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## Nuance and Complexity of First-generation College Student Success, from College Choice to Retention

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Nuance and Complexity of First-Generation College Student Success, from College  
Choice to Retention

A Dissertation Presented

by

LING CHEN

Submitted to the Graduate School of the  
University of Massachusetts Amherst in partial fulfillment  
of the requirements for the degree of

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College of Education

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LING CHEN

Approved as to style and content by:

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Ryan Wells, Chair

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Lin Tang, Member

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Jessica Pearlman, Member

---

Shane Hammond, Associate Dean for Student Success  
College of Education

## **DEDICATION**

To my parents,  
who have always loved and supported me,  
in every way they could,  
I am because you are.

To my grandmother,  
whose legacy of love inspires me every day,  
Forever cherished in my heart.

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I couldn't have reached this goal without the help of many people in my life. I'd like to take this opportunity to thank them for their support.

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## **ABSTRACT**

### **NUANCE AND COMPLEXITY OF FIRST-GENERATION COLLEGE STUDENT SUCCESS, FROM COLLEGE CHOICE TO RETENTION**

September 2024

LING CHEN, B.A., UNIVERSITY OF CALIFORNIA, IRVINE

M.A., UNIVERSITY OF CALIFORNIA, LOS ANGELES

Ph.D., UNIVERSITY OF MASSACHUSETTS AMHERST

Directed by: Professor Ryan Wells

Higher education serves as an important vehicle for social mobility, particularly for students from disadvantaged socioeconomic backgrounds. However, achieving equitable outcomes in college access and success remains challenging, influenced by various layers of contexts, including personal, institutional, and policy dimensions. Despite increased attention and support for first-generation college students, significant disparities persist in retention and completion rates compared to their continuing-generation peers. Understanding these disparities and the complexities facing first-generation college students requires a close examination of the variation within the population.

This dissertation aims to understand the complexities of the college experiences of first-generation students through three interconnected studies. This dissertation not only investigates heterogeneity within the first-generation college student population but also specifically seeks to explore how institutional-level factors affect first-generation students and how the interaction between institutional-level and personal factors shapes college experiences and outcomes.

The first study investigates how high school contexts impact college choice for first-generation students, particularly leading to college undermatching. Additionally, this study contributes methodologically significance by demonstrating the inclusion and control of college selectivity when studying college undermatching as an outcome. The second study explores the differential effects of college undermatching on postsecondary outcomes for first-generation and non-first-generation students, including GPA and retention rates. The third study examines how postsecondary outcomes vary between students with and without cognitive disabilities, stratified by first-generation college student status.

The findings of this dissertation study challenge the common notion of the first-generation college student population as a homegroups group. Results emphasize the importance of tailored support mechanisms at the institutional level, including secondary and postsecondary settings. By recognizing the diversity within this population, institutions can better address the unique needs of first-generation students and promote equitable outcomes.

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# CHAPTER 1 INTRODUCTION

## **Nuances and Complexities among First-Generation Students**

Higher education is well recognized as a pathway to social mobility, especially for students from disadvantaged backgrounds. However, college access and success in practice are more complicated because it is challenging to produce equitable outcomes across diverse groups. The college process can be influenced by various elements, such as parents' education level, access to college information, high school contexts, and other student factors, such as cognitive disabilities. After students enrolling in college, a student's college experience and success are shaped by the challenges they encounter and the support they receive in the postsecondary environment. Thus, disparities and inequities in college access and success among students of diverse backgrounds are nuanced and complicated, requiring a closer examination and disaggregation of the student population in order to have a more comprehensive understanding.

Although the enrollment of first-generation college students has drastically increased, the gaps in college retention and completion between first-generation college students and continuing-generation college students are still quite large. Although over half of undergraduate students in the 2015-2016 cohort were first-generation college students, the completion rate of first-generation college students was only 56%, compared to 74% for continuing-generation college students (Glass, 2022). Furthermore, compared to their continuing-generation peers, first-generation college students are 71% less likely to persist in college after their first year (Pratt et al., 2019). Investigating the obstacles faced by first-generation college students is necessary to provide targeted supports and narrow the gaps between them and their continuing-generation peers.

The definition of a first-generation college student can vary among studies. In this dissertation study, first-generation college student status was operationally defined by parental education level. Students who did not have a parent who had attained a bachelor's degree are labeled as first-generation college student. While categorizing students as either first-generation or not helps to enhance our understanding of college students, it may also limit our understanding of the diversity within the first-generation population. It is true that first-generation college students face shared obstacles in their college experience. However, viewing them as a homogenous group may overlook the complexities and nuances within this population. This dissertation examines three specific examples of this: their interactions with high school contexts, issues of college undermatching, and cognitive disabilities.

The college experience, from college access to college completion, is influenced by a range of factors, including students' background, such as first-generation college student status and institutional contexts. It is important to understand how these factors interact with one another since these interactions could result in differences in the college experiences, and therefore outcomes, of first-generation college students.

The high school context could have different effects on prospective first-generation college students and their continuing-generation peers. Even when attending the same high school and having access to the same resources, prospective first-generation college students may not necessarily benefit from the resources in the same way as their continuing-generation peers, which can possibly result in differences in college application behaviors and college access. Prospective first-generation students often have

limited resources for receiving college information, relying primarily on the resources provided by their high school.

In contrast, their continuing-generation peers may have the advantage of navigating the college application process with the help of parents who have college experience. Due to the multitude of decision-making processes involved in college applications, which require knowledge about colleges and universities, prospective first-generation college students may not have the necessary information to make the most advantageous decisions, potentially resulting in their attendance at less selective colleges than they could have otherwise attended. This phenomenon, where students enroll in postsecondary institutions with selectivity levels below what their academic qualifications predict, is defined as college undermatching (Ovink et al., 2018), and limited relevant knowledge is one of the plausible explanations for this phenomenon.

While mixed results have been found regarding college undermatching, numerous studies indicate that college undermatching often leads to negative consequences, such as low completion and employment rates (Fosnacht, 2014; Muskens et al., 2019). Regardless of whether its role is positive or negative, college undermatching could shape the college experience of first-generation and continuing-generation college students differently. Compared to their counterparts who enter a “matched” school, under-matched students are less likely to graduate on time (Horn, 2006), have fewer self-perceived gains, and have lower levels of college satisfaction (Fosnacht, 2014; Muskens et al., 2019). This is important because first-generation college students are more likely to experience college undermatching (Kang & García Torres, 2021; Rodriguez, 2013). However, the effects of the interaction between college undermatching and first-generation status on

college experiences are not fully understood. It is unclear whether first-generation college students have either stronger negative effects or weaker negative effects than their continuing-generation college students from college undermatching, or if the effects are possibly even positive.

In addition to college undermatching, the effects of the interaction between first-generation college student status and disabilities on college experiences and outcomes, such as retention and completion, are also unclear. Previous scholarship has demonstrated that students with disabilities require additional support to navigate and adjust to college life (Herbert et al., 2014; Kim & Lee, 2016), and first-generation students find more difficulties in navigating college life than their continuing-generation peers (Gibbons et al., 2019). It requires further examinations to comprehensively understand how disabilities shape the college experience of first-generation college students.

Overall, there is a growing need to investigate the complexities and nuances within the first-generation student population. Overlooking the differences and nuances among first-generation college students, in addition to the differences between first-generation and continuation-generation students, in educational research can result in a failure to recognize the diverse and unique needs among first-generation college students, which may perpetuate the existing inequities in higher education.

### **Purpose of This Dissertation**

This dissertation study has two primary purposes. First, I investigate the complexities and nuances of the college experiences of first-generation college students. Second, I examine the role of institutions in shaping college access, experience, and outcomes, particularly for first-generation college students. To do so, I conducted three studies,

addressing how (a) how high school contexts influence first-generation college students and non-first-generation college students differently on college choice, resulting in college undermatching, (b) how college undermatching affects first-generation college students and their continuing-generation peers differently on postsecondary outcomes, including college GPA and retention, and (c) how postsecondary outcomes, such as college persistence and completion, differ between students with and without cognitive disabilities, stratified by first-generation college student status.

To guide this dissertation study and better understand the mechanism of college success of first-generation college students, I will draw upon Perna's (2006) conceptual model of college choice and Bowman's (2022) interdisciplinary theory of college student success as conceptual frameworks. Both Perna's and Bowman's models explain the factors that influence college success, but they focus on different stages of the college experience. Perna's model emphasizes the factors that influence college choice and access, while Bowman's model focuses on the factors that contribute to college success after students enroll in college.

Perna's (2006) model suggests that college access is influenced by different levels of contexts, including school and community contexts, higher education institutions, and the social, economic, and policy contexts. These levels of contexts interrelate with each other, and the interplay affects students' decisions about whether to attend college and which type and selectivity of the college they finally enroll in. Bowman's model (2022) suggests college success is shaped jointly by pre-college influences and institutional factors. The interplay between pre-college influences and institutional factors affects the way students engage and interpret the college experience. Students' construals (or

meaning-making or interpretation) of college experience could be different even if they have the same experience, which could result in differences in college outcomes. Both Perna's and Bowman's models emphasize the effects of the interplay between first-generation college student status and other factors in the college experience. Using these two theoretical frameworks allows this dissertation study to account for the complex and unique needs within the population of first-generation college students, and to provide a focus on institutional factors as well.

I use two large-scale nationally representative datasets from the National Center for Education Statistics for this dissertation study: the High School Longitudinal Study of 2009 (HSL:09) and the Beginning Postsecondary Students Longitudinal Study (BPS:12/17). HSL:09 is a nationally representative, longitudinal study of 23,000+ 9<sup>th</sup> graders from 944 schools in 2009, with a first follow-up in 2012 and a second follow-up in 2016. This study collected data through surveys distributed to students, their parents, math and science teachers, school administrators, and school counselors. HSL: 2009 includes information about students' high school activities, college application behaviors, and postsecondary institutions, which is used for the first and the second studies of this dissertation.

BPS:12/17 is also a nationally representative study that tracks a cohort of first-time beginning postsecondary students for six years, 2011-12 through 2016-17. BPS: 12/17 provides data on students' demographic backgrounds, such as disability types and first-generation college student status, institutional characteristics, and postsecondary outcomes, including retention and degree completion, which is used for the third study of this dissertation.

Drawing from large-scale nationally representative datasets, the conclusions of this dissertation study can provide insight into the experiences of first-generation college students in the current higher education system and potentially lead to recommendations for institutional practice and policy making. This dissertation study challenges the concept of a monolithic population of first-generation college students. Postsecondary institutions should be mindful that students who fall under the first-generation college student category come from diverse backgrounds and require tailored assistance.

The results of this dissertation study also provide insights into the future research of first-generation college students. Due to the complexities and nuances within the population of first-generation college students, future research on this group should consider the interaction between first-generation college status and other factors in college experiences in shaping college experiences. Building from this dissertation, future research can have a more comprehensive understanding rather than oversimplifying the experiences of the population. The results of this study also contribute to the understanding of college undermatching, especially for first-generation college students. They offer description of college undermatching nationwide and reveal the role of institutions in perpetuating or mitigating this phenomenon. In the following section, I will provide a brief introduction to the three studies in this dissertation study.

## **Paper 1: The Role of High School Contexts for First-Generation Students in College**

### **Choice and Undermatching**

In the first paper, I explore how the interaction between first-generation college student status and high school contexts shapes college access, specifically college undermatching, using national data from the High School Longitudinal Study of 2009

(Radford et al., 2018). This study answers three questions: 1) To what extent does a student's first-generation status affect college undermatching? 2) To what extent do high school academic climate and assistance in college selection influence college undermatching, after controlling individual characteristics? 3) To what extent do the effects of high school characteristics on college undermatching differ for first-generation college students relative to non-first-generation college students? To do so, I use logistic regression to estimate the effects of student-level variables on college undermatching, then estimate the effects of student-level as well as school-level variables on undermatching. By comparing the results of these two steps, I aim to evaluate how school-level variables may alter the relationship between first-generation college student status and college undermatching.

**Paper 2: The Role of College Undermatching in College GPA and Persistence  
among First-Generation College Students**

In the second paper, I investigate the role college undermatching plays in postsecondary outcomes for first-generation college students and non-first-generation college students and investigate whether the relationships differ by institutional sector (4-year vs. 2-year) and students' high school achievement level, and if these relationships change when accounting for college selectivity. To do so, I address four specific research questions: (1) To what extent do the relationships between college undermatching and postsecondary outcomes vary by first-generation college student status? (2) To what extent do the effects of undermatching and first-generation college student status differ when examining only four-year institutions? (3) To what extent do the effects of undermatching and first-generation college student status differ when examining only

high-achievers? (4) To what extent does our understanding of the influence of college undermatching change if we account for selectivity directly when examining the relationship between college undermatching and outcomes? I examine college undermatching status by using high school academic records and the postsecondary institution a student first enrolled in after high school. Then, I use regression models to examine the relationship between college undermatching and postsecondary outcomes (college GPA and retention). Furthermore, I compare whether these relationships differ across different institutional sectors (4-year vs. 2-year) and among students from diverse academic backgrounds in high school. Lastly, I conducted all regression analyses with two versions: one that excluded college selectivity level as a covariate, and another that included it.

### **Paper 3: How Does Disability Shape the College Experience of First-Generation College Students?**

In the third paper, I investigate how the differences between first-generation and continuing-generation college students in postsecondary outcomes vary based on cognitive disability status. I ask these research questions: (1) To what extent does the relationship between first-generation status and a) college GPA, b) college continuous enrollment, and c) college completion vary by cognitive disability status? (2) To what extent do the relationships change for students who ever attended postsecondary institutions and students who attended four-year institutions only? Cognitive disability includes specific learning disability or dyslexia, attention deficit disorder (ADD), and developmental disability. I use data from the Beginning Postsecondary Students Longitudinal Study (BPS:12/17). With these data, I run regression models to predict

attainment of a bachelor's degree, continuous enrollment, and college GPA, with the whole sample and students who enrolled in four-year institutions.

Overall, these three papers provide examples of the ways that the heterogeneity of the first-generation college student population can be examined. Doing so reveals the nuance and complexity that faces first-generation students in their college access and success trajectories. These studies point to ways that first-generation students can be better served in higher education and provide a foundation from which future research should continue this effort.

## CHAPTER 2

### THE ROLE OF HIGH SCHOOL CONTEXTS FOR FIRST-GENERATION STUDENTS IN COLLEGE CHOICE AND UNDERMATCHING

The college application process can be complex for high school students navigating the transition from secondary to postsecondary education. The whole process includes a number of tasks, decisions, and considerations, all of which have the potential to significantly influence their academic and personal trajectories. Although undergraduate enrollment has drastically increased over the past 20 years, there is a disparity in college enrollment between first-generation and continuing-generation college students (Glass, 2022). Although the definition of first-generation college students is varied by researchers, first-generation college students mostly refer to those whose parent(s) did not complete a college or university degree (House et al., 2020). When first-generation college students enroll in postsecondary institutions, they are more likely to enroll in two-year colleges and the least selective institutions even when they are academically qualified for the more selective institutions (Freeman, 2017; Fry & Cilluffo, 2019). Due to factors such as cost and proximity, one of the plausible explanations is that many first-generation college students experience college undermatching. College undermatching describes a phenomenon where students end up going to a postsecondary institution with selectivity that is below where they could have attended given their academic qualifications (Ovink et al., 2018).

Undesirable consequences occur when students experience college undermatching. Compared to their counterparts who enter a “matched” school, undermatched students are less likely to graduate on time (Horn, 2006), have fewer self-perceived gains, and have

lower levels of college satisfaction (Fosnacht, 2014; Muskens et al., 2019). Further, students who experience undermatching are less likely to be employed after college and have lower earning-outcomes (Ovink et al., 2018). Given these research findings, undermatching among first-generation college students will likely have negative impacts on their social mobility and economic equity in the long run. Therefore, it also likely adds to overall social inequality.

Student characteristics, high school contexts, and the interaction between the two jointly shape college access. The effects of student characteristics, such as locus of control, computer learning experiences, SAT math scores, and the class rank in high school have been well documented (Crisp et al., 2009; Harrell & Bower, 2011). However, students also develop learning skills and make friendships within their high school context. In many cases, the extensive coursework students complete is constrained by coursework the high school can offer. In addition, the learning environment and social support students receive from school contribute to students' learning outcomes, which can influence college access (Kim & Nunez, 2013).

First-generation college students are in disadvantaged positions as they are less likely to obtain college information from their parents or benefit from family social/cultural capital, whereas their continuing-generation peers could access such information from their college-educated parents (Engle, 2007; Glass, 2022). Insufficient knowledge of college application processes, such as admission requirements and financial aid, make prospective first-generation college students more vulnerable (Lee & Mueller, 2014; Perna, 2006). While students' characteristics were highlighted in existing research, high school contexts should not be overlooked. Students' academic performance and college

admission are shaped by their high school experience, including the academic intensity, facilities, physical environment, and college-going culture (McKillip et al., 2013). For example, the important role high school counselors play has been well documented, and the impact of counselors is more significant for first-generation college students (Bryan et al., 2011; M. M. Holland, 2015). Compared to their continuing-generation peers, first-generation college students are significantly more likely to identify their high school counselor as most influential (Cholewa et al., 2015), which suggests that high school counselors could be one of the vital supports first-generation college students could access.

Although scholarship has demonstrated the important roles student characteristics and high school contexts play in college access, the effects of high school contexts on college undermatching for first-generation college students require further direct study. This study will contribute to this knowledge gap, using Perna's (2006) conceptual model of college access and choice as a framework. Perna's (2006) model demonstrated that the interplay between student individual habitus and school contexts shaped students' college choice and access.

Perna's model has been widely used in scholarship of college access and college undermatching from both qualitative perspective (Bell et al., 2009; Perna et al., 2008) and quantitative perspective (Johnson et al., 2021; Sowl & Crain, 2021). However, there is a knowledge gap of using Perna's model to understand college undermatching for first-generation college students from a quantitative perspective using a nationally representative sample. This study aims to explore how the interaction between first-generation college student status and high school contexts shapes college access,

specifically college undermatching, using a national dataset from the High School Longitudinal Study of 2009 (Radford et al., 2018).

This study answers three questions: 1) To what extent does a student's first-generation status affect college undermatching? 2) To what extent do high school academic climate and assistance in college selection influence college undermatching, after controlling individual characteristics? 3) To what extent do the effects of high school characteristics on college undermatching differ for first-generation college students relative to continuing-generation college students? In other words, is there an interaction effect between high school contexts and first-generation status on undermatching?

### **Conceptual Framework**

To better understand students' college choice, it is necessary to consider factors from economic and sociological approaches. On one hand, the costs and benefits of higher education shape students' attitudes as well as decisions toward college application; on the other hand, the decisions made by students are influenced by their high school, higher education institution, social, and policy contexts. Failing to recognize either the economic or sociological perspectives facilitating student college access would hinder a comprehensive understanding of the college application process. Thus, Perna (2006) proposed a combined model of student college choice that integrated these two disciplinary approaches, to emphasize multiple contextual layers possibly influencing students' college choice. She argued that an individual's college choice decisions were shaped by four contextual layers: (1) the individual's habitus; (2) school and community

context; (3) the higher education context; and (4) the broader social, economic, and policy context.

Layer 1 included an individual's demographic characteristics as well as social and cultural capital. Layer 2 reflected how the high school and community context influenced student college choice. Layer 3 explained the role higher education institutions played in shaping student college choice. Layer 4 emphasized the ways in which changes in social forces, economic conditions, and policy context influenced students' college choice (Perna, 2006).

Even though students make decisions in the process of college access, the information, gathered from high school contexts, could facilitate or impede the student's college decision. High school contexts, such as teachers, counselors, and peers could provide access to opportunities while the high school context could also restrict college choice for students from disadvantaged backgrounds (Stanton-Salazar, 1997). Given this study focuses on the interplay between first-generation college student status and high school contexts on college undermatching, this study will be guided by Layer 1 and Layer 2 of Perna's model, focusing on the roles of individual's habitus and high school contexts in shaping students' college choice, specifically college undermatching.

### **Literature Review**

Individual habitus and high school contexts served as tools to explain the differences in undermatched enrollment among students from different family backgrounds. Research demonstrates that students with similar family backgrounds tended to have similar perspectives in terms of parent obligations, expectations, and cultural norms (Coleman, 1988; Lareau, 2015). In addition, the academic rigor,

relationship between school and students' families, and academic climate of high schools jointly influenced students' application behaviors and overall college choice (Attewell & Domina, 2008; Corwin & Tierney, 2007). Application behaviors, in turn, influence whether a student undermatches. In grounding this study, the components of Perna's model (layer 1 and layer 2) are used as conceptual framework, along with existing literature, in selecting relevant variables. This literature review explains the role student characteristics and high school contexts play in the college application process, thereby contributing to students' application behaviors, culminating in possible undermatch.

