD who attend college represent a distinct subset of individuals with the disorder (Blase et al., 2009; Kaminski et al., 2006; Schwanz et al., 2007; Weyandt & DuPaul, 2008). Glutting et al. (2005) contended that "college students with ADHD are likely to have (a) higher ability levels, (b) greater academic success during primary and secondary school, and (c) better compensatory skills than individuals with ADHD from the general population" (p. 44). Although college students with ADHD may have higher academic functioning than their non-college ADHD peers, there is considerable evidence suggesting that the former group is still at risk for academic impairment.

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The transition to college is often challenging for adolescents; in fact, the initial years after high school have been referred to as a "period of floundering" (Halpern, 1991, p. 203). Although most incoming freshmen struggle with the increased academic rigor, loss of parental supervision, and reduced structure of college, students with ADHD may encounter additional hurdles due to their attention problems, executive functioning deficits, and under-developed self-regulation skills (Fleming & McMahon, 2012; Weyandt & DuPaul, 2008). Furthermore, few college students with ADHD have experience advocating for themselves to get the support they need (Stamp et al., 2014). These challenges put college students with ADHD at greater risk for poor academic functioning.

Compared with their non-ADHD peers, college students with ADHD demonstrate lower academic performance. Cross-sectional studies have reliably found that college students with ADHD obtain significantly lower college grade point averages (GPA) than college students without ADHD (Advokat et al., 2011; Blase et al., 2009; Heiligenstein et al., 1999). Students with ADHD also have a higher prevalence of withdrawal from courses (Advokat et al., 2011) and placement on academic probation (Heiligenstein et al., 1999) than their peers. These students report greater academic concerns than their non-disabled peers (Blase et al., 2009), with medium effect sizes (*d*=.48; Rabiner et al., 2008). They tend to have inferior test-taking strategies (Reaser et al., 2007), less developed organizational skills based on self-report (*d*=-2.95), and greater overall executive dysfunction (*d*=2.10; Weyandt et al., 2013). Unfortunately, these poor outcomes occur despite similar hours spent studying (Kaminski et al., 2006).

Poor academic performance contributes to greater dropout rates for students with ADHD[1]. Several studies have found that individuals with ADHD typically complete fewer years of school compared to their peers (Barkley et al., 2006; Wagner et al., 2005), with only 28% actually graduating, approximately half of the graduation rate for students without disabilities (Gregg, 2009). There is also some research suggesting that students with ADHD are at greater risk of dropping out during their first year of college. For example, Koch et al. (2018) followed students with disabilities, including ADHD, over the course of three years and found that students with disabilities were more likely to drop out of college during their first year compared to their peers without a disability. Additionally, the odds of withdrawing in the first year were 85% greater for students with ADHD, learning disabilities, or psychiatric disabilities than for students without disabilities.

Taken together, academic performance and retention outcomes highlight both the need to better understand the academic functioning of college students with ADHD and the need to examine the "factors that may contribute to their academic failure or success at the college level" (Weyandt & DuPaul, 2008, p. 314). In line with this call for further research, the purpose of this study was to investigate the variables that predict the academic performance and retention of college students with ADHD.

Predictors of College Academic Functioning: General Population

Many studies have examined potential predictors of college academic performance and retention. Most examine two predictor categories: pre-college variables and college variables. Pre-college variables, which remain relatively stable throughout the lifespan, include demographics, past academic achievement, and cognitive skills. College variables include academic support, internalizing symptomology, and learning strategies. The distinction between pre-college and college variables in the proposed study is informed by similar research (LaRose et al., 2019), and offers a paradigm that acknowledges the differing support structures available in the pre-college and college settings, though its application also requires some arbitrary distinctions between variables.

Pre-college Predictors of GPA and Retention
Demographics
Gender is consistently a significant predictor of college GPA, with females outperforming males (DeBerard et al., 2004; Mattson, 2007). Research regarding the influence of gender on college retention, however, is inconsistent (Alarcon & Edwards, 2013; Ishitani, 2016). Studies examining the effect of race on college GPA and retention have found that minority students are more likely to have a lower GPA and drop out from college more often than non-minority students (Murtaugh et al., 1999; Ransdell, 2001). Research regarding the influence of socioeconomic status (SES) on college academic performance and retention is mixed, with some showing poorer academic outcomes for students from low SES backgrounds, while other studies show no effects of SES (Baier et al., 2016; Pritchard & Wilson, 2003).

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[1] College dropout is not solely attributable to a lack of academic success. There are many factors that might influence a student's decision not to return to their postsecondary institution including several variables that will be examined in the present study such socioeconomic circumstances and mental health issues.

Past Academic Achievement and Cognitive Skills

Standardized aptitude tests (e.g., Scholastic Aptitude Test [SAT]) and cognitive skills (e.g., measures of a person's reasoning abilities, such as IQ) are significant positive predictors of GPA and retention (Burks et al., 2015; DeBerard et al., 2004; Shaughnessy & Evans, 1983). For example, Ridgell and Lounsbury (2004) found that general intelligence significantly predicted college GPA, accounting for nearly 15% of the variance. Because standardized aptitude test scores (i.e., SAT scores) are highly correlated with IQ test scores (Frey & Detterman, 2004), however, the current study only examined the latter. Several studies have also reported that scores on standardized achievement tests (e.g., Wide Range Achievement Test, Woodcock Johnson Test of Achievement) are significantly predictive of college GPA (e.g., Kaufman et al., 2012; Shaugnessy & Evans, 1983). Research examining the association of achievement test performance on college retention, however, is limited.

College Predictors of GPA and Retention
Academic Support

The frequency and quality of student non-classroom discussions with faculty, including through academic advising, is significantly and positively correlated with academic achievement and retention (Baier et al., 2016; Pascarella, 1985). Additionally, students who use academic support center services (e.g., tutoring, workshops, study groups) are more likely to have higher grades and graduate compared to students who did not (Grillo & Leist, 2013).

