

## **Work in Progress: College Students with ADHD: A Framework for Studying the Role of the College Experience on Academic Success**

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## **Abstract**

Students with attention deficit hyperactivity disorder (ADHD) represent a growing fraction of the college population. We plan to study the experiences of college students with ADHD majoring in science, engineering, and mathematics (SEM) and explore how those experiences relate to academic success (i.e., academic achievement, persistence, and creativity). For this work-in-progress paper, we present our project's conceptual framework and share how specific aspects of it may relate to the academic success of students with ADHD. Our framework is based on Terenzini and Reason's college impact model, which includes precollege characteristics and experiences, the organizational context, the college experience, and students' educational outcomes (i.e., academic success). We also describe the quantitative portion of our two-part research study that will analyze longitudinal data from three nationally-administered, multi-institutional surveys. That analysis will guide further qualitative research focused on the college experience and academic success of college students with ADHD.

## **Introduction**

Approximately 6.5% of incoming college freshman are students with attention deficit hyperactivity disorder (ADHD) [1], [2]; yet, the college experience and academic success of these students remain understudied [3]. Students with ADHD commonly identify high energy levels, resilience, courage, and the ability to hyper-focus on tasks of interest as strengths [4]-[6], which are likely advantageous for academic success. However, college students with ADHD earn lower grades than their peers on average [2], [7]-[9] and are less likely to graduate [10]. Researchers attribute these students' lower than average academic achievement to difficulty with executive functioning [3], [11]-[13], which makes self-regulation, attentional control [14-15], organization, and time management [13] more challenging.

Though a few studies focus on engineering students with ADHD [e.g., 16], studies specifically investigating the academic success of students with ADHD majoring in science or mathematics are lacking. Some of the positive traits commonly associated with ADHD (e.g., high levels of creative [17] and divergent thinking [18]) are advantageous for developing unique problem-solving approaches and innovative ideas [16], [19]-[20]. Despite evidence of the need for creative and innovative thinking for engineers, these skills play a lesser role in engineering education [16] and perhaps more broadly in science, engineering, and mathematics education. Researchers suggest that students with ADHD may find the limited emphasis on creative and divergent thinking in "traditional" higher education engineering environments challenging [16, p. 214]. Additionally, many science, engineering, and mathematics (SEM) college classrooms may not align with the strengths (e.g., see [16], [19] for engineering) or learning preferences [21], [22] of students with ADHD. For example, instead of actively engaging students in learning, SEM classes are predominately taught by lecture [20], [23]-[25]. The challenges associated with lecture-style classes for students with ADHD are well-documented and include sustaining attention and effective notetaking (e.g., [22]). Our study aims to continue filling this research gap

by exploring the relationship between the broader college experience of SEM (we are not including students majoring in technology) students with ADHD and their academic success.

## Research Aims

The purpose of this work-in-progress paper is to provide an overview of our study's guiding conceptual framework and a description of how it relates to the literature about college students with ADHD. We also describe our plans for quantitative analysis of the academic success of college students with ADHD majoring in SEM.

Although our study will include two parts, comprising quantitative and then qualitative analysis, this paper will focus on the former. We plan to use multinomial logistic regression to explore the relationship between students' college experiences and academic success (i.e., academic achievement, persistence, and creativity) of SEM college students with ADHD. Then, we will qualitatively investigate these aspects in-depth. We hope to translate our findings into actionable recommendations for college administrators and instructors.

## Research Questions

Our proposed study will answer the following research questions.

RQ1. What factors of the student college experience are associated with the academic success of college students with ADHD? How do those factors compare to students without ADHD?

RQ2. What factors of the student college experience are associated with the academic success of SEM college students with ADHD? How do those factors compare to students without ADHD?