### **Layer 1: Habitus**

**Cultural capital.** Cultural capital is a symbolic good that promotes college-related behaviors and outcomes (McDonough, 1997). Cultural capital could be manifested in terms of students' attitude towards higher education and parents' attitude towards education. A great amount of evidence has demonstrated a strong association between educational expectation and academic success (Cross et al., 2019; Fan & Wolters, 2014; Trusty, 1998). Students from high-income families were more likely to have higher educational expectations than their counterparts from low-income families (Radford et al., 2018). Parents' expectations and attitudes towards higher education played important roles in shaping students' college choice. Specifically, parents' attitudes and behaviors mediated the negative impact of disadvantaged backgrounds on college enrollment (Crosnoe et al., 2002). However, since parents' definition of success varied with social status, parents had different educational expectations to their children given their social status. Parents from low-income families were more likely to define success as a secure job after high school graduation while parents from high-income families were more

likely to define success as attending to a highly selective four-year college (McDonough, 1997). Both students' and parents' attitudes toward higher education influenced students' motivation, belief, and behaviors, and eventually shaped college enrollment.

**Social capital.** Social capital could be manifested by parents' involvement in which parents used their class resources to help their children to promote college enrollment (Coleman, 1988). Insufficient or false information about the college application process and admission requirements might be the most salient reason for college undermatching as demonstrated in previous studies (Giani & Walling, 2020; Howell & Pender, 2016). Information was a critical mechanism of the college application process, which directly influenced students' college choice (Deutschlander, 2017). Students, especially low-income and first-generation college students, needed guidance with financial literacy. The more information students had; the more likely students got into their "matched" schools.

However, information was not equally distributed to every student. Students would receive more knowledge of college access if their parents discussed the college process, application, and enrollment at home. Middle-class parents could share their college experience and insights with their children, in order to facilitate their children's transition to higher education (Bastedo & Flaster, 2014; Rodriguez, 2015). Furthermore, middle-class parents were able to use their class resources to provide their children academic, social, and career support (Hamilton et al., 2018). However, parents without college degree(s) felt difficulty in fully participating in and facilitating the college application process even though they could help their children with basic needs, including food, housing, and transportation (Page & Scott-Clayton, 2016). Parental involvement played an important role in delivering knowledge of college access and choice.

In addition to being unfamiliar with application processes, students were also prevented from accessing higher education due to insufficient financial literacy. The high student-to-counselor ratio at under resourced schools could result in not accessing information of financial aids or grants in time. Seeking resources proactively became a critical skill. However, compared with their middle-class counterparts, prospective first-generation college students were less likely to get accommodations from institutions due to the gaps in soft skills (Lareau, 2015).

A student's family background plays a crucial role in providing social capital, which includes guidance and motivation, influencing college-access outcomes. The challenges that prospective first-generation college students face in obtaining the cultural and social capital necessary for college access leads to my first hypothesis: prospective first-generation college students are more likely to experience college undermatching than their continuing-generation peers.

## **Layer 2: High school and Community Context**

Rigorous high school courses helped students obtain more access to advanced course opportunities. Under-resourced high schools had less availability of Advanced Placement courses, which created additional barriers for low-income students to get into selective colleges (Attewell & Domina, 2008). Although access and academic quality of Advanced Placement (AP) increased among urban public high schools, students' performance on AP exams did not indicate their preparedness for college (Hallett & Venegas, 2011). To address inequality of resource distribution among different schools, postsecondary institutions, especially selective colleges, started adopting holistic admission processes, which meant that the academic rigor was measured by the most

rigorous curriculum offered by school rather than simply looking at the course students had taken. However, students in the lowest income quartile were less likely to maximize their math and science curriculum (Bastedo et al., 2016). Thus, students from educationally and economically disadvantaged families were less likely to be rewarded from college admission process.

Students were best served by schools with strong “college-going” cultures. A “college-going culture” was defined as the one in which students found encouragement and resources to help them for college success. In addition to academic momentum, important components of this culture included an understanding of how college plans develop, a clear mission statement, comprehensive college services, coordinated and systemic college support (Corwin & Tierney, 2007), and building connections with parents (Auerbach, 2004). However, students from disadvantaged backgrounds were more likely to attend under-resourced public high schools (Holland & Farmer-Hinton, 2009). For students whose parents did not have college experience, high school personnel needed to put more effort in cultivating a “college-going” culture (McKillip et al., 2013).

Schools with rigorous academic climate and providing guidance in college admission could possibly help students from being undermatched, which leads to my second hypothesis: a rigorous academic climate and high assistance in college application decrease the probability of being college undermatched. Students who could not access college-related information from their family were more likely to heavily rely on resources and information that their high schools provide. This reliance makes prospective first-generation college students more vulnerable. The sole reliance on under-resourced public high schools that prospective first-generation college students

experience leads to my third hypothesis: the effects of academic climate and assistance in college application provided by high school are different on college undermatching between prospective first-generation college students and their continuing-generation peers. In other words, there are interaction effects between first-generation college student status and the school variables.

### **Expected Benefits and Costs**

Perna's (2006) model assumed that a student's calculation of benefits and costs of an investment in college was shaped by four contextual layers: habitus, high school context, higher education context, and social, economic, and policy context. Little evidence was found that income expectations of low-income students were significantly different from their high-income student peers (Rouse, 2004), which meant that students from low-income families did not expect lower economic returns of college investment than students from high-income families. However, low-income students were less capable of translating their income expectation into actual application behaviors and college attendance and matching. High-income students tended to apply to a few "par" colleges, a few "reach" colleges, and a few "safety" schools ("achievement-typical" behavior) while low-income students tended to apply to non-selective colleges ("income-typical" behavior) (Hoxby & Avery, 2012). One plausible explanation was that students with a college-going habitus were likely to make "conscious, utility-maximizing decision" about their educational trajectory (Hoxby & Avery, 2012). In terms of the timeline of application behaviors, students with a college-going habitus were also likely to apply to a four-year college by spring of their senior year in high school (Grotsky & Rieglecrumb, 2010). Although not all first-generation college students came from low-

income families, there was a substantial overlap of these two groups. That said, students who on average lacked accurate college information, such as low-income and first-generation college students, were less likely to apply and enroll in a “matched” school.

### **Data and Methods**

The purpose of this study is to examine how individual characteristics and high school contexts interact to shape college undermatching. The data were drawn from the High School Longitudinal Study of 2009 (HSL:09) that tracked high school students’ secondary and postsecondary trajectories of a nationally representative sample. The base year (2009) and first follow-up (2012) collected data about students’ demographic information, such as race, gender, socioeconomic status, college aspirations, and academic backgrounds in 9<sup>th</sup> grade. The second follow-up (2016) data was collected three years after high school addressed questions about the transition from high school to college. The HSL dataset includes over 23,000 9<sup>th</sup> graders from 944 schools by surveys answered by students, parents, math and science teachers, school administrators, and school counselors. This dataset includes the selectivity of postsecondary institutions, the colleges students applied to, college admission status, and the institution a student eventually enrolled in, which were used to define the status of college undermatching. Also, academic climate and college counseling opportunities in high school, and students’ individual characteristics are available in the dataset.

Since this study is interested in the factors that shape college undermatching, I limited the data to students who ever attended college by the end of February 2016. The status of being college undermatched was able to be defined only when the information of colleges students applied for, college admission status, and college they eventually

enrolled in was available. Thus, 6,390 students remained in the analytic sample after dropping the missing cases. All sample sizes were rounded to the nearest 10 in accordance with NCES restricted data license.

### **Outcome Variable**

The outcome variable of this study is whether students were undermatched in their college enrollment. The HSLs data did not include a variable of college undermatching, but it included postsecondary institutions that students applied to and attended. Undermatching could be defined by different approaches (Bastedo & Flaster, 2014) based on a student's college application and admission, in combination with their grades and/or test scores. In general, the operationalization of undermatch can be divided into two steps: a) estimating the highest selectivity a student has access to based on their academic record, and b) comparing it to the selectivity of the postsecondary institution a student actually enrolls after high school. I utilized this method, which was similar to the approach of Smith et al. (2013).

First, I classified colleges into 5 groups by selectivity based on the HSLs variable "postsecondary institution selectivity", including highly selective, moderately selective, inclusively selective, 2-year colleges, and less than 2-year. Different from previous undermatching scholarship that utilized Barrons's competitiveness Index (Kang & García Torres, 2021; Rodriguez, 2015), this study used the selectivity classification available in the HSLs dataset, which was based on Integrated Postsecondary Education Data System (IPEDS), and relied on the Carnegie Undergraduate Profile Classification.

I then created a variable for a student's ideal level of college "match." To determine the highest selectivity level a student had access to, I used logistic regression to estimate

the predicted probability of a student being admitted to each selectivity level based on the student's academic performance, including high school GPA, SAT score, and earned credits in AP/IB. Thus, each student had a corresponding predicted probability of being admitted to each selectivity level. After estimating the probability of each selectivity level, I used a 90 percent probability threshold to determine the highest selectivity level a student would likely be admitted to, based on their past academic performance.

For example, if a student has an estimated probability of being admitted to a highly selective college that was over 90 percent, this student was labeled as having access to highly selective colleges, even if the probability of being admitted to moderately selective institution was higher. If a student had an estimated probability of getting admitted to a moderately selective college that was below 90 percent but had an estimated probability of getting admitted to 2-year college that was over 90 percent, this student would be categorized as having access to 2-year colleges as their ideal "match." Thus, like Smith's (2013) study, this 90-percent threshold would result in a conservative estimate of undermatch.

Finally, after estimating the highest selectivity level that each student had access to, I compared this selectivity level to the selectivity level of the institution where a student actually enrolled, from HSLS data. Students were categorized as undermatched if the level of postsecondary institution that they had access to was more selective than the postsecondary institution where they actually enrolled. The dichotomous variable, being college undermatched or not, was the dependent variable of this study.

### **Student-Level Variables**

I included academic and demographic dimensions of students' individual characteristics. The academic dimension included variables of high school GPA, SAT scores, and the number of credits earned in AP/IB courses. The demographic dimension included variables such as first-generation college student status, household income level, underrepresented racial minority status, and gender. All demographic variables were binary. I used a threshold of \$35,000 to categorize income level. Although estimates and definitions of low-income varied, the U.S. Census Bureau define household middle-class income ranging from around \$35,000 to \$99,999 for 2017 data. Also, under 35,000 is the lowest category of the variable in HSLs data. Underrepresented racial minority includes races other than White and Asian students. Although the importance of utilizing inclusive gender identity is well documented (Fraser, 2018), only binary gender information is available in the dataset.

### **School-Level Variables**

To examine the extent to which high schools help students to attend schools that they are best matched to academically, I included two school-level indicators: a) whether a high school helps 75% or more of 11/12 graders select colleges and b) the percentage of the student body enrolling in AP courses, as a proxy for high school academic climate. These two variables, indicating the college counselling opportunities and college-going culture that students received, align with the high school and community contexts in Perna's (2006) nested model.

## **Data Analysis**

I first conducted descriptive analyses to describe the student- and school-level variables across first-generation and continuing-generation college students, with appropriate weight. In this dataset, an individual student is nested in school, which means students in the same school tend to be more similar than students from different schools. Failure to recognize students within the same school share the same random effect could get inaccurate coefficient estimates and standard errors. To account for this issue, a mixed effect model contains both fixed and random effects, which could well address this issue. Therefore, I used logistic regression to estimate the effect of student-level variables on college undermatching (Model 1). To estimate the effect of school-level variables on undermatching, I added the two school-level variables in the regression model (Model 2). In multilevel analyses, to properly interpret the model, group mean variables should be included at level 2 (which is equivalent to group mean centering) (Bell et al., 2018). Finally, I added an interaction between first-generation college student status and each of the school-level variables (Model 3).

## **Results**

### **Descriptive statistics by First-generation Status**

Table 1 presents the means of all variables by first-generation status. At the student level, the first-generation college students had significantly lower GPA and SAT scores and fewer AP/IB credits earned in high school than non-first-generation students, which paralleled with previous scholarship (Froggé & Woods, 2018). The results confirm that a significantly higher percentage of first-generation college students were from a low-income family (33% vs. 8%) or were underrepresented minorities (42% vs. 23%). At the

school level, non-first-generation college students were more likely to attend a high school with a more rigorous academic climate and greater counseling opportunities. First-generation college students attended high schools that had a lower average rate of enrolling students in AP courses (16% vs. 19%) and that had lower average rates of offering adequate assistance for students in college selection (28% vs. 37%).

Surprisingly, the proportion of students who undermatched upon college enrollment was nearly identical between first-generation and non-first-generation college students, which is not consistent with previous scholarship (Rodriguez, 2013). Thus, the results do not provide enough evidence to support the first hypothesis.

Table 1. Means and standard errors of the estimates, by first-generation status

Variable	All students		Continuing-Gen		First-Gen		Difference
	Mean	SE	Mean	SE	Mean	SE	
Undermatch	0.12	(0.01)	0.11	(0.01)	0.13	(0.01)	0.02
GPA	3.13	(0.01)	3.27	(0.01)	2.99	(0.02)	-0.28***
SAT	1,032	(4.47)	1,089	(5.07)	974	(5.13)	-115***
AP/IB credits	1.98	(0.08)	2.45	(0.10)	1.50	(0.11)	-0.95***
Low-income (\$35,000)	0.21	(0.01)	0.08	(0.01)	0.33	(0.01)	0.25***
Underrepresented minority	0.32	(0.01)	0.23	(0.01)	0.42	(0.02)	0.19***
Female	0.52	(0.01)	0.51	(0.01)	0.53	(0.01)	0.02
% of student body enrolled in AP courses	17.53	(0.83)	19.15	(0.76)	15.84	(1.09)	-3.31***
Adequate assistance in selecting college	0.33	(0.02)	0.37	(0.03)	0.28	(0.03)	-0.09**
Observations	6,390		3,860		2,530		

\* p<.05; \*\* p<.01; \*\*\* p<0.001

NOTE: Significant differences between first-generation college students and continuing-generation college students indicated.

SOURCE: U.S. Department of Education, National Center for Education Statistics, 2009-16 High School Longitudinal Study (HSLs:09/16).

### **Individual characteristics on college undermatching**

To answer my first research question, I ran a mixed-effect logistic regression (Table 2, Student-level) to predict college undermatching based on first-generation status with covariates as high school GPA, SAT scores, AP/IB credits earned in high school, low-income family, racial minority, and gender. Although the difference between first-generation college students and continuing-generation college students in college undermatching is not statistically significant, the results suggest that first-generation college students may be more likely to experience college undermatching. This matches a small (statistically non-significant) gap in the descriptive statistics between first-generation and continuing-generation students. Students with more AP/IB credits earned in high school are less likely to be undermatched. However, students with higher GPA are more likely to experience undermatching according to this regression model, which adjusts for a variety of covariates.

### **High school context on college undermatching**

For my second research question asking how high school academic climate and college counseling support contribute to college undermatching, I ran a the same mixed-effect logistic regression, but with school-level variables added (Table 2, student-level + school-level), to predict college undermatching while adjusting for the student-level measures. The effects of student-level variables did not change significantly after adding the two school-level variables. Although the effects of the two school-level variables were not significant, the results suggest that a high school with a higher percentage of the student body enrolling in AP courses and providing high assistance in college selection might be negatively associated with college undermatching. Thus, students in a high

school with a rigorous academic climate and sufficient college counseling support could be less likely to experience undermatch, though the evidence is not strong for this conclusion overall, averaging across both first-generation college students and their continuing-generation peers.

Table 2. Logistic regression of undermatching

Independent Variables	Student-level		Student-level + school level		Interaction model	
	Coefficient	(SE)	Coefficient	(SE)	Coefficient	(SE)
GPA	2.465***	(0.375)	2.451***	(0.373)	2.428***	(0.368)
SAT	0.001	(0.001)	0.001	(0.001)	0.001	(0.001)
AP/IB credits	-0.320***	(0.068)	-0.315***	(0.068)	-0.314***	(0.067)
First-generation	0.335	(0.230)	0.340	(0.233)	0.56*	(0.268)
Low-income	-0.401	(0.244)	-0.403	(0.244)	-0.419	(0.232)
Underrepresented minority	0.252	(0.234)	0.252	(0.232)	0.302	(0.225)
Female	0.236	(0.191)	0.230	(0.188)	0.222	(0.186)
% of student body enrolled in AP courses			-0.014	(0.011)	-0.019	(0.014)
Adequate assistance in selecting college			-0.301	(0.207)	0.142	(0.286)
First-generation * % of student body enrolled in AP courses					0.008	(0.014)
First-generation * Adequate assistance in selecting college					-1.084*	(0.463)
Observations	6,390		6,390		6,390	

\* p<.05; \*\* p<.01; \*\*\* p<0.001

SOURCE: U.S. Department of Education, National Center for Education Statistics, 2009-16 High School Longitudinal Study (HSLs:09/16).

### **Individual characteristics and High school context on college undermatching**

My final research question asks to what extent the effect of high school contexts on college undermatching for first-generation college students differs from the effect for non-first-generation college students. To answer this question, I added an interaction term between first-generation college students and each of the school-level measures: the percentage of the student body enrolling in AP courses and whether students receiving adequate assistance in college selection. Results indicated that there was a significant interaction between receiving high assistance in college selection and first-generation college students. Results suggested that first-generation college students got an additional boost from the college selection support, contributing to a relatively lower likelihood of undermatching compared with their non-first-generation peers. Thus, the results provide evidence to support the third hypothesis.

To further assess this regression model, I estimated the average marginal effects (AME) for ease of interpretation. The results in Table 3 suggested that the probability of undermatching was negatively associated with credits increase in AP/IB credits earned in high school, and positively associated with high school GPA. For a more intuitive understanding of the interaction results, Figure 1 (based on Model 2 from Table 2) and Figure 2 (based on Model 3 from Table 2) present the predicted probabilities of undermatching for students who did and did not attend a high school with high assistance in college selection by first-generation college student status. Figure 2 demonstrated that the differences between first-generation college students and their continuing-generation peers were significantly larger for students who attended a high school without high assistance in college selection than students who attended a high school with high

assistance. For students who attended a high school without high assistance in college selection, the probability of being undermatched for first-generation college students is significantly higher than their continuing-generation peers. However, by not including the interaction, these results mask the way that first-generation status moderates the relationship between high levels of college assistance and undermatching. Figure 3 accounts for the interactions and shows that for students who attended a high school with high assistance in college selection, the probability of being undermatched for first-generation college students became lower than their continuing-generation peers (although the confidence intervals still overlapped). But for students in schools without high levels of assistance, there is now a statistically significant gap between the groups, with first-generation college students being more likely to undermatch.

Table 3. Mixed-effects logistic regression of undermatching

Independent Variables	Student-level		Student-level + school level		Interaction model	
	dy/dx	(SE)	dy/dx	(SE)	dy/dx	(SE)
GPA	0.260***	(0.036)	0.258***	(0.036)	0.254***	(-0.035)
SAT	0.000	(0.000)	0.000	(0.000)	0.000	(0.000)
AP/IB credits	-0.034***	(0.007)	-0.033***	(0.007)	-0.033***	(-0.007)
First-generation	0.036	(0.025)	0.036	(0.025)	0.034	(-0.022)
Low-income	-0.040	(0.022)	-0.040	(0.022)	-0.041	(-0.021)
Underrepresented minority	0.027	(0.026)	0.027	(0.026)	0.033	(-0.026)
Female	0.025	(0.020)	0.024	(0.020)	0.023	(-0.019)
% of student body enrolled in AP courses			-0.002	(0.001)	-0.002	(-0.001)
Adequate assistance in selecting college			-0.031	(0.021)	-0.035	(-0.02)
Observations	6,390		6,390		6,390	

Note. All reported sample sizes are rounded to the nearest 10 in accordance with NCES restricted data license.