Internalizing Symptomology

There is a growing body of research supporting the connection between internalizing symptoms and impaired college functioning, including decreased academic functioning. Due to common symptoms associated with depression, such as persistent sadness, discouragement, loss of self-worth, and decreased interest in daily activities, students experiencing depression may lose interest in learning, disengage from classes, and consequently perform poorly on exams and assignments. For example, depression significantly predicts lower college GPA and dropping out of college (Eisenberg et al., 2009; Heiligenstein et al., 1996). Studies examining anxiety's impact on college academic performance and retention, however, have yielded inconsistent findings, with some studies showing deleterious effects while others show no impact (Eisenberg et al., 2009; Pritchard & Wilson, 2003).

Learning Strategies

Self-efficacy and motivation positively influence college academic performance and retention (Alarcon & Edwards 2013; Cheng & Ickes, 2009; Robbins et al., 2004). Effective time-management skills also predict higher GPAs (Kaminski et al., 2006).

Predictors of College Academic Functioning: ADHD Population

Though many studies examine predictors of academic success among college students generally, there are relatively few similar investigations of students with ADHD. The limited studies focused on students with ADHD examine some of the same pre-college and college variables, as well as ADHD symptomology and medication use.

Pre-college Predictors of GPA and Retention
Demographics, Past Academic Achievement, and Cognitive Skills

Other than research utilizing the same sample as the current study (e.g., Anastopoulos et al., 2018; DuPaul et al., 2018), to date, there have been no studies examining the influence of gender, race, SES, past academic achievement, or cognitive skills on college academic performance or retention in college students with ADHD.

ADHD Symptomology

Researchers have investigated how ADHD symptomology predicts college academic performance and retention among college students generally (Norvilitis et al., 2010; Pope, 2010; Schwanz et al., 2007) and college students with ADHD specifically (Rabiner et al., 2008). In the former studies, participants completed ADHD rating scales (Norvilitis et al., 2010; Pope, 2010; Schwanz et al., 2007). Results across studies suggest that inattentive symptoms, not hyperactive-impulsive symptoms, are associated with worse academic performance and higher college dropout rates.

College Predictors of GPA and Retention
Academic Support

Studies investigating the influence of college accommodations on academic performance have not yielded positive findings (as cited in Gormley et al., 2019). However, some research supports the educational benefits of receiving specific services and interventions such as faculty support (Koch et al., 2018), tutoring (Sibley & Yeguez, 2018), coaching (Prevatt & Yelland, 2015), and academic skills assistance (DuPaul et al., 2017).

Medication Use

Though considerable evidence supports stimulant medication as an effective treatment for children and adolescents with ADHD (Greenhill, 2002), research on the impact of medication on college students with ADHD is more limited. No studies have examined medication use's effects on retention. Results among studies examining the impact of medication on college GPA generally suggest no added benefit (Advokat et al., 2011; Rabiner et al., 2008; Gray et al., 2018).

Internalizing Symptomology

Aside from the DuPaul et al. (2018) study that utilized the same sample as the current study, only one study has examined how internalizing symptoms predict outcomes among college students with ADHD. Prevatt et al. (2015) found that students with ADHD who have high levels of inattention and anxiety may be at greater risk for lower academic performance and drop-out.

Learning Strategies

College students with ADHD have reported that organization, time-management, test preparation, problem solving, self-awareness, and self-control skills bolster their academic performance (Advokat et al., 2011; Kaminski et al. 2006; Sibley & Yeguez 2018). Higher levels of motivation have also been linked to stronger academic performance (Dvorsky & Langberg, 2019).

Gaps in the Literature and Study Purpose

Given the paucity of literature examining predictors of academic functioning and retention specifically for college students with ADHD, it is tempting to apply findings from general undergraduate samples. It is unclear, however, whether these findings would hold considering the documented differences in academic functioning between students with and without ADHD across all school levels. More research investigating college students with ADHD is needed to identify which variables best explain these students' academic functioning.

Although the extant literature targeting academic functioning among college students with ADHD is growing, there are several gaps. First, many of the studies claiming to investigate the relationship between ADHD and academic functioning used students from the general college population as opposed to the ADHD-specific college population (Norvilitis et al., 2010; Pope, 2010; Schwanz et al., 2007). Other studies examined students previously diagnosed with ADHD, mostly relied on student self-report (Advokat et al., 2011; Koch et al., 2018; Rabiner et al., 2008). There is an obvious need for studies that use multi-method, multi-informant evaluation systems to confirm the diagnosis of ADHD, especially in light of the potential biases of self-report (Mannuzza et al., 2002). Second, qualitative studies inform much of our understanding in this area (Sibley & Yeguez, 2018). Quantitative designs are needed to provide additional data regarding the degree to which college academic performance is associated with various pre-college and college variables. Third, research on the college success of students with ADHD has primarily focused on isolated individual characteristics. There have been no studies comprehensively examining pre-college and college-variables together. Consequently, the relative power of academic performance (pre-college or college) predictors for students with ADHD remains unclear. Research in this area is imperative to inform future interventions.

The present study aimed to address limitations in the extant literature by examining pre-college and college factors related to academic performance and retention for college students with ADHD. In particular, the following research questions were investigated:

Research Question 1: What pre-college (demographics, past academic achievement and cognitive skills, and ADHD symptoms) and college (college service use, medication use, internalizing symptomology, and learning strategies [Time Management, Motivation]) variables significantly predict first year cumulative GPA for college students with ADHD?

Hypothesis 1: Based on previous research, gender and race were hypothesized to significantly predict first year cumulative GPA; female gender and a non-minority status would predict significantly higher GPA. Lower cognitive skills, lower standardized tests scores, higher inattentive ADHD symptoms, and higher depressive symptoms were hypothesized to significantly predict lower first year cumulative GPA. The use of college services and learning strategies, such as better time management and higher levels of motivation, were hypothesized to significantly predict higher first year cumulative GPA. Based on prior literature, it was hypothesized that several variables would not be significant predictors, including, SES, hyperactive-impulsive symptoms, use of medication, and anxiety symptomatology.

Research Question 2: What pre-college (demographics, past academic achievement and cognitive skills, and ADHD symptoms) and college (college service use, medication use, internalizing symptomology, and learning strategies [Time Management, Motivation]) variables significantly predict retention for first year students with ADHD?