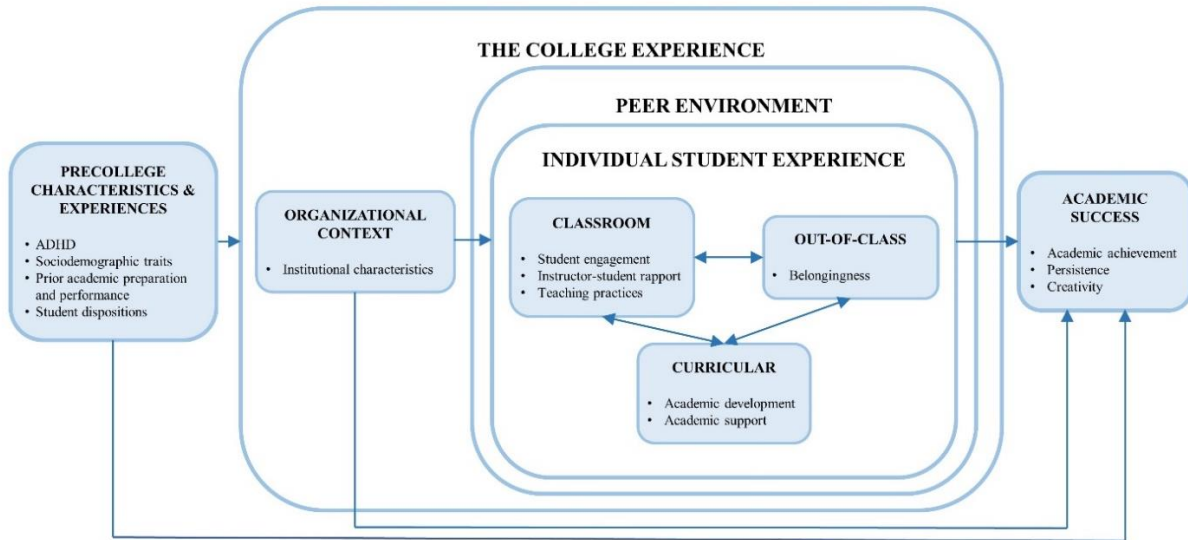
RQ2a. What teaching practices are associated with the academic success of SEM college students with ADHD? How do those factors compare to students without ADHD?

RQ3. How do teaching practices mediate the relationship between precollege characteristics and experiences and the academic success of SEM college students with ADHD? How does that mediating role compare to students without ADHD?

## Conceptual Framework

Terenzini and Reason's college impact model [26], [27] – based on the work of Astin [28], Tinto [29], and Pascerallo [30] – guides our study. The model relates students' *precollege characteristics and experiences* and their *college experiences* to student *outcomes* [26], [27]. In this model, aspects of the college experience, *classroom*, *curricular* and *out-of-class*, interact and influence student outcomes [26]. Although initially intended for students' first college year, this model also applies to all four years of college [26].

To adapt this model to our study, we generally follow Reason [27] to specifically define its different components (e.g., *classroom experience*) and add whether a student self-reports having ADHD to *precollege characteristics and experiences*. Further, we consider academic success for student outcomes and include creativity, based on the work of Taylor and coauthors [16].



**Figure 1.** Conceptual framework for SEM academic success based on the college impact model of Terenzini and Reason [26] and Reason [27]

### *Precollege characteristics and experiences*

*Precollege characteristics and experiences* incorporates *sociodemographic traits, prior academic preparation and performance, and student dispositions* [26], [27]. In our model, we also include whether a student self-reports having *ADHD*. Sociodemographic traits include gender, race/ethnicity, first-generation college status, and financial resources, enabling researchers to study the relationship between these characteristics and the college experience of different groups of students [26], [27]. Additionally, prior academic preparation and performance is associated with collegiate academic success [26], [27], and here we include precollege standardized test scores and high school grades, as these indicators are related to college persistence in both engineering (e.g., [31]-[33]) and in science (e.g., [34]). In student dispositions, we include a single factor, creativity, based on recent work [16] in engineering education.

### *The College Experience*

*Organizational context* falls within the college experience [26], [27]. Although there are multiple potentially influential organizational factors, we only include institutional selectivity because of its well-established relationship with persistence [27].

### *Classroom*

We include student engagement, instructor-student rapport, and teaching practices in *classroom* experiences.

Student engagement and teaching practices are interrelated (e.g., active learning, by definition, *engages* students in the learning process [35]). Particular instructional pedagogies may align with the strengths and learning preferences of students with ADHD [20]-[22]. For example, individuals with ADHD may prefer active engagement when they are learning, they may be motivated by stimulating, novel tasks, and they may find motivation in learning content of high interest [4], [21]. Similarly, college students with ADHD may find instructional practices that require passive listening and notetaking, such as lecture, to be challenging [20], [22]. Accordingly, Lefler and coauthors [22] recommend that instructors use short periods of lecture with interspersed active learning, offer relevant activities of interest, and shift focus away from notetaking. Although these recommendations align with educational researchers' calls to support student learning, they are not implemented in SEM consistently [23]-[25].