\*  $p < .05$ ; \*\*  $p < .01$ ; \*\*\*  $p < 0.001$

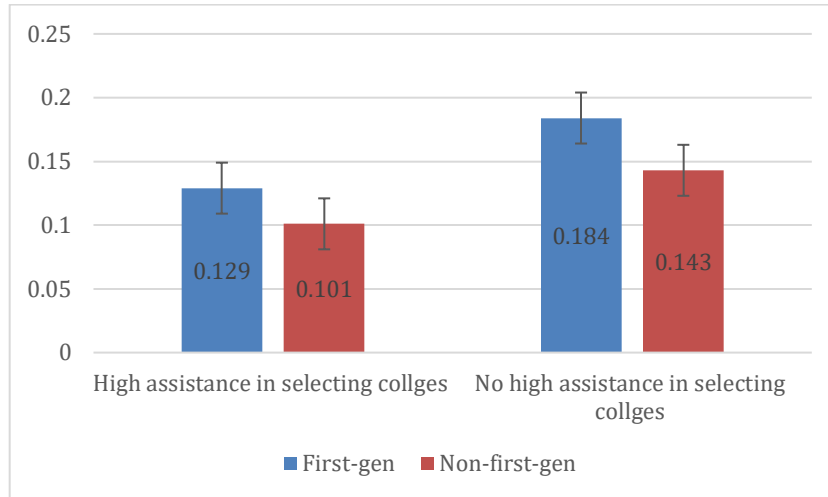


Figure 1. Predicted Probabilities of Undermatching (model 2 - student + school level)

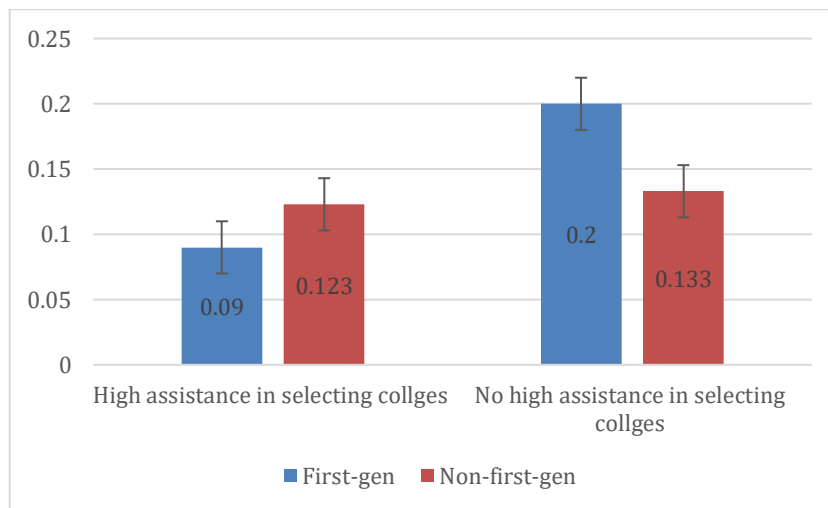


Figure 2. Predicted Probabilities of Undermatching (model 3 - interaction)

Alternate graphs of the interaction results are presented in Figure 3 & 4, which also include the percentage of students enrolled in AP in the high school. In high schools without high assistance in selecting colleges, first-generation tended to have a higher probability of being undermatched than their continuing-generation peers. The gap between first-generation and their continuing-generation peers barely narrowed down with the increase in the percentage of the student body enrolling in AP courses. In high schools with high assistance in selecting colleges, on the contrary, first-gen students were less likely to be undermatched when the percentage of student body enrolling in AP courses compared with their non-first-generation peers. However, with the increase in the student body enrolling in AP courses, the gap became narrow. Eventually, the probability of being undermatched for first-generation college students would become higher than their continuing-generation peers. It's worth noting that there was a significant interaction between first-generation college student status and high assistance in selecting colleges but not between first-generation status and the percentage of student body enrolling in AP. In addition, the descriptive results suggested that the means of the percentage of the student body enrolling in AP courses were not over 20. The graph might not accurately present the relationship among the three since the interaction between first-generation status and the percentage of student body enrolling in AP courses is not statistically significant. Thus, the results do not provide enough evidence to support the second hypothesis.

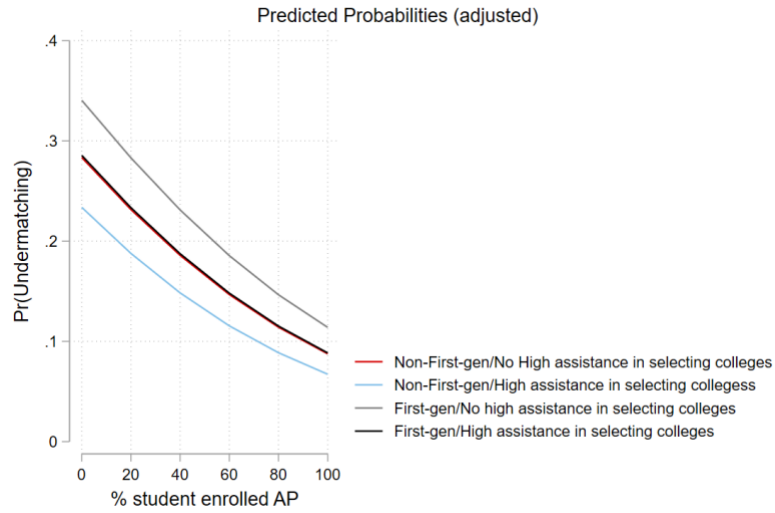


Figure 3. Predicted Probabilities of Undermatching (model 2 - student + school level)

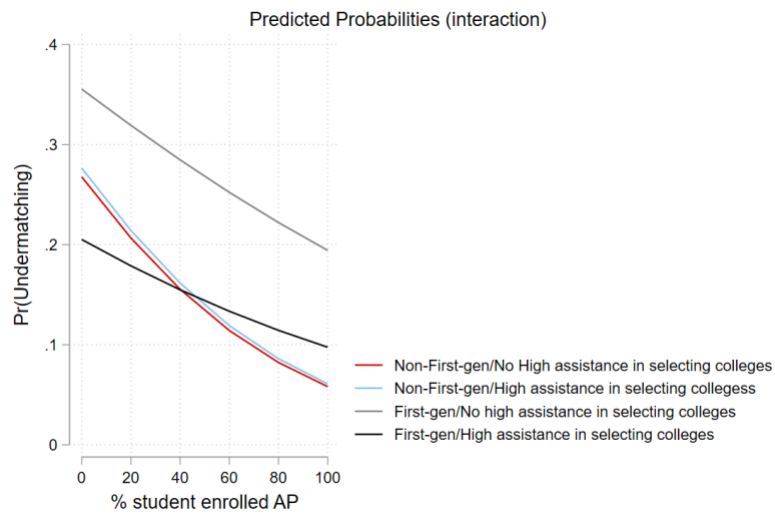


Figure 4. Predicted Probabilities of Undermatching (model 3 - interaction)

In sum, these results suggested that receiving high assistance in college selection while in high school matters more for prospective college students who are first-generation and could reduce their probability of being undermatched more than their continuing-generation students.

## Discussion

College undermatching could result in negative effects for college students, such as being less likely to graduate on time and being employed after graduation, although undermatching may bring a few benefits, such as having more frequent interaction with faculties and participating in collaborative learning activities (Fosnacht, 2014). Investigating how individual characteristics and high school contexts shape college access, particularly college undermatching, is a critical step in understanding the process of undermatching as well as finding potential solutions to prevent college undermatching. This study used data from the 2009 HSLs to examine the differences in college undermatching between prospective first-generation college students and their continuing-generation peers. I further asked whether attending a high school with rigorous academic climate and receiving high assistance in college selection mitigated the differences in college undermatching between first-generation and their continuing-generation peers.

The descriptive results showed significant disparities in GPA, SAT, and AP/IB credits earned in high school between first-generation college students and their continuing-generation peers. This finding supports existing research suggesting that first-generation students are less likely to be academically prepared for college (Taylor et al., 2019). Also, first-generation college students were more likely to come from a low-income family and to be underrepresented minorities. That said, there may be a large overlap among the populations of first-generation college students, low-income, and underrepresented minorities, which is paralleled with previous scholarship (Tate et al., 2015). In addition, first-generation college students were less likely to attend a high

school with a rigorous academic climate and abundant counseling opportunities for college access. Results likewise supported that prospective first-generation college and low-income students tended to attend an under-resourced public high school (N. E. Holland & Farmer-Hinton, 2009). However, the significant differences in undermatching between first-generation college students and their continuing-generation peers were not found. This does not support my first hypothesis. Also, the rate of undermatching (12%) in this study is lower than previous studies (Dillon & Smith, 2017; Smith et al., 2013). The differences might be due to a different population/cohort and a different selectivity standard. The classification of selectivity in HSLs:2009 was based on IPEDS classification while most previous studies employed Barron's competitiveness Index (Kang & García Torres, 2021; Rodriguez, 2015).

In answering my questions about the role of individual characteristics in college matching, I found that GPA had positive effect on college undermatching, which confirmed the findings of the association between high school grades and undermatching (Fosnacht, 2014). Results also showed that more AP/IB credits earned in high school could significantly mitigate college undermatching. This finding confirms the effect of maximizing high school curriculum on college matching (Bastedo et al., 2016). That said, GPA is not the only important indicator in college admission. Given the fact that students from low-income families and who were underrepresented minorities were less likely to maximize their high school curriculum and benefit from doing so in the college admission process (Bastedo et al., 2016; Bastedo & Flaster, 2014), the negative association between AP/IB credits earned in high school increases the risk of being undermatched for first-generation college students.

The effects of individual characteristics remained about the same after controlling the school-level variables. Both rigorous academic climate and receiving high assistance in college selection showed marginal negative main effects, if any, on college undermatching.

In answering to my final question, I found significant interaction between first-generation college status and receiving high assistance in college selection. This supports third hypothesis. Results suggested that receiving high assistance in college selection not only narrows the gap of undermatching between first-generation college students and their non-first-gen peers but also help first-generation college students become less likely to be undermatched, after controlling other covariates. This finding has important implications given that disadvantaged students are more likely to attend under-resourced public high school (Holland & Farmer-Hinton, 2009).

### **Implications**

Policies and interventions aiming to address college undermatching should consider college counseling as an important factor. First-generation college students, and students from disadvantaged backgrounds, are the population need most support from their high school due to limited ways of access to college knowledge. High schools should provide additional support for prospective first-generation college students and other populations who may need assistance in the process of college application, specifically selecting colleges.

At a higher level, policymakers should invest more in programs like TRIO, Upward Bound, and GEAR UP that support low-income and first-generation students in navigating the path to college. Implementing programs that provide comprehensive

financial literacy education for first-generation college students and their parents could help them make better college decisions. Additionally, policymakers should foster collaboration between high schools and postsecondary institutions to offer more opportunities for high school students to explore college, such as through college tours and dual enrollment programs.

Although this study contributes the understanding of the effect of receiving assistance in selecting colleges on undermatching, more research is needed to fully understand college undermatching specifically for first-generation college students. For example, results of this study suggest the association between college counseling and college undermatching, future research could evaluate the effectiveness of intervention programs, such as college counselling, and other programs, like financial literacy workshop, share college knowledge like the effects of college selectivity and college undermatching.

The results suggest a low rate of college undermatching. While this might seem positive, it does not necessarily indicate a drastic decrease in college undermatching, as there could be various underlying reasons for this finding. Future research should explore different populations and employ varying operational definitions of college undermatching to compare with the results of this study, thereby providing a more comprehensive picture of the issue.

Future researchers might also consider comparing the differences in undermatching outcomes using various selectivity classification schemes. Such studies would enable scholars to better understand the process of defining the undermatching population and uncover possible explanations for undermatching.

### Chapter 3

#### **THE ROLE OF COLLEGE UNDERMATCHING IN COLLEGE GPA AND PERSISTENCE AMONG FIRST-GENERATION COLLEGE STUDENTS**

College undermatching, a phenomenon where a student attends a less selective college or university than their academic performance predicts (Bastedo & Flaster, 2014; Fosnacht, 2014; Rodriguez, 2015), is a critical issue of educational equity. Although college undermatching could possibly have positive effects (Wolniak & Muskens, 2021), the negative consequences of college undermatching are well documented (Dillon & Smith, 2017; Hoxby & Avery, 2012; Muskens et al., 2019). Compared to more selective colleges, less selective colleges tend to have fewer resources and support that students need to succeed in college, particularly for students who come from disadvantaged backgrounds (Bastedo & Flaster, 2014).

Students from disadvantaged backgrounds requiring additional support to succeed in college are well documented, including first-generation college students. These students are less likely to have the connections and tools to navigate institutions that have fewer resources and less support. However, college undermatching is prevalent among first-generation students (Hoxby & Avery, 2012; Rodriguez, 2013; Smith et al., 2013). Therefore, college undermatching may have different effects and implications for first-generation college students, compared to their continuing-generation peers. Both first-generation college student status and college undermatching have been well studied as factors related to college outcomes separately, but there is a gap in the literature in considering these two factors simultaneously. Additionally, the support, resources, and academic rigor can be vastly different between two-year and four-year institutions. As a

specific type of undermatch, more attention should be paid to the distinction between the sectors.

Lower perceived gains and lower levels of college experience satisfaction may also be related to high-achievers who experience college undermatching (Fosnacht, 2014). Although perceived gains and college experience contribute to college outcomes, such as college academic performance and persistence, the relationships between undermatching and college outcomes for high-achievers require further investigation. Given these complexities, it's reasonable to assume college undermatching may work differently depending on students' achievement status.

Despite the evident relationship between the selectivity levels of postsecondary institutions and college undermatching, prior research frequently overlooked the specific effect of institutional selectivity versus the unique contribution of the undermatch itself, when delving into the connection between college undermatching and college outcomes (Fosnacht, 2014; Kang & García Torres, 2021; Ovink et al., 2018). Accounting for institutional selectivity in analyses of undermatching can be crucial as it could potentially alter the findings related to college undermatching effects and therefore our understanding of how to advise and support students. Models that control for both college selectivity and high school academics provide a more accurate estimate of the relationships between student outcomes and undermatching as a phenomenon that is distinct from simply selectivity. This is because high school academics and college selectivity, especially the latter, exert direct effects on college outcomes themselves.

Thus, the purpose of this dissertation study is to understand the role college undermatching plays in postsecondary outcomes for first-generation college students and

their continuing-generation peers. Moreover, this study explores whether the relationships differ by institutional sector and students' achievement status. Additionally, the study aims to improve on the methods used in past literature on the topic by more accurately accounting for the influence of postsecondary institution selectivity on the connection between college undermatching and outcomes. This study aims to provide substantive significance by understanding undermatch in a more nuanced and complicated manner for first-generation students, but also to provide methodological significance by improving on the regression models of past studies.

To do so, I address the following research questions: (1) To what extent do the relationships between college undermatching and postsecondary outcomes vary by first-generation college student status? (2) To what extent do the effects of undermatching and first-generation college student status differ when examining only four-year institutions? (3) To what extent do the effects of undermatching and first-generation college student status differ when examining only high-achievers? (4) To what extent does our understanding of the influence of college undermatching change if we account for selectivity directly when examining the relationship between college undermatching and outcomes?

### **Literature Review**

Previous research suggests that being a first-generation college student and experiencing college undermatching are both factors that could contribute to the risk for college success. This section will review the interplay between first-generation college student status and college undermatching on college success. Given the differences between first-generation college students and their continuing-generation peers, it is

likely that the effects of undermatching are different between first-generation and non-first-generation college students on student success. First-generation college students are more in need of support in financial aid and student services than their continuing-generation peers to persist in and graduate from college (House et al., 2020). However, first-generation college students tend to have less access to these necessary resources if they experience college undermatching because less selective colleges also tend to have fewer resources and supports.

### **Financial Aid**

First-generation college students are more likely to experience financial stress than their continuing-generation peers. Although first-generation college students don't necessarily come from low-income families, there is an overlap in population between first-generation college students and low-income students. It has been documented that first-generation college students are more likely to experience financial distress (House et al., 2020). Students who experience financial stress are more likely to work long hours and have less time spent on coursework, which negatively affects their academic performance (Bennett et al., 2015). Financial stress is also related to dropping courses and being less likely to graduate (Welbeck et al., 2014). Even though colleges and universities provide different services to help students, financially stressed students tend to focus on coping with the stress and perceive a less supportive campus environment (Fosnacht & Dong, 2013). Financial stress makes first-generation college students worry about money and prevents them from completing their degrees, which indicates that first-generation college students need more financial support than their continuing-generation peers.

First-generation students would receive more financial resources and support in the most selective colleges. Hoxby and Avery (2012) found that a low-income student who received admission to one of the most selective colleges can actually expect to pay less than to attend a non-selective 4-year college or 2-year college. Studies indicated that students would choose to attend a more selective college if they correctly estimated the net costs (Avery & Turner, 2010; Dillon & Smith, 2013). The most selective colleges offer generous financial aid by replacing loans with grants for low-income students. However, most moderately selective colleges are not able to replace loans with grants as the most selective colleges. Although moderately selective colleges provide rich instructional and financial support, the financial aid moderately selective colleges provide disproportionately includes loans (Hoxby & Avery, 2012). Since moderately and low selective colleges receive little endowment or funds from their state government, they are not able to subsidize their students with financial constraints as the highly selective colleges do.

First-generation college students still tend to enroll in less selective colleges than their academic ability due to financial reasons. Research demonstrated that students from economically disadvantaged backgrounds tend to be risk-averse to student loans (Baum & Schwartz, 2015). They tend to choose less selective colleges and universities if they need to take out a high student loan for a more selective college. Thus, even when students have well informed about the correct college net costs, they still tend to go to a less selective college with lower costs. In most cases, first-generation students who are academically qualified to attend a moderately selective college may not receive sufficient financial support. Rather than taking student loans to attend a moderately selective

college with rich instructional resources, first-generation college students are likely to attend a less selective college with lower costs.

### **Student services**

Compared with their continuing-generation peers, first-generation college students are more in need of student services support. First-generation college students often receive emotional support but little concrete information about the college experience from their parents (Azmitia et al., 2018). First-generation college students experience difficulties in adjusting to college and do not feel prepared for the transition from high school to college coursework. It has been documented that 54 percent of first-generation college students were required to take remedial courses because they were deemed underprepared for the rigor of college-level courses (Chen & Simone, 2016).

In addition to academic readiness, a sense of belonging on campus has positive effects on adjustment to college, academic performance, and overall college experience (Ostrove & Long, 2007). However, students from working-class backgrounds, such as first-generation college students, tend to have a lower sense of belonging on campus (Bettencourt, 2021). The academic under-preparedness and a lower sense of belonging advocate that first-generation college students need a strong student support service system, including academic tutoring and advising.

More selective institutions tend to have stronger student support service systems. Research has demonstrated that institutional spending on student services was negatively related to college leaving and had a positive effect on college completion (Chen, 2012; Webber & Ehrenberg, 2010). Student services include but are not limited to academic tutoring and advising, career advising, and even non-academic services (i.e., events and

recreation center). It is well documented that these types of student services have positive effects on college success and completion (Tate et al., 2015; Webber & Ehrenberg, 2010). More selective colleges and private colleges tend to have a higher expenditure per student (Webber & Ehrenberg, 2010). Elite colleges (e.g., Yale University) would provide more than \$13,000 more per student in educational spending than institutions only one tier lower (e.g., Boston University) (Hoxby & Avery, 2012), which indicates more selective colleges are able to provide students more abundant student services. To put it another way, the fewer student services provided by less selective colleges could possibly contribute to college dropout.

First-generation college students are more likely to be undermatched and attend a less selective college, where they have less access to student services than in a "matched" college. For first-generation college students who are college undermatched, they may not have access to sufficient student services, including academic and non-academic support, to persist in college. First-generation college students are more likely to benefit from student services. However, they are actually less likely to access sufficient student services in less selective colleges due to college undermatching.

### **Institutional Selectivity**

Institutional selectivity is often considered a proxy for college quality in academic research. While there are various methods to measure college selectivity, the average or median scores of incoming or enrolled students on standardized tests, such as the ACT and the SAT, are commonly employed (Pascarella et al., 2006). Different indices are widely used to assess college selectivity, including the Carnegie Classification from the Carnegie Foundation for the Advancement of Teaching. An alternative measure is from

Barron's Index, based on the college's average SAT scores and the ratio of applicants to those admitted (Witteveen & Attewell, 2017). Carnegie's Classification centers on the classification of institutions, considering factors like the variety and scope of degree programs available and the annual amount of federal support received by each institution (*The Carnegie Classification of Institutions of Higher Education*, n.d.). While relying on standardized test scores as a means to assess college quality may pose challenges, and acceptance rates and standardized test scores might not be ideal proxies for evaluating college quality, there is a connection between institutional selectivity and positive college practices and outcomes (Pascarella et al., 2006). Nevertheless, this study has also revealed that approximately 90 percent of the variance in good college practices cannot be explained by institutional selectivity. Therefore, further research is needed to delve into the relationship between institutional selectivity and college quality.

Previous studies demonstrates that the relationship between selectivity and college outcomes (Fosnacht, 2014, 2015; Wolniak & Muskens, 2021). More selective institutions are able to provide not only more recourses, academic as well as financial, but also allow students to study with more competitive/excellent peers (Hoxby, 2009). Also, study also suggests that students have best learning outcome when they experience academic challenge, although going to a less selective institutions could have positive effects in short term, such as satisfaction of college experience and academic self-confidence (Wolniak & Muskens, 2021).

The main reason that studies claim that college undermatching has negative effects on college outcomes is that less selective institutions have fewer resources (Fosnacht, 2014; Kang & García Torres, 2021). So even students who are academically

prepared in more selective institutions will have better college outcomes if they attend an academically matched institution. However, previous studies did not include selectivity level of postsecondary institutions as a covariate, which could possibly confound the relationships between college undermatching and college outcomes, which could be due to the selectivity level alone rather than the undermatch per se. Some previous studies about college undermatching and college outcomes utilized methods such as propensity score matching, so they used pre-treatment effects, such as personal background and high school academics as covariates in the regression models (Fosnacht, 2014; Kang & García Torres, 2021; Rodriguez, 2015; Wolniak & Muskens, 2021).