Hypothesis 2: Based on existing research it was hypothesized that race would be a significant predictor of college retention, with higher dropout rates among minority students. Lower cognitive skills, higher inattentive symptomology, and higher depressive symptoms were hypothesized to significantly predict lower rates of retention. College service use and learning strategies were hypothesized to significantly predict retention. Several variables were hypothesized to not be significant predictors of retention including gender, SES, hyperactive-impulsive symptoms, and anxiety symptoms. Given the limited research examining the influence of achievement tests or medication on retention for students with ADHD, no specific hypotheses in these areas were stated.

Method

Participants

Participants for the current study are a subsample from the Trajectories Related to ADHD in College (TRAC) Project study (Anastopoulous et al., 2018; DuPaul et al., 2018), a longitudinal, multi-site study examining the experiences of college students with and without ADHD. Participants were recruited over the span of two consecutive years (i.e., Fall 2012 and Fall 2013). Recruitment efforts included flyers, Facebook posts, campus wide emails, freshmen orientation sessions, office of disability referrals, and campus fairs. Students who indicated interest were screened for eligibility for the ADHD or comparison group (see below for detailed description of screening procedures). The resulting sample included 456 first year college students (228 with ADHD, 228 comparison students) who were followed for four years. The present study, however, only examined data from first year college students with ADHD (109 males, 119 females). The majority of students identified as Caucasian (76.8%) and were approximately 18 years old ($M = 18.27$, $SD = 0.58$).

Procedures

A multi-gating, multi-method assessment procedure was used to determine group status. Students and their parents first completed ADHD Rating Scales. Researchers next administered a semi-structured ADHD interview to each student whose self-report and parent-report indicated the presence of at least four or more symptoms of hyperactivity/impulsivity or inattention on the ADHD Rating Scales both in childhood (before age of 12) and in the past six months. To be included in the ADHD group, students needed to report five or more symptoms of either hyperactivity/impulsivity or inattention during the inter-

view, and meet all other DSM-5 criteria for ADHD. To be included in the comparison group, students or parents could endorse no more than three symptoms on either the ADHD Rating Scale or semi-structured ADHD interview. Following screening assessments, a panel of four ADHD experts evaluated participant data to ensure that diagnostic criteria for ADHD were met and to determine if comorbid conditions might also be present. To address comorbidity, panel members independently reviewed diagnoses and information collected from the Structured Clinical Interview for DSM Disorders (SCID-I; First et al., 2002), Beck Anxiety Inventory (BAI; Beck & Steer, 1993); Beck Depression Inventory-Second Edition (BDI-II; Beck et al., 1996). Unanimous panel agreement was required for group and comorbid status determinations. Eligible students then completed a series of measures over two to three meetings led by trained research assistants.

Screening Measures
ADHD Rating Scales (Parent Version, Childhood Version, and Past Six Months)

Three different versions of the same 18-item questionnaire (DuPaul et al., 1998) were administered to obtain the participant's self-report ratings of ADHD symptoms in childhood and over the past six months, as well as parent ratings of the participant's ADHD symptoms over the same time spans. Each form yielded three scale scores and severity scores corresponding to the three presentations of ADHD: Inattention, Hyperactive-Impulsive, and Combined.

Semi-Structured ADHD Interview

Adapted to the DSM-5 criteria (American Psychiatric Association, 2013), the adult semi-structured ADHD interview assesses symptom presentation and impairment. Half of the interview's 18 questions focus on inattention symptoms, and half focus on hyperactivity/impulsivity symptoms. The interview produced Inattention, Hyperactivity- Impulsive, and Combined scale scores, which have high internal consistency ($\alpha = .90$, $.85$, and $.93$ respectively).

Structured Clinical Interview for DSM Disorders (SCID-I; First et al. 1996)

The SCID-I is a computer-based semi-structured interview that assesses clinically significant presentations of psychiatric disorders. Only the modules for mood episodes/disorders and anxiety, somatoform, and eating disorders were administered.

Beck Anxiety Inventory (BAI; Beck & Steer, 1993)

The BAI is a 21-item self-report measure that assesses anxiety severity for individuals 17 and older. The scale measures symptom severity over the past week. Each item is rated on a 4-point Likert Scale (0 = *not at all*, 3 = *severely*), with higher scores indicating greater anxiety severity. The BAI has adequate levels of reliability and validity (Beck & Steer, 1993).

Beck Depression Inventory-Second Edition (BDI-II; Beck et al., 1996)

The BDI-II, a self-report measure, assesses depression severity in individuals 13 and older. Participants complete 21 four-point Likert scale items (0 = *not at all*, 3 = *severely*) measuring depressive symptoms over the past two weeks. Higher ratings indicate greater depression symptom severity. The BDI-II has adequate internal consistency among college students and strong test-retest correlations (Beck et al., 1996).

Independent Variables
Demographics

Participant age, gender, race, ethnicity, parental education, and parental occupation were collected via demographic questionnaire. Participants were asked to indicate all races with which they identified (Caucasian, African American, Asian, Native American, Multiracial, or Other). As a proxy for socioeconomic status, participants were asked to indicate each parent's highest level of education and current occupation. For the current study, gender, race, and parent education level were used as dichotomous independent variables (gender: 0 = *female*, 1 = *male*; race: 0 = *minority*, 1 = *non-minority*; parent education level: 0 = *no parent had a college education*, 1 = *at least one parent had a college education*).

Past Academic Achievement and Cognitive Skills

The Wechsler Individual Achievement Test-Third Edition (WIAT-III; Wechsler, 2009) was administered early in freshman year to capture students' baseline academic achievement. Specifically, the word reading and numerical operations subscales were used. These subscales have excellent reliability and validity among young adults (Wechsler, 2009). Cognitive skills scores (i.e., FSIQ) were ascertained from participants' scores on the Wechsler Abbreviated Scale of Intelligence-Second Edition (WASI-2; Wechsler, 2011), and has acceptable or adequate strong reliability and validity (Wechsler, 2011).