Instructor-student rapport may be a salient factor within students' classroom experiences. Instructors who are supportive of students and their learning (e.g., perhaps by providing multiple opportunities for success) may benefit students with ADHD who may lack confidence in their academics [36], [37]. Qualitative research highlights the value of positive instructor-student interactions shared by college students with ADHD and the lasting repercussions of negative interactions [36], [38]. In one study, students noted that instructors' responses (positive or negative) to accommodation requests, such as extended test time or lecture notes, were meaningful [36].

### *Curricular*

Students' *curricular* experiences generally relate to their curricular and co-curricular involvement and to the development of academic skills and competence [26], [27]. In *curricular* experiences, we include two factors: academic development and academic support.

In terms of academic development, we include students' time management and study skills. Many students with ADHD find time management, organization, and notetaking difficult [11], [22], [39], and some find homework, studying, test-taking, and writing more time-consuming than students without ADHD [36], [37].

Academic support may include first-year seminars or programs that teach study, note-taking, or organizational skills, academic development programs, and services offered by offices of disability services (e.g., academic coaching). Besides generally supporting college persistence [27], academic support programs that help students develop time management and study skills may also benefit the academic success of students with ADHD. In a qualitative study, college students with ADHD shared positive reflections on the disability services office and its relationship to their academic success [36].

### *Out-of-Class*

We include belongingness in *out-of-class* experiences to capture both students' belongingness within the larger campus community and within their SEM field of major. Students' feelings of belonging relate to their decisions to persist in science, engineering, and mathematics (e.g., [40]).

### *Academic Success*

We use three *academic success* metrics [41]: academic achievement, persistence, and creativity. For academic achievement, we use college grades; we consider persistence as students' continued enrollment in a major within SEM; and we include students' self-reported creativity.

## **Quantitative Research Methods**

### *Data Set Acquisition*

We will use a multi-institution, longitudinal data set from the Higher Education Research Institute (HERI), with data spanning the time from when students enter college until their senior year. We will use three surveys: The Freshman Survey (TFS) [42], administered to incoming college freshman; the Your First College Year (YFCY) survey [43], administered to college students at the end of their first year; and the College Senior Survey (CSS) [44], administered to graduating students finishing their senior year of college. Data from these three HERI surveys capture students' precollege characteristics and experiences, college experiences, and academic success [42]-[44]. The TFS includes items related to precollege characteristics and experiences (sociodemographic traits, prior academic preparation and performance, and student dispositions) upon entering college [42]. The YFCY focuses on students' first-year college experiences and academic success [43]. Finally, the CSS contains items on students' college experiences and academic success [44].

We will acquire data from four cohorts of college students attending four-year U.S. higher education institutions spanning multiple years (2010 to 2018) who indicated whether or not they have ADHD (as an incoming college freshman). A data subset will only include students planning on majoring in SEM. We include computer science, physical and biological sciences, mathematics, statistics, and engineering as SEM majors [45].

### *Analytical Plan*

We plan to use multinomial logistic regression models with robust standard errors to study the academic success of college students with ADHD. Our academic success outcome variables are college grades, persistence, and creativity. The outcome variable for college grades will be categorical. The outcome variable, representing persistence, will be nominal and have three categories (no longer enrolled in college, enrolled in college, but no longer majoring in SEM, and enrolled in college and pursuing a SEM major).

We focus our study on the individual student experiences of students with ADHD. Thus, our key independent variables are whether a student self-reports having ADHD and those in classroom, curricular, and out-of-class experiences. We will control for precollege characteristics and experiences and institutional selectivity. Our goal is to identify the most salient factors in promoting the academic success of students with ADHD and then further explore these factors using qualitative methods.

We are in the process of acquiring the HERI data, and we will conduct our proposed quantitative data analysis during the summer of 2021.

## Summary

Our work is designed to learn more about the academic success of students with ADHD and its relationship to their college experience. This work in progress paper overviewed our conceptual framework and the quantitative study we will conduct as the first phase of analysis. We expect our quantitative study findings to guide our qualitative study.

During our conference presentation, we look forward to hearing feedback from colleagues about the framework constructs and our plans for collecting and analyzing data.

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