The literature review suggests that first-generation college students often face financial difficulties in the college experience. Although not all first-generation college students have financial constraints, many of them heavily rely on institutional support to seek financial aid due to limited information and assistance from their parents. Since less selective colleges tend to provide fewer resources, first-generation college students who experience college undermatching are less likely to receive the assistance they need, and the difficulties of navigating the complex postsecondary setting create additional barriers to college success.

### **Conceptual Framework**

This study used the interdisciplinary theory of college student success (Bowman, 2022) as the conceptual framework (see Figure 1), to show where the specific concepts used in this study—undermatching, first-generation status, high school achievement, institutional selectivity—fit into an overall understanding of student success. The theory suggests that college student success is shaped jointly by pre-college influences and

institutional factors, along with the broader contexts. College success can be exemplified by four questions: Can I do it? Do I belong here? Why should I do it? Can I afford it? The dynamics of college student success start well before college. Socialization, identities, academic preparation, educational intentions, psychological attributes, and material resources are described as pre-college influences. Policies, bureaucracy, programs, agents, and communication are categorized as institutional factors. The interplay between pre-college influences and institutional factors directly affects the way students engage and interpret the college experience.

Institutions may not be able to alter pre-college influences, but they are able to create support systems as well as barriers, to alter the student's experience, and likely to affect college student success. These institutional factors include financial support and student services, as reviewed above. These experiences, where background factors like first-gen status meet institutional factors, are then construed by students to have certain meaning. It is worth noting that students' construals (or meaning-making or interpretation) of experience could be different even for the same experiences. Students reinforce or modify their answers to the four questions mentioned above, which eventually affect college retention and persistence.

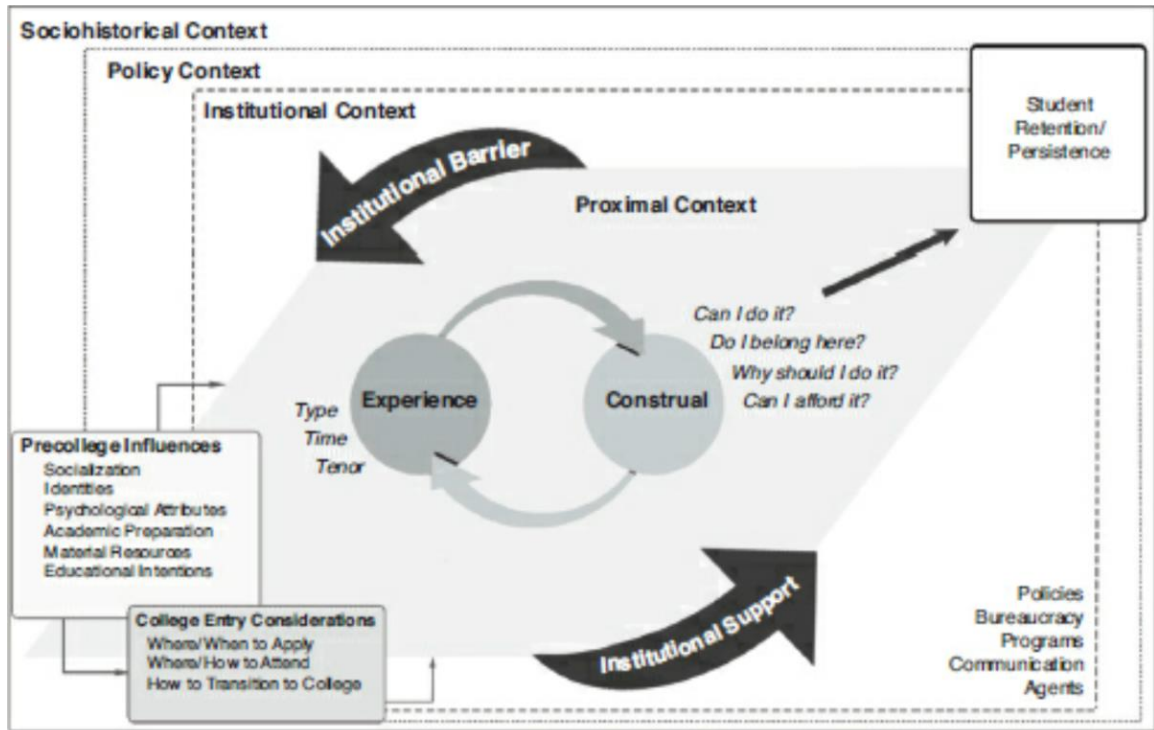


Figure 5. Interdisciplinary theory of college student success (Bowman, 2022)

The interdisciplinary theory of college student success (Bowman, 2022) is a helpful framework for thinking about the college experiences of first-generation college students. First-generation college students require additional support when they transition to college life. It is common for them to feel disconnected and struggle to adjust to academic and social life in college when they face challenges of navigating resources and assistance available to them. Due to the complex postsecondary setting, bureaucratic hassles would have negative effects on college students' sense of belonging (Reeves, 2015), which can lead first-generation college students to ask themselves, "Do I really belong here?" Failing to navigate the resources they need may result in negative college outcomes, including college grades, persistence, and completion, which can lead first-generation college students to ask themselves, "Can I do it?" This cyclical process could

pose a threat to first-generation college students, and they solidify the response to these questions throughout the experience.

Bowman's model (2022) is also helpful for understanding the experience of students being college undermatched. "College entry considerations," such as where/when to apply and where/how to attend, directly affect students' college application and enrollment. College undermatching can be seen as the consequence of these considerations. In the college application process, college undermatched students may feel that it is difficult to answer the question, "Why should I choose a more selective college?" Due to limited financial aid literacy, many of them may believe that less selective colleges are more affordable. However, in many instances, students receive less financial as well as academic assistance in less selective colleges, which leads them to ask themselves, "Can I afford it?" and "Why do I attend?" In less selective colleges, academic and financial resources are more limited, which can be particularly challenging for students who heavily rely on these resources.

The institutional sector and students' achievement status should also be taken into account when examining the effects of undermatching on college success. The institutional setting and college experience can be vastly different depending on these two factors. Overall, this model provides a way of thinking about how undermatch fits within a broader schema of college student success and whether it is a positive or negative influence.

### **Method**

In this study, I investigated the extent to which relationships between college undermatching and postsecondary outcomes vary by first-generation college student

status. Moreover, I investigated if the relationships are different when examining only four-year institutions or when focusing solely on high-achieving students. To contribute to the methodological advancement of the field and to gain insight into how undermatching is uniquely related to college outcomes when the selectivity of the college is separately and explicitly taken into account, all regression analyses will be conducted in two versions: one without including selectivity as a covariate (similar to most existing research in this area) and one including college selectivity level in the model.

### **Sample**

The data were from the High School Longitudinal Study of 2009 (HSL:09) that tracks high school students' secondary and postsecondary trajectories for a nationally representative sample. The analytical samples were restricted to students who ever attended postsecondary institutions. I employed multiple imputation to handle missing data by generating 20 imputations. These imputations incorporated all study variables into the imputation models, and I executed this process using the "mi impute chained" command in Stata.

I defined the college undermatching status based on its determinants and then included the college undermatching variable in the imputation model. It's worth noting that there exist some opinions that advocate for the imputed model to consist solely of independent variables because including the dependent variables in the model can inflate the sample populations. However, Graham (2009) refers to this as a myth and explains that the imputation model is more biased with the dependent variable excluded than included. In my imputed models, I incorporated both independent and dependent variables.

Although the data had a high missingness rate of 67%, it's important to highlight that only three variables have missing rates exceeding 20%: college undermatching (23%), working more than 20 hours per week (31%), and receiving financial support from their first institutions (35%). While a high rate of missingness may raise concerns about the reliability of the statistical results, this issue can effectively be addressed through multiple imputation techniques (Graham, 2009).

The imputed and weighted sample comprised 8,500 students, with 1,140 classified as undermatched and 7,360 as non-undermatched. Among the 6,110 students who attended four-year institutions, 440 were identified as undermatched. Within the subset of 3,950 high-achieving students who had access to highly and moderately selective institutions based on their high school academic performance, 800 students were categorized as undermatched. All sample sizes were rounded to the nearest 10 in accordance with NCES restricted data license.

## **Variables**

**Dependent variables.** The dependent variables were GPA at the first postsecondary institution and college persistence by 2016. Based on Bowman's model, college persistence and completion should be examined as college outcomes. However, the data only include information about college persistence but not completion. In order to gain some insight into college outcomes, and to build on past literature which has examined this variable, I also examine college GPA as an important college outcome.

**Independent variables.** The two key independent variables were college undermatching status and first-generation college students. College undermatching is operationally defined by high school academics and the selectivity of the postsecondary

institution a student firstly enrolled in. If students enroll in a postsecondary institution that is less selective than the ones they are academically qualified for, they are labeled as college undermatched.

First-generation college student status was operationally defined by parental education level. Students who did not have a parent who had attained a bachelor's degree are labeled as first-generation college student.

**Covariates.** Drawing on the literature review and Bowman's model, I will include factors that possibly influence college GPA and persistence in the regression models as covariates. These covariates will include a student's belief in college as a good financial investment, number of hours worked per week, receipt of institutional aid, academic preparation for college, high school academics, institutional selectivity, and demographic information such as underrepresented minority status and gender.

An essential covariate for addressing my final research question is institutional selectivity. This covariate is derived from the original variable representing the selectivity of the first postsecondary institution that respondents attended after high school. This variable categorizes postsecondary institutions into five levels: (1) Highly selective, 4-year institution, (2) Moderately selective, 4-year institution, (3) Inclusive, 4-year institution, (4) Selectivity not classified, 4-year institutions, (5) Selectivity not classified, 2-year institution, (6) Selectivity not classified, less than 2-year institution. This variable is derived from data obtained from the 2016 Integrated Postsecondary Education Data System (IPEDS), which relies on the Carnegie Undergraduate Profile Classification, itself based on equivalent ACT scores.

Due to the smaller populations in levels 3 and 4 compared to other groups, I have combined these two levels. The other categories remain unchanged in the new variable. It's worth noting that previous research typically did not include this covariate in regression models examining undermatching. This omission could potentially introduce confounding effects of institutional selectivity on outcomes, rather than capturing the unique impact of undermatching itself. By including this variable in my analysis, I aim to enhance the quality of my research compared to previous studies.

### **Analysis**

The analysis could be divided into three steps. First, I examined college undermatching status by using high school academic records and the postsecondary institution a student first enrolled in. Using the approach of Smith et al. (2013), I computed the probabilities of students gaining admission to different levels of selectivity. To achieve this, I employed a logistic regression model to investigate whether a student's admission to any selectivity level based on their high school academic credentials. These academic credentials encompassed high school GPA, SAT or ACT scores, and the number of credits earned in Advanced Placement (AP) or International Baccalaureate (IB) coursework. Following the estimation of each student's likelihood of admission to various college selectivity levels, I categorized students based on the highest level of college selectivity to which they were likely to have access, using a threshold of 90 percent. For example, if a student had an estimated probability of 90 percent or greater for admission to a highly selective college, they were considered to have access to a highly selective college. If a student's chance of admission to a highly selective college was below 90 percent but exceeded 90 percent for a moderately selective college, they

were classified as having access to a moderately selective college. Students are considered to be "college undermatched" if they enroll in a college with a selectivity level that is lower than the one they had access to based on their qualifications.

Second, I examined the means and standard errors for all variables, comparing these values for undermatched students and non-undermatched students. Third, I used linear regression to examine the relationship between college undermatching and college GPA and logistic regression for the relationship between college undermatching and college persistence. To answer research question #1 about the varying effect of college undermatching based on first-generation college student status, the interaction terms between these two variables were added in the regression models. Regression models included college undermatching and first-generation college student status, adjusted by all covariates. To address research questions #2 and #3 concerning the role of college undermatching in postsecondary outcomes within various contexts, I ran regressions for three sets of populations: a) all students who ever attended postsecondary institutions, b) students in four-year institutions only, and c) students who have access to highly and/or moderately selective institutions (higher-achievers). Average marginal effects (AME) are used for ease of interpretation. Statistical tests were conducted to examine differences between sub-groups. Predicted probabilities provide a more intuitive understanding of the regression models, accounting for all variables within the model.

Moreover, issues have been raised regarding the use of z-statistics of the coefficient of a multiplicative term to test for statistical interaction in nonlinear models with categorical dependent variables (Mustillo et al., 2018), including discrepancies in residual variation among groups (Williams, 2009) and other concerns. In other words,

utilizing the coefficient of the interaction term to draw conclusions about statistical interaction in categorical models such as logit, probit, and Poisson is not recommended (Long & Mustillo, 2017).

To answer research question #4, I conducted all regression analyses with two versions: one that excluded college selectivity level as a covariate (similar to most existing studies), and another that included it. Given that prior research often omitted college selectivity when examining the impact of college undermatching on college outcomes, this approach aimed to explore the extent to which including college selectivity altered our comprehension of the role of college undermatching in college outcomes across different contexts.

### **Limitation**

Like any research, this study comes with certain limitations. As previously mentioned, I classified college undermatching status based on a threshold (90%) of the predicted probabilities of admission to any level of postsecondary institutions' selectivity. While employing a threshold is a common approach to define college undermatching, it can potentially result in information loss by not capturing the true variance of college undermatching (e.g., for students who are close to the 90% threshold) when converting a continuous variable into a binary one.

College persistence is a valuable metric for evaluating college outcomes, but to have a more comprehensive understanding of college undermatching, it would be advantageous to include information about degree completion. Unfortunately, the HSLs dataset lacks information regarding degree completion.

## Results

### **Descriptive statistics by college undermatching status**

Table 4, Table 5, and Table 6 present the means of all variables by college undermatching status for students who ever attended postsecondary institution, students in 4-year institutions, and higher-achievers, respectively. Undermatched students had significantly higher college GPA than their non-undermatched peers among all students (3.07 vs. 2.51) and students in 4-year institutions (3.22 vs. 2.73). While no significant differences emerged between undermatched and non-undermatched students in terms of college persistence among those who have attended postsecondary institutions (Table 4) or students in 4-year institutions (Table 5), a distinct pattern existed among high-achievers (64% vs. 84%) (Table 6), where undermatched students exhibited a lower rate of persisting in college. Undermatched students were more likely to be first-generation college students, but significant differences were found among high-achievers only (52% vs. 30%) (Table 6). Across all groups, undermatched students had lower rates of attending moderately selective colleges and higher rates of enrolling in inclusively selective colleges and 2-year institutions, compared to their non-undermatched peers.

Table 4. Means and standard errors of the estimates, for all variables (all students)

	All		Non-undermatched		Undermatched		Difference
	Mean	SE	Mean	SE	Mean	SE	
GPA at first postsecondary institution	2.58	(0.02)	2.51	(0.02)	3.07	(0.05)	0.56***
College persistence	0.61	(0.01)	0.61	(0.01)	0.60	(0.03)	-0.01
First-gen student	0.55	(0.01)	0.54	(0.01)	0.57	(0.03)	0.03
College will be good financial investment	0.89	(0.01)	0.89	(0.01)	0.93	(0.01)	0.04**
Worked more than 20 hours while attending college	0.38	(0.01)	0.37	(0.01)	0.41	(0.03)	0.04
Received any institution aid at primary first year institution	0.41	(0.01)	0.40	(0.01)	0.44	(0.03)	0.04
URM	0.41	(0.01)	0.43	(0.02)	0.28	(0.03)	-0.15***
Female	0.52	(0.01)	0.52	(0.01)	0.58	(0.02)	0.06*
College readiness	0.70	(0.01)	0.70	(0.02)	0.71	(0.03)	0.01
High school GPA	2.92	(0.02)	2.85	(0.02)	3.41	(0.02)	0.56***
SAT	966	(5.98)	955	(6.44)	1,043	(8.40)	88***
Earned Credits in AP/IB	1.51	(0.07)	1.54	(0.07)	1.32	(0.11)	-0.22*
Moderately selective	0.27	(0.01)	0.31	(0.01)	0.01	(0.00)	-0.30***
Inclusively selective	0.16	(0.01)	0.14	(0.01)	0.31	(0.02)	0.17***
2-year	0.38	(0.01)	0.34	(0.01)	0.63	(0.03)	0.29***
Less than 2-year	0.02	(0.00)	0.02	(0.00)	0.06	(0.01)	0.04**
Observations	8,500		7,360		1,140		

\* p<.05; \*\* p<.01; \*\*\* p<0.001

NOTE: All reported sample sizes are rounded to the nearest 10 in accordance with NCES restricted data license.

Significant differences between undermatched students and non-undermatched students indicated

SOURCE: U.S. Department of Education, National Center for Education Statistics, 2009-16 High School Longitudinal Study (HSL:09/16).

Table 5. Means and standard errors of the estimates, for all variables (4-year institutions only)

	All		Non-undermatched		Undermatched		Difference
	Mean	SE	Mean	SE	Mean	SE	
GPA at first postsecondary institution	2.77	(0.02)	2.73	(0.02)	3.22	(0.06)	0.49***
College persistence	0.72	(0.01)	0.72	(0.01)	0.69	(0.03)	-0.03
First-gen student	0.45	(0.01)	0.45	(0.01)	0.50	(0.04)	0.05
College will be good financial investment	0.91	(0.01)	0.90	(0.01)	0.95	(0.02)	0.05**
Worked more than 20 hours while attending college	0.30	(0.01)	0.30	(0.01)	0.28	(0.04)	-0.02
Received any institution aid at primary first year institution	0.56	(0.01)	0.55	(0.02)	0.69	(0.04)	0.14**
URM	0.36	(0.02)	0.37	(0.02)	0.26	(0.03)	-0.11**
Female	0.54	(0.01)	0.53	(0.01)	0.59	(0.03)	0.06
College readiness	0.76	(0.01)	0.75	(0.02)	0.79	(0.03)	0.04
High school GPA	3.17	(0.02)	3.14	(0.02)	3.56	(0.03)	0.42***
SAT	1,037	(6.30)	1,033	(6.59)	1,103	(11.67)	70***
Earned Credits in AP/IB	2.16	(0.09)	2.18	(0.09)	1.91	(0.18)	-0.27
Moderately selective	0.44	(0.01)	0.47	(0.01)	0.02	(0.01)	-0.45***
Inclusively selective	0.29	(0.01)	0.24	(0.01)	0.97	(0.01)	0.73***
Observations	6,110		5,670		440		

\* p<.05; \*\* p<.01; \*\*\* p<0.001

NOTE: All reported sample sizes are rounded to the nearest 10 in accordance with NCES restricted data license.

Significant differences between undermatched students and non-undermatched students indicated

SOURCE: U.S. Department of Education, National Center for Education Statistics, 2009-16 High School Longitudinal Study (HSL:09/16).

Table 6. Means and standard errors of the estimates, for all variables (high-achievers only)

	All		Non-undermatched		Undermatched		Difference
	Mean	SE	Mean	SE	Mean	SE	
GPA at first postsecondary institution	3.17	(0.02)	3.17	(0.02)	3.20	(0.05)	0.03
College persistence	0.79	(0.01)	0.84	(0.01)	0.64	(0.02)	-0.20***
First-gen student	0.35	(0.01)	0.30	(0.02)	0.52	(0.03)	0.22***
College will be good financial investment	0.94	(0.01)	0.94	(0.01)	0.94	(0.02)	0.00
Worked more than 20 hours while attending college	0.23	(0.01)	0.19	(0.01)	0.35	(0.03)	0.16***
Received any institution aid at primary first year institution	0.64	(0.01)	0.68	(0.02)	0.54	(0.03)	-0.14***
URM	0.21	(0.01)	0.20	(0.02)	0.25	(0.03)	0.05*
Female	0.57	(0.01)	0.57	(0.01)	0.58	(0.03)	0.01
College readiness	0.77	(0.02)	0.78	(0.02)	0.76	(0.03)	-0.02
High school GPA	3.56	(0.01)	3.57	(0.01)	3.53	(0.02)	-0.04*
SAT	1,154	(4.37)	1,175	(4.49)	1,085	(7.07)	-90***
Earned Credits in AP/IB	2.88	(0.11)	3.29	(0.12)	1.53	(0.11)	-1.76***
Moderately selective	0.37	(0.01)	0.48	(0.02)	0.00	(0.00)	-0.48***
Inclusively selective	0.12	(0.01)	0.01	(0.00)	0.49	(0.03)	0.48***
2-year	0.12	(0.01)	0.00	(0.00)	0.50	(0.03)	0.50***
Observations	3,950		3,150		800		

\* p<.05; \*\* p<.01; \*\*\* p<0.001

NOTE: All reported sample sizes are rounded to the nearest 10 in accordance with NCES restricted data license.