Conners' Adult ADHD Rating Scale- Self Report: Long Version (CAARS; Conners et al., 1999)

The CAARS is a rating scale that measures ADHD symptomology and severity for adults. The measure consists of 66 four-point Likert scale items (0 = *not at all/never*, 3 = *very much/frequently*). The CAARS manual specifies that the scale has adequate factorial, discriminant, and construct validity as well as internal consistency reliability. For the present study, the DSM-IV Inattentive symptoms and DSM-IV Hyperactive-Impulsive symptoms T-Scores were used as independent variables.

College Service Use

Students self-reported their college service use on the Services for College Students Interview—College Version. This semi-structured interview was created for the TRAC Project. Students were asked about the following services: "meet with a professor or your advisor to discuss your academic performance/progress," "campus tutoring services," "academic skill assistance," "writing/speaking assistance," "career counseling," and "formal disability service accommodations." Because the literature supports meeting with faculty, tutoring, and receiving academic skills assistance, the current study included these services as dichotomous independent variables. All responses were coded as a binary "yes" or "no" indicating whether the student used the service.

Medication Use

For the current study, the medication use independent variable was determined based on participant response to a question about medication use on the SCSI-College Version (i.e., "at any time during the fall semester, did you take medication for ADHD-related difficulties?"). Students who answered "yes" were coded as a 1 and students who said "no" were coded as a 0.

Internalizing Symptomology

Participant ratings of anxiety and depression were collected as part of study screening procedures using the BAI and BDI-II, respectively (see previous descriptions). For the present study, BAI and BDI-II total scores were used as independent variables.

The Learning and Study Strategies Inventory (LASSI; Weinstein & Palmer, 2002)

The LASSI is an 80-item self-report inventory that measures students' learning and study strategies related to "skill, will and self-regulation components of strategic learning" (Weinstein & Palmer, 2002, p. 4). The LASSI is comprised of 10 subscales: Anxiety, Attitude, Concentration, Information Processing, Motivation, Self-Testing, Study, Selecting Main Ideas, Test Strategies, and Time Management. Each

subscale contains eight five-point Likert scale items (a = *not at all typical of me*, e = *very typical of me*). The measure yields a raw score for each of the 10 subscales with higher scores indicating more positive functioning. The LASSI has adequate internal consistency and reliability (Weinstein & Palmer, 2002). For the current study, scores on Motivation and Time Management subscales were included as independent variables given that the constructs represented by these scales consistently and significantly predict college GPA and retention in the greater literature.

Dependent Variables
First Year GPA

One outcome measure of interest for the present study was first year cumulative GPA. With student consent, first year cumulative GPA was collected using archival information from college registrar offices. When archival information was unavailable, GPA data were collected via student self-report (n = 4). GPAs were reported on a 4.0 scale for all but one university where GPAs were reported on a 4.3 scale. For the current study, the latter was converted to a 4.0 scale.

Retention

The other outcome measure of interest was student retention between freshman and sophomore year. Information about student retention was collected from the registrar's office. Students enrolled in greater than 0 credits in either the fall or spring of their second year were coded as retained. Spring data were considered because several students who did not enroll in fall classes returned for their spring semester.

Data Analysis Plan[2]

Descriptive statistics were calculated for all variables. Before conducting the hierarchical linear regression analyses, assumptions of normality, linearity, homoscedasticity, and absence of multicollinearity were tested. Normality was tested using skewness and kurtosis. Linearity, normality of residuals, and homoscedasticity were tested through visual examination of relevant graphs. Multicollinearity was tested using variance inflation factor (VIF; values less than 5) and evaluating a correlation matrix (no intercorrelations greater than .8; see Table 1). Several efforts were also made to detect outliers including Cook's D and studentized residuals. For the hierarchical lo-

gistic regression analysis, the following assumptions were checked: (1) the variable of interest was a dichotomous variable, (2) outcomes were statistically independent, (3) the model was correctly specified (i.e., contained all relevant predictors and no irrelevant predictors), (4) the categories under analysis were mutually exclusive and collectively exhaustive, (5) the sample was large, and (6) absence of multicollinearity among predictors (Wright, 2003).

A hierarchical multiple regression analysis was used to answer the first research question regarding predictors of first year cumulative GPA. The predictor variables were entered incrementally. The hierarchical multiple regression predicting first year cumulative GPA contained three blocks, grouped conceptually based upon the availability of literature supporting the factors as related to college GPA. The first block of variables entered included student demographic characteristics (i.e., race, gender, SES-parent education level). The second consisted of pre-college variables (i.e., WASI-2 FSIQ score, WIAT-III numerical operations subscale score, WIAT-III word reading subscale score, CAARS inattentive T-score, CAARS hyperactive-impulsive T-score). The third included college variables (i.e., college service use, medication use, internalizing symptomology, and learning strategies). A hierarchical logistic regression was used to answer the second research question regarding predictors of retention. Predictor variables were entered in the same blocks as outlined for Research Question 1.

Results

Research Question 1

Descriptive statistics for both research questions are listed in Table 2. Because hierarchal multiple regression analyses require complete data sets, cases with missing data were removed and explored. For the first research question predicting college GPA, 34 cases (14.9%) were removed, leaving 194 complete cases. Results indicated that excluded cases did not differ from included cases with respect to GPA, ADHD symptom severity, gender, race, or SES. All assumptions of the procedure were checked and met.

The first model predicting first year cumulative GPA containing only demographic variables failed to reach statistical significance (*p* = .162; see Table 3 for hierarchical regression statistics). The addition of pre-college factors resulted in a statistically sig-

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2   A post-hoc power analysis using G-Power3 software (Faul et al., 2007) was conducted for each research question. The parameters were an effect size of .15 (i.e., a medium effect size), alpha probability error of 0.05, sample size of 194 (Research Question 1) and 204 (Research Question 2), and 16 predictors. The results indicated power (1-β)=0.94 for Research Question 1 and power (1-β)=0.95 for Research Question 2, both of which are well above the accepted level of .80, thus indicating that sample sizes have adequate power to detect a medium effect size.