Significant differences between undermatched students and non-undermatched students indicated

SOURCE: U.S. Department of Education, National Center for Education Statistics, 2009-16 High School Longitudinal Study (HSLs:09/16).

### College undermatching and college outcomes

The regression findings indicate a positive relationship between college undermatching and college GPA for all students who have enrolled in postsecondary institutions (Table 7, Model 1), those who exclusively attended four-year institutions

(Table 8, Model 1), and high-achieving students (Table 9, Model 1). This correlation is observed when all covariates are included, but without incorporating college selectivity as a covariate. However, when college selectivity is included as a covariate, a significant positive correlation remains for only students who attended four-year institutions (Table 8, Model 2), but it no longer holds for all students who attended any postsecondary institution (Table 7, Model 2) nor high school high-achieving students (Table 9, Model 2).

Table 7. Regressions on college GPA (all students)

	Model 1		Model 2	
	Coefficient	SE	Coefficient	SE
College undermatched	0.20**	(0.06)	0.15	(0.08)
First-gen student	-0.11**	(0.04)	-0.12**	(0.04)
College will be good financial investment	0.42***	(0.06)	0.42***	(0.06)
Worked more than 20 hours while attending college	-0.05	(0.05)	-0.05	(0.05)
Received any institution aid at primary first year institution	0.15**	(0.04)	0.16**	(0.04)
URM	-0.14**	(0.04)	-0.13**	(0.04)
Female	0.05	(0.04)	0.04	(0.04)
College readiness	-0.03	(0.04)	-0.03	(0.04)
High school GPA	0.55***	(0.05)	0.58***	(0.05)
SAT	0.00	(0.00)	0.00	(0.00)
Earned Credits in AP/IB	0.03***	(0.01)	0.03***	(0.01)
College undermatched * First-gen student	-0.01	(0.09)	-0.03	(0.09)
Selectivity of postsecondary institutions				
Highly selective			(reference group)	
Moderately selective			0.08	(0.04)
Inclusively selective			0.05	(0.07)
2-year			0.11	(0.07)
Less than 2-year			0.47*	(0.23)
Observations		8,500		

\* p<.05; \*\* p<.01; \*\*\* p<0.001

NOTE: All reported sample sizes are rounded to the nearest 10 in accordance with NCES restricted data license.

SOURCE: U.S. Department of Education, National Center for Education Statistics, 2009-16 High School Longitudinal Study (HSLs:09/16).

Table 8. Regressions on college GPA (4-year institutions only)

	Model 1		Model 2	
	Coefficient	SE	Coefficient	SE
College undermatched	0.20***	(0.05)	0.22**	(0.08)
First-gen student	-0.13**	(0.04)	-0.13**	(0.04)
College will be good financial investment	0.35***	(0.07)	0.35***	(0.07)
Worked more than 20 hours while attending college	-0.09	(0.05)	-0.09	(0.05)
Received any institution aid at primary first year institution	0.11*	(0.04)	0.11*	(0.04)
URM	-0.13**	(0.05)	-0.13**	(0.05)
Female	0.11*	(0.04)	0.11*	(0.04)
College readiness	0.01	(0.04)	0.00	(0.04)
High school GPA	0.63***	(0.05)	0.63***	(0.05)
SAT	0.00	(0.00)	0.00	(0.00)
Earned Credits in AP/IB	0.02**	(0.01)	0.02**	(0.01)
College undermatched * First-gen student	-0.06	(0.12)	-0.05	(0.12)
Selectivity of postsecondary institutions				
Highly selective			(reference group)	
Moderately selective			0.07	(0.04)
Inclusively selective			0.01	(0.07)
Observations		6,110		

\* p<.05; \*\* p<.01; \*\*\* p<0.001

NOTE: All reported sample sizes are rounded to the nearest 10 in accordance with NCES restricted data license.

SOURCE: U.S. Department of Education, National Center for Education Statistics, 2009-16 High School Longitudinal Study (HSLs:09/16).

Table 9. Regressions on college GPA (high-achievers only)

	Model 1		Model 2	
	Coefficient	SE	Coefficient	SE
College undermatched	0.19**	(0.06)	0.25	(0.25)
First-gen student	-0.13**	(0.05)	-0.14**	(0.05)
College will be good financial investment	0.47***	(0.08)	0.48***	(0.08)
Worked more than 20 hours while attending college	-0.09*	(0.05)	-0.10*	(0.05)
Received any institution aid at primary first year institution	0.05	(0.04)	0.05	(0.04)
URM	-0.16**	(0.05)	-0.16**	(0.05)
Female	0.13***	(0.03)	0.13***	(0.03)
College readiness	0.03	(0.04)	0.03	(0.04)
High school GPA	0.72***	(0.06)	0.73***	(0.06)
SAT	0.00*	(0.00)	0.00*	(0.00)
Earned Credits in AP/IB	0.01*	(0.01)	0.02**	(0.01)
College undermatched * First-gen student	-0.03	(0.08)	-0.02	(0.08)
Selectivity of postsecondary institutions				
Highly selective			(reference group)	
Moderately selective			0.09*	(0.04)
Inclusively selective			-0.04	(0.25)
2-year			0.01	(0.25)
Less than 2-year			-0.03	(0.42)
Observations			3,950	

\* p<.05; \*\* p<.01; \*\*\* p<0.001

NOTE: All reported sample sizes are rounded to the nearest 10 in accordance with NCES restricted data license.

SOURCE: U.S. Department of Education, National Center for Education Statistics, 2009-16 High School Longitudinal Study (HSLs:09/16).

The regression results reveal a negative relationship between college undermatching and college persistence for three distinct groups: all students who have enrolled in postsecondary institutions (Table 10, Model 1), those who attended four-year institutions (Table 11, Model 1), and high school high-achievers (Table 12, Model 1). This

correlation is evident when all covariates are taken into account, but when college selectivity is not included in the model. However, when I included college selectivity as a covariate, the coefficient for college undermatch was reduced in size in each case. No significant correlation remained for students who attended postsecondary institutions (Table 10, Model 2), students who attended four-year institutions (Table 11, Model 2), nor high school high-achieving students (Table 12, Model 2).

Table 10. Regressions on college persistence (all students)

	Model 1		Model 2	
	Coefficient	SE	Coefficient	SE
College undermatched	-0.55**	(0.16)	0.28	(0.18)
First-gen student	-0.50***	(0.10)	-0.41***	(0.10)
College will be good financial investment	0.92***	(0.13)	0.94***	(0.13)
Worked more than 20 hours while attending college	0.33**	(0.11)	0.37**	(0.12)
Received any institution aid at primary first year institution	0.39***	(0.11)	0.21	(0.12)
URM	0.17	(0.10)	0.14	(0.10)
Female	0.01	(0.09)	0.04	(0.09)
College readiness	0.09	(0.11)	0.08	(0.11)
High school GPA	0.85***	(0.11)	0.53***	(0.11)
SAT	0.00	(0.00)	-0.00	(0.00)
Earned Credits in AP/IB	0.07*	(0.03)	0.05	(0.03)
College undermatched * First-gen student	-0.01	(0.09)	-0.16	(0.16)
Selectivity of postsecondary institutions				
Highly selective			(reference group)	
Moderately selective			-0.16	(0.16)
Inclusively selective			-1.03***	(0.18)
2-year			-1.20***	(0.20)
Less than 2-year			-2.42***	(0.47)
Observations			8,500	

\* p<.05; \*\* p<.01; \*\*\* p<0.001

NOTE: All reported sample sizes are rounded to the nearest 10 in accordance with NCES restricted data license.

SOURCE: U.S. Department of Education, National Center for Education Statistics, 2009-16 High School Longitudinal Study (HSL:09/16).

Table 11. Regressions on college persistence (4-year institutions only)

	Model 1		Model 2	
	Coefficient	SE	Coefficient	SE
College undermatched	-0.82***	(0.22)	-0.10	(0.26)
First-gen student	-0.55***	(0.12)	-0.51***	(0.12)
College will be good financial investment	0.94***	(0.16)	0.94***	(0.16)
Worked more than 20 hours while attending college	0.06	(0.13)	0.10	(0.13)
Received any institution aid at primary first year institution	0.39**	(0.13)	0.32*	(0.13)
URM	0.03	(0.13)	0.07	(0.13)
Female	-0.03	(0.10)	-0.01	(0.10)
College readiness	0.27	(0.14)	0.26	(0.14)
High school GPA	0.96***	(0.13)	0.78***	(0.13)
SAT	0.00	(0.00)	-0.00	(0.00)
Earned Credits in AP/IB	0.03	(0.03)	0.03	(0.03)
College undermatched * First-gen student	0.22	(0.32)	0.16	(0.32)
Selectivity of postsecondary institutions				
Highly selective			(reference group)	
Moderately selective			-0.07	(0.17)
Inclusively selective			-0.83***	(0.20)
Observations		6,110		

\* p<.05; \*\* p<.01; \*\*\* p<0.001

NOTE: All reported sample sizes are rounded to the nearest 10 in accordance with NCES restricted data license.

SOURCE: U.S. Department of Education, National Center for Education Statistics, 2009-16 High School Longitudinal Study (HSLs:09/16).

Table 12. Regressions on college persistence (high-achievers only)

	Model 1		Model 2	
	Coefficient	SE	Coefficient	SE
College undermatched	-0.86***	(0.19)	0.07	(1.04)
First-gen student	-0.71***	(0.16)	-0.70***	(0.16)
College will be good financial investment	1.05***	(0.26)	1.04***	(0.27)
Worked more than 20 hours while attending college	-0.03	(0.16)	-0.02	(0.16)
Received any institution aid at primary first year institution	0.42**	(0.14)	0.40**	(0.15)
URM	0.18	(0.19)	0.20	(0.19)
Female	-0.05	(0.14)	-0.06	(0.14)
College readiness	0.20	(0.15)	0.20	(0.16)
High school GPA	0.55*	(0.22)	0.55*	(0.22)
SAT	-0.00	(0.00)	-0.00	(0.00)
Earned Credits in AP/IB	0.04	(0.03)	0.04	(0.03)
College undermatched * First-gen student	0.09	(0.26)	0.10	(0.26)
Selectivity of postsecondary institutions				
Highly selective			(reference group)	
Moderately selective			-0.04	(0.17)
Inclusively selective			-0.88	(1.07)
2-year			-1.05	(1.04)
Less than 2-year			-2.32	(1.36)
Observations			3,950	

\* p<.05; \*\* p<.01; \*\*\* p<0.001

NOTE: All reported sample sizes are rounded to the nearest 10 in accordance with NCES restricted data license.

SOURCE: U.S. Department of Education, National Center for Education Statistics, 2009-16 High School Longitudinal Study (HSLs:09/16).

It's notable that first-generation college students have negative relationships with both college GPA and college persistence among all populations. No interaction effects were found between college undermatching and first-generation college students on college outcomes, including both college GPA and college persistence. Importantly, these

results remain consistent whether I adjusted the model for college selectivity as a covariate or not.

The findings also reveal the relationship between high school academics and college outcomes, which aligns with expectations. Specifically, high school GPA demonstrates a positive correlation with both college GPA and persistence across all analyzed populations, whether or not college selectivity was included as a covariate. Moreover, the accumulation of credits through Advanced Placement (AP) or International Baccalaureate (IB) courses during high school is positively associated with college GPA within all populations.

While previous research often overlooked college selectivity, it is evident that the level of selectivity of postsecondary institutions indeed exhibits significant associations with both college GPA and persistence. Notably, among high school high-achievers (Table 9), those enrolled in moderately selective institutions exhibit higher GPAs compared to students attending the most selective institutions. For all postsecondary students (Table 10) and those enrolled in four-year institutions (Table 11), attending highly selective institutions significantly increases the likelihood of college persistence when contrasted with their counterparts attending moderately selective, inclusively selective, two-year, or less than two-year institutions. It's important to highlight that while no statistically significant relationship between selectivity level and college persistence was observed among high school high-achievers, the correlation between low selectivity and low persistence persists (Table 12).

### **Predicted outcomes by undermatched and first-generation status**

Table 13 and Table 14 display the predicted college GPA and predicted probabilities of college persistence for both undermatched and non-undermatched students, categorized by their first-generation college student status. These predictions are presented in two versions: a) one without college selectivity included as a covariate (Model 1), and b) one including college selectivity as a covariate (Model 2).

Table 13. Predicted college GPA

		First-gen			Non-first-gen		
		Undermatched	Non-undermatched	Difference	Undermatched	Non-undermatched	Difference
All students	Model 1	2.54	2.36	0.18*	2.99	2.79	0.2**
	Model 2	2.50	2.37	0.13	2.95	2.79	0.16*
4-year institutions only	Model 1	2.67	2.53	0.14	3.13	2.94	0.19***
	Model 2	2.70	2.53	0.17	3.16	2.94	0.22**
High-achievers only	Model 1	3.15	3.00	0.15*	3.40	3.21	0.19**
	Model 2	3.20	2.97	0.23	3.45	3.20	0.25

\* p<.05; \*\* p<.01; \*\*\* p<0.001

SOURCE: U.S. Department of Education, National Center for Education Statistics, 2009-16 High School Longitudinal Study (HSLs:09/16).

Table 14. Predicted probabilities of persistence

		First-gen			Non-first-gen		
		Undermatched	Non-undermatched	Difference	Undermatched	Non-undermatched	Difference
All students	Model 1	0.40	0.55	-0.15***	0.62	0.73	-0.11**
	Model 2	0.53	0.52	0.01	0.75	0.71	0.04
4-year institutions only	Model 1	0.52	0.64	-0.12*	0.65	0.80	-0.15**
	Model 2	0.64	0.63	0.01	0.78	0.79	-0.01
High-achievers only	Model 1	0.60	0.76	-0.16***	0.73	0.86	-0.13***
	Model 2	0.71	0.68	0.03	0.83	0.83	0.00

\* p<.05; \*\* p<.01; \*\*\* p<0.001

SOURCE: U.S. Department of Education, National Center for Education Statistics, 2009-16 High School Longitudinal Study (HSLs:09/16).

In general, undermatched students tend to have significantly higher college GPAs than their non-undermatched peers (Table 13). When college selectivity is not included as a covariate (Model 1), significant differences are observed among first-generation students, particularly for those who attended postsecondary institutions and high school high-achievers. Nevertheless, these significant differences diminish after adjusting for college selectivity. Among non-first-gen students, without considering college selectivity as a covariate, significant differences are found across all populations. However, these significant differences diminish for high school high-achievers after accounting for college selectivity.

Overall, undermatched students generally exhibit a lower likelihood of college persistence compared to their non-undermatched peers (refer to Table 14). Without including college selectivity as a covariate (Model 1), significant differences are evident for both first-generation and non-first-gen students. However, all of these significant differences were diminished once I accounted for college selectivity (Model 2).

### **Discussion**

The negative effects of college undermatching have been extensively documented, including degree completion and post-college employment (Fosnacht, 2014; Kang & García Torres, 2021; Ovink et al., 2018). However, the specific influence of college undermatching on college outcomes for first-generation and non-first-generation students remains unclear. Investigating how college undermatching intersects with first-generation college student status to shape college outcomes and whether these patterns persist across diverse populations—such as students who have attended postsecondary

institutions, those enrolled in four-year institutions, and high-achievers—represents a crucial stride in comprehending the undermatching process and its impact.

Furthermore, considering the prevailing assumption that undermatched students tend to experience less positive college outcomes due to the potentially limited resources and support available in less selective institutions compared to their more selective counterparts, the incorporation of postsecondary institution selectivity level into the examination of the relationship between college undermatching and college outcomes is of utmost significance. This approach facilitates a deeper grasp of the role college undermatching plays in shaping overall college outcomes, as distinct from the role of institutional selectivity itself, and improves on the regression models used in past studies.

The descriptive findings reveal disparities in both college GPA and college persistence between undermatched and non-undermatched students. Among students who have attended college and those enrolled in four-year institutions, undermatched students exhibit higher college GPAs. This outcome aligns with existing research suggesting that college undermatching is positively associated with engagement in collaborative learning activities, increased interaction with faculty (Fosnacht, 2015), and higher levels of academic self-efficacy (Wolniak & Muskens, 2021). However, past literature suggested that undermatched students face challenges in terms of college persistence, particularly evident among high-achievers who have access to the most selective and highly selective institutions. This finding reinforces existing research that underscores the link between college undermatching and decreased degree completion rates (Fosnacht, 2014; Kang & García Torres, 2021; Ovink et al., 2018). Furthermore, undermatched students are

inclined to attend institutions that are less selective, which aligns logically with the patterns observed.

In addressing the research questions about the role of college undermatching in shaping college outcomes and the consistency of these relationships across diverse populations, a noteworthy departure from prior findings emerges. Contrary to prior studies (Fosnacht, 2014; Kang & García Torres, 2021; Ovink et al., 2018), this investigation reveals that college undermatching does not yield the anticipated negative effects. Instead, a positive correlation emerges between college undermatching and college GPA among students who ever attended postsecondary institutions and those enrolled in four-year institutions, though this connection does not hold for high-achievers. It is plausible that if a student had access to a more selective institution with potentially more rigorous courses, they find the courses at their attended institution to be relatively easier, resulting in higher average GPAs.

Intriguingly, unlike earlier research (Kang & García Torres, 2021), no significant relationship is established between college undermatching and persistence. The variance between this study's outcomes and those of prior research could be attributed to several factors. Firstly, this study employs data from the High School Longitudinal Study of 2009 (HSL:09), while preceding investigations often utilized different datasets such as Education Longitudinal Study of 2002 (ELS:2002) (Kang & García Torres, 2021; Ovink et al., 2018; Smith et al., 2013) or The National Survey of Student Engagement (Fosnacht, 2014, 2015). Divergences in the studied populations might contribute to the contrasting outcomes.

Importantly and aligned with one purpose of this study, the role of postsecondary institution selectivity level attenuates the impact of college undermatching. Unlike prior studies, this analysis accounts for the influence of institutional selectivity, revealing that selectivity level maintains a significant relationship with college persistence among students who have attended postsecondary institutions and those enrolled in four-year institutions. Specifically, students attending less selective institutions compared to their highly selective counterparts exhibit a diminished likelihood of persisting in college.

College selectivity significantly influences our understanding of the role of college undermatching in college performance. Institutions categorized as the most selective are often regarded as top-tier colleges. In this study, the most selective colleges are defined by the highest standardized scores of their incoming students, indicating that students who enroll alongside academically prepared peers are more likely to persist in college. While this holds true in many cases, it's essential to note that institutional selectivity does not guarantee college success. In other words, enrolling in the most selective colleges does not ensure a superior college experience or positive outcomes.

Previous research has often emphasized the negative effects of college undermatching without considering the direct effect of the selectivity of the institution, as distinct from undermatching. However, this study's findings deviate from this perspective, by accounting for college selectivity as a covariate.

As a result, conclusions linking negative college outcomes solely to undermatching may have been overstated due to the omission of college selectivity. In essence, undermatched students typically enroll in lower-selectivity colleges, suggesting that prior findings may have inadvertently conflated the effects of selectivity with those of college

undermatching. This study has endeavored to disentangle this confounding factor and no longer identifies a negative effect on college outcomes, particularly in terms of college persistence.

Overall, this study implies that it is not the act of "undermatching" itself that necessarily leads to adverse outcomes; rather, it may be more closely linked to the level of selectivity where the student ultimately enrolls, which can entail reduced resources and other associated factors.

Future research should incorporate college selectivity into the model alongside other relevant data to investigate the consistency of the results. Additionally, selectivity can be defined in many different ways, such as Barron's Selectivity Index, and should be investigated to see if they lead to the same conclusions of this study. Exploring these different standards of college selectivity and their implications for college outcomes advances our understanding of college undermatching and broader college experience.

Additionally, it is crucial to explore other college outcomes to validate the findings. While college persistence is a significant metric, it is also worthwhile to investigate degree completion and post-graduate employment, among others.

Furthermore, future research should expand upon the current results by disaggregating data based on various student identity factors, not only first-generation college student status but also considerations such as race, gender, and more. It's important to acknowledge that disability was not a part of this study, but it should be included in future research to provide a more comprehensive understanding of its impact.

## Chapter 4

### THE JOINT ROLE OF FIRST-GENERATION STATUS AND COGNITIVE DISABILITY IN STUDENT SUCCESS

The value of a college degree has increased in the labor market as many jobs require a higher level of education than ever before. Obtaining a college degree is a critical factor for securing professional job opportunities and achieving upward social mobility, particularly for students from disadvantaged backgrounds, such as first-generation college students. Based on data from the 2015-16 National Postsecondary Student Aid study, as of the academic year 2015-16, over 50% of undergraduates were first-generation college students (RTI International, 2019). However, the gaps in completion rates, selectivity of the institution, and even income after college completion between first-generation and continuing-generation students are still large (Fry, 2021). The gaps between these two groups highlight a concerning equity issue.

The gaps in college completion between first- and continuing-generation students can be explained by different factors. First-generation college students are less likely to receive the same level of guidance from their parents who have not gone through college experiences when they encounter barriers in college (Bettencourt et al., 2020; Engle, 2007; Fry, 2021). They are more likely to experience financial hardship when they adjust to college life (Ferguson, 2020; Martinez et al., 2012). Also, first-generation college students may need more academic support and assistance since they tend to attend college with lower academic preparedness (Dennis et al., 2005; Engle, 2007).

First-generation college students share backgrounds and some needs, but they are not a homogenous group. Their college experience could be vastly different due to their

diverse backgrounds and identities, particularly when these backgrounds and identities predispose them to additional barriers to success in college. For example, the college experience of first-generation college students with cognitive disabilities may be vastly different from first-generation college students without cognitive disabilities. Unlike physical or other types of disabilities, cognitive disabilities are often not readily apparent. This lack of visibility makes it challenging for both the system and cognitively disabled students themselves to recognize their specific needs (Wegner, 2017), likely contributing to lower college completion rates (Cortiella & Horowitz, 2014; Yu et al., 2018).

Cognitive disabilities encompass a wide spectrum of impairments and may manifest differently depending on the contexts. In this study, cognitive ability refers to specific learning challenges like dyslexia, attention deficit disorder (ADD), and developmental disabilities. Students with cognitive disabilities face unique challenges in navigating college life, from applying for disability services to navigating student support systems. However, the additional disadvantage of not having parents with college knowledge and experience can make the process even more challenging. The barriers and complicated systems faced by students with cognitive disabilities are compounded for first-generation college students who are less likely to have college guidance from their parents. This highlights the unique needs of the student group which is the focus of this study.

First-generation college students and students with cognitive disabilities have been extensively studied as separate groups. Given that both of these populations are growing in postsecondary settings (RTI International, 2019; Schaeffer, 2023), it's reasonable and worthwhile to explore the intersection of these two backgrounds: first-generation college students with cognitive disabilities. However, there are few studies

that have explored this specific population, especially on a national scale. Thus, there is a need to investigate the heterogeneity within first-generation college students by cognitive disability status. To do so, I use the Beginning Postsecondary Students Longitudinal Study (BPS:12/17) data to understand how cognitive disability may play a role in the relationship between first-generation college student status and college GPA, continuous enrollment, and completion. Specifically, this study addresses these research question: (1) To what extent does the relationship between first-generation status and a) college GPA, b) college continuous enrollment, and c) college completion vary by cognitive disability status? (2) To what extent do the relationships change for students who ever attended postsecondary institutions and students who attended four-year institutions only?

### **Literature Review**

Both first-generation college students and students with cognitive disabilities face unique challenges when navigating the complex system of higher education. They require additional academic, financial, and health support to succeed in college. When students with cognitive disabilities face challenges in college, those with parents holding college degrees are more likely to receive guidance on navigating these complicated postsecondary support systems, enabling them to advocate for their needs and access essential resources. These students benefit from access to networks and resources, enhancing their capacity to thrive and maintain enrollment in college. In other words, they are more likely to experience success in college. Conversely, first-generation college students with cognitive disabilities may encounter difficulties accessing necessary resources and support systems related to their disability if they lack family guidance throughout the process.

## **Financial support**

Compared with their continuing-generation peers, first-generation college students tend to experience financial strain. Indeed, previous scholarship suggests that first-generation college students see money as one of the biggest barriers to college success (Azmitia et al., 2018; Duggan, 2001; Gibbons et al., 2019). Even though financial aid is available, first-generation college students find difficulties in accessing information to obtain and renew financial aid (Gibbons et al., 2019). First-generation college students need to rely on their own resources if they fail to navigate the complexities of the financial aid application process, which makes it difficult for them to persist in college.

Students with cognitive disabilities may also encounter a range of financial barriers and require additional support during their college experience. Although there is a lack of documented information regarding the relationship between financial stress and cognitive disabilities in postsecondary settings, financial barriers affecting students with disabilities overall have been well documented. Previous research has highlighted the extra costs associated with disability, including general expenses such as healthcare, as well as disability-specific items like assistive devices (Mitra et al., 2017). These higher financial costs can lead to negative experiences of belonging, engagement, and support for students with disabilities compared to their non-disabled peers (Fox et al., 2022). In addition, students with disabilities often accumulate greater amounts of education-related debt than their non-disabled peers (Chambers et al., 2013), which may contribute to lower rates of persistence and completion (Newman et al., 2009).

Students with cognitive disabilities face unique financial barriers and challenges that can negatively impact their college outcomes, and when coupled with being a first-

generation college student, these challenges are likely amplified. Theoretically, federal financial aid can cover most of the costs related to a student's disability, such as assistive devices and healthcare. However, most financial aid information on university websites does not assist students in understanding how financial aid policies can either support or hinder their disability-related needs (Perlow et al., 2021). This lack of information makes it challenging for students with cognitive disabilities to seek financial help for their specific needs. This is likely compounded by first-generation status when students may not have family support to navigate complicated financial processes. Furthermore, students with disabilities, including cognitive disabilities, must document these expenses to the financial aid administrator. This document process requires self-confidence and self-advocacy skills that may not be well-developed in first-generation college students (Wolanin, 2005). Therefore, the combination of being a first-generation college student and having cognitive disabilities may lead to a higher risk of diminished college outcomes.

### **Academic support**

Compared with their continuing-generation peers, first-generation college students are more likely to encounter academic challenges. First-generation college students tend to have lower levels of confidence regarding their academic readiness for college, which could negatively affect their potential to thrive in college (Duggan, 2001; Odeleye & Santiago, 2019; Pratt et al., 2019). Despite their hard work, first-generation college students may anticipate significant academic obstacles and feel less confident in their ability to overcome them (Pratt et al., 2019). Furthermore, due to responsibilities such as work and family, first-generation college students are less likely to seek out

academic support or participate in campus activities (Bettencourt, 2021; Engle & Tinto, 2008; Katrevich & Aruguete, 2017). These challenges highlight the need for academic support for first-generation college students.

Academic challenges also often arise among students with cognitive disabilities, who face a higher risk of poor academic performance and early departure from college (Smedema et al., 2015). Although students with cognitive disabilities can attain the same academic achievements as their peers without disabilities, they often require more time to do so. This includes the need for extended deadlines for academic tasks and degree completion, a reduced course load, and extra time for exams (Wolanin, 2005). These accommodations can only be fulfilled if students with cognitive disabilities advocate for themselves and seek help proactively.

Compared with their peers without disabilities, students with disabilities are expected to advocate more for their needs (Moriña, 2019; Pratt et al., 2019). Self-advocacy has been shown to have positive impacts on academic performance, directly related to higher grade point averages for students with disabilities (Fleming et al., 2017). Self-advocacy skills allow students to get their own needs met, such as forming a relationship with faculty. Despite the importance of self-advocacy, however, a study suggests that less than 20% of students with disabilities self-identify with the disability resources office and actively seek out support (Herbert et al., 2014). It is crucial for students with disabilities to practice self-advocacy and proactively seek help, yet only a small percentage of them utilize the available resources effectively.

First-generation college students with cognitive disabilities are even less likely to seek assistance (Killam & Castillo, 2021). When first-generation students with cognitive

disabilities are not well-equipped to navigate the complexities of the support system and do not advocate for their academic needs, their needs may be neglected. As a result, these students are penalized twice by the postsecondary systems and processes, both for their cognitive disabilities and their first-generation-related advocacy skills, which can ultimately lead to diminished postsecondary outcomes.

### **Health and Well-being support**

Cognitively disabled students are likely to face additional challenges, including comorbidity with other types of disabilities (Wolf, 2001) including those related to physical and mental health (McDermott et al., 2006). For instance, a student with a cognitive disability may also have mental health disorders such as anxiety or depression. These overlapping diagnoses make their college experiences more challenging and add complexities to navigating the postsecondary system, which highlights the critical need for support and accessibility for students with cognitive disabilities.

Furthermore, students with cognitive disabilities are often subjected to stigma associated with their disability (Shifrer, 2013). This stigma can lead to heightened levels of stress and anxiety. This stigma could manifest in various forms, such as social exclusion, discrimination, or negative stereotypes, which can exacerbate existing challenges and adversely affect their overall well-being and college experience. Furthermore, this negative stigma may be more pronounced for non-apparent disabilities compared to apparent disabilities. Previous work suggests that students with non-apparent disabilities are less likely to be perceived as sociable and academically capable (Akin & Huang, 2019). That is to say, students who disclose their disabilities in order to

access support and resources may face greater risks, potentially hindering their access to appropriate assistance (Martin, 2010; Trammell & College, 2009).

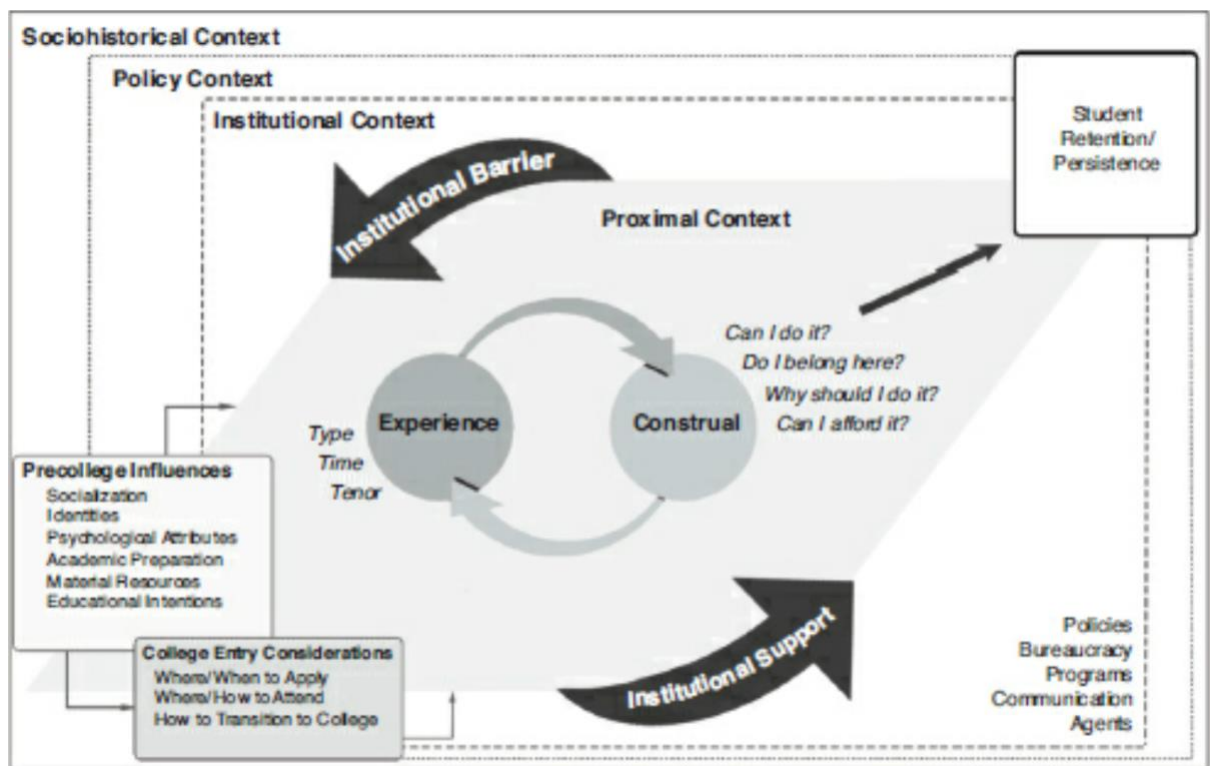
The comorbidity, complexities, and stigma faced by students with cognitive disabilities underscore the importance of accessibility to mental and/or physical services on campus. However, students who come from families with prior college experience may receive recommendations and advice on how to effectively utilize these services and navigate the system, whereas first-generation college students are less likely to receive this kind of guidance. This disparity underscores the necessity for targeted support and outreach initiatives to ensure that cognitively disabled students not only have access to necessary resources but also feel safe and supported in disclosing their disabilities.

### **Theoretical Framework**

I situate this study broadly within the interdisciplinary theory of college student success (Bowman, 2022) as the theoretical framework (see Figure 1). The theory suggests that college student success is shaped jointly by the student and institutional factors, along with the broader contexts. College success can be exemplified by four questions: Can I do it? Do I belong here? Why should I do it? Can I afford it? The dynamics of college student success start well before college. Socialization, identities, academic preparation, educational intentions, and psychological attributes are described as pre-college influences. Pre-college influences could include family background, such as first-generation status, as well as disability identity. Policies, bureaucracy, programs, agents, and communication are categorized as institutional factors. This can include the academic, financial, and health-related services that exist on college campuses to support students. It can also include barriers at the institutions, such as complexity or policies and

practices that is more burdensome for first-generation students and/or cognitively disabled students. The interplay between pre-college influences and institutional factors directly affects the way students engage and interpret the college experience. It is worth noting that students' construals (or meaning-making or interpretation) of experience could be different even for the same experience, especially for students with and without cognitive disabilities. Students reinforce or modify their answers to the four questions mentioned above, which eventually affect college continuous enrollment and persistence.

Figure 1. Interdisciplinary theory of college student success (Bowman, 2022)



The interdisciplinary theory of college student success (Bowman, 2022) is a helpful framework for thinking about college GPA, continuous enrollment, and completion related to the interplay between first-generation college student status and cognitive disabilities. The model includes pre-college influences, such as identities. First-

generation college student identity and cognitive disability status align well with pre-college influences. That is to say, similar financial, academic, and health-related support could shape different college experiences between first-generation college students with cognitive disabilities and first-generation college students without cognitive disabilities. Overall, this model provides a way of thinking about how the interplay of first-generation college student status and cognitive disability status shapes college outcomes.

### **Method**

In this study, I investigated the extent to which relationships between first-generation college students and postsecondary outcomes varied by cognitive disability status. Given that one of the outcome measures is the attainment of a bachelor's degree, it was important to assess whether there were variations in results between the overall population and students enrolled in four-year universities. Therefore, the analyses were conducted for two separate populations: a) all undergraduates and b) those who attended four-year institutions. The following section provided details about the sample, variables, and the analyses.

### **Sample**

The data were derived from the Beginning Postsecondary Students Longitudinal Study BPS:12/17) that tracked first-time beginning undergraduate students' postsecondary trajectories in a nationally representative sample. The data included information of persistence and attainment in the sixth year after students' initial enrollment in postsecondary education. To address missing data, I employed multiple imputation, generating 20 imputations (Manly & Wells, 2015; van Buuren, 2012). All study variables were incorporated into the imputation models, and I executed this process

using the "mi impute chained" command, with in Stata, incorporating appropriate sampling weights and strata variables.

Due to the presence of missing data in most variables, including sampling weights and strata information, 8,554 cases were excluded from the study before addressing missing data. These were students from The National Postsecondary Student Aid Study (NPSAS:12), which served as the baseline data collection, who were not appropriate for inclusion in BPS:12/17, rendering these cases unusable.

The remaining cases exhibited a missingness rate of 57%. The primary contributors to missing data were three variables: services used in academic advising and support, financial aid, and student health, with a missing rate of approximately 54%. Despite this high missing rate, I chose to include them in the analyses due to their relevance for this study and alignment with the literature reviewed. For all other variables, excluding these three, the missing rate was below 10%. It is worth noting that multiple imputation is capable of generating accurate estimated values even with a relatively high missing data rate (Madley-Dowd et al., 2019).

The imputed and weighted sample included 22,530 students, among whom 860 were classified as students with cognitive disabilities and 21,670 as students without cognitive disabilities. Of the 8,320 students attending four-year institutions, 290 were identified as students with cognitive disabilities. All sample sizes were rounded to the nearest 10 in accordance with NCES restricted data license.

## **Variables**

**Dependent variables.** The dependent variables were college GPA, continuous enrollment, and bachelor's degree attainment. These three variables were typical college

outcomes. College GPA was defined by undergraduate GPA at all known institutions attended. The attainment of a bachelor's degree was defined by whether students received at least one bachelor's degree by June 2017.

College continuous enrollment was operationalized by determining whether students experienced a stopout from the beginning of their postsecondary education until June 2017. Unlike dropping out from college, a stopout was defined as a temporary withdrawal from college enrollment. The original variable contained information about the academic year of students' first stopout from college, including cases that a student never stopped out. In this study, to investigate the association between first-generation college student status, cognitive abilities, and continuous enrollment, I chose to recode the original variable of college stopout into a binary variable. This binary variable indicated whether a student has ever exhibited stopout behavior. If a student had never demonstrated stopout behavior, they were considered to have continuous enrollment.

**Independent variables.** The two key independent variables were first-generation college student status and cognitive disability status. Both of the variables were dichotomous. First-generation college student status was operationally defined by parental education level. Students who did not have a parent who had attained a bachelor's degree are labeled as first-generation college student.

Cognitive disability status was operationally defined by the variable for the main type of condition or impairment for students with disabilities. The original variable in the dataset was a categorical variable that indicates whether students had specific types of disabilities, including hearing impairment, blindness or visual impairment, speech or language impairment, orthopedic or mobility impairment, specific learning disability or

dyslexia, attention deficit disorder (ADD), health impairment or problem, mental, emotional psychiatric condition, depression, developmental disability, brain injury, and others. Students were labeled as cognitively disabled if they experienced at least one type of these disabilities: specific learning disability or dyslexia, attention deficit disorder (ADD), and developmental disability. This means that students without cognitive disabilities also include those who did not report any disabilities at all.

**Covariates.** Variables that potentially affect college outcomes were included based on existing scholarship, including pre-college academic performance, institutional support, and other demographic information. High school GPA served as a proxy for pre-college academic performance. Underrepresented minority status and gender were included as demographic information. In this study, students who identified themselves as African Americans, American Indians/Alaskan Natives, or Hispanics were considered underrepresented minorities.

In alignment with the reviewed literature, institutional support consisted of three dimensions: academic advising and support services used (scale 0-4), financial aid services used (scale 0-2), and student health services used (scale 0-2). Academic advising and support were operationally defined by four survey questions: whether the respondent used academic support in 2011-12 and 2013-14, and whether the respondent used academic advising in 2011-12 and 2013-14. All of these survey questions were binary (yes/no). Students received one point for each "yes" response to these questions. Students could receive a maximum of 4 points for academic advising and support.

Financial aid service was operationally defined by whether students used financial advising in 2011-12 and 2013-14. The survey questions were binary, and students could receive a maximum of 2 points for financial aid service.

Similar to academic and financial services, health services were operationally defined by whether students used health services in 2011-12 and 2013-14. The survey questions were binary, and students could receive a maximum of 2 points.

According to Bowman's theory, students' college experience is jointly shaped by students' precollege influences and institutional factors. These variables provided information about the use of institutional support rather than solely their availability. They indicated whether students actually used the resources provided, as they may choose not to use them even if available. Therefore, this information could provide insight into how beneficial it was to use institutional services for college success, but also adjusted the regression model to better isolate the relationships between first-generation status, disability status, and the outcomes.

### **Data analyses**

The analyses of this study included two steps: descriptive analyses and regressions. Both descriptive analyses and regression models included two sets of populations: a) the whole sample of the study (all undergraduates) and b) students who enrolled in four-year institutions.

Descriptive analyses provided a description of students with and without cognitive disabilities. These analyses included means and standard errors for all variables, comparing these values between cognitively disabled and non-cognitively disabled students.

Since this study was interested in differences in college outcomes between first-generation and continuing-generation college students based on disability status, the regression models included two key independent variables: first-gen status and cognitive disability status. Models also included the interaction term of these two key independent variables, as well as covariates. Logistic regressions were used for degree attainment and continuous enrollment as the dependent variables, and linear regressions were used for college GPA as the dependent variable. Average marginal effects (AME) were calculated for ease of interpretation when the dependent variable was dichotomous.

### **Limitations**

Taking a closer look at first-generation college students by cognitive disability status does partially recognize the heterogeneity among first-generation college students, which is a needed consideration. However, after breaking down the population of first-generation college students by disability status, the number of first-generation college students with disabilities was small (not over 500), as expected. This could increase the risk of biased results. Additionally, due to the small population of students with cognitive disabilities, it becomes more challenging to explore heterogeneity within the population by other factors, such as institutional sector (4-year vs. 2-year).

This study considered students with specific learning disability or dyslexia, attention deficit disorder (ADD), and developmental disability as one group. While they do share some characteristics and challenges in college experiences, grouping them together could overlook the nuances among the subgroups. Due to the small sample sizes of these subgroups, perceiving them as distinct groups presented challenges; however, seeing them as a homogenous group by no means implies an oversight for the differences

among them. Future research may consider studying them as distinct groups and using the results of this study as a reference point.