Table 1

Intercorrelations Between the Hierarchical Multiple Regression Variables for First Year Cumulative GPA Among College Students with ADHD

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1. Cumulative GPA	-.09																
2. Gender	.03	.03															
3. Race	.13	.06	.21**														
4. Par. Ed.	.18**	.11	.13	.15*													
5. WASI FSIQ	.15*	.10	.14*	.18*	.25**												
6. WIAT Word	.40**	.28**	.06	.10	.42**	.27**											
7. WIAT Num	.00	.09	-.04	-.16*	-.11	.02	.04										
8. CAARS Hi/Imp	-.10	.20**	.02	-.03	.01	-.03	.02	.38**									
9. CAARS Inatt	.05	.01	-.01	-.05	-.10	-.16*	.08	.00	-.01								
10. Col Serv: Tutor	-.10	-.04	-.06	-.07	.04	-.00	-.05	.03	-.05	.21**							
11. Col Serv: Aca	-.11	-.04	-.07	-.16*	.04	-.03	-.14	-.03	-.12	.17*	.16*						
12. Col Serv: Prof	.15*	.04	-.11	-.01	.03	.02	.05	-.11	-.19**	.14	.12	.12					
13. LASSI: Time	.36**	-.11	-.17*	-.02	.13	.13	.15*	-.04	-.22**	.09	.07	.12	.62**				
14. LASSI: Motiv	-.03	-.21**	-.05	-.13	-.12	.02	-.17*	.27**	.07	.09	.09	-.08	-.03	-.02			
15. BAI	-.12	-.21**	-.09	-.18**	-.18**	-.16*	-.16*	.20**	.15*	.17	.03	-.03	-.21**	-.17*	.61**		
16. BDI-II	.07	-.00	.25**	.10	.14	.07	.11	-.12	.04	-.06	.12	-.04	.13	.03	-.06	-.19**	
17. Medication																	

Note. $* = p < .05$; $** = p < .01$. Parent Ed = highest parent education level; WASI FSIQ = Wechsler Abbreviated Scale of Intelligence-Second Edition Full Scale IQ Score; WIAT Word = Wechsler Individual Achievement Test-Third Edition Word Reading; WIAT Num = Wechsler Individual Achievement Test-Third Edition Numerical Operations; CAARS Hi/Imp = Conners' Adult ADHD Rating Scale Hyperactive/Impulsive Symptoms; CAARS Inatt = Conners' Adult ADHD Rating Scale Inattentive Symptoms; Col Ser: Tutor: College Service Use-Tutoring; Col. Ser: Aca = College Service Use = Academic Skills Assistance; Col. Ser: Prof = College Service Use-Meeting with Professor; LASSI: Time = Learning and Study Strategies Inventory Time Management; LASSI: Motiv = Learning and Study Strategies Inventory Motivation; LASSI: Time = Learning and Study Strategies Inventory Time Management; BAI = Beck Anxiety Inventory; BDI-II = Beck Depression Inventory Second Edition; Medication = Medication Status

Table 2

Descriptive Statistics for Dependent and Independent Variables

Gender (% Male)	47.8%
Race (% Non-Minority)	76.8%
African Americans	11%
Asian	2.5%
Multiracial	4.4%
Other	5.3%
Parent Education (% at least 1 parent with college ed)	74.6%
WASI Full Scale IQ (Standard Score)	$M = 110.86, SD = 12.67$
WIAT Word Reading (Standard Score)	$M = 107.88, SD = 10.08$
WIAT Numerical Operations (Standard Score)	$M = 107.17, SD = 15.45$
CAARS Hyperactive/Impulsive (Standard score)	$M = 63.46, SD = 13.42$
CAARS Inattentive (Standard score)	$M = 78.52, SD = 12.24$
Tutoring Services (% Receiving Service)	34.2%
Academic Skills Assistance (% Receiving Service)	19.7%
Meeting with Professor (% Receiving Service)	58.8%
LASSI-Time Management (Raw score)	$M = 19.68, SD = 6.00$
LASSI-Motivation (Raw score)	$M = 28.79, SD = 6.09$
BAI (Raw Score)	$M = 14.33, SD = 11.00$
BDI-II (Raw Score)	$M = 15.52, SD = 9.62$
ADHD Med Use (% Medicated)	43.4%
Cumulative GPA	M = 2.91, SD = 0.70
Retention (% Retained)	70.2%

Note. $N = 228$; BAI = Beck Anxiety Inventory; BDI-II = Beck Depression Inventory Second Edition; LASS I= Learning and Study Strategies Inventory, Medication = Medication Use; WASI = Wechsler Abbreviated Scale of Intelligence-Second Edition; WIAT = Wechsler Individual Achievement Test-Third Edition

Table 3

Hierarchical Multiple Regression Statistics for Model Predicting First Year Cumulative GPA

Model	Variable	*R/B*	*R²/ß*	*SE*	*p*-Value	ANOVA *F*	Model *p*
1		.16	.03	.70		1.73	.162
	Gender	-.10	-.71	.10	.329		
	Race	.03	.02	.12	.788		
	Parent Ed	.24	.15	.12	**.044**		
2		.45	.20	.64		5.84	**<.001**
	Gender	-.27	-.19	.10	**.008**		
	Race	-.02	-.01	.11	.869		
	Parent Ed	.18	.11	.11	.110		
	WASI FSIQ	.00	.05	.00	.480		
	WIAT Word Reading	.00	.03	.01	.686		
	WIAT Numerical Op.	.02	.41	.00	**<.001**		
	CAARS Hi/Imp	.00	.04	.00	.626		
	CAARS Inattentive	-.00	-.04	.00	.598		
3		.55	.30	.61		4.66	**<.001**
	Gender	-.21	-.15	.10	**.038**		
	Race	.07	.04	.11	.561		
	Parent Ed	.16	.10	.11	.151		
	WASI FSIQ	.00	.04	.00	.581		
	WIAT Word Reading	-.00	-.02	.01	.806		
	WIAT Numerical Op.	.02	.34	.00	**<.001**		
	CAARS Hyp/Imp	.00	.02	.00	.761		
	CAARS Inattentive	.00	.02	.00	.740		
	Col Serv: Tutoring	.06	.04	.10	.553		
	Col Serv: Academic Skills	-.16	-.10	.11	.157		
	Col Serv: Meeting w/ Prof	-.09	-.06	.10	.391		
	ADHD Medication Use	-.00	-.00	.10	.975		
	BAI	.01	.08	.01	.401		
	BDI-II	-.01	-.10	.01	.247		
	LASSI-Time Management	-.00	-.04	.01	.685		
	LASSI-Motivation	.04	.31	.01	**<.001**		