## **Results**

### **Descriptive statistics by cognitive disability status**

Table 15 and Table 16 present the means of all variables by cognitive disability status for all students and those enrolled in four-year institutions, respectively. Students with cognitive disabilities exhibited significantly lower outcomes than their non-cognitively disabled peers on all three dependent variables. Cognitively disabled students had a lower college GPA for both the entire population (2.55 vs. 2.91) and students in four-year institutions (2.60 vs. 2.97), a lower rate of continuous enrollment for the entire population (54% vs. 62%) and for four-year institutions (65% vs. 73%), and a lower rate of bachelor's degree attainment for the entire population (25% vs. 37%) and for four-year institutions (48% vs. 65%). Additionally, cognitively disabled students had lower high school GPA and a lower proportion of females, both for the entire sample and students in four-year institutions

Table 15. Means and standard errors of the estimates, for all variables (all students)

	All		With Cognitive Disabilities		Without Cognitive Disabilities		Difference
	Mean	SE	Mean	SE	Mean	SE	
Bachelor's Degrees Attainment	0.37	(0.01)	0.25	(0.02)	0.37	(0.01)	-0.12***
Continuous Enrollment	0.61	(0.01)	0.54	(0.03)	0.62	(0.01)	-0.08**
College GPA	2.89	(0.01)	2.55	(0.06)	2.91	(0.01)	-0.36***
First-Gen student	0.61	(0.01)	0.59	(0.03)	0.62	(0.01)	-0.03
PSE services used: academic advising and support services	2.07	(0.02)	2.10	(0.10)	2.07	(0.02)	0.03
PSE services used: financial aid services	0.95	(0.01)	0.94	(0.08)	0.95	(0.01)	-0.01
PSE services used: student health services	0.50	(0.01)	0.65	(0.08)	0.49	(0.01)	0.16*
High School GPA	3.00	(0.01)	2.85	(0.04)	3.01	(0.01)	-0.16***
Underrepresented Minority	0.24	(0.01)	0.26	(0.03)	0.24	(0.01)	0.02
Female	0.57	(0.01)	0.47	(0.03)	0.57	(0.01)	-0.10***
4-year institution (nonprofit)	0.48	(0.02)	0.43	(0.03)	0.49	(0.02)	-0.06
2-year public institution	0.37	(0.02)	0.42	(0.03)	0.37	(0.02)	0.05
Observations	22,530		860		21,670		

\* p<.05; \*\* p<.01; \*\*\* p<0.001

NOTE: All reported sample sizes are rounded to the nearest 10 in accordance with NCES restricted data license.

Significant differences between undermatched students and non-undermatched students indicated

SOURCE: U.S. Department of Education, National Center for Education Statistics, 2012/17 Beginning Postsecondary Students Longitudinal Study.

Table 16. Means and standard error of the estimates, for all variables (4-year institutions only)

	All		With Cognitive Disabilities		Without Cognitive Disabilities		Difference
	Mean	SE	Mean	SE	Mean	SE	
Bachelor's Degrees Attainment	0.64	(0.01)	0.48	(0.04)	0.65	(0.01)	-0.17***
Continuous Enrollment	0.72	(0.01)	0.65	(0.04)	0.73	(0.01)	-0.08*
College GPA	2.96	(0.02)	2.60	(0.07)	2.97	(0.02)	-0.37***
First-Gen student	0.45	(0.01)	0.47	(0.04)	0.45	(0.01)	0.02
PSE services used: academic advising and support services	2.32	(0.03)	2.40	(0.12)	2.31	(0.03)	0.09
PSE services used: financial aid services	0.87	(0.02)	0.94	(0.08)	0.87	(0.02)	0.07
PSE services used: student health services	0.71	(0.02)	0.86	(0.08)	0.71	(0.02)	0.15
High School GPA	3.18	(0.01)	3.00	(0.05)	3.19	(0.01)	-0.19***
Underrepresented Minority	0.21	(0.01)	0.21	(0.03)	0.21	(0.01)	0.00
Female	0.56	(0.01)	0.46	(0.04)	0.57	(0.01)	-0.11**
Observations	8,320		290		8,030		

\* p<.05; \*\* p<.01; \*\*\* p<0.001

NOTE: All reported sample sizes are rounded to the nearest 10 in accordance with NCES restricted data license.

Significant differences between undermatched students and non-undermatched students indicated

SOURCE: U.S. Department of Education, National Center for Education Statistics, 2012/17 Beginning Postsecondary Students Longitudinal Study.

No differences were observed between cognitively and non-cognitively disabled students in academic and financial services utilization for the entire sample or students in four-year institutions. Cognitively disabled students were more likely to use health services for the entire sample, but the difference becomes non-significant for students in four-year institutions. No significant differences were observed between cognitively disabled and non-cognitively disabled students in first-generation college student status or underrepresented minority status.

### **Cognitive disability, first-gen status, and college outcomes**

The regression models indicated negative relationships between first-generation college student status and all three dependent variables for both the entire sample (Table 17) and students in four-year institutions (Table 18). The regressions also revealed negative relationships between cognitive disability status and college GPA and degree attainment (Table 17 and Table 18). The results indicated no differences between first-generation and continuing-generation students in college outcomes, varying by their cognitive disability status (i.e., the interaction term).

Table 17. Regressions on college outcomes (all students)

	GPA		Continuous enrollment		Bachelor's degree attainment	
	Coefficient	SE	Coefficient	SE	Coefficient	SE
Cognitive Disability	-0.31***	(0.07)	-0.35	(0.18)	-0.61**	(0.20)
First-Gen student	-0.12***	(0.02)	-0.40***	(0.06)	-1.21***	(0.06)
PSE services used: academic advising and support services	-0.00	(0.01)	0.24***	(0.03)	0.42***	(0.04)
PSE services used: financial aid services	-0.03	(0.02)	-0.17**	(0.05)	-0.29***	(0.04)
PSE services used: student health services	-0.02	(0.02)	0.16**	(0.06)	0.57***	(0.05)
High School GPA	0.32***	(0.02)	0.27***	(0.04)	1.05***	(0.06)
Underrepresented Minority	-0.22***	(0.02)	-0.31***	(0.06)	-0.47***	(0.07)
Female	0.11***	(0.02)	-0.20***	(0.05)	0.09	(0.06)
Cognitive Disability * First-Gen student	0.03	(0.11)	-0.02	(0.23)	-0.12	(0.28)
Observations	22,530					

\* p<0.05; \*\* p<0.01; \*\*\* p<0.001

NOTE: All reported sample sizes are rounded to the nearest 10 in accordance with NCES restricted data license.

SOURCE: U.S. Department of Education, National Center for Education Statistics, 2012/17 Beginning Postsecondary Students Longitudinal Study.

Table 18. Regressions on college GPA (4-year institutions only)

	GPA		Continuous enrollment		Bachelor's degree attainment	
	Coefficient	SE	Coefficient	SE	Coefficient	SE
Cognitive Disability	-0.25**	(0.08)	-0.31	(0.25)	-0.64**	(0.24)
First-Gen student	-0.17***	(0.03)	-0.34***	(0.08)	-0.80***	(0.08)
PSE services used: academic advising and support services	0.01	(0.02)	0.21***	(0.05)	0.39***	(0.05)
PSE services used: financial aid services	-0.04*	(0.02)	-0.25***	(0.07)	-0.31***	(0.06)
PSE services used: student health services	0.02	(0.02)	0.19**	(0.06)	0.53***	(0.06)
High School GPA	0.47***	(0.03)	0.31***	(0.07)	1.00***	(0.08)
Underrepresented Minority	-0.23***	(0.03)	-0.19*	(0.09)	-0.51***	(0.09)
Female	0.10***	(0.02)	-0.03	(0.07)	0.18**	(0.07)
Cognitive Disability * First-Gen student	-0.05	(0.15)	-0.08	(0.36)	-0.29	(0.35)
Observations	8,320					

\* p<.05; \*\* p<.01; \*\*\* p<0.001

NOTE: All reported sample sizes are rounded to the nearest 10 in accordance with NCES restricted data license.

SOURCE: U.S. Department of Education, National Center for Education Statistics, 2012/17 Beginning Postsecondary Students Longitudinal Study.

The regression results also indicated relationships between services provided by institutions and college outcomes. The use of academic advising and student health services was positively related to continuous enrollment and degree attainment for both the entire sample and students enrolled in four-year institutions. The use of financial aid services was negatively related to continuous enrollment for both the entire sample and students enrolled in four-year institutions. Additionally, financial aid services were negatively related to GPA for four-year students but not for the entire sample. No significant relationships were found between the use of academic advising services and college GPA, as well as between health services and college GPA.

High school GPA was significantly positively related to college GPA, continuous enrollment, and degree attainment for both the entire sample and students enrolled in four-year institutions. Being an underrepresented minority was negatively related to all outcome variables for both populations. Females tended to have higher college GPAs for both populations, were less likely to enroll continuously for the entire sample but not for students enrolled in four-year institutions, and were more likely to attain a Bachelor's degree for students enrolled in four-year institutions but not for the entire sample.

Table 19 and Table 20 present the predicted probabilities of college outcomes for first-generation college students and continuing-generation college students, respectively. Predicted probabilities offer an alternative, and arguably more accurate, method for interpreting the results, particularly for categorical dependent variables, compared to relying solely on coefficients (Long & Mustillo, 2017). The results of predicted probabilities, for both first-generation college students and continuing-generation college students, suggest that cognitively disabled students tend to have lower college GPAs and

are less likely to attain a bachelor's degree. Given that first-generation college students already tend to have lower performance in these three dependent variables, first-generation college students with cognitive disabilities represent a group that is doubly penalized and exhibits the lowest performance.

Table 19. Predicted probabilities and values for first-generation students

		With Cognitive Disabilities	Without Cognitive Disabilities	Difference
All students	Bachelor's degree attainment	0.16	0.28	-0.12***
	College GPA	2.51	2.86	-0.35***
	Continuous enrollment	0.50	0.58	-0.08*
4-year institutions only	Bachelor's degree attainment	0.36	0.57	-0.21***
	College GPA	2.48	2.88	-0.40**
	Continuous enrollment	0.60	0.69	-0.09

\* p<.05; \*\* p<.01; \*\*\* p<0.001

SOURCE: U.S. Department of Education, National Center for Education Statistics, 2012/17 Beginning Postsecondary Students Longitudinal Study.

Table 20. Predicted probabilities and values for non-first-generation students

		With Cognitive Disabilities	Without Cognitive Disabilities	Difference
All students	Bachelor's degree attainment	0.37	0.51	-0.14***
	College GPA	2.60	2.98	-0.38***
	Continuous enrollment	0.60	0.67	-0.07
4-year institutions only	Bachelor's degree attainment	0.58	0.72	-0.14**
	College GPA	2.70	3.05	-0.35***
	Continuous enrollment	0.69	0.76	-0.07

\* p<.05; \*\* p<.01; \*\*\* p<0.001

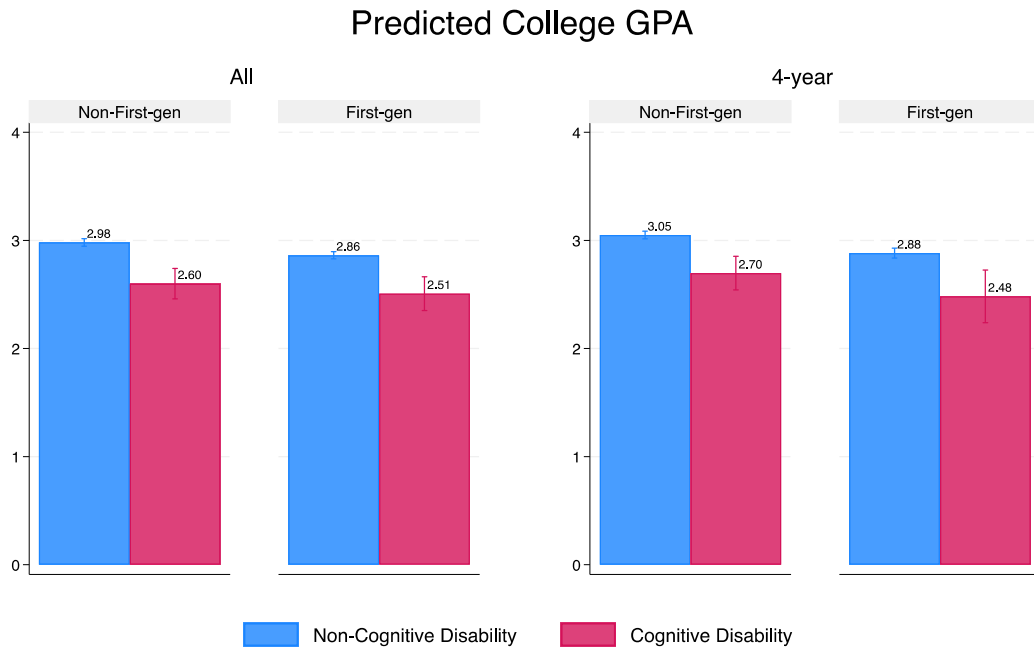
SOURCE: U.S. Department of Education, National Center for Education Statistics, 2012/17 Beginning Postsecondary Students Longitudinal Study.

Disparities in outcomes between students with and without cognitive disabilities are greater for first-generation students at 4-year institutions compared to other student groups (Table 19 and Table 20). Figures 2 through 4 highlight distinctions between students with and without cognitive disabilities, stratified by first-generation college student status, in an alternative way. To be clear, these figures utilize the same information as Tables 19 & 20, but present them in a visual, more intuitive manner.

Each figure presents college outcomes for the entire sample as well as for students enrolled in four-year institutions, thereby effectively delineating differences in cognitive abilities between first-generation and non-first-generation students across both the entire sample and students who enrolled in four-year institutions. Figure 4 illustrates the disparity in bachelor's degree attainment across the entire sample and among students enrolled in four-year institutions. Among first-generation students, those enrolled in four-year institutions exhibit significantly higher rates. However, the differences between

students with and without cognitive disabilities is more pronounced among students enrolled in four-year institutions.

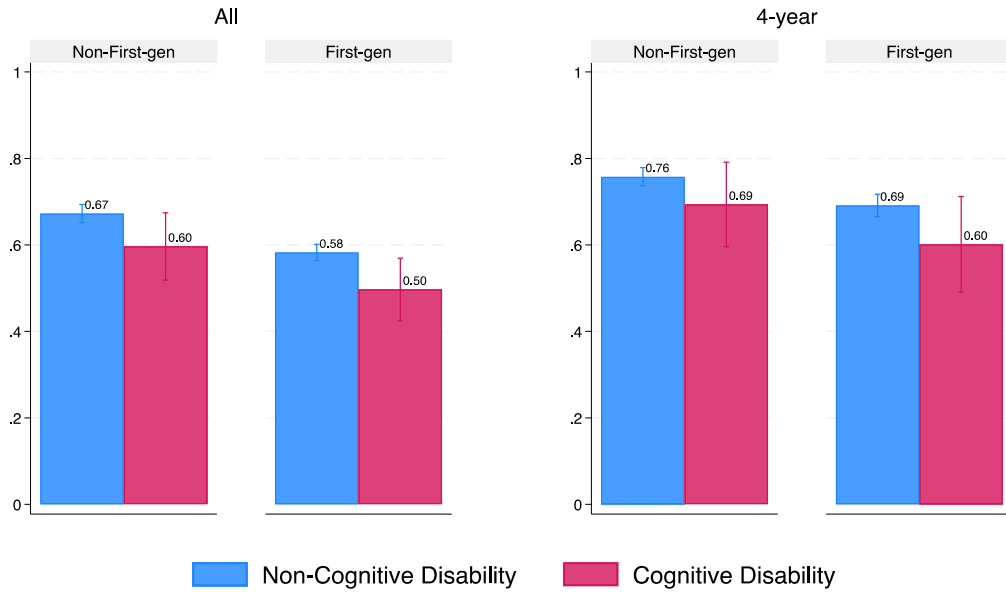
This implies that the challenges of navigating the disability aspects of college may be particularly pronounced for first-generation students within the 4-year institution settings. It's important to note that for non-first-gen college students, no significant differences were found between those with and without cognitive disabilities for both the entire non-first-gen population and non-first-gen students specifically in four-year institutions. This discrepancy is only observed between the entire first-generation college student population and first-gen who attending four-year institutions.



SOURCE: U.S. Department of Education, National Center for Education Statistics, 2012/17 Beginning Postsecondary Students Longitudinal Study.

Figure 6. Predicted College GPA

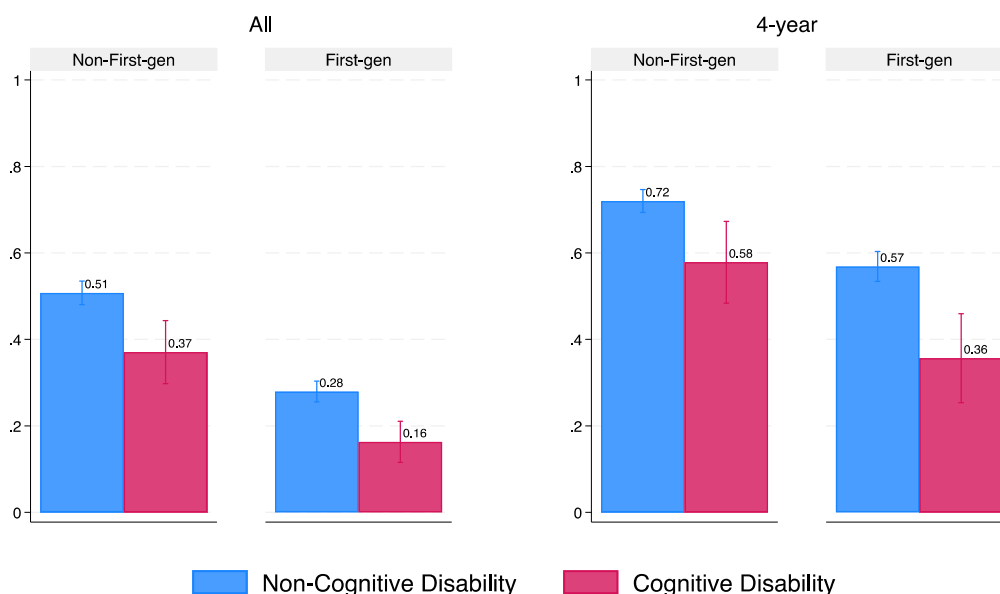
## Predicted Probabilities of College Continuous Enrollment



SOURCE: U.S. Department of Education, National Center for Education Statistics, 2012/17 Beginning Postsecondary Students Longitudinal Study.

Figure 7. Predicted Probabilities of College Continuous Enrollment

## Predicted Probabilities of Degree Attainment



SOURCE: U.S. Department of Education, National Center for Education Statistics, 2012/17 Beginning Postsecondary Students Longitudinal Study.

Figure 8. Predicted Probabilities of Degree Attainment

### Discussion

The disadvantages faced by first-generation college students and those with cognitive disabilities have been extensively documented in college outcomes (Fleming et al., 2017; Fry, 2021; RTI International, 2019; Yu et al., 2018). However, the descriptive picture of first-generation college students with cognitive disabilities was unclear prior to this study. A closer examination of how cognitive disability status intersects with first-generation college student status to shape college outcomes, and whether these patterns persist across the entire sample and among students enrolled in four-year institutions, provides a clearer understanding of the heterogeneity within first-generation college students.

The descriptive findings reveal differences between students with and without cognitive disabilities in college GPA, continuous enrollment, and college completion. In both the entire sample and among students enrolled in four-year institutions, those with cognitive disabilities tend to have lower college GPAs and are less likely to continuously enroll and attain a bachelor's degree. This outcome aligns with existing research suggesting that students with learning disabilities typically experience lower college completion rates (Cortiella & Horowitz, 2014; Yu et al., 2018).

In addressing the research question regarding the role of cognitive disabilities in shaping first-generation college students and continuing-generation college students, it was found that significant differences existed between the first-generation college students and their continuing-generation peers, regardless of students' cognitive disability status. However, these differences were not intensified or mitigated by the presence of cognitive disabilities (i.e., no interaction effect), which is unanticipated. As previously mentioned, relying on the coefficient of the interaction term to draw conclusions about statistical interaction in categorical models can be problematic (Mustillo et al., 2018). Therefore, it is recommended to use predicted probabilities for interpreting the results (Long & Mustillo, 2017). The results derived from predicted probabilities indicate similar findings, with no interaction effect observed. Nonetheless, it's noteworthy that first-generation college students with cognitive disabilities are the group most disadvantaged in college outcomes, and the unique needs of both first-generation and continuing-generation college students with cognitive disabilities should not be overlooked.

The significance of student services is underscored by the findings in this study. The results suggest a positive correlation between academic support, advising services, and

health services with both continuous enrollment and college completion. This aligns with existing research, which indicates that resources like tutoring support and academic advising contribute to a more seamless academic progression in college (Yu et al., 2018). Additionally, the positive association between health services and student well-being implies that maintaining good health conditions supports students in remaining enrolled and successfully completing their degree programs.

Nevertheless, the observed negative association between financial aid services and continuous enrollment, as well as college completion, appears counterintuitive. Several explanations could account for this unexpected relationship. It is plausible that financial aid services might not sufficiently address students' needs, hindering their ability to stay enrolled and complete college. Another possible explanation is that students utilizing financial aid services are those facing significant financial challenges; while financial aid provides some assistance, it may not fully cover all necessary expenses, thereby decrease the likelihood of remaining enrolled and complete college.

The results of predicted probabilities demonstrate a consistent pattern: Cognitively disabled students often face unique challenges resulting in academic performance compared to their non-cognitively disabled peers, regardless of whether they are first-generation or non-first-generation students. While not a strong finding, the disparity between students with and without cognitive disabilities appears to be more pronounced among first-generation students in four-year institutions, suggesting that they may encounter additional barriers and require extra support in the four-year institution setting. Several factors could contribute to this disparity.

Firstly, the academic rigor and demands of four-year universities may pose unique challenges for first-generation students with cognitive disabilities. While four-year institutions tend to offer more support and resources, navigating the system and accessing these resources could pose additional hurdles for these students, particularly if their parents haven't personally experienced higher education and therefore cannot offer guidance to their children. A student's college experience is shaped jointly by both individual and institutional factors, as well as broader contextual factors, as suggested by Bowman's theory. First-generation college students are more likely to rely heavily on institutional support compared to their continuing-generation peers, as they may have limited access to other sources of guidance. Institutions can facilitate access to resources and provide necessary support, addressing the needs of first-generation students. Thus, institutional context plays a crucial role in college success, particularly for first-generation students with cognitive disabilities.

Overall, more attention is needed for the first-generation college students with cognitive disabilities. Although both groups have received comprehensive discussion, the impact of their joint role within higher education contexts remains often overlooked. Besides ensuring to provide essential support services for cognitively disabled students, guiding those without parental guidance in academic settings on how to navigate available resources and the postsecondary system is equally crucial for their success in college.

Future research could expand upon the findings of this study by further disaggregating students with specific learning disabilities such as dyslexia, attention deficit disorder (ADD), and developmental disabilities, which could uncover the

heterogeneity of students with cognitive disabilities and better provide tailored support to this population. Future research could use different measurements, definition of cognitive disability, or methods to examine the relationships among college success, cognitive disability, and first-generation college student status. Such different approaches not only contribute to a more nuanced conversation but also offer insights for potential effective interventions and support. Exploring college outcomes beyond the three variables of this study, such as college engagement, sense of belonging, post-graduation outcomes, or other related elements were also worthy of future studies to better understand the population.

## Chapter 5

### DISCUSSION OF THE DISSERTATION STUDY

#### Overview of dissertation

Over the past decade, there has been a significant surge in the enrollment of first-generation college students, resulting in a notable demographic shift within higher education institutions. This change facilitates a considerable amount of research aimed at understanding, serving, and supporting this unique population. However, the large population and heterogeneity of this group need a more comprehensive understanding of their diverse backgrounds, challenges, and needs for success. This dissertation seeks to challenge the notion of viewing first-generation college students as a homogenous group and instead explores how their status intersects with various personal factors as well as institutional-level factors, influencing their access to and success in college. Each paper within this three-paper dissertation looks into a specific aspect—high school contexts, college undermatching, and cognitive disability—and examines how these factors interact with the first-generation college student experience, ultimately impacting their collegiate success.

The first study investigates how high school contexts contribute to college access, specifically college undermatching, for both first-generation and continuing-generation college students. The second paper explores the roles college undermatching plays in college success for both first-generation college students and their continuing-generation peers. In the third paper, I examine the interplay between first-generation student status and cognitive disabilities in college success. Utilizing nationally representative samples, this dissertation consistently compares U.S. first-generation college students with their

continuing-generation peers to examine differences in their college experiences, ranging from college access to college success.

Institutional roles are key elements across all three studies in this dissertation. Both Perna's (2006) conceptual model of college choice and Bowman's interdisciplinary theory of college student success (2022) suggest that institutional contexts not only influence students' college access and experiences but also interact with personal factors, ultimately shaping students' college experiences and success. In the first study, the research incorporates college counseling support and the academic rigor provided by high schools to examine their roles in college access. The second study includes the selectivity level of postsecondary institutions to understand the effects of college undermatching. The third study incorporates the utilization of academic, advising, financial, and health support services when examining college success metrics such as college GPA, continuous enrollment, and completion rates. By investigating the role of institutional contexts from high school to college, alongside other factors in students' backgrounds, this dissertation contributes significantly to understanding the college success of first-generation college students.

### **Review of Research Questions**

The overarching goal of this dissertation study is to unfold the complexities and nuances within the first-generation college student population, and to recognize their heterogeneity and potentially differing needs. Additionally, the study aims to explore the role of institutions, including both secondary and postsecondary settings, in college access and success. Specifically, it seeks to examine the interplay between first-generation college student status and various other factors within the institutional context.

To achieve this goal, this dissertation study includes three groups of research questions across its three studies. The first study tries to answer: 1) To what extent does a student's first-generation status affect college undermatching? 2) To what extent do high school academic climate and assistance in college selection influence college undermatching, after controlling individual characteristics? 3) To what extent do the effects of high school characteristics on college undermatching differ for first-generation college students relative to non-first-generation college students? In other words, is there an interaction effect between high school contexts and first-generation status on undermatching?

The second study tries to answer: (1) To what extent do the relationships between college undermatching and postsecondary outcomes vary by first-generation college student status? (2) To what extent do the effects of undermatching and first-generation college student status differ when examining only four-year intentions? (3) To what extent do the effects of undermatching and first-generation college student status differ when examining only high-achievers? (4) To what extent does our understanding of the influence of college undermatching change if we account for selectivity directly when examining the relationship between college undermatching and outcomes?

The third study tries to answer: To what extent does the relationship between first-generation status and a) college GPA, b) college continuous enrollment, and c) college completion vary by cognitive disability status?

While each study has its own questions and purposes, when taken together, they help achieve the goal of investigating the complexities and nuances of the college experiences of first-generation college students. Additionally, they examine the role of institutions in

shaping college access, experience, and outcomes, particularly for first-generation college students.

### **Review the Significance of the Study**

First-generation college students are one of the historically marginalized groups that have received increasing attention in educational research. Previous studies have extensively documented the challenges these students may face and explored the support or interventions that institutions or communities could offer to compensate for the need of relevant guidance from their parents when navigating the postsecondary system (Duggan, 2001; Engle & Tinto, 2008; Katreovich & Aruguete, 2017). While these studies have certainly enhanced our understanding of and support for first-gen students as a collective group, more research is needed to look deeper into this group and recognize the nuances within it. It is crucial to acknowledge that being a first-generation college student is just one aspect of students' backgrounds; their other identities and backgrounds could also significantly influence their college experiences and intersect with their first-generation college student status. This dissertation adds complexity to our understanding of first-generation students by examining the diverse experiences within this group and contributing to a broader understanding of their multifaceted needs.

College undermatching, which is a key component of two of the papers in this dissertation, has been extensively studied in previous research (Fosnacht, 2015; Smith et al., 2013; Wolniak & Muskens, 2021). However, the factors contributing to college undermatching and its specific impacts on college success, particularly for first-generation college students, remain unclear.

The first study in this dissertation reveals not only the relationship between first-generation college students and college undermatching but also the interplay between first-generation college students and high school contexts in the phenomenon of college undermatching. Although a direct significant relationship between being first-generation college students and college undermatching was not found, the study revealed a significant interaction between first-generation college students and high assistance in college selection provided by high schools in the context of college undermatching. This suggests that while there may not be a direct link between being first-generation and college undermatching, the support received from high schools in college selection is critical for first-generation college students, as it decreases the odds of them experiencing college undermatching. Thus, the absence of a direct relationship between being first-generation and college undermatching does not imply equal odds of college undermatching for first-generation college students and their continuing-generation peers. Rather, it underscores the importance of assistance in college selection for first-generation students to mitigate the risk of college undermatching.

While the negative impacts of college undermatching have been extensively discussed and documented (Bastedo & Flaster, 2014; Rodriguez, 2015; Smith et al., 2013), college undermatching may not directly lead to college persistence or other outcomes. Although a negative and significant relationship between college undermatching and college persistence was initially observed in the second study, this relationship was weakened once college selectivity was controlled for in regression models. Enrolling in more selective colleges could significantly increase the likelihood of college persistence when pre-college academics are taken into account. These results

suggest that the detrimental effects of college undermatching reported in prior studies might have been overstated due to a lack of consideration for college selectivity.

Part of the reason for the differences in my results from some past research on undermatching is attributed to a specific methodological choice regarding the statistical model employed. This choice represents a methodological contribution to the existing body of literature. By incorporating selectivity and relevant covariates into the final regression model, this study aimed to provide a more precise understanding of the impact of undermatching. Past literature may have overestimated the impact of undermatching by solely focusing on the effect of attending a less selective institution that a student could have attended, without adequately considering the direct influence of college selectivity itself regardless of undmatch.

However, it is worth noting that while college selectivity is directly associated with college outcomes, further exploration is needed to understand what college selectivity entails in this context. Does it mean low admission rates, higher standardized scores, more resources and support, or other factors? Addressing these questions and examining key differences among universities of varying selectivity could potentially provide more insight and support for first-generation students attending less selective universities or those undermatched.

Also, the results do not imply that college undermatching holds no significance in shaping college experiences or other outcomes such as completion and post-college endeavors. In addition, the second study did not identify significant differences in the relationships between college undermatching and college outcomes between first-generation and non-first-generation college students. It is noteworthy that first-generation

students do not face additional penalties if they experience college undermatching, especially considering that they are more likely to experience college undermatching. The second study significantly contributes to the conversation by highlighting the role of selectivity level in college undermatching and encourages future college undermatching research to consider including college selectivity as a crucial factor.

The third paper demonstrates another dimension of the college experience for first-generation students: cognitive disability. This paper addresses a previous gap in the literature by examining first-generation college students in relation to their cognitive disability status with a nationally representative sample, specifically exploring whether there is an interaction effect between being first-generation college student and having a cognitive disability on college outcomes. The results reveal no interaction effect between these two factors, which is positive news as it suggests that institutional barriers related to cognitive disability do not have a greater impact on first-generation college students. However, it's important to note that first-generation students with cognitive disabilities still remain the most disadvantaged group in terms of college outcomes. The results also demonstrate the significance of academic advising and support services, which have been shown to increase college persistence. These findings further emphasize the importance of institutional support, particularly for those who heavily rely on institutional resources for their academic success.

Taken together, this dissertation demonstrates the complexities of college access and success for first-generation college students. Specially by studying phenomena such as undermatching, college persistence, and cognitive disability this dissertation provides more nuance about this diverse and heterogeneous group. Thus, it contributes to a broader

understanding of the many challenges faced by first-generation college students and highlights the importance of tailored support mechanisms to address their diverse needs. By considering factors such as high school support, college selectivity, and disability, the dissertation provides valuable insights into improving the educational experiences and outcomes of first-generation college students.

### **Theoretical implications**

This dissertation study employs Perna's (2006) conceptual model of college choice and Bowman's interdisciplinary theory of college student success (2022) to guide the exploration and understanding of the college process and experience. While Perna's model primarily focuses on college access and Bowman's model on college experience, both frameworks suggest the intricate interplay between individual-level characteristics and institutional contexts in shaping students' educational behaviors and outcomes. The findings of the three studies presented in this dissertation underscore the significance of this interplay. The first study emphasizes the importance of college counseling in high school for facilitating college access and alleviating college undermatching. The second study highlights how the selectivity level of postsecondary institutions influences college outcomes. Lastly, the third study emphasizes the role of services provided by postsecondary institutions in shaping college outcomes. All these results reaffirm the importance of considering both personal factors and institutional support in facilitating student success in both secondary and postsecondary settings.

While these frameworks were useful in providing a context to examine institutional- and individual-level factors, they are also limited in some ways. These frameworks are very broad and overarching, which allowed me to situate the studies of first-generation

student access and success within them effectively. However, by being so broad, the specific mechanisms at work in affecting undermatching, persistence, and completion are not clear. To build on my findings, additional frameworks could be used that would allow researchers to focus in more clearly on the mechanisms of college outcomes and student development.

Although Perna's (2006) conceptual model of college choice provides a comprehensive view demonstrating how different levels of context influence students' behaviors and choices, resulting in college success, Iloh's (Iloh, 2019) model of college-going decisions and trajectories offers an alternative perspective. The ecological approach emphasizes the relationships between individuals and society, as well as the interrelationships among various dimensions and factors. This model focuses on three key dimensions: information, time, and opportunity, highlighting their nonlinear and codependent relationships. By considering these dimensions as interconnected and influential throughout different stages of life, this model offers a more comprehensive understanding of the decisions and trajectories of students.

Bowman's theory does not include detailed discussion on social integration in college, which is emphasized in Tinto's Theory of Student Departure (1993), for example. Tinto's framework explicitly explains the crucial interplay between students and their academic institutions, emphasizing factors like a sense of belonging, which could improve the comprehensiveness of this dissertation's framework.

For future research interested in understanding how different dimensions influence college success for first-generation students, employing intersectionality as a framework could be beneficial. Intersectionality recognizes multiple systems of oppression,

including ableism, classism, and racism, as interconnected, interrelated, and mutually shaping one another (Crenshaw, 1991). This approach could offer insight into how students with doubly or more disadvantaged backgrounds, such as first-generation college students with disabilities, experience oppression due to the intersection of multiple systemic oppressions, such as classism and ableism.

In addition to the need for further development in the comprehensiveness of the framework, there are certain aspects of these broad overarching models that cannot be thoroughly examined with the data and methods I utilized. For instance, Bowman's theory introduces a critical concept, construal, which describes the process of how students interpret their experiences in college. This process consistently shapes their understanding of the college experience and influences their behaviors and decisions. While behaviors and decisions, such as college persistence and outcomes, can be measured and included in the dataset, capturing this sense-making process can be challenging. It's highly possible that this process varies significantly from one student to another.

### **Implications for Practice**

As the theoretical frameworks of this dissertation suggest, students' college experience and success are jointly shaped by factors across different dimensions. Institutions and practitioners need to recognize that college success not only relies on students' individual efforts but is also influenced by institutional factors as well as policy contexts.

High school teachers and practitioners need to acknowledge the significance of college knowledge and counseling in facilitating college access for first-generation

students. While this dissertation does not reaffirm that college undermatching has negative effects on college outcomes as previous studies have suggested, high schools should still understand that assisting students in navigating the college application process is crucial, especially for those who heavily rely on school resources and information, such as first-generation college students. Given that the second study reveals the significance of college selectivity on college outcomes, high school teachers and counselors should make students aware of the implications of college selectivity. While the most selective colleges may not be the optimal choice for everyone, a more selective college could entail a higher quality learning environment, access to resources and peers, as well as increased financial and academic support.

It is essential to ensure that students are aware of the resources available to them. Despite challenges such as low student-counselor ratios in some under-resourced high schools, where counselors may not be able to provide individual attention to every student due to limited funding, alternative methods could be employed to disseminate information about college counseling resources, particularly for first-generation college students. High schools need to help students with navigating the financial aid application system, for example.

Given the increasing population of students with cognitive disabilities and first-generation college students, institutions ought to prioritize attention to these two groups, including those with both backgrounds. Recognizing the unique challenges faced by these students is the initial step toward designing tailored programs to support their specific needs effectively. While this dissertation focuses solely on first-generation college

students with cognitive disabilities, it also brings up the importance of high schools identifying and assisting this population in navigating the college application process.

In practice, high school teachers and counselors should make first-generation students or those with cognitive disabilities aware of whether the schools they apply to have enough support for their needs. Of course, there are many factors to consider during the college application and decision-making process, such as financial and academic considerations. However, high schools have a responsibility to inform students about the types of resources and support they may require during college and to highlight which colleges are more likely to offer the support they need.

Without proper support and opportunities, these students may never attend college. The support system should include various dimensions, including academic, financial, and health support, informed by direct engagement and discussion with the students and customized program development to address their specific needs.

Postsecondary practitioners can also be informed by this study. For example, there are many efforts to promote success for first-gen students. While this is an improvement over the days when this student group was largely ignored, it is not enough. Now program and interventions need to acknowledge and react to the complicated and nuanced experiences this group has, which is a reflection of their heterogeneity. Colleges can proactively foster collaboration with high schools by offering workshops about financial aid as well as specific university funding opportunities. Additionally, colleges could create comprehensive online resources and utilize social media and communication platforms to disseminate information. Investing in on-campus support centers specifically

designed to assist first-generation students with the financial aid process would also be beneficial.

For instance, how effectively do these intervention programs recognize and address the diverse academic and financial backgrounds, cultural identities, health conditions, and other elements within this population? Additionally, do these programs provide tailored support that addresses the unique challenges faced by first-generation students, such as navigating unfamiliar academic environments and accessing financial resources? Furthermore, how do they promote awareness of the resources they offer so that all first-generation students, not just those who are more vocal advocates, can benefit from these resources? By beginning to address these questions and adapting interventions accordingly, postsecondary practitioners can better serve the varied needs of first-generation students and facilitate their success in higher education.

### **Implications for Policy**

Recognizing the pivotal role of college counseling and selection in the college application process, policymakers could ensure an adequate number of college counselors, particularly in under-resourced school districts. Additionally, given the significant impact of college selectivity on college persistence, policymakers should consider whether school counselors should apprise students of the potential outcomes if they opt for less selective colleges despite being accepted into more selective ones. This is only one factor among many to consider, but should not be ignored.

Policymakers could facilitate collaboration between colleges and high schools to streamline the financial aid application process for students. This collaboration could involve developing intuitive systems and resources to assist students in navigating

financial aid options effectively. Policymakers can facilitate the collaboration between colleges and high schools to simplify the financial aid application process for students, which can be exemplified by user-friendly financial application systems and joint workshops for improving access to college information for first-generation college students between high school and colleges about the application process.

To better support first-generation students with cognitive disabilities, policymakers could enact policies that provide targeted support across institutions. For example, allowing students more time to complete coursework and offering assistance during their studies could significantly enhance their academic success. It is critical that these accommodations are implemented uniformly across institutions rather than relying on specific faculties or departments, ensuring equitable support for all students in need. In summary, to ensure more equitable access and experiences in college.

### **Implications for Research**

This dissertation not only contributes to a more comprehensive understanding of first-generation college students by recognizing the heterogeneity within the group but also highlights the necessity of continuing efforts to comprehend the college access and success experiences of these individuals. I recommend that future research build upon the findings of this dissertation by utilizing them as a baseline or reference point, and conducting similar investigations with different populations to create a shared dialogue about this topic. While this dissertation study utilized nationally representative secondary data, some information remains inaccessible.

Selectivity should be considered as a key variable in future research on college undermatching. The second study indicates that the disparity attributed to college

undermatching diminishes when accounting for college selectivity levels. These findings not only challenge the understanding of college undermatching but also emphasize the methodological significance of considering college selectivity. Future research ought to incorporate college selectivity when examining college undermatching as an outcome, or at the very least, carefully deliberate before excluding it.

As with college selectivity, other institutional-level factors should be considered in future research when studying first-generation students. While the effects of institutional factors might have been studied, it remains unclear if these relationships differ between first-generation students and their continuing-generation peers. Therefore, future research could begin by examining whether there is an interaction effect between these institutional factors and first-generation student status.

This dissertation uncovered unexpected results, revealing that the effects of college undermatching are mitigated after controlling for college selectivity levels, and there are no significant differences in college undermatching between first-generation college students and their continuing-generation peers. Qualitative research can be the most suitable approach to investigate and understand these phenomena from the students' perspectives. Some tentative questions that should be asked include: What are the individual motivations and decision-making processes contributing to college undermatching? What are the unique challenges and barriers faced by first-generation college students in navigating the college application process? By exploring these questions and others like them, qualitative research can provide insight to deepen the understanding of college undermatching and overall college access.

Additionally, engaging in conversations with high school teachers and practitioners could provide valuable insights into aspects of college access and experience that may not be captured in scholarly literature or datasets. These conversations could inform future data collection efforts in a national level, ensuring a more comprehensive understanding of the college journey for first-generation college students.

### **Conclusion**

In conclusion, this three-paper dissertation describes the nuances and complexities of first-generation college students. By examining factors influencing college access and success, this dissertation facilitates our understanding of the intricate interplay between personal background, academic performance, institutional settings, and the support mechanisms available within secondary and higher education institutions that are relevant for first-generation students. It demonstrates the significance of considering various contextual factors in shaping student outcomes, reaffirming the critical role of institutional support at every level.

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