Note. N = 194; Parent Ed = highest parent education level; WASI FSIQ = Wechsler Abbreviated Scale of Intelligence-Second Edition Full Scale IQ Score; WIAT Word Reading = Wechsler Individual Achievement Test-Third Edition Word Reading; WIAT Numerical Op.= Wechsler Individual Achievement Test-Third Edition Numerical Operations; CAARS Hi/Imp = Conners' Adult ADHD Rating Scale Hyperactive/Impulsive Symptoms; CAARS Inattentive = Conners' Adult ADHD Rating Scale Inattentive Symptoms; Col Ser: Tutoring = College Service Use-Tutoring; Col Ser: Academic Skills = College Service Use = Academic Skills Assistance; Col Ser: Meeting w/ Prof = College Service Use-Meeting with Professor; BAI = Beck Anxiety Inventory; BDI-II = Beck Depression Inventory Second Edition; LASSI: Time = Learning and Study Strategies Inventory Time Management; LASSI: Motivation = Learning and Study Strategies Inventory Motivation

nificant change in R^2, F^Δ (5, 184) = 8.10, $p < .001$, uniquely accounting for 17.5% of the variance, with the whole model predicting 20.2% of the variance. The addition of college variables also resulted in a statistically significant change in R^2, F^Δ (8, 176) = 2.09, $p < .001$, uniquely accounting for 9.6% of the variance, with the whole model predicting 29.8% of the variance and indicative of a large effect size (f^2 = .42). Among coefficients, only gender (β = -.15, p = .038), WIAT numerical operations (β = .34, $p < .001$), and LASSI-motivation (β = .31, $p < .011$) significantly predicted first year cumulative GPA among college students with ADHD. Specifically, being male significantly predicted lower GPA, while having higher scores on the WIAT numerical operation subscale and LASSI-motivation scale significantly predicted higher first year cumulative GPA. Furthermore, examination of squared correlations revealed that 1.7% of the variance in first year cumulative GPA was uniquely explained by gender, 7.5% of was uniquely explained by WIAT numerical operations score, and 5.1% was uniquely explained by LASSI-motivation scores.

Research Question 2

Similar to hierarchical regression analyses, logistic regression analyses require complete data sets. For the second research question predicting freshman year retention, 24 cases (10.5%) were removed. When exploring missing data for research question 2, no significant differences were found between participants with complete and incomplete data in terms of hyperactive-impulsive symptom severity, gender, race, or SES. However, participants with complete data had significantly lower inattention symptom severity (M = 77.5, SD = 12.1) than participants with missing data (M = 85.04, SD = 11.87). All assumptions of the procedure were checked and met.

The first and second models predicting retention of first year students failed to reach statistical significance (Model 1: χ^2[3] = .68, p = .878; Model 2: χ^2[8] = 9.44, p = .307). The third model, however, was approaching statistical significance (χ^2[16] = 23.5430, p = .10) and indicative of a medium effect size (f^2 = .19). This model correctly classified 76.5% of cases. Only one variable significantly predicted retention for first year students with ADHD. Specifically, higher LASSI-motivation score was associated with increased likelihood of first year retention (OR = 1.08, 95% CI: 1.01-1.16; d = .04; see Table 4 for hierarchical logistic regression statistics).

Discussion

Research Question 1 Findings

Consistent with several of the study's initial hypotheses, results indicate that three variables significantly predict better first year cumulative GPA: female gender, higher standardized test scores (i.e., WIAT-III numerical operations subscale), and possessing greater levels of motivation. These findings replicate past research indicating females outperform males academically (DeBerard et al., 2004; Mattson, 2007) potentially because females have been demonstrated to have higher levels of organization, dependability, and self-discipline (Duckworth & Seligman, 2006; Jacob, 2002; Riegle-Crumb, 2007). Males may also have lower GPA due to their generally greater symptom severity (Barkley, 2006) and increased likelihood of engaging in risk-taking behaviors such as alcohol use, illicit substance use, and risky sexual behaviors (Pollack et al., 2018), all of which may detract from academic success. The WIAT-III numerical operations subscale score's status as a significant predictor of first year cumulative GPA aligns with research suggesting that many of the skills needed to do well in math, such as critical thinking, logical reasoning, and problem-solving skills, benefit students across content areas (Bull & Johnston, 1997; Hecht et al., 2001). Finally, results mirror those in the greater literature suggesting that motivation is positively and significantly linked to cumulative GPA (Cheng & Ickes, 2009; Robbins et al., 2004). Motivation has been proposed as a protective factor for students who lack organizational skills, such as those with ADHD, because students with high motivation may direct greater effort toward overcoming organizational limitations (Cheng & Ickes, 2009). An examination of squared correlations, however, reveals that only 14.3% of the 29.8% of variance explained in the final model is accounted for by these three significant predictors. This finding suggests that some non-significant predictors described below are also contributing to the variance, albeit not at a statistically significant level.

Contrary to hypotheses and past research, several pre-college variables, including race, cognitive skills, and standardized testing reading scores did not significantly predict first year cumulative GPA. Though the lack of a predictive effect of race is difficult to interpret, it is plausible that family characteristics that typically put minority students at a disadvantage (e.g., first generation college student) were not as relevant in the current study, where 74.6% of participants had at least one parent with a college education. In terms of the lack of findings for FSIQ score and WIAT-III

Table 4

Hierarchical Logistic Regression Statistics for Model Predicting First Year Retention

Model	Variable	B	*SE*	*Wald*	*df*	*p*-Value	Odds-Ratio	Nagelkerke *R²*	Model *p*
1	Gender	.15	.32	0.21	1	.645	1.16	.01	0.878
	Race	-.12	.38	0.10	1	.752	0.89		
	Parent Ed	.23	.36	0.42	1	.519	1.26		
2	Gender	-.11	.34	0.10	1	.758	0.90	.07	0.307
	Race	-.24	.39	0.38	1	.536	0.78		
	Parent Ed	.06	.38	0.03	1	.875	1.06		
	WASI FSIQ	.00	.02	0.07	1	.789	1.00		
	WIAT Word Reading	.02	.02	1.82	1	.177	1.02		
	WIAT Numerical Op.	.02	.01	3.22	1	.073	1.02		
	CAARS Hi/Imp	-.01	.01	0.14	1	.709	0.99		
	CAARS Inattentive	.01	.02	0.14	1	.706	1.01		
3	Gender	-.15	.38	0.16	1	.687	0.86	.16	0.100
	Race	-.19	.43	0.19	1	.661	0.83		
	Parent Ed	.05	.41	0.02	1	.897	1.06		
	WASI FSIQ	.00	.02	0.03	1	.863	1.00		
	WIAT Word Reading	.03	.02	1.81	1	.178	1.03		
	WIAT Numerical Op.	.01	.01	0.71	1	.400	1.01		
	CAARS Hyp/Imp	.00	.02	0.06	1	.814	1.00		
	CAARS Inattentive	.01	.02	0.75	1	.387	1.01		
	Col Serv: Tutoring	.37	.39	0.91	1	.339	1.45		
	Col Serv: Academic Skills	-.13	.43	0.09	1	.769	0.88		
	Col Serv: Meeting w/ Prof	.01	.38	0.00	1	.985	1.01		
	ADHD Medication Use	.51	.37	1.94	1	.164	1.67		
	BAI	-.03	.02	2.32	1	.127	0.97		
	BDI-II	-.00	.02	0.02	1	.879	1.00		
	LASSI-Time Management	-.00	.04	0.01	1	.920	1.00		
	LASSI-Motivation	.08	.04	4.33	1	.037	1.08		

Note. N =204; Parent Ed = highest parent education level; WASI FSIQ = Wechsler Abbreviated Scale of Intelligence-Second Edition Full Scale IQ Score; WIAT Word Reading = Wechsler Individual Achievement Test-Third Edition Word Reading; WIAT Numerical Op.= Wechsler Individual Achievement Test-Third Edition Numerical Operations; CAARS Hi/Imp = Conners' Adult ADHD Rating Scale Hyperactive/Impulsive Symptoms; CAARS Inattentive = Conners' Adult ADHD Rating Scale Inattentive Symptoms; Col Ser: Tutoring: College Service Use-Tutoring; Col Ser: Academic Skills = College Service Use = Academic Skills Assistance; Col Ser: Meeting w/ Prof = College Service Use-Meeting with Professor; BAI = Beck Anxiety Inventory; BDI-II = Beck Depression Inventory Second Edition; LASSI: Time = Learning and Study Strategies Inventory Time Management; LASSI: Motivation = Learning and Study Strategies Inventory Motivation

word reading subscale score, it is possible that the WIAT-III numerical operations subscale score, which was significantly correlated with both the FSIQ score and WIAT-III word reading subscale score, may have captured variance that would have otherwise been attributed to cognitive or standardized testing scores.

Unexpectedly, several college variables also did not significantly predict first year cumulative GPA. Neither inattentive ADHD symptoms nor depression symptomatology significantly predicted first year cumulative GPA. Sample characteristics may account for this outcome. This study's average CAARS inattention score fell in the clinically elevated range (i.e., T-score greater than 65), suggesting a possible ceiling effect. This restricted range of inattention scores may have attenuated correlations, leading findings to diverge from the greater literature. As to depression symptoms, moderate-to-severe depression is more strongly associated with poor academic outcomes (Heiligenstein et al., 1996), whereas the average BDI-II score in the present study was 15.52, indicating only mild depression (Beck et al., 1996). Results suggest that neither academic support service use nor time management learning strategies predict first year cumulative GPA.

There are several potential reasons why the present findings depart from the previous literature. Regarding academic support services, the present study did not collect data on the frequency of service use, quality of services offered, or the amount of student engagement in sessions. These findings may therefore represent the minimal effectiveness of academic support services. Relatedly, because this study only inquired about support-service use at one point in time, it is possible that data collected did not capture students who began using academic support services after being surveyed. Regarding time-management learning strategies, the present study's findings may diverge from the greater research because the LASSI-time management variable was significantly correlated with the LASSI-motivation variable ($r = .62$, $p < .01$). Consequently, the LASSI-motivation variable may have accounted for variance that would have otherwise been attributed to the LASSI-time management variable.

Research Question 2 Findings

The findings' capacity to adequately predict retention is limited because the final model is only approaching statistical significance. Nevertheless, among pre-college and college predictors, there was one factor, motivation, that significantly predicted retention as hypothesized. Students with higher motivation had an 8.1% greater likelihood of being retained.

According to Weinstein and Palmer (2002), the LASSI-motivation subscale assesses students' diligence and self-discipline. It is operationally defined by the students' willingness to exert the effort necessary to successfully complete academic requirements (sample item: *When work is difficult I either give up or study only the easy parts*). Students who score low on this scale benefit from increasing investment in their academic outcomes and learning how to set and use goals to help accomplish specific tasks. It follows, then, that students in the current study with higher LASSI-motivation subscale scores were more invested in studying and performance, fostering behaviors such as preparing for class, completing assignments on time, and being diligent in studying. Consequently, high-motivation students were more likely to reenroll for sophomore year. These findings add to the considerable evidence that suggests that college retention rates are higher among motivated learners (Alarcon & Edwards, 2013; Robbins et al., 2004).

Current findings conflict with the greater literature on several predictor variables. First, race did not emerge as a significant predictor of retention, potentially due to how this study operationalized race as a dichotomous variable (i.e., minority and non-minority) whereas previous investigations examined multiple categories (Murtaugh, 1999). Although collapsing race into a binary predictor was necessary for this study due to small cell sizes (e.g., only 6 Asian students), doing so could have diminished subtle but important nuances between racial groups retention outcomes. Second, cognitive skills did not significantly predict college persistence. In light of several studies finding personality traits more predictive of post-secondary educational performance than intelligence (e.g., Di Fabio & Busoni, 2007), it is possible that unexamined personality variables here accounted for greater variance in retention than did intelligence. Third, inattentive ADHD symptoms did not significantly predict lower rates of retention, possibly due to the exclusion of participants with missing data who had significantly higher inattention symptom severity. Excluding these individuals may have mitigated the impact of inattentive ADHD symptoms in the overall analysis. Finally, this study's findings that several college variables did not significantly predict retention conflict with prior research. As with the first year cumulative GPA findings, these departures may be accounted for by type of data collection (i.e., academic support services data did not reflect quality of services), sample characteristics (i.e., mild depression levels), and intercorrelations among variables (i.e., LASSI scales were significantly correlated).

Limitations

The current study's findings must be interpreted in light of its limitations. First, the study sample consisted only of students with ADHD enrolled at 4-year universities. Recognizing research suggesting that students with ADHD are more likely to be enrolled in 2-year college, community college, technical, or vocational schools than 4-year colleges (Kuriyan et al., 2013; Morningstar et al., 2015), it is unclear whether these results could be generalized to students not enrolled in 4-year institutions. Second, the study's dataset presented methodological difficulties. The study's use of self-report to measure some independent variables may have impacted reliability and validity data based on the participants' understanding of interview and questionnaire items, and participants' ability to accurately recall past behaviors. Further, because data were collected at one point in time, they may not have captured changes during the year. Third, internalizing symptoms were assessed using a dimensional measure which only reflects experiences over the past few weeks as opposed to a more stable categorical measure (i.e., expert panel's diagnostic classification). Fourth, the present analysis collapsed multiple categorical variables, such as race, socioeconomic status, and medication use, into binary variables, detracting from analysis of specific racial backgrounds, level of income, and medication dosage impacts on academic performance and retention. Fifth, findings also may have been affected by the fact that participants included in Research Question 2 analysis had significantly lower inattention symptom severity than the overall sample. This factor may have attenuated the impact of some variables (e.g., those measuring pathology) on retention. Finally, the operationalization of retention limited study results. Students were considered retained if they were enrolled in greater than 0 credits in either the fall or spring of their sophomore year. Though this definition has been used in prior studies (Ishitani, 2016), it lacks practical significance given that most single-semester college courses are worth three credits and the majority of four-year colleges require 120 credit hours to graduate (Johnson et al., 2012). A more appropriate operationalization may have been students who were enrolled in six or more credits, as this is the minimum number of credits needed to be considered a part-time student at most colleges and universities.

Considerations for Future Research and Practice

Present findings raise several important directions for future research. First, additional research regarding predictors of academic performance and retention of college students with ADHD is needed, as the final models only accounted for 29.8% and 15.8% of the variance, respectively. Second, the study's motivation findings call for further exploration of academic performance and retention of college students with ADHD through prevailing motivational theories such as achievement goal theory, self-determination theory, and attribution theory. Third, further research should target community college and vocational settings, as these are institutions that students with ADHD are more likely to attend (Kuriyan et al., 2013). Finally, because 30% of students with ADHD in this study were not retained, future studies should monitor students who drop out to see whether they return and, if so, what predicts their return.

This study also offers several implications for practice. First, results suggest male college students with ADHD need more academic support, as they have significantly lower first-year cumulative GPAs than females. Recognizing this population is at-risk, high schools and colleges should offer preventative academic services directed toward male students with ADHD. Promising interventions also include coaching, study groups, workshops, mentors, and CBT (Anastopoulos & King, 2015; Matthews et al., 2013; Prevatt & Yelland, 2015). For example, Anastopoulos and King (2015) found that an eight-week CBT program paired with individual mentoring led to education gains including a 0.2 increase in GPA and decrease rates of academic probation. Second, findings suggest student use of academic support service was limited (i.e., 19.7% report receiving academic skills assistance, 34.2% report receiving tutoring services, and 58.8% report meeting with professor or academic advisor). It is possible that some of the students in this study never learned that resources specifically for students with ADHD were available. For postsecondary institutions seeking to best serve students with ADHD, it is recommended they follow a more proactive model of service delivery. If students have disclosed their diagnosis, universities should follow up with them to inform them of services available to them. A flyer or guide to campus for ADHD students may also be a useful tool to help students familiarize themselves with available resources. Third, results highlight the importance of motivation to college success. Consequently, motivation is something that college counselors, academic advisors and even high school counselors need to pay attention to and foster with their students. There are several evidence-based motivational interventions that can be used at the high school and college level to increase levels of motivation, including attributional retraining and achievement motivation training programs. The goal of attributional retraining is to help students reframe

what they think about success and failure, encouraging them to take responsibility for their academic outcomes, whereas the purpose of achievement motivation training programs is to change students' achievement motive through teaching them to think, feel, and behave like high-achievers (Wagner & Szamoskozi, 2012). According to Wagner and Szamoskozi's (2012) meta-analysis, both attributional retraining and achievement motivation training programs have significant effects in enhancing academic motivation (d = .30 and d = .53, respectively). Secondary and postsecondary educators should consider using these intervention approaches to help increase student motivation before, during, and after the transition to college.

Conclusions

This study adds to the growing body of research examining college academic performance of students with ADHD. As the first study using a relatively large, rigorously defined, multi-site sample to examine pre-college and college factors contributing to academic functioning of college students with ADHD, this investigation identified several key variables related to college academic success. Specifically, motivation was found to predict first-year cumulative GPA and retention, and gender and standardized test scores significantly predicted first year cumulative GPA. Though these findings highlight potential targets for intervention at the high school and college level, additional studies are required to fully understand which factors promote college academic achievement and retention for students with ADHD as well as to facilitate improved educational outcomes for this population.